Susitna-Watana Hydroelectric Project

(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

October 2016

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LIST OF ACRONYMS AND SCIENTIFIC LABELS

ABBREVIATION	DEFINITION
$\delta^{13}C$	Carbon-13 isotopic signature, reported in parts per thousand (per mil, ‰)
$\delta^{15}N$	Nitrogen-15 isotopic signature, reported in parts per thousand (per mil, ‰)
°C	Degrees Celsius
°F	Degrees Fahrenheit
µg	Microgram
µg/L	Micrograms per liter
µm	Micrometer
AAC	Alaska Administrative Code
Ac-ft	acre-feet
ADCP	Acoustic Doppler Current Profiler
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AEA	Alaska Energy Authority
AFDM	ash free dry mass
Ahtna	Ahtna, Inc.
AIC	Akaike's Information Criteria
ANILCA	Alaska National Interest Lands Conservation Act of 1980
APA	Alaska Power Authority
APE	Area of potential effect
ARIS	adaptive resolution imaging sonar
ARRC	Alaska Railroad Corporation
ARRI	Aquatic Restoration & Research Institute
AS	Alaska Statutes
ASTM	American Society for Testing and Materials
AUC	area under curve

ABBREVIATION	DEFINITION
BEI	Bank Energy Index
BEM	Bed Evolution Model
BMI	benthic macroinvertebrates
BMPs	Best management practices
BPT	Biological Performance Tool
Ca	Calcium
CFR or C.F.R.	Code of Federal Regulations
cfs	Cubic feet per second
CI	confidence interval
CIBW	Cook Inlet Beluga Whales
CIRI	Cook Inlet Region, Inc.
CIRWG	Cook Inlet Region Working Group
cm	Centimeter
CPUE	catch per unit effort
CV	Coefficient of Variation
DCH	Delta Caribou Herd
DIDSON	Dual Frequency Identification Sonar
DM	dry mass
DNA	Deoxyribonucleic acid
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DOI	U.S. Department of the Interior
DQO	Data Quality Objectives
DSM	Demand Side Management
DSS	Decision Support System
DV	Dependent variable
EFC	Environmental Flow Components
EFDC	Environmental Fluid Dynamics Code
EIS	Environmental Impact Statement

ABBREVIATION	DEFINITION
El.	Elevation
ELH	early life history
EPA	U.S. Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera, insect orders of typically sensitive taxa
ESA	Endangered Species Act
ET	Evapotranspiration
et al.	“et alia”; and the rest
FA	Focus Area
FDA	Fish Distribution and Abundance
FDAML	Fish Distribution and Abundance Study in the Middle and Lower Susitna River Study 9.6
FDAUP	Fish Distribution and Abundance Study in the Upper Susitna River Study 9.5
FERC	Federal Energy Regulatory Commission
FGM	Fluvial Geomorphology Modeling
FL	Fork Length
FLIR	Forward Looking Infrared
FPTWG	Fish Passage Technical Workgroup
FSP	Final Study Plan
FST	Fixation Index-Statistics
ft	Feet
ft MSL	Feet Mean sea level
FUHI	Fish Use Habitat Index
FWS	Fish and Wildlife Service (also USFWS)
FY	Fiscal Year
g	Gram
GCL	Gene Conservation Laboratory
GINA	Geographic Information Network of Alaska
GIS	Geographic Information System

ABBREVIATION	DEFINITION
GMU	Game Management Unit
GPS	Global positioning system
GRTS	generalized random tessellation stratified sampling
GW/SW	Groundwater/Surface Water
HDR	HDR Alaska, Inc.; HDR, Inc.
HRC	Hydropower Reform Coalition
HSC	Habitat Suitability Criteria
HSI	Habitat Suitability Index
IFS	Fish and Aquatics Instream Flow Study 8.5
IHA	Indicators of Hydrologic Alteration
ILF-1	Intermediate Load Following – Scenario 1
ILP	Integrated Licensing Process
in	Inch
IP	Implementation Plan
ISR	Initial Study Report
km	Kilometer
km^2	Kilometer(s) squared
L	Liter(s)
L-DM	length relationship to dry mass
licensing participants; Participants	Agencies, ANSCA corporations, Alaska Native entities and other stakeholders
LiDAR	Light Detection and Ranging
LR	Lower Susitna River Segment, PRM 102.4 to PRM 0
LWD	Large Woody Debris
m	Meter(s)
M.S.	Master of Science
Mat-Su	Matanuska Susitna
Max-LF OS1b	Maximum Load Following Operational Scenario

ABBREVIATION	DEFINITION
MBI	Modified Braiding Index
MC	Main Channel
MDN	marine-derived nutrients
MeHg	Methylmercury
METF	Mid-eye to fork
Mg	Magnesium
mg	Milligram
mg/L	Milligrams per liter
mi	Mile(s)
mi^2; sq.mi.	Square mile(s)
mm	Millimeter(s)
MP	Mile post
MR	Middle Susitna River Segment, PRM 187.1 to PRM 102.4
MRSP	Modified Revised Study Plan
MSA	Mixed-stock analysis
MSB	Matanuska-Susitna Borough
MSL	Mean sea level
MVUE	Minimum Variance Unbiased Estimator
MW	Megawatts (one million watts)
n/a	Not applicable or not available
NAAQS	National Ambient Air Quality Standards
NAWQA	National Water-Quality Assessment
NCDC	National Climate Data Center
NEPA	National Environmental Policy Act
NLUR	Northern Land Use Research
NMFS	NOAA National Marine Fisheries Service
No.	Number
NOAA	National Oceanic and Atmospheric Administration

ABBREVIATION	DEFINITION
NPS	U.S. Department of the Interior, National Park Service
NRCS	USDA Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric turbidity unit
NWI	National Wetlands Inventory
OM	organic matter
OS	Operating Scenario
OWFRM	Open-water Flow Routing Model
PAD	Pre-Application Document
PAR	Photosynthetic Active Radiation
PCE	Primary Constituent Elements
PCR	Polymerase Chain Reaction
PDO	Pacific Decadal Oscillation
PHABSIM	Physical Habitat Simulation
PIT	passive integrated transponders
PM	Particulate matter
PM&E; PME	Protection, mitigation and enhancement
PMF	Probable maximum flood
POC	Proof of Concept
PRM	Project River Mile
Project	Susitna-Watana Hydroelectric Project, FERC No. 14241
PSP	Proposed Study Plan
Q	Discharge
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCP	Representative Concentration Pathway
RIFS	Riparian Instream Flow Study 8.6

ABBREVIATION	DEFINITION
RM	River mile or historic river mile
RMSE	Root mean Square Error
ROS	Recreational opportunity spectrum
RP	River Productivity
RPD	Relative Percent Difference
RSP	Revised study plan
RVT	Rapid Vegetation Transect
s	Second
SC	Side Channel
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SCR	Study Completion Report
SCUBA	self-contained underwater breathing apparatus
SD	standard deviation
SDC	Serial Discontinuity Concept
SDI	Sediment Delivery Index
SES	City of Seward Electric System
sf; ft^2	Square foot (feet)
SGR	Specific growth rate
SHP	APA Susitna Hydroelectric Project
SHPO	State Historic Preservation Officer
SIA	stable isotope analysis
SIR	2014-2015 Study Implementation Report
SNP	Single Nucleotide Polymorphism
SOP	Standard Operating Procedures
SPD	Study Plan Determination
spp.	species
SQuiRT	Screening Quick Reference Table

ABBREVIATION	DEFINITION
SRC et al.	Susitna River Coalition, Talkeetna Community Council, Alaska Surviva Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmo Center
TDS	Total dissolved solids
TIR	Thermal Infrared
TKA	Talkeetna River
TM	Technical Memorandum
TNC	The Nature Conservancy
TNYOS	The next year of study
TP	Total Phosphorus
TRM	Tributary River Mile
TRVs	Toxicity Reference Values
TSS	Total Suspended Solids
TWG	Technical Workgroup
U.S., US	United States
U.S.C.; USC	U.S. Code
UAF	University of Alaska Fairbanks
UR	Upper Susitna River Segment, PRM 261.3 to PRM 187.1
USACE	U.S. Army Corps of Engineers
uSAT	Unified Score-Based Association Test
USFS	USDA, Forest Service
USFWS	USDOI, Fish and Wildlife Service
USGS	USDOI, Geological Survey
USR	Updated Study Report
VHF	Very high frequency
VHG	Vertical Hydraulic Gradient
VIE	Visible Implant Elastomer
VOB	Visual on boat
VOC	Volatile organic compound

ABBREVIATION	DEFINITION
VOG	Visual on ground
VOH	Visual on helicopter/air
WM	wet mass
WQ	Water Quality
WSE	Water Surface Elevation
WUA	Weighted Usable Area
ZHI	Zone of Hydrologic Influence

1. INTRODUCTION AND OVERVIEW

1.1. Introduction

This document provides the Alaska Energy Authority's (AEA) responses to comments on the Initial Study Report (ISR) for the original licensing of the proposed Susitna-Watana Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC or Commission) Project No. 14241. AEA filed its ISR in June 2014 in accordance with the Commission's Integrated Licensing Process (ILP) regulations, 18 C.F.R. § 5.15(c), which require an applicant to "describ[e] its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule." Under the Commission's ILP regulations, the ISR also is to "include any modifications to ongoing studies proposed by the potential applicant."

The ISR provided a detailed status report of AEA's progress in implementing the suite of 58 individual studies for the Project set forth in the December 2012 Revised Study Plan (RSP), as approved by Commission staff in the study plan determinations issued February 1, 2013, April 1, 2013, and April 26, 2013 (collectively referred to as the Study Plan). For each individual study, AEA reported on its progress in implementing the study through the 2013 study season, including variances from the Study Plan and schedule approved by staff, as well as all modifications AEA proposed to implement when completing the Study Plan. In November 2015, AEA supplemented the June 2014 ISR with its Part D Supplemental Information to the Initial Study Report. The ISR Part D provided updates to the ISR for work done during the period June 2014 to November 2015, as well as a comprehensive "roadmap" to the record of information generated for each study under the Study Plan. Unless otherwise specified, AEA hereinafter will use the term "ISR" to refer to both documents collectively.

The Commission's ILP regulations, 18 C.F.R. § 5.15(c)(4) and (5), allow for licensing participants to file comments on the ISR, and for the potential applicant to respond to comments. AEA received numerous comments on the ISR from a range of licensing participants, and this document responds to such comments.

Data collected during the Study Plan implementation, to the extent they have been verified through AEA's quality assurance and quality control procedures and are publicly available, can be accessed at http://gis.suhydro.org/suwareports/.

1.2. Background

The ISR was the product of over three years of intense work and consultation among AEA, federal and state resource agencies, Alaska Native entities, and other licensing participants. Since the filing of AEA's Notice of Intent and Pre-Application Document in December 2011, AEA and licensing participants have consulted closely in the development and implementation of the Study Plan. Further meetings and consultations have occurred since filing of the ISR Part D in November 2015.

These efforts are highlighted as follows:

- ***Environmental Scoping***: Pursuant to the National Environmental Policy Act, the Commission issued its Scoping Document 1 in February 2012. In March 2012, the Commission held a series of environmental scoping meetings in Anchorage, Wasilla, Glennallen, Sunshine, Cantwell, and Fairbanks. In response, licensing participants filed nearly 170 comment letters, and the Commission issued Scoping Document 2 in July 2012.
- ***Data Gap Analyses and Baseline Studies***: In 2011 AEA conducted and reported on numerous Data Gap Analyses focused on compiling existing resource information related to the Susitna River that helped identify gaps in baseline information for wildlife, water quality/sediment, aquatic, socioeconomics, recreation, air quality, transportation, subsistence, cultural, and Alaska Native resources. During the 2012 study season, AEA implemented a suite of 18 baseline studies of the Susitna River and the Project area, developed in consultation with licensing participants. These studies helped inform the study planning process and provided updated information that supplemented existing information. The results of these studies were reported in a set of over 30 technical memoranda, map books, and study reports, all of which were publicized on AEA's website for the Project, http://www.susitna-watanahydro.org/type/documents/.
- ***Proposed Study Plan****:* Beginning in early 2012, AEA developed its Proposed Study Plan (PSP). In an effort to assist licensing participants in preparing for what AEA expected to be a large number of study requests and an extensive study program, AEA took several steps—beyond the requirements of the Commission's ILP regulations—to facilitate consultation and assist licensing participants. For instance, AEA took the initiative to prepare and distribute 46 preliminary model draft study requests that participants could use in preparing their study requests. Starting with the development of the PSP, AEA also agreed to provide funding—through an innovative agreement between AEA, Alaska Department of Natural Resources Office of Project Management and Permitting, and federal resource agencies—to help support federal resource agencies' participation in the Project licensing. AEA filed its PSP in July 2012.
- ***Revised Study Plan****:* Following its filing and distribution of the PSP, AEA continued its approach of engaging licensing participants beyond the requirements of the Commission's ILP regulations in development of the Revised Study Plan (RSP). Shortly after its release of the PSP, AEA held a series of Technical Work Group (TWG) meetings in August 2012 to review each of the 58 proposed studies. Following these initial meetings, AEA held monthly TWG meetings, as well as numerous individual and focused outreach meetings and teleconferences with licensing participants, to solicit comments on AEA's PSP and resolve concerns and differences of opinion related to study objectives, methodologies, scopes, and levels of effort. In an effort to incorporate participants' comments and memorialize progress in resolving participants' concerns related to the PSP, AEA agreed to prepare an interim draft RSP, and engage in another iteration of review and comment with licensing participants. AEA distributed the interim RSP in October 2012. Following additional opportunity for comment and consultation, AEA filed the final RSP with the Commission in December 2012.
- ***Technical Workgroup Meetings****:* Following Commission staff's study plan determinations, the hallmark of AEA's consultative effort in implementing the Study

Plan has been a series of regular TWG meetings for each of the 58 studies. These TWG meetings—typically held on a quarterly basis for each study—have provided a venue for licensing participants to receive regular status updates of AEA's progress in meeting study objectives, identify challenges and adaptations required to implement the studies effectively, and discuss early results of data collected. A full listing of these TWG meetings, together with the agendas, presentations and meeting notes, appears on AEA's website for the Project, http://www.susitna-watanahydro.org/meetings/past-meetings/.

- ***2013 Field Season:*** AEA and its study team conducted extensive field work in implementing the individual studies in the Study Plan, producing an immense amount of data which would ultimately be detailed in the June 2014 ISR. During the 2013 study season, an estimated 350 scientists, archaeologists, biologists, and other specialists worked in the field, collecting water samples, radio tagging fish, studying cultural resources, investigating terrestrial and botanical resources, and surveying the recreating public, among other field activities. Additional scientists and researchers conducted literature reviews, analyzed data, and commenced several complex, analytical modeling efforts.
- ***June 2014 ISR:*** In February 2014 AEA filed with the Commission a draft ISR constituting over 7,000 pages of material documenting the massive 2013 field effort. It then held additional meetings and outreach with licensing participants in an effort to resolve ongoing issues, review 2013 study results, and focus AEA's 2014 study season. AEA filed a final ISR in June 2014. For each of the 58 individual studies included in the Commission-approved Study Plan, the June 2014 ISR consisted of three parts:
    - Part A: To avoid having licensing participants re-review the same material included in the February 2014 draft ISR, Part A of the final ISR reproduced the February 2014 draft ISR. Part A detailed AEA's progress with each of the 58 individual studies by reporting on the methodologies employed and the results achieved through the 2013 study season. Part A also identified any variances in methodologies from the Study Plan, discussed how AEA met study objectives in light of such variances, and in many instances evaluated how the data collected through the 2013 study season compare to historical scientific data in the Project area.
    - Part B: For each study, Part B contained any new supplemental information or errata with respect to Part A. The information in Part B was derived either from comments received during TWG meetings following AEA's distribution of the draft ISR, or as a result of AEA's internal review of the draft ISR document following its February 3 submittal.
    - Part C: For each study, Part C contained new information not included in the draft ISR. Part C presented an updated executive summary for each individual study and detailed AEA's plans for completing the Study Plan, including modifications. It also included AEA's specific proposal for 2014 and 2015 work and explained how the modifications would meet Study Plan objectives.
- ***Continued Data Collection:*** Although AEA had limited funding available for fieldwork in 2014, based on its then-recently obtained land access permit from the Cook Inlet

Region Working Group (CIRWG), AEA was able to conduct targeted studies on lands that were not accessible to AEA during the 2013 study season.

- ***Release of 2014 Technical Memoranda:*** In preparation for ISR meetings scheduled for October 2014, AEA filed over 20 technical memoranda with the Commission in September 2014. These technical memoranda reported on: (1) results of studies conducted during 2013 and 2014 that were not available at the time AEA filed the ISR in June 2014; (2) decision points set forth in various study plans (e.g., lower extent of modeling at PRM 29.9); and (3) significant modifications to the FERC-approved Study Plan proposed by AEA (e.g., Study 9.5, Study 9.16, and Study 9.17).

- ***Post-ISR Technical Workgroup Meetings:*** Following AEA's filing of the ISR in June 2014, it continued to hold TWG meetings on ongoing study efforts. In September 2014, for example, it held a three-day fish passage feasibility workshop. In October 2014, AEA convened a total of six, one-day ISR meetings to review progress on each of the 58 individual studies. In December 2014, AEA held TWG meetings for aquatics, fish passage, geomorphology, and groundwater studies.

- ***Release of Study Implementation and Completion Reports:*** Following a suspension of the ILP for several months due to the State budget deficit, beginning in October 2015 AEA began its release of reports for 38 of the 58 studies included in the Commission-approved Study Plan. For 27 of the 38 studies on which AEA has made substantial progress to date, AEA prepared a "study implementation report." For 11 studies AEA considered completed, AEA prepared and filed with the Commission a comprehensive "study completion report." (AEA had previously reported on completion of two studies in the June 2014 ISR.) As of October 2015, eighteen studies had not advanced to the point of a study implementation report, but AEA's progress in implementing these studies has been documented in the ISR, together with technical memoranda and/or technical workgroup meeting presentations. A complete listing of supporting documents for each study appears in ISR Part D, and the status of each study in the Commission-approved Study Plan appears in Table 1.3-1, below.

- ***ISR Part D:*** Pursuant to the Commission's revised ILP schedule, the ISR Part D provided a comprehensive "roadmap" for each study highlighting important achievements, providing an update of any work done since the June 2014 ISR, providing crosswalk tables referencing relevant reports, technical memoranda, and other documents, noting study variances and modifications, and identifying steps to complete the study plan.

- ***March 2016 Study Meetings:*** AEA conducted five days of public meetings on the study plans in March 2016. On April 25, 2016, AEA filed meeting summaries and transcripts for these ISR meetings.

In accordance with the Commission's December 2015 process plan and schedule order, licensing participants had until June 23, 2016, to file disagreements with AEA's meeting summaries and proposals for study modifications or new studies. By June 23, a total of 36 resource agencies, Alaska Native entities, environmental organizations, and individuals filed 17 comment letters with the Commission. Since June 23, a total of 9 licensing participants (some of whom filed initial comments prior to the June 23 deadline) have filed 14 additional comment letters. In total, in response to the ISR and ISR meeting summaries, AEA received 31 comment letters spanning nearly 1,700 pages. A complete list of comment letters received appears in Table 1.2-1.

Table 1.2-1. Comments on ISR and ISR Meeting Summaries Filed by Licensing Participants

Commenter	Date(s) Comment(s) Filed with FERC
Federal and State Resource Agencies	
Alaska Department of Natural Resources	6/23/2016
Federal Energy Regulatory Commission	6/23/2016
National Marine Fisheries Service	6/22/2016
National Park Service	6/22/2016
U.S. Army Corps of Engineers	6/23/2016
U.S. Fish and Wildlife Service	6/22/2016
Alaska Native Entities	
Ahtna, Incorporated	N/A (See Attachment 1 to this ISR Response)
Local Community Organizations	
Talkeetna Community Council	6/20/2016, 6/23/2016[*], 6/23/2016[*]
Willow Area Community Organization	5/19/2016
Environmental Organizations	
Alaska Center	6/23/2016[*]
Alaska Hydro	6/23/2016[†], 8/22/2016, 8/7/2016
Alaska Survival	6/23/2016[*],6/23/2016[*], 6/23/2016[†]
American Rivers	6/23/2016[†]
American Whitewater	6/23/2016[†]
Appalachian Mountain Club	6/23/2016[†]
California Sportfishing Protection Alliance	6/23/2016[†]
Central Sierra Environmental Resource Center	6/23/2016[†]
Copper Country Alliance	6/20/2016, 6/23/2016[†]
The Friends of the Kinni	6/23/2016[†]
Friends of the River	6/23/2016[†]
Hydropower Reform Coalition	6/23/2016[†]
Idaho Rivers United	6/23/2016[†]
Maine Rivers	6/23/2016[†]
Michigan Hydropower Reform Coalition & Great Lakes Council of the International Federation of Fly Fishers	6/23/2016[†]
Natural Resources Defense Council	6/23/2016
The Nature Conservancy	6/18/2016
Naugatuck River Revival Group, Inc.	6/23/2016[†]

Commenter	Date(s) Comment(s) Filed with FERC
Pacific Rivers Council	6/23/2016†
Save the River	6/23/2016†
Susitna River Coalition	6/23/2016*,6/23/2016*, 6/23/2016†
Talkeetna Defense Fund	6/23/2016*,6/23/2016*
Trout Unlimited	6/23/2016*,6/23/2016*, 6/23/2016†
Wild Salmon Center	6/23/2016*,6/23/2016*
Individuals	
Donnie Billington	9/7/2016
Rebecca Long	6/2/2016, 6/9/2016, 8/10/2016, 8/22/2016, 9/5/2016
Denis Ransy	8/21/2016
Charlie & Linda Rutledge	6/23/2016, 9/12/2016
John Strasenburgh	9/4/2016
Cathy Teich	6/23/2016, 8/20/2016, 9/7/2016
Ruth Wood	9/11/2016

* Part of a joint filing of 7 organizations that submitted two separate comment letters on 6/23/2016, which are referred to herein as "SRC et al."

† Part of a joint filing of 19 organizations, which is referred to herein as "HRC."

AEA's responses to proposed modifications to the Commission-approved studies are found in Section 2 of this Response. Section 3 contains AEA's responses to new study requests submitted by licensing participants. While Sections 2 and 3 respond to specific requests to modify approved studies and proposed new studies, licensing participants' comments raised similar issues and themes. AEA's general responses to these recurring comments and themes are addressed in Section 1.5 below.

1.3. Purpose of the ISR

The Commission's ILP regulations provide an opportunity for the license applicant, resource agencies, Alaska Native entities, and other licensing participants to review interim study results and progress, and to evaluate whether new studies or study modifications are needed to support the license application. The ISR is a progress report in implementing the Commission-approved Study Plan, including a description of data collected, an explanation of any variances from the Study Plan and schedule, and any modifications to ongoing studies or new studies proposed by the applicant. *See* 18 C.F.R. § 5.15(c)(1). While this interim review typically occurs shortly after the first study season, as the Commission has recognized the circumstances of this Project are unique—namely, the large volume of studies, fluctuations in Project appropriations and the need to continue some data collection, and on-the-ground challenges of implementing an extensive study program in a remote, isolated location of Southcentral Alaska.

In commenting on the ISR, licensing participants may propose modifications to ongoing studies or new studies. 18 C.F.R. § 5.15(c)(4). However, any proposal to modify an ongoing study must be accompanied by a showing of "good cause" *and* must include a demonstration either that: (1)

approved studies were not conducted as provided for in the approved study plan; or (2) the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way. 18 C.F.R. § 5.15(d). Any proposal for new information gathering or studies also must be accompanied by a showing of good cause, and must include, as appropriate to the facts, a statement explaining: (1) any material changes in the law or regulations applicable to the information request; (2) why the goals and objectives of any approved study could not be met with the approved study methodology; (3) why the request was not made earlier; (4) significant changes in the project proposal or that significant new information material to the study objectives has become available; and (5) why the new study request satisfies the study criteria in 18 C.F.R. § 5.9(b).

The study requirements in § 5.9(b) are as follows:

(1) Describe the goals and objectives of each study proposal and the information to be obtained;

(2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;

(3) If the requester is not a resource agency, explain any public interest considerations in regard to the proposed study;

(4) Describe existing information concerning the subject of the study proposal, and the need for additional information;

(5) Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;

(6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field seasons(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge; and

(7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Thus, the Commission does not lightly require modification of approved studies, and the criteria for ordering new studies at this stage of the ILP are quite rigorous. As detailed in this ISR response document, AEA believes that the vast majority of new and modified study proposals submitted in this ILP process do not meet these regulatory standards and should not be approved by the Commission. These new and modified studies are simply unneeded to meet the objectives of the Commission-approved Study Plan and otherwise understand the environmental effects of the proposed Project. As the Alaska Department of Natural Resources (ADNR) (ADNR_pp1_ph2) commented:

> *Overall, we have found the studies were conducted as intended. The project has produced a significant amount of the information necessary to provide a baseline and the remaining field work can be completed within a year. . . . It is time to finish the study process and complete the license application. The State requests that no further studies be approved unless a critical need for the FERC decision making process can not be met with the current studies.* (emphasis added)

Based on the comments filed by licensing participants in this ILP for the Project, studies fall into one of the following five categories:

1. Studies which AEA believes are complete with no disagreement or proposed modification by another licensing participant;

2. Studies which AEA believes are complete but which one or more licensing participants have raised a disagreement or proposed a modification to which AEA objects;

3. Studies which are in progress and which no licensing participant has raised a disagreement or proposed a modification to which AEA objects;

4. Studies which are in progress and which one or more licensing participants have raised a disagreement or proposed a modification to which AEA objects; and

5. New studies proposed by licensing participants that are not included within the FERC-approved Study Plan.

The status of each study in the Commission-approved Study Plan and each new study proposed by licensing participants in their ISR comments appears in Table 1.3-1, below.

Table 1.3-1. Status of Each Study in the Commission-Approved Study Plan and Proposed New Studies

Study Description	Study Implementation or Completion Report
Category 1: Completed Studies with No Disagreements or Proposed Modifications	
Study 10.13: Bat Distribution and Habitat use	Study Completion Report (filed 11/4/2015)
Study 10.18: Wood Frog Occupancy and Habitat use	Study Completion Report (filed 11/4/2015)
Study 16.5: Probably Maximum Flood (PMF) Study	Study Completion Report (filed 6/3/2014)
Study 16.6: Site-Specific Seismic Hazard Study	Study Completion Report (filed 11/17/2015)
Category 2: Completed Studies with Disagreements and/or Contested Proposed Modifications	
Study 5.5: Baseline Water Quality Study	Study Completion Report (filed 11/25/2015)
Study 7.7: Glacial and Runoff Changes Study	ISR Part A – Literature Review (filed 6/3/2014) Technical Memorandum, Assessment of the Potential for Changes in Sediment Delivery to Watana Reservoir Due to Glacial Surges (filed 11/14/2014)
Study 9.7: Salmon Escapement Study	Study Completion Report (filed 11/9/2015)
Study 9.9: Characterization and Mapping of Aquatic Habitats	Study Completion Report (filed 11/4/2015)
Study 10.7: Dall's Sheep Distribution and Abundance	Study Completion Report (filed 11/4/2015)

Study Description	Study Implementation or Completion Report
Study 10.9: Wolverine Distribution, Abundance, and Habitat Occupancy	Study Completion Report (filed 11/4/2015)
Study 10.10: Terrestrial Furbearer Abundance and Habitat Use	Study Completion Report (filed 11/4/2015)
Study 10.15: Waterbird Migration, Breeding, and Habitat Use	Study Completion Report (filed 11/4/2015)
Study 15.9: Air Quality Study	Study Completion Report (filed 11/4/2015)
Category 3: Ongoing Studies with No Disagreements or Contested Proposed Modifications	
Study 4.5: Geology and Soils Characterization Study	Study Implementation Report (filed 11/18/2015)
Study 9.10: The Future Watana Reservoir Fish Community and Risk of Entrainment Study	None; other relevant documents are listed at ISR Part D (Study 9.10), Section 4
Study 9.15: Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area	None; other relevant documents are listed at ISR Part D (Study 9.15), Section 4
Study 10.11: Aquatic Furbearer Abundance and Habitat Use	Study Implementation Report (filed 11/4/2015)
Study 10.12: Small Mammal Species Composition and Habitat Use	None; other relevant documents are listed at ISR Part D (Study 10.12), Section 4
Study 10.17: Population Ecology of Willow Ptarmigan in Game Management Unit 13	None; other relevant documents are listed at ISR Part D (Study 10.17), Section 4
Study 10.19: Evaluation of Wildlife Habitat Use	None; other relevant documents are listed at ISR Part D (Study 10.19), Section 4
Study 11.5: Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin	None; other relevant documents are listed at ISR Part D (Study 11.5), Section 4
Study 11.6: Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam	2014-15 Study Implementation Report (filed 11/4/2015)
Study 11.7: Wetland Mapping Study in the Upper and Middle Susitna Basin	None; other relevant documents are listed at ISR Part D (Study 11.7), Section 4
Study 11.8: Rare Plant Study	None; other relevant documents are listed at ISR Part D (Study 11.8), Section 4
Study 11.9: Invasive Plant Study	None; other relevant documents are listed at ISR Part D (Study 11.9), Section 4
Study 13.5: Cultural Resources Study	Study Implementation Report (filed 5/17/2016)
Study 13.6: Paleontological Resources Study	None; other relevant documents are listed at ISR Part D (Study 13.6), Section 4
Study 14.5: Subsistence Resources	Study Implementation Report (filed 11/4/2015)
Study 15.5: Regional Economic Evaluation Study	None; other relevant documents are listed at ISR Part D (Study 15.5), Section 4
Category 4: Ongoing Studies with Disagreements and/or Contested Proposed Modifications	
Study 5.6: Water Quality Modeling Study	Study Implementation Report (filed 11/17/2015)
Study 5.7: Mercury Assessment and Potential for Bioaccumulation Study	Study Implementation Report (filed 11/4/2015)
Study 6.5: Geomorphology Study	Study Implementation Report (filed 11/4/2015)

Study Description	Study Implementation or Completion Report
Study 6.6: Fluvial Geomorphology Modeling Below Watana Dam Study	Study Implementation Report (filed 11/4/2015)
Study 7.5: Groundwater Study	Study Implementation Report (filed 11/9/2015)
Study 7.6: Ice Processes in the Susitna River Study	Study Implementation Report (filed 11/9/2015)
Study 8.5: Fish and Aquatics Instream Flow Study	Study Implementation Report (filed 11/9/2015)
Study 8.6: Riparian Instream Flow Study	Study Implementation Report (filed 11/5/2015)
Study 9.5: Study of Fish Distribution and Abundance in the Upper Susitna River	Study Implementation Report (filed 11/5/2015)
Study 9.6: Study of Fish Distribution and Abundance in the Middle and Lower Susitna River	Study Implementation Report (filed 11/5/2015)
Study 9.8: River Productivity Study	Study Implementation Report (filed 11/4/2015)
Study 9.11: Fish Passage Feasibility Study	Study Implementation Report (filed 11/4/2015)
Study 9.12: Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries	Study Implementation Report (filed 11/4/2015)
Study 9.13: Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area	None; other relevant documents are listed at ISR Part D (Study 9.13), Section 4
Study 9.14: Genetic Baseline Study for Selected Fish Species	Study Implementation Report (filed 11/4/2015)
Study 9.16: Eulachon Distribution and Abundance in the Susitna River Study	None; other relevant documents are listed at ISR Part D (Study 9.16), Section 4
Study 9.17: Cook Inlet Beluga Whale Study	None; other relevant documents are listed at ISR Part D (Study 9.17), Section 4
Study 10.5: Moose Distribution, Abundance, Movements, Productivity, and Survival	Study Implementation Report (filed 11/5/2015)
Study 10.6: Caribou Distribution, Abundance, Movements, Productivity, and Survival	None; other relevant documents are listed at ISR Part D (Study 10.6), Section 4
Study 10.8: Distribution, Abundance, and Habitat Use by Large Carnivores	Study Implementation Report (filed 11/4/2015)
Study 10.14: Surveys of Eagles and Other Raptors	Study Implementation Report (filed 11/4/2015)
Study 10.16: Landbird and Shorebird Migration, Breeding, and Habitat Use	Study Implementation Report (filed 11/4/2015)
Study 10.20: Wildlife Harvest Analysis	None; other relevant documents are listed at ISR Part D (Study 10.20), Section 4
Study 12.5: Recreation Resources Study	Study Implementation Report (filed 11/4/2015)
Study 12.6: Aesthetic Resources Study	Study Implementation Report (filed 11/4/2015)
Study 12.7: River Recreation Flow and Access Study	Study Implementation Report (filed 11/4/2015)
Study 15.6: Social Conditions and Public Goods and Services Study	None; other relevant documents are listed at ISR Part D (Study 15.6), Section 4
Study 15.7: Transportation Resources Study	Study Implementation Report (filed 11/4/2015)
Study 15.8: Health Impact Assessment Study	Study Implementation Report (filed 11/4/2015)

Study Description	Study Implementation or Completion Report
Category 5: New Study Requests Proposed by Licensing Participants	
New Study Request 1: Social Conditions and Public Goods and Services Study	N/A; AEA opposes this new study request; see Section 3.1 below
New Study Request 2: Impacts of Climate Change in the Susitna River Basin	N/A; AEA opposes this new study request; see Section 3.2 below
New Study Request 3: Terrestrial Invertebrates Study	N/A; AEA opposes this new study request; see Section 3.3 below
New Study Request 4: Susitna-Watana Integrated Modeling and Decision-Support System	N/A; AEA opposes this new study request; see Section 3.4 below

While AEA responds to proposed modifications to the Study Plan in Section 2 below, and to proposed new studies in Section 3 below, as provided in 18 C.F.R. § 5.15(c)(5) and the Commission's process plan and schedule for this Project, it should be noted that some of the comments go beyond the purpose and scope of the ISR and raise questions more appropriate for later phases of the proceeding. For example, TNC's comments attach a several hundred page report entitled *Phase I Preliminary Framework for Ecological Risk Assessment of Large-scale Hydropower on Braided Rivers in Alaska* as "[r]elated to the purpose and scope of the Initial Study Reports" (TNC June 18, 2016, page 1). The purpose of the ISR is to summarize data collection to date, not to assess impacts of the proposed Project. Impacts of the proposed Project, alternatives, and potential protection, mitigation and enhancement measures will be identified and analyzed in Exhibit E of the License Application. 18 C.F.R. § 5.18(b)(5). TNC also attached a white paper entitled *Toward Sustainable Development of Hydropower in Alaska: Approaches to Avoid and Minimize Risks to Alaska's Pacific Salmon Populations*. Consideration of Project mitigation measures is premature at this stage of the ILP, however, and, again, would be addressed in the license application. 18 C.F.R. § 5.18(b)(5).

Similarly, some commenters continue to express concern that AEA implemented some studies and collected data outside the typical sequence of events contemplated in the Commission's ILP regulations, and that their ability to provide timely scientific review and recommendations has thus been somehow impaired. The Commission already has addressed these concerns and determined that the 2014 and 2015 work should be fully considered as part of the ISR, and that AEA's documentation in the record of study results since June 2014 meets the intent of the ISR.[1]

1.3.1. Reference to Licensing Participants' Comments

Due to the voluminous comments submitted by licensing participants in response to the ISR, AEA developed a reference system for this ISR response document to facilitate cross reference back to the licensing participant's original comment letter. This reference system is structured as follows:

Commenter_Page#_Paragraph#

[1] Letter from Ann F. Miles to Wayne Dyok, Project No. 14241 (Dec. 2, 2015).

The "Commenter" field identifies the licensing participant filing the comment letter. The "Page#" field identifies the page from the commenter's letter on which the cited or quoted comment begins. (Cited or quoted comments that span multiple pages are referenced only by the page on which the cited or quoted passage begins.) The "Paragraph#" field identifies the paragraph on the page where the quoted or cited material begins (again only identifying the first paragraph in cases where multiple paragraphs from the comment letter are quoted or cited).

By way of example, "ADNR_pp4_ph3" is a reference to a passage from ADNR's comment letter, on page 4, third paragraph, which reads as follows:

> *Due to the state fiscal situation, it is incumbent that study efforts are focused solely on the critical components necessary to make permitting decisions. We recommend studies be constrained to what is absolutely essential for completion of the license application.*

In the few instances in which a licensing participant filed multiple comment letters (see Table 1.2-1), AEA added an additional field to this citation format, which indicates the date the cited or quoted material was filed with the Commission. Thus, a citation to "Long_160608_pp1_ph1" references Ms. Rebecca Long's comment letter filed with the Commission on June 8, 2016, page 1, first paragraph.

1.4. Purpose of the Study Plan

The purpose of licensing studies is to describe Project effects and inform the development of license conditions. *See* 18 C.F.R. § 5.9(b)(5). FERC has stated:

> *The purpose of an approved study plan is to bring, to the extent possible, pre-filing finality to the issue of what information gathering and studies will be required by the Commission to provide a sound evidentiary basis on which the Commission and other participants in the process can make recommendations and provide terms and conditions. The study plan is developed in conjunction with NEPA scoping, and the latter inevitably involves judgments about which potential alternatives are reasonable to consider, and which alternatives will be eliminated from detailed consideration. It therefore follows that the Commission-approved study plan will reflect those determinations.*[2]

Thus, the adequacy of the study plan may be determined by reference to FERC's decisional requirements under the Federal Power Act (FPA) and the National Environmental Policy Act of 1969 (NEPA). FERC's ILP regulations also stipulate that the study plan should include information and studies needed for consultation under section 7 of the Endangered Species Act and for state water quality certification under section 401 of the Clean Water Act. 18 C.F.R. § 5.9(a).

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[2] Hydroelectric Licensing Under the Federal Power Act, 68 Fed. Reg. 51,070, 51,078 (Aug. 25, 2003).

1.4.1. FPA Requirements

FPA section 313(b) requires FERC's findings of fact to be "supported by substantial evidence." 16 U.S.C. § 825*l*(b). Substantial evidence has been defined to mean "such relevant evidence as a reasonable mind might find adequate to support a conclusion."[3] This standard "does not require perfect information."[4] To meet the standard, FERC must "examine the relevant data and articulate a satisfactory explanation for its action including a 'rational connection between the facts found and the choice made.'"[5]

1.4.2. NEPA Requirements

NEPA requires that federal agencies take a "hard look" at a project,[6] and, if it appears that the project will have a significant effect on the quality of the human environment, to prepare a full Environmental Impact Statement (EIS). 42 U.S.C. § 4332(c). NEPA does not require a "crystal ball inquiry."[7] "An EIS is required to furnish only such information as appear to be reasonably necessary under the circumstances for evaluation of the project rather than to be so all-encompassing in scope that the task of preparing it would become either fruitless or well nigh impossible."[8]

1.5. Responses to General Comments

1.5.1. Response to Concerns Regarding Anomalous Study Conditions

Some commenters assert that the value of certain studies is limited because they were carried out during what they view to be anomalous environmental conditions, and thus believe that those studies may have to be repeated. NMFS goes so far as to say that due to "recent anomalous weather patterns we are concerned that project studies do not accurately represent Susitna River baseline resources and cannot serve as an adequate basis for assessing any future project impacts. Additional years of study must be conducted to determinate [sic] the value of data collected in these years of anomalous conditions" (NMFS June 22, 2016, page 4). NMFS and other commenters cite: record warm conditions in the past two winters causing an abundance of open water and ice jamming; record high snow fall in the winter of 2012-2013; a 50-year flood which occurred on the river in 2013, and September 2012 flooding of the Susitna River as a result of 300

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3 *Allegheny Elect. Coop. v. FERC* , 922 F.2d 73, 80 (2d Cir. 1990).

4 *Wis. Power & Light Co. v. FERC*, 363 F.3d 453, 464 (D.C. Cir. 2004).

5 *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co*., 463 U.S. 29, 43 (1983) (quoting *Burlington Truck Lines, Inc. v. United States*, 371 U.S. 156, 168 (1962)).

6 *Kleppe v. Sierra Club*, 427 U.S. 390, 410 n.21 (1976).

7 *Nat. Res. Def. Council v. Morton*, 458 F.2d 827, 837 (D.C. Cir. 1972).

8 *Nat. Res. Def. Council v. Callaway*, 524 F.2d 79, 88 (2d Cir. 1975) (citing *Indian Lookout Alliance v. Volpe*, 484, F.2d 11 (8th Cir. 1973)).

percent above-normal precipitation, which likely caused scouring of salmon redds and displacement of juveniles, affecting fish abundance and distribution; the latest spring ice breakup on record with one of the highest flows on record which occurred in late May of 2013, delaying the start of fish sampling and affecting the ability to sample juvenile outmigration; unusually low adult Chinook salmon returns and reduced older age classes; and a very dry summer of 2013 (*e.g.*, NMFS June 22, 2016, pages 3-4; USFWS June 22, 2016, page 4; TNC June 18, 2016, page 3).

The Commission's regulations recognize that a study may have to be modified (e.g., extended or repeated) due to "anomalous environmental conditions." 18 C.F.R. § 5.15(d)(2). However, FERC typically does not grant such requests. While the Commission has not defined what it considers anomalous environmental conditions, illustrative examples include severe drought,[9] record low snowpack,[10] and the closure of a nearby nuclear plant.[11] In addition, the Commission has recognized the value of variability in environmental conditions during the study process,[12] and has acknowledged that such conditions can be described and evaluated in context with existing information, rather than delaying or modifying the study plan.[13] Studies may not have to be repeated even with anomalous conditions if study results together with other available information are adequate to describe project effects and inform the development of license conditions.[14] In addition, the level of effort and cost of repeating studies in light of the information to be gained must be considered, because these are elements of whether a study is required in the first instance. 18 C.F.R. § 5.9(b)(7).

AEA acknowledges that during data collection efforts, meteorology and hydrologic conditions did vary and that at times these variations deviated significantly from the average. However, as noted in the Commission determination for the Yuba River Hydroelectric Project (see footnote 12), it is

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[9] Determination on Requests for Study Modifications and New Studies, Project No. 619-158 (issued Jan. 29, 2016) (ordering additional year of water temperature monitoring due to extreme drought conditions during 2013 to 2015).

[10] Determination on Requests for Study Modifications, Project No. 14383-005 (issued Apr. 29, 2016) (ordering an additional year of water quality monitoring due to anomalous conditions resulting from record low snowpack levels experienced in 2015).

[11] Study Plan Determination for Aquatic Studies, Project Nos. 1892-026 *et al*. (issued Feb. 21, 2014) (approving delay in conducting aquatic studies affected by the closure of the nuclear facility because of the expected change to baseline water temperature conditions).

[12] Determination on Requests for Modifications to the Yuba River Hydroelectric Project Study Plan, Project No. 2246-058 (issued Nov. 13, 2014) (rejecting another year of study for the diversion tunnel entrainment study, finding that although the study was conducted under anomalous environmental conditions (water years that were dryer than average), both diversion tunnels reached a maximum diversion capacity and study provided the necessary data to evaluate potential project effects under varying water years and diversion seasons).

[13] Determination on Requests for Study Modifications for the Don Pedro Hydroelectric Project, Project No. 2299-075 (issued Apr. 29, 2014) (rejecting proposal to delay large woody debris surveys until the second or third high flow event of the year to avoid anomalous conditions created by a recent wildlife, finding that while the fire may result in anomalous data, "we disagree that such data lack utility. Variability in environmental conditions, such as the result of the recent fire, can be described and evaluated in context with existing information.").

[14] Determination on Requests for Study Modifications and New Studies, Project Nos. 1892-026 *et al*. (issued June 29, 2016) (rejecting a request for a second year of fish spawning studies despite unexpected paucity of spawning observations).

important to collect information over a range of conditions in order to assess Project effects on environmental resources. Variable conditions also are important to calibrate and validate models. It is not valid to conclude that just because conditions may be outside the norm and even near the extremes that additional data must necessarily be collected. The Alaska Power Authority, AEA's predecessor, collected detailed data in the 1980s. This data, along with the data AEA collected in the 2012 to 2014 period, will be used along with other available information from the historic record and information still to be collected pursuant to the Commission-approved Study Plan, to better understand the existing environmental baseline and the effects that meteorology and hydrology have on environmental resources.

AEA provides specific responses in Section 2 to comments regarding anomalous environmental conditions for the following studies: water quality, ice, fisheries, wildlife (including birds, caribou and moose), recreation, and socioeconomic resources. The following narrative provides a context as to how the environmental conditions under which the data were collected compare to historic conditions.

Meteorology Conditions

The Alaska Climate Research Center maintains climate data for 20 first order stations in Alaska including Talkeetna, the closest weather station in the Susitna River basin to the Project:

http://akclimate.org/statewide/2012/annual.html

http://akclimate.org/summary/statewide/annual/2013

http://akclimate.org/summary/statewide/annual/2014

http://akclimate.org/summary/annual/2015

A review of Talkeetna temperature and precipitation records for 2012 to 2015 indicates that on an annual basis there were deviations from the norm as would be expected in any year, but the deviations are not anomalous.[15] On a daily and monthly basis there were some significant departures from the 30 year averages.

Talkeetna temperatures in 2012 averaged 33.2 ˚F versus the normal 36 ˚F, or 2.8 ˚F below the norm. However, January was a very cold month with temperatures on the order of 14 ˚F below normal. April was slightly warmer than average and May was cooler. In general, the summer and fall were cooler.

In 2013, the annual temperature was close to the annual average, being 35.7 ˚F, or 0.3 ˚F below normal. January and February were above normal, whereas March, April and May were below normal. April was about 7 ˚F below normal. The cold spring followed immediately by high temperatures resulted in a late and significant breakup. October was warmer than normal, and November was slightly warmer than normal.

[15] The Alaska Climate Research Center compares temperature and precipitation to a 30 year historic period from 1981 to 2010.

In 2014, the average temperature at Talkeetna was 2.4 °F above the norm, averaging 38.4 °F for the year. January was substantially above normal, and February and June were the only two months that were colder than normal. Spring temperatures were about 2 °F above normal. November and December were also above normal with December being about 7 °F above normal. This resulted in a later than normal freeze-up.

Above normal temperatures persisted in 2015, with the Talkeetna average annual temperature being 37.8 °F, or 1.8 °F above normal. Temperatures from January through June were about 2 °F above normal except for February which was 4.8 °F above normal at 22.9 °F. July, August and September were slightly below normal and the months of October, November and December were above normal.

Precipitation in Talkeetna was slightly below the average annual of 27.97 inches in 2012, measuring 27.07 inches. 2013 was wetter at 37.48 inches, or about 34 percent above the norm. The precipitation total in 2014 was 20.24 inches or 7.73 inches below normal. In 2015, precipitation measured 29.00 inches, or about 4 percent greater than normal.

This type of variability in precipitation and temperature is to be expected, and should not be considered anomalous on an annual basis. However, as discussed in the hydrology section below, there were times of very significant precipitation and combinations of warm temperatures and a sizeable snowpack that led to very high flows over short periods of time in the fall of 2012 and spring of 2013.

Although Talkeetna averages about 137.1 inches of snow annually (http://akclimate.org/stations/Talkeetna), Talkeetna snowfall data for 2012-2015 is not reported. Accordingly, AEA looked at snowfall records for Anchorage and Fairbanks. The winter of 2011-2012 produced a record snowfall of 135.5 inches in Anchorage, well above the average of 74 inches. However, Fairbanks received only 57.4 inches of snow, or about 8 inches below normal. Since the Susitna basin lies between Anchorage and Fairbanks, a great deal of caution must be exercised in looking at snowfall records and extrapolating to the Susitna basin. Therefore, for 2011-2012, it is not reasonable to make a snowpack determination based upon snowfall records at Anchorage and Fairbanks. It is better to rely on hydrology data, as discussed below, to assess flow effects. For effects on wildlife species like moose and caribou, the observations of the field personnel conducting the survey would be better indicators of snowpack and the effect that snowpack had on wildlife.

AEA cannot substantiate that the Susitna basin had a record snowfall the winter of 2012-2013, as some licensing participants appear to assert in their comments. For the winter of 2012-2013, Anchorage had a greater than average snowpack and Fairbanks had a slightly greater than average snowpack, so it is likely that the Susitna basin experienced a greater than average snowpack. Similarly, for the 2013-2014 winter, both Anchorage and Fairbanks had below normal snowpacks, so it is likely that the Susitna basin had a below normal snowpack but not abnormal. However, winter 2014-2015 snowpacks for both Anchorage and Fairbanks were well below the normal at 25.1 and 43.8 inches, respectively, suggesting that the Susitna basin also was well below normal.

In summary, in reviewing both temperature and precipitation records for Talkeetna and snowfall records for Anchorage and Fairbanks, AEA concludes that there were certainly variations that occurred during the data collection period, but these meteorological conditions in and of themselves do not warrant additional years of data collection. Nor do the commenters explain how these meteorological conditions would have impaired the value of the collected data. In fact, the varied conditions should assist AEA in better understanding the environmental baseline and assessing Project effects. For example, during the cold spring of 2013 and the associated late breakup, caribou calf mortality was significantly greater than in 2014 when spring conditions were warmer than average. This variability in conditions helps in understanding the effects of meteorology on moose and caribou. AEA will use this type of information to aid in understanding how the Project would affect the environmental resources.

Hydrologic Conditions

Table 1.5.1-1 provides a comparison of monthly open water flow conditions at the Susitna River gauging station located near Gold Creek (USGS 15292000) for the primary period of data collection (2012-2014) to the average, wettest and driest months. The table also illustrates the mean monthly flows for the driest year of record (1969), monthly flows for the years AEA has proposed to model (i.e., 1976, 1981 and 1985), and the shoulder years around the primary data collection (2011 and 2015). The monthly flow data clearly shows that the months of July, August and September 2013 were not as dry as some licensing participants suggest. In fact, these months were closer to average monthly flows, with September 2013 being on the wetter side. Despite the variations in the start of breakup, the May flows for 2013 were also closer to the average May flow. Similarly, October monthly flows were closer to the average monthly flows and well above the lowest monthly October flow, but below the wettest October flow.

Table 1.5.1-1. Susitna River Monthly Average Open Water Flows (cfs) (Gold Creek Gauge)

Year	May	Jun	Jul	Aug	Sep	Oct	Avg	Notes
1969	11,050	15,500	16,100	8,879	5,093	3,124	9,958	Driest Year
1976	12,620	24,380	18,940	19,800	6,881	3,874	14,416	Dry/Cold
1981	16,550	19,300	33,940	37,870	13,790	7,463	21,486	Warm/wet
1985	11,170	26,330	26,510	19,920	15,640	6,944	17,752	Average Year
2011	18,170	22,400	19,470	20,490	10,540	5,088	16,026	
2012	16,750	36,220	23,350	17,570	24,140	11,190	21,537	Data Collection (18 studies)
2013	13,280	37,640	20,630	22,010	20,960	9,042	20,594	Data Collection
2014	17,680	21,850	20,700	18,860	17,100	7,273	17,244	Data Collection
2015	17,190	18,170	20,380	17,860	14,190			
Historic Average	14,300	26,500	23,700	21,200	14,000	6,440	17,690	
Wettest Month	26,940	50,580	34,400	37,870	26,510	12,580		
Driest Month	3,745	15,500	16,010	8,879	5,093	3,124		

Because the mean monthly flows do not tell the entire flow story, AEA developed Table 1.5.1-2, which provides the maximum and minimum daily flows for the months of May through October for 1976, 1981, 1985, and 2011 through 2015. The table illustrates significant variability in daily average flows for virtually every month. During the month of May, flows typically start out low, in the 2,000 to 6,000 cfs range. The year 2014 has a higher minimum flow because breakup began earlier than the other years shown. The May maximums varied from a low of 17,000 cfs to a high of 78,000 cfs in 2013, with the high flows exceeding about 40,000 cfs in three of the eight years. In 2013, flows exceeded 60,000 cfs for three days in late May and three days in early June for a total of six days. The high late May flows contributed to significant ice jams between Watana and Talkeetna. However, ice jams in this reach are common.

Table 1.5.1-2. Minimum and Maximum Daily Flows at Gold Creek for the Open Water Period (cfs)

Year	May		Jun		Jul		Aug		Sep		Oct		Notes
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
1976	3,800	17,000	17,200	33,300	15,100	22,800	9,340	32,000	5,620	9,280	3,000	5,400	May 6 break up
1981	4,000	30,000	15,000	29,200	14,800	60,800	23,600	54,100	8,000	22,700	4,520	10,200	May 6 break up
1985	2,400	39,700	19,600	37,400	19,800	38,000	14,400	25,800	11,900	26,800	3,600	11,700	May 24 late break up
2011	3,400	44,300	16,600	38,900	17,100	24,600	15,200	31,000	6,880	15,700	3,400	6,580	
2012	5,400	41,400	20,300	52,200	17,000	30,600	14,700	26,700	10,200	70,800	4,100	27,300	Flow > 60,000 cfs for 3 days starting Sept 22
2013	1,780	78,000	20,800	86,800	16,200	26,800	15,400	45,400	10,600	32,200	6,820	11,100	Flow > 60,000 cfs for 6 days late May/early June
2014	11,500	24,300	13,300	41,200	18,800	38,800	16,600	22,400	10,600	22,500	4,040	9,870	
2015	4,400	22,900	14,800	26,400	16,700	24,400	13,700	23,700	10,500	26,800	6,780	28,000	

The June minimums were relatively consistent during the years presented varying from a low of about 13,000 cfs to about 20,800 cfs, whereas maximums varied from about 26,400 cfs to 86,800 cfs. The 86,800 cfs flow in June 2013 was certainly higher than the other high flows shown, but the high flows were only for the first part of June and flows quickly subsided, resulting in a typical June for the last half of the month. As explained in the comment responses for Study 9.16 (Section 2.6.12), the distribution of Eulachon spawning sites documented in 2013 was similar to that observed in the 1980s.

July and August flows were typical in 2012 and 2013, with low flows similar to low flows for the other years illustrated. The high flows were likewise similar among the years presented. This shows that the months of July and August have significant monthly variability, ranging from lows of about 15,000 cfs to highs of 23,000 cfs to about 38,000 cfs. July and August 1981 had higher flows of 60,800 and 54,100 cfs respectively, but it is this particular high flow year that was selected for modeling to help illustrate baseline conditions and Project effects over a wide range of conditions. The July and August flow data for 2012 and 2013 did exhibit similar variability as the other months and generally would be characterized as normal.

The September minimum flows for all years presented were relatively similar, with 1976 and 2011 being lower. However, 1976 was selected for modeling because it is a low flow year. There was more variation in the maximum daily flow for September. The year 2012, which was a data collection year for 18 studies, had a maximum flow of 70,800 cfs. This flow occurred on September 22. Flows were above 60,000 cfs for 3 days. In comparison, 60,000 cfs at the Gold Creek gage represents a 5-year flow event. For most of the month, flows were more typical. By the time the high September flows occurred, much of the salmon spawning was completed. The majority of salmon spawning that occurs in the mainstem Susitna River occurs in lateral habitats rather than the main channel. These lateral habitats are somewhat protected from the main force of high river flows. A 5-year flow event will cause limited mobilization of salmon spawning-sized sediments in lateral habitats used by spawning salmon.

The geomorphic modeling, and in particular the 2-D modeling, will quantify the effects of Baseline Conditions and Project operations on sediment movement in the side channels or side sloughs and therefore incubation success. The late May high flows in the spring of 2013 could have affected salmon outmigration. AEA plans to consider this in its analysis. However, AEA also conducted salmon studies in 2014 (and in the 1980s), and 2014 was essentially a normal flow year.

September 2013 flows were higher than normal primarily due to flows up to about 32,000 cfs for a few days. This higher flow is only about 6,000 cfs higher than what occurred in other years shown in Table 1.5.1-2.

The October low flows for all years shown varied from only 3,000 cfs to 6,800 cfs. These low flows were typically near the end of the month. The maximum October flows were typically in the 10,000 to 12,000 cfs range. But late storms in 2012 and 2015 caused the maximum flows to be about 28,000 cfs.

Figure 1.5.1-1 illustrates peak annual flows for the period of record. This graphic shows that the peak flow of 90,800 cfs in early June 2013 was extreme, but there are 5 other years in the 62-year record where peak annual flows exceeded 80,000 cfs. Figure 1.5.1-1 also shows that there are significant variations in annual peak flow over the historic record. AEA's data collection period captured much of the variability, which will assist in furthering the understanding of flow effects on the environment. Similarly, the data collected in the 1980s provides additional variability from the historic record where detailed data were collected on the environmental resources.

In summary, flows for the primary data collection years of 2012 and 2013 cannot be characterized as anomalous except perhaps for short periods at the end of May/early June 2013 and late September 2012. Measurements taken before, during, and after these events will allow AEA to assess the effects of flow variations on sediment transport, water quality and fishery resources. The water quality conditions likely returned to more normal conditions after the high flow event. AEA's fishery impact assessment will examine the effect of these high flow conditions on fish habitat.

The higher flow conditions themselves are not likely to have affected the moose, caribou or avian populations, although the habitat for these species could have been affected at least temporarily. AEA will review the data to determine if the high flows may have had effects, but given the additional years of environmental resources data collected and considering the relatively short duration of these events, AEA does not see a need to collect additional years of data because of the high flow events. The additional historic environmental data collected and the hydrologic, water quality, geomorphic, and fisheries modeling should be sufficient to understand the existing baseline and determine Project effects without the need to collect additional years of data.

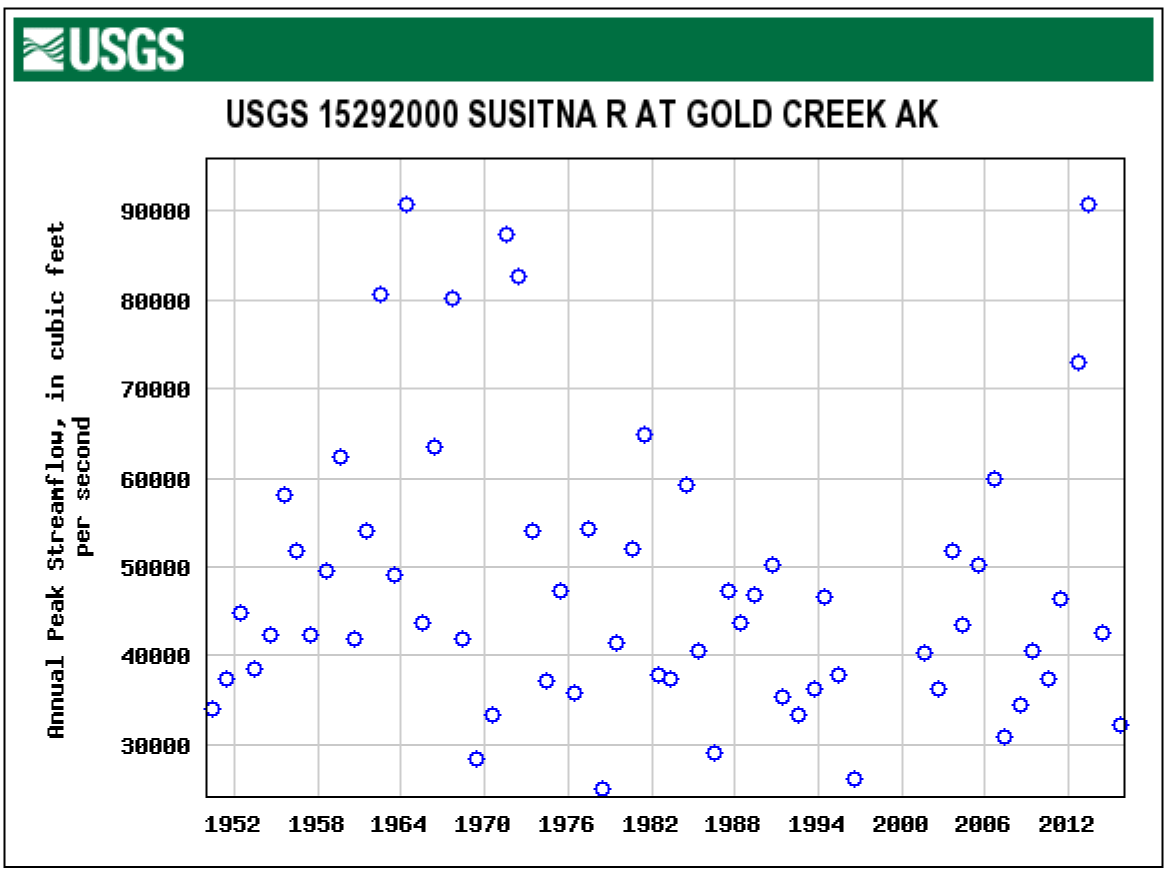

Figure 1.5.1-1. Annual Peak Streamflow at Gold Creek

Breakup and Freeze-up Conditions

AEA has evaluated breakup dates over the historic record. Although the 2013 ice breakup was late (May 26), there are five other years in the 66 years of record where breakup occurred after May 20: May 24, 1949; May 25, 1952; May 23, 1955; May 31, 1964; and May 22, 1985. Typically, breakup occurs about May 9, but breakup has occurred as early as April 24. AEA has documented breakup data from the 1980s and 2012-2014. Time lapse photography captured the breakups of 2012 and 2013. In 2012 and 2014 breakup occurred on May 1 and May 2, respectively. AEA has observed varied breakup conditions and this information will be valuable in calibrating and validating the ice model. AEA believes that no additional years of breakup data are needed for the ice model.

The ice jamming that occurred in 2013 was severe and affected vegetation in several areas along the Susitna River between Watana and Talkeetna. AEA will be assessing the effects of this ice jamming on environmental resources through its modeling effort. However, AEA also has breakup data for years in which breakup was milder and little or no ice jamming occurred (e.g., 2014). This too will be useful information in describing baseline conditions and assessing Project impacts. Capturing variability in breakup data over the range of conditions observed is far more valuable than monitoring only years in which there is no variability. AEA plans to evaluate the effects of ice breakup in the context of the different meteorological and hydrological conditions that will be modeled. This information will be used to assess effects on environmental and social resources.

AEA has evaluated freeze-up at Talkeetna for which ice cover extends from the mouth of the Susitna River to Talkeetna. Freeze-up is based upon the annual freezing degree days being greater than 170. There is significant variability in the freeze-up date, ranging from October 29 (1996) to January 2 (2003). More typically, freeze-up occurs between November 8 and December 7. Freeze-up was monitored in 2012, 2013 and 2014. Freeze-up in these years occurred on November 21, November 21 and December 27, respectively. AEA intends to model water years 1976, 1981 and 1985, on which freeze-up varied between November 7, 1975, and December 4, 1980, with the 1985 freeze-up date being November 15, 1984. The freeze-up dates are not considered anomalous but the variability among years including data from the 1980s will aid AEA in understanding how baseline freeze-up varies and how freeze-up might vary during Project operations. No additional freeze-up data is needed beyond that planned for in the study plan.

1.5.2. Response to Proposals for Expanded Climate Change Studies

Several licensing participants provided lengthy comments on climate change, with some requesting a new study or study modification that would have AEA conduct extensive climate change studies of the entire Susitna River basin.

AEA concurs with these participants on the appropriateness of a climate change study for a new project the size of Susitna-Watana and its long-term implications on meeting Railbelt energy and natural resources needs. Accordingly, AEA proposed in its PSP and RSP to conduct Study 7.7, Glacier and Runoff Changes Study. The Commission ultimately determined not to require AEA to conduct the study in its entirety.[16] Nonetheless, AEA did conduct the study as discussed in detail in Section 2.4.3, below.

As explained in Sections 2.4.3 and 3.2, AEA's study plan is cost-effective and will permit the Commission and other NEPA cooperating federal agencies to effectively address climate change in the EIS. AEA's proposed approach to climate change capitalizes on the Commission's conventional hydrological approach,[17] the climate change study already conducted by AEA, and an assessment of future trends based on planned sensitivity analyses and common sense. Thus, there is no need for a modified or new study on climate change.

1.5.3. Response to Requests to Extend Studies to Lower Susitna River

1.5.3.1. General Response

A number of commenters requested that several studies be extended downstream of the Parks Highway Bridge into the Lower River and in some instances downstream of PRM 29.9. The commenters contend that if biophysical studies indicate that there will be changes to the river, floodplain, riparian vegetation or fish and wildlife then other studies like recreation and aesthetics would likewise need to be extended downstream. This section describes the biophysical effects assessment conducted by AEA within the Lower River, and AEA's justification for not extending study areas for some resources further downstream. A more detailed response, addressing this issue with respect to each individual study in which licensing participants have requested a downstream extension of the study area, appears in the study-specific responses in Section 2, below.

1.5.3.2. Water Levels

A comparison of mainstem river water levels (i.e., river stage elevations) during the open water period using results of the Open Water Flow Routing Model (OWFRM) under Existing Conditions and post-Project operations scenario ILF-1 are provided below for PRM 29.9, PRM 44.5, PRM 49.0, PRM 64.6, and PRM 88.0. PRM 44.5 is located within the Willow Community and is downstream of the Deshka River confluence (PRM 44.9). PRM 49.0 is also located within the Willow Community and is downstream of the Willow Creek confluence (PRM 52.1). PRM 64.6 is downstream of the Susitna Landing at the Kashwitna River confluence, while PRM 88.0 is located at the USGS Sunshine gage near the Parks Highway Bridge. Version 2.8 of the OWFRM was used to prepare the stage comparisons.

Version 2.8 of the OWFRM is documented in Study 8.5, SIR Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8).* This version of the model is separated into two reaches – Dam Site to the USGS Sunshine gage, and Sunshine gage to PRM 29.9. The results for the lower reach from the Sunshine gage to PRM 29.9 are preliminary since

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16 *Alaska Energy Authority*, 144 FERC ¶ 61,040 (2013).

17 *See id*.

additional data collection is anticipated during the next study period; however, results provide an estimate of the potential stage changes in the Lower River.

At PRM 29.9 in summer months (June through September), the average daily stage is at most 0.7 feet lower under post-Project scenario ILF-1 in a dry year (1976), 0.9 feet lower post-Project in an average year (1985), and 1.1 feet lower post-Project in a wet year (1981). The USGS gage at PRM 29.9 is located at a constriction in the river that is atypical of that reach. The channel is narrow with a maximum channel depth of 37 feet at a flow of 112,000 cfs. The character of the river channel at PRM 36.4 is more representative of this portion of the river; it is four times wider than the river at PRM 29.9 with a maximum channel depth of approximately 18 feet at a flow of 112,000 cfs. Using a rating curve developed for transect at PRM 36.4, a stage change of one foot at PRM 29.9 would represent about a 7-inch stage change at PRM 36.4. In terms of flow, the stage height changes at PRM 29.9 are less than a ten percent change in discharge pre- and post-Project under open-water conditions. Table 1.5.3-1 shows a comparison of the average monthly stage between Existing Conditions and ILF-1 scenarios for the three representative years. Differences between Existing Conditions and ILF-1 were typically small in September because the reservoir would often be full or near full in September, and incoming flows generally would be passed through, except for flood flows which would be attenuated because flood storage space is allocated in the reservoir for flows up to the 50-year flood.

During a wet year, the reservoir would be full in August, and differences between existing conditions and ILF-1 would be small in both August and September. The range of daily stage, i.e., the difference between the maximum daily stage and the minimum daily stage, is essentially unchanged between the conditions with the range differing by less than 0.1 feet. Table 1.5.3-2 compares the average range of daily stage for Existing and ILF-1 scenarios for the three representative years. Results for PRM 44.5 are provided in Tables 1.5.3-3 and 1.5.3-4 and are similar to those at PRM 29.9, but with slightly higher differences since the Yentna River which comes in at PRM 31.4 further dampens the effects of the dam operations on the discharge observed at PRM 29.9. Results for PRM 49.0 and 64.6 are provided in Tables 1.5.3-5 through 1.5.3-8.

Results for PRM 88.0 are provided in Tables 1.5.3-9 and 1.5.3-10. At PRM 88.0 in summer months (June through September), the average daily stage is at most 1.0 feet lower post-Project in a dry year (1976), 1.4 feet lower post-Project in an average year (1985), and 1.7 feet lower post-Project in a wet year (1981). Similar to the other PRMs presented, the range of daily stage does not change substantially post-Project.

Table 1.5.3-1. Average monthly stage (ft) at PRM 29.9

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	42.31	41.63	42.73	41.97	42.47	41.90
July	42.88	42.43	43.93	43.05	44.74	43.69
August	41.96	41.31	42.53	41.88	45.12	45.08
September	37.79	37.86	40.92	40.72	39.56	39.62

Table 1.5.3-2. Average monthly range of daily stage (ft) at PRM 29.9

Month	Dry (1976)	Average (1985)	Wet (1981)

	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	0.48	0.44	0.41	0.38	0.27	0.23
July	0.42	0.40	0.48	0.45	0.57	0.55
August	0.40	0.40	0.50	0.50	0.76	0.74
September	0.37	0.35	0.49	0.45	0.34	0.33

Table 1.5.3-3. Average monthly stage (ft) at PRM 44.5

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	69.35	68.30	69.49	68.26	68.76	67.80
July	69.20	68.45	70.69	69.27	71.82	70.15
August	69.11	68.12	69.45	68.43	72.53	72.50
September	64.71	64.83	68.01	67.69	66.87	66.95

Table 1.5.3-4. Average monthly range of daily stage (ft) at PRM 44.5

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	0.43	0.37	0.47	0.41	0.27	0.19
July	0.38	0.35	0.47	0.36	0.64	0.55
August	0.34	0.31	0.41	0.40	0.83	0.78
September	0.26	0.24	0.52	0.48	0.26	0.34

Table 1.5.3-5. Average monthly stage (ft) at PRM 49.0

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	83.48	82.96	83.54	82.94	83.19	82.70
July	83.37	83.00	84.07	83.39	84.58	83.77
August	83.31	82.82	83.47	82.96	84.93	84.91
September	81.02	81.09	82.75	82.59	82.18	82.22

Table 1.5.3-6. Average monthly range of daily stage (ft) at PRM 49.0

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	0.21	0.18	0.22	0.20	0.13	0.10
July	0.18	0.17	0.21	0.17	0.32	0.27
August	0.17	0.15	0.19	0.19	0.40	0.38
September	0.14	0.13	0.26	0.24	0.13	0.19

Table 1.5.3-7. Average monthly stage (ft) at PRM 64.6

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	149.95	149.52	149.97	149.48	149.67	149.30
July	149.77	149.46	150.38	149.78	150.81	150.15
August	149.74	149.36	149.85	149.45	151.07	151.07
September	147.49	147.54	149.31	149.23	148.70	148.80

Table 1.5.3-8. Average monthly range of daily stage (ft) at PRM 64.6

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	0.18	0.14	0.19	0.16	0.12	0.07
July	0.16	0.14	0.21	0.16	0.27	0.22
August	0.15	0.12	0.18	0.15	0.32	0.30
September	0.13	0.13	0.17	0.15	0.13	0.19

Table 1.5.3-9. Average monthly stage (ft) at PRM 88.0

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	267.64	266.65	267.68	266.53	266.99	266.10
July	266.92	266.19	268.32	266.92	269.39	267.74
August	266.88	265.94	267.07	266.08	269.96	269.95
September	263.22	263.32	265.74	265.47	264.93	265.00

Table 1.5.3-10. Average monthly range of daily stage (ft) at PRM 88.0

Month	Dry (1976)		Average (1985)		Wet (1981)	
	Existing	ILF-1	Existing	ILF-1	Existing	ILF-1
June	0.40	0.34	0.45	0.38	0.26	0.19
July	0.35	0.32	0.48	0.34	0.64	0.52
August	0.30	0.25	0.39	0.34	0.83	0.76
September	0.15	0.15	0.47	0.43	0.21	0.28

The stage changes identified in ILF-1 indicate that Project operations would minimally influence river flows and water levels and that flows would be within the range of normal variation under existing, baseline conditions. Specifically, stage changes at PRM 49.0 and PRM 64.6 indicate that river flows at the Deshka River confluence and at Susitna Landing would be minimally affected. Under post Project conditions, since the water levels during open water conditions would not appreciably be affected, resources effects from the water level changes would likely not be appreciably affected. Even during the average and dryer years in June and July, the lower water levels under ILF-1 would be within the normal range of variation. This is demonstrated by the daily surface water level comparisons at PRM 44.5 for average and dry years (Figures 1.5.3-1 and 1.5.3-2).

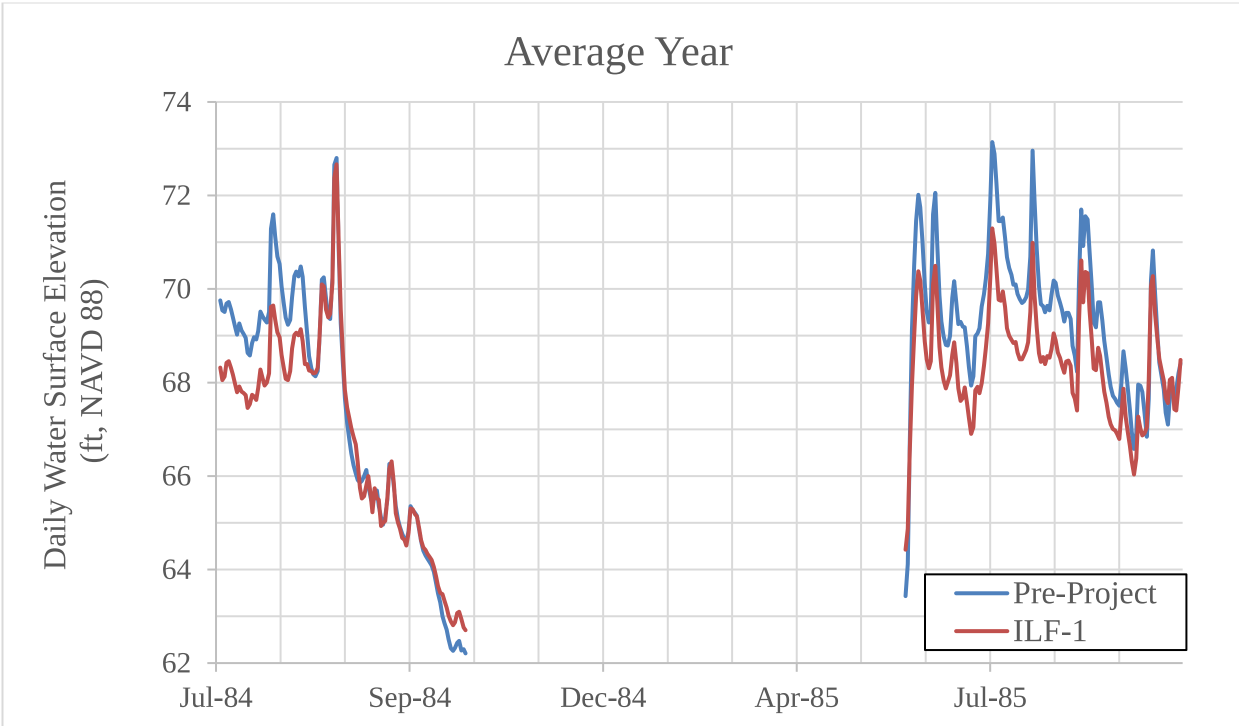

Figure 1.5.3-1. Daily Water Levels at PRM 44.5 for Average Year Conditions

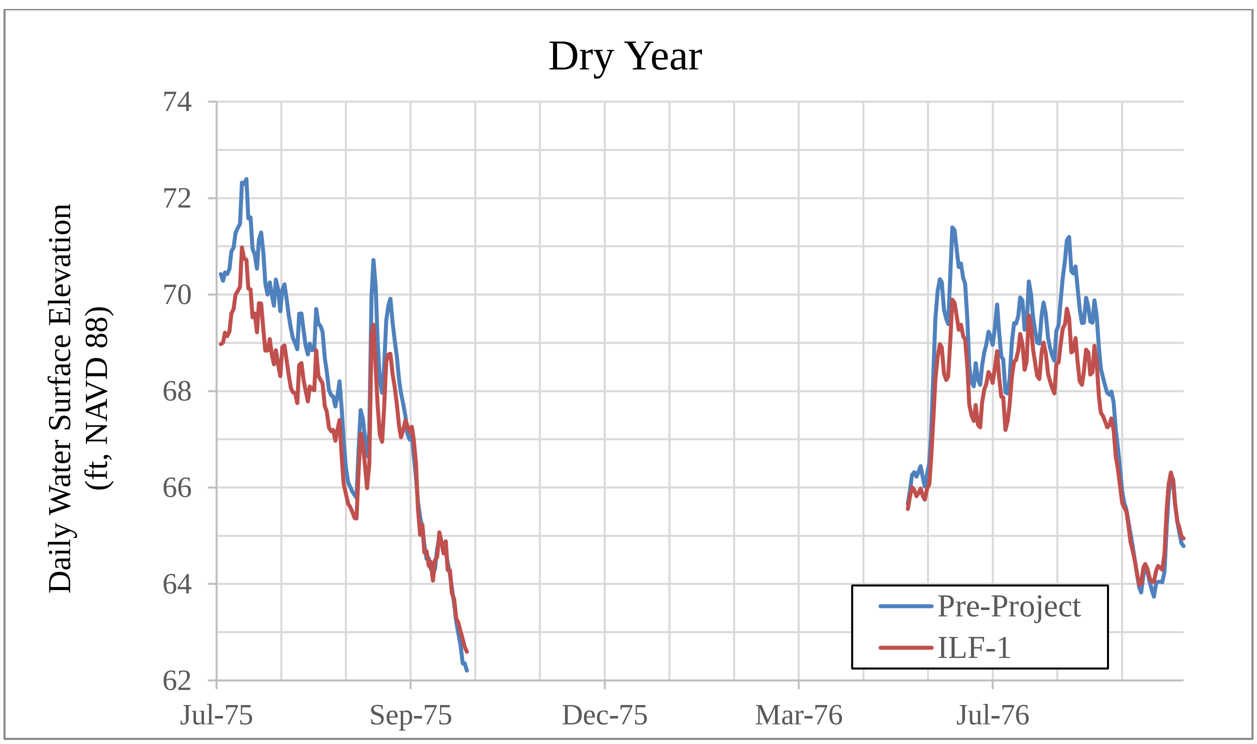

Figure 1.5.3-2. Daily Water Levels at PRM 44.5 for Dry Year Conditions

In its comments, the NPS is correct that flow and water dependent resources are not only affected by flow magnitudes, but also "by the frequency, duration, seasonality and rate of change of with-dam flows" (NPS June 22, 2016, page 4). The timing of any flow effects could also be important. Comparison of the daily flows and water levels in the Lower River between baseline and ILF-1 conditions shows that the frequency, duration, seasonality, rate of change, and timing mirror one another (see Figure 1.5.3-1 and 1.5.3-2). Therefore, AEA concludes that changes in river stage in the Lower River would not materially affect the flow-dependent downstream resources.

1.5.3.3. Ice Conditions

As discussed in the June 2014 ISR Part C (Section 7.1.1) for the Ice Processes Study (Study 7.6), this study utilized the Lower River HEC-RAS modeling and the historical period of record for the USGS gages at Sunshine to determine estimates of what the "normal" range of stage would be at the beginning of the freeze-up period (when frazil ice first appears in the river) and following the establishment of an ice cover at Sunshine (PRM 80 to 86.3) in the vicinity of the Parks Highway Bridge. At Sunshine, at the beginning of freeze-up, the Susitna River discharge ranges from 5,000 to 28,000 cfs with corresponding representative stage (within the Sunshine modeled reach) of 243.8 to 250.2 ft., respectively. Following the establishment of a stationary ice cover in this reach, the discharge ranges from 3,000 to 8,000 cfs with a corresponding stage of 246.2 to 249.1 ft., respectively. Model runs were conducted to simulate increases in peak discharge for with-Project conditions to 10,000 and 12,000 cfs. While these with-Project peak flows are within the natural range of discharge at the beginning of freeze-up (5,000 to 28,000 cfs), they are slightly higher than the natural peak discharge following the establishment of a stationary ice cover and result in stages (with a stationary ice cover) of 249.8 to 250.4 ft., respectively. The modeling indicates that even if proposed operational scenarios increase the peak discharge for a stationary ice cover to 12,000 cfs, the resulting stages (250.4 ft.) would only be increased by a maximum of about 1 ft. over the naturally occurring peak stage for a stationary ice cover (249.1 ft.) and nearly the same as the naturally occurring peak stage just prior to freeze-up (250.2 ft.).

Similar modeling was conducted for a reach at Susitna Station (PRM 29.9). At Susitna Station, at the beginning of freeze-up, the natural discharge ranges from 11,000 to 58,000 cfs with a corresponding representative stage of 32.7 to 39.0 ft., respectively. Following the establishment of a stationary ice cover in this reach, the discharge ranges from 7,000 to 25,000 cfs with a corresponding stage of 31.4 to 38.7 ft., respectively. Similar to Sunshine, model runs were conducted to simulate increases in peak discharge for with-Project conditions to 30,000 and 35,000 cfs (higher than proposed ILF-1 flows). While these with-Project peak flows are within the natural range of discharge at the beginning of freeze-up (11,000 to 58,000 cfs), they are slightly higher than the natural peak discharge following the establishment of a stationary ice cover and result in stages (with a stationary ice cover) of 40.0 to 41.1 ft., respectively. The modeling indicates that even if proposed operational scenarios increase the peak discharge for a stationary ice cover to 35,000 cfs, the resulting stages (41.1 ft.) would only be increased by a maximum of about 2 ft. over the naturally occurring peak stage for a stationary ice cover (38.7 ft.) or the naturally occurring peak stage just prior to freeze-up (39.0 ft.). Furthermore, under ILF-1, ice formation would likely not begin at high stage flow levels or drop to as low of a level as would occur under natural processes, therefore the ice cover may end up being more stable (Study 7.6 ISR Part A, Appendix A, Figure 4.3-4). Other factors that affect ice formation are expected to be the same throughout freeze-up, midwinter, and breakup including temperature and flow, which would only affect ice formation at the dam site. The complete first year results of the Ice Processes Study are provided in the Ice Processes ISR (Study 7.6 ISR).

Results from the above analysis do not indicate that the Project would affect winter ice-dependent resources in the reach of the Susitna River downstream of the Parks Highway Bridge (PRM 88.9). Changes in ice formation and ice break-up in the Lower River due to Project-induced changes would not appreciably affect ice stability, safety, or water levels. As a result, ice processes under post-Project conditions would be within the range of normal variation currently experienced under existing, baseline conditions.

1.5.3.4. Groundwater Changes

Commenters expressed the concern that potential impacts on the Lower River could include groundwater changes that affect egg incubation or rearing habitat, which would in turn affect other activities such as sport fishing. However, since mainstem river stages would not be appreciably different between baseline and Project conditions during open water or ice covered conditions, groundwater flows would likewise not be appreciably different during either open water or ice conditions.

Section 1.5.3.2 presents a comparison of water level changes during the open water period using results of the OWFRM under Existing Conditions and post-Project operations scenario ILF-1. At PRM 29.9 in summer months (June through September), the average daily stage is at most 0.7 feet lower under post-Project scenario ILF-1 in a dry year (1976), 0.9 feet lower post-Project in an average year (1985), and 1.1 feet lower post-Project in a wet year (1981). The stage height changes at PRM 29.9 are less than a ten percent change in discharge pre- and post-Project under open-water conditions. Any change in groundwater levels due to Project effects would be driven by changes in surface water stage. Changes in groundwater elevation would be greatest close to the river and diminish rapidly with distance. Therefore, the water level changes between Existing Conditions and post-Project operations scenario ILF-1 as predicted by the OWFRM are maximum groundwater level changes that would only be seen immediately adjacent to the river.

Timing of changes can also be important for controlling flux between groundwater and surface water, and resulting temperature effects. Comparison of modeled hourly and daily flows and water levels in the Lower River between baseline and ILF-1 conditions shows that the frequency, duration, seasonality, and timing mirror one another. Therefore, AEA concludes that changes in river stage in the Lower River would not materially alter groundwater flow processes that may influence aquatic biota utilizing the mainstem habitats.

1.5.3.5. Water Quality

Water quality modeling was conducted from the proposed dam site at PRM 187.1 downstream to PRM 29.9 to evaluate the potential Project effects on three parameters (temperature, dissolved oxygen [DO], and total suspended solids [TSS]) to determine the lower extent necessary for EFDC modeling. The evaluation was conducted by modeling the Existing Conditions against the maximum load following scenario (OS-1b). Water temperature was selected because of the possibility it could be affected by the reservoir due to the longer residence time of water in the reservoir and its importance to aquatic life. Modeling indicated that water temperature at PRM 29.9 showed little or no change in temperature patterns over the year (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 6.2). DO was selected because it is an important water quality indicator and is directly related to fish health and aquatic life. Since DO saturation is dependent on temperature, DO saturation is expected to show minimal change at PRM 29.9. With little change in DO concentration noted at PRM 29.9, oxygen-demanding sources in the river that would modify this relationship are not present. TSS is the most important indicator of pollutant transport from the watershed land surface and to the river. With the Project, TSS will be slightly reduced due to the trapping of silt and clay by the reservoir, however, the watershed contributions from the Three Rivers will remain the same and maintain current TSS concentrations at PRM 29.9.

AEA's study plans call for additional water quality modeling in the reach upstream of PRM 29.9. However, based on the initial results of water quality modeling in the reach downstream of Sunshine, water quality is not likely to be appreciably affected. Accordingly, the effects on water quality dependent resources are not likely to be materially affected.

1.5.3.6. Changes in Channel Forming Discharge and Potential for Channel Width Change

In the September 2014 Technical Memorandum: *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9*, potential channel width change in the Lower River was reevaluated based on updated estimates of the Project effects on peak flow hydrology under maximum load following OS-1b using a version of the 1-D bed evolution model (BEM) that extended to Susitna Station. The reductions of peak flow in the channel forming range (about 1.5- to 5-year return period) were 17 to 19 percent at Sunshine Station (PRM 87.9) and 11 to 9 percent at Susitna Station (PRM 29.9). These translated to estimated bankfull width reductions of approximately 9 to 10 percent between the Three Rivers Confluence and the Yentna River confluence. Downstream of the Yentna River confluence, due to the further moderating effect of Yentna River water and sediment inflow, only a 5 to 6 percent width reduction was predicted.

In the same 2014 Technical Memorandum, the results of the 50-year simulations using the 1-D BEM indicated that the Lower River tends to be aggradational for both existing and maximum load following OS-1b conditions, but slightly less so under the with-Project condition. In the Lower River, reach-average bed elevation change over 50-years ranged from 0.65 to 3.5 feet for existing conditions and from 0.43 to 3.2 feet for Max LF OS-1b conditions. This information, combined with the prediction of 10 percent or less adjustment of the channel width under the with-Project condition, resulted in a conclusion that the basic channel form and character of the Susitna River will remain the same, but with slightly narrower channels. The technical memorandum showed that throughout the Lower River, the expected changes in channel width and changes to other hydrologic, hydraulic, and sediment transport conditions were small in relation to the existing natural variability. AEA concludes that although there would be channel changes, these changes would have limited effects on downstream resources like recreation, aesthetics, wildlife habitat, or fisheries habitat and would not warrant extensive additional baseline data collection to extend further into the Lower River. AEA intends to further discuss the effects of channel changes in its Draft License Application, but the requested extensive data collection proposed by commenters is unnecessary to characterize the effects. For example, the Lower River is currently aggrading, but under Project operations the aggradation will be less. Therefore, the consequent effects of the aggradation under a with-Project operations scenario will be closer to existing conditions than future conditions without-Project. AEA maintains that this in and of itself does not warrant additional data collection.

1.5.3.7. Change in Extent of Riparian Vegetation

In terms of the vegetated floodplain, since the valley in which the floodplain and channels of the Lower River are contained will not be changed by the Project, the area of the floodplain will increase by the amount that the channels decrease. Thus, riparian vegetation will expand slightly in some areas as the channel adjusts to a narrower width.

The expansion of vegetation in the Lower River is a process that was determined to have occurred over the past 60 years in the Geomorphology Study (6.5) from analysis of aerial photography. The turnover analysis in the 2014 Technical Memorandum *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials* (Tetra Tech 2014), which quantifies the amount of floodplain converted to channel and the amount of channel converted to floodplain, indicated that in the period from the 1950s to 2012, 5 of the 6 Lower River geomorphic reaches (Reaches LR-1, LR-2, LR-3, LR-4 and LR-6) experienced net increases in the amount of floodplain (which represents a corresponding net decrease in channel area) with the average annual rate of increase in floodplain area within these reaches ranging from about 20,000 sq. ft. per mile to 60,000 sq. ft. per mile (or 4 to 11 ft. per year) (Tetra Tech 2014, Figures 6.1-5 and 6.1-6). This trend was most pronounced in the period from the early 1980s to 2012, with the same five reaches showing an average annual rate of net increase in floodplain area ranging from 20,000 ft. sq. per mi. to 100,000 sq. ft. per mi. (or 4 to 19 ft. per year). In contrast, the only reach in which floodplain area decreased and thus channel area increased was Lower River Geomorphic Reach LR-5, which experienced an average annual rate of increase in channel area of 25,000 sq. ft per mi. (or 5 ft. per year) from the 1950s to 2012 and 10,000 sq. ft. per mi. from the 1980s to 2012 (or 2 ft. per year). The results of the turnover analysis indicate that the relationship between the channel area and the vegetated floodplain is dynamic and varies over time.

These results indicate that Project-induced changes to riparian habitat would be very limited and occur within a dynamic floodplain environment. As the channel slightly narrows in width the riparian vegetation habitat would expand in some areas. This change in habitat would be small relative to the larger habitat areas that exist in the Lower River. Furthermore, an increase in riparian vegetation could potentially increase habitat. Overall changes to riparian vegetation habitat and wildlife resources would be extremely limited and would not adversely affect other downstream resources.

1.5.3.8. Fish Barriers and Sport Fishing

Commenters assert that not enough is known about Lower River tributary mouths to determine whether fish barriers may develop post-Project, and that the development of fish barriers would cut off access to tributary habitat, decrease the availability of migratory fish associated with sport fishing, or eliminate sport fishing opportunities at tributary mouths.

As part of the decision on whether to extend several studies below PRM 79 in the Lower River, five tributary mouths were selected for study (R2 2013 and Tetra Tech 2013c): Birch Creek (PRM 92.5) and Trappers Creek (PRM 94.5) in geomorphic reach LR-1, and Sheep Creek (PRM 69.5), Caswell Creek (PRM 67.0) and the Deshka River (PRM 45.0) in geomorphic reach LR-2. These tributaries were selected for study to identify whether there would be potential passage/access issues at the tributary mouths as a result of Project-induced changes in stage and flows in the adjacent Susitna River mainstem or side channel. Three of the five tributaries (Trapper Creek, Birch Creek and Deshka River) were surveyed in 2013 and/or 2014 consisting of the collection of cross sectional measurements of depths, velocities and substrate. Mainstem transects located at PRM 95, PRM 96, and PRM 97 were also surveyed. Data analysis has been ongoing and will result in completion of a 1D PHABSIM analysis that will also consider fish passage. Surveys still need to be completed at the lower sites (Caswell and Sheep creeks and adjacent mainstem areas) in LR-2.

Though the studies have not been completed, based on the site conditions and knowledge of the geomorphology of the Lower River gained from other resource studies including in particular the Geomorphology Studies, and the anticipated relatively small range of stage differences expected under Project operations, the potential for Project operations to create flow-induced migration barriers at the tributary mouths is relatively low. Importantly, in terms of potential channel morphology changes, in contrast to the Middle River tributaries, the tributaries to the Lower River discharge to the Susitna River at or across the extensive Susitna River floodplain and thus confluence conditions are inherently adjustable depending on flow and sediment supply from the tributaries and the locations of the receiving Susitna River mainstem or lower order side channels. The west side tributaries (e.g. Trappers Creek, Deshka River) have low sediment loads due to their contributing drainage basins being primarily underlain by Late-Pleistocene-age glacial till and glacio-lacustrine sediments that support extensive areas of muskeg. Therefore, the potential for tributary mouth barriers to form due to channel morphology changes under Project conditions is low since there is insufficient coarse sediment supply to form fan deposits, and the Project will have no effect on either the tributary flows or sediment yields.

The smaller east side tributaries (e.g. Birch Creek and Caswell Creek) also drain areas underlain by Late-Pleistocene-age glacial and glacio-lacustrine sediments that support extensive muskeg. Consequently, for the same reasons as for the west side tributaries, there are unlikely to be any tributary mouth barriers created by channel morphology changes under Project conditions. The larger east side tributaries drain the Talkeetna Mountains and do carry a substantial sediment load (e.g. Sheep Creek, Willow Creek, and Kashwitna River). However, though both the flows and sediment loads from the larger tributaries are substantial, the lower reaches should be able to adjust both laterally and vertically because their mouths are not fixed by bedrock or other erosion-resistant materials. Consequently, it is unlikely that tributary mouths will change sufficiently under Project conditions to create barriers to fish migration or decrease the availability of migratory fish associated with sport fishing, or eliminate sport fishing opportunities at tributary mouths.

Regarding impacts to fish and sport fishing in the Lower River, AEA has investigated fish distribution and abundance as part of Study 9.6 and Study 9.16 and will evaluate the potential impacts to fish resources as part of the FERC-approved Study Plan and AEA’s proposed modifications. The Fish Distribution and Abundance study will be continued in the next year of study implementation and AEA has proposed additional efforts to characterize fish use of rare off-channel habitats as described in Section 2.6.2.9.1. AEA also conducted a field study on Eulachon in 2013 (Study 9.16). To complete Study 9.16, another year of fish surveys will be conducted and AEA proposed to expand the study with a model to address potential impacts to Eulachon spawning habitat during future study implementation (see Section 2.6.12.2, Section 2.6.12.3 and *2015 Proposed Eulachon Spawning Habitat Study Modifications* filed with the Commission September 17, 2014)).

1.5.3.9. Summary of Lower River Discussion

AEA's studies to date show that with the Project, the basic channel form and character of the Susitna River will remain the same, but with slightly narrower channels. Since the valley in which the floodplain and channels of the Lower River are contained will not be changed by the Project, the area of the floodplain will increase by the amount that the channels decrease. Thus, riparian vegetation will expand slightly in some areas as the channel adjusts to a narrower width. The results of the turnover analysis also indicate that the relationship between the channel area and the vegetated floodplain is dynamic and varies over time. The stage changes identified above indicate that Project operations would minimally influence river flows and that flows would be within the range of normal variation under existing, baseline conditions. Similarly, information collected to date indicates that the Project would likely cause minimal effects on water levels, groundwater, ice conditions, and water quality, as well as other environmental, recreational and socioeconomic resources in the Lower River. Accordingly, AEA maintains there is no basis for extending studies further downstream than already proposed by AEA for any of the studies in the Commission-approved Study Plan.

1.5.4. Costs of Proposed Modified and New Studies

As discussed above, the level of effort and cost of studies are criteria that FERC's regulations require to be considered in FERC's study plan determinations. 18 C.F.R. §§ 5.9(b)(7), 5.15(e)(5). The costs of licensing participants' proposed modifications and new studies are addressed for each specific study in Sections 2 and 3, below. Cumulatively, the cost of the modifications and new studies requested by commenters would add between $200 million and $290 million to the cost of completing the environmental studies needed to prepare the Project's license application. If adopted, the proposed new and modified studies also would add several more years to a study program that began over four years ago in 2012 and further delay construction and operation of the Project.

Since beginning this effort in 2012, the State of Alaska has expended $130 million on environmental studies needed to develop the license application for this Project, with a total licensing effort so far of almost $200 million over five years. Those costs far exceed the FERC licensing costs for any other project. The study modifications and new studies proposed by the commenters have the potential to double or nearly triple the cost of environmental studies for the Project and extend the study process for years. As noted by ADNR (ADNR_pp4_ph2):

> *The Alaska Department of Natural Resources . . . agrees to AEA's recommended modifications to the ISR and finds no compelling reason for further modifications,*

> *new studies and/or additional years of study. We believe AEA has made significant progress and is on track to meet FERC-approved study objectives.*

As described in the individual, study-specific discussions in Sections 2 and 3 below, the new information that would be gained from the enormous expansion of work proposed would not yield information that is any more probative or relevant than what is already being produced under the Commission-approved Study Plan. In light of this and consistent with ADNR's position, AEA submits that costs of the magnitude submitted by licensing participants in this ILP strongly supports the Commission's rejection of the modifications and new studies proposed. Simply stated, the exorbitant cost increase is wholly unjustified.

2. RESPONSE TO PROPOSED STUDY MODIFICATIONS AND COMMENTS

2.1. Geology and Soils

2.1.1. Study 4.5 – Geology and Soils Characterization Study

As established in the Study Plan (RSP Section 4.5.1), the overall goals of this study are to conduct a geology and soils evaluation to define the existing geological conditions at the dam site, reservoir, and access and transmission line corridors, and to develop design criteria to ensure that the proposed Project facilities and structures will be safe and adequate to fulfill their stated functions.

The specific objectives of the Geology and Soils Characterization Study, as described in the RSP (Section 4.5.1), are to:

- identify the existing soil and geology at the proposed construction site, reservoir area, and access road and transmission line corridors;
- determine the potential effects of Project construction, operation, and maintenance activities on the geology and soil resources (including mineral resources) in the Project area including identification and potential applicability of protection, mitigation, and enhancement measures;
- identify known mineral resources and mineral potential of the Project area; and
- acquire soils and geologic information for the Project area for use in the preparation of a supporting design report that demonstrates that the proposed structures are safe and adequate to fulfill their stated functions.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA does not propose any additional modifications to Study Plan Section 4.5. Two modifications were previously identified and implemented during the 2014 field season:

1. As explained in Section 1.3 of the ISR Part D Overview, AEA removed the Chulitna Corridor from the study area.

2. The Denali East Corridor Option was added to the study area as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (ISR Part C, Section 7.1.2).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 4.5. AEA received no comments on Study 4.5.

2.2. Water Quality

2.2.1. Study 5.5 – Baseline Water Quality Study

As established in the Study Plan (RSP Section 5.5.1), the overall goal of the water quality study is to document existing water quality, sediment, porewater, and meteorological conditions on the Susitna River, and provide data for modeling the impacts of the proposed Project on these resources in Study 5.6.

The specific objectives of the Baseline Water Quality Study, as described in the Study Plan (RSP Section 5.5.1), are to:

- Document historical water quality data and combine with data generated from this study. The combined data set will be used in the water quality modeling study to predict Project impacts under various operations (Section 5.6).
- Add three years of current stream temperature and meteorological data to the existing data. An effort will be made to collect continuous water temperature data year-round, with the understanding that records may be interrupted by equipment damage during river floods, ice formation around the monitoring devices, ice break-up and physical damage to the anchoring devices, or removal by unauthorized visitors to a site.
- Develop a monitoring program to adequately characterize surface water physical, chemical, and bacterial conditions in the Susitna River within and downstream of the proposed Project area.
- Measure baseline metals concentrations in sediment and fish tissue for comparison to state criteria.
- Perform a pilot thermal imaging assessment of a portion (between Talkeetna and Devils Canyon) of the Susitna River. Discussion of thermal refugia data collection is located in the Study Plan (RSP Section 5.5.4.9).

FERC recommended two changes to the Standard Operating Procedures (SOP) and Quality Assurance Project Plan (QAPP):

1. Implementation of Environmental Protection Agency (EPA) 1631E method for laboratory analysis of total mercury in water, sediments, and fish tissue, and EPA Method 1630 for laboratory analysis of methylmercury in water and fish tissue, and application of Method 1669 (Clean Hands/Dirty Hands) for all mercury field sampling.

2. Utilization of Toxicity Reference Values (TRVs) as an additional benchmark when evaluating the need for additional baseline water quality data collection.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 23, 2016, AEA plans no modifications of the methods of this study.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, FERC, ADF&G, NMFS, USFWS, SRC et al., TNC, and Rebecca Long filed comments for Study 5.5. SRC et al. submitted one study modification proposal, while NMFS and USFWS submitted 6 and 4 study modification proposals, respectively. The majority of the requested modications were redundant amongst commenters and NMFS's Modification 4-1, part 2 is essentially the same as a NMFS proposed modification request to Study 5.7 (Modification 2-2). Alternatively, ADF&G stated that all of the field work, data collection, data analysis and reporting are complete and that no modifications or further studies are needed to meet the study objectives of the FERC-approved Study Plan.

Responses to requests for study modification and comments for Study 5.5 are organized by study objective then technical issue. When applicable, comments that provide background on a study modification request are included with the discussion of the request. Agency comments and study modification proposals on Study 5.5 and AEA's responses are presented in Table 2.2.1-1 and below.

There is significant overlap between Study 5.5 Objective 4 and the Mercury Assessment and Potential for Bioaccumulation Study 5.7 Objective 2 (RSP Section 5.7.4.2) and to a lesser extent between Study 5.5 Objective 6 and Study 5.7 Objective 2. Study 5.5 Objective 4, to measure baseline metals concentrations in sediment and fish tissue for comparison to state criteria, was developed to support the mercury assessment study. As described in RSP Section 5.7.4.2, the intent of Study 5.7 Objective 2 is to characterize the baseline mercury concentrations of the Susitna River and tributaries. This included collection and analyses of vegetation, soil, water, sediment porewater, sediment, piscivorous birds and mammals, and fish tissue samples for mercury and other metals. Also, Study 5.5 Objective 6, to implement Environmental Protection Agency (EPA) 1631E method for laboratory analysis of total mercury in water, sediments, and fish tissue, and EPA Method 1630 for laboratory analysis of methylmercury in water and fish tissue, and application of Method 1669 (Clean Hands/Dirty Hands) for all mercury field sampling (EPA 1996), as recommended by FERC in the April 1, 2013 Study Plan Determination, pertains to Study 5.7 as well. To reduce redundancy and increase readability, AEA's responses to comments pertaining to Study 5.5 Objective 4 and Study 5.5 Objective 6 have been consolidated under Study 5.7 Objective 2 (Section 2.2.3.2). The three comments relevant to Study 5.5 Objective 4 but which do not pertain to Study 5.7 are addressed below in Table 2.2.1-1.

Table 2.2.1-1. Study 5.5 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp8_ph2	*All of the field work, data collection, data analysis, and reporting for this study are complete and we believe no modifications or further studies are needed to meet FERC-approved study objectives.*	AEA agrees

Reference Number	Comment or Study Modification Request	AEA's Response
Objective 1		
NMFS_pp5.5-12_ph6; USFWS_pp5.5-19_ph2	*[SCR] Page 30, Section 6.1 – It is stated that "water quality conditions have not changed over the past approximately 30 years and is typical of water quality….".While this statement is true for the majority of the data, there is significant difference in the concentration of dissolved calcium and magnesium (increased 1,000 times during summer).*	The difference in dissolved calcium and magnesium concentrations when comparing historical to current water quality conditions is a reporting error of measurement units in Study 5.5 SCR Table 6.1-4. Dissolved calcium and magnesium concentrations in Table 6.1-4 are reported as µg/L and historical data is reported in mg/L. When historic data are expressed as µg/L similarity of results is no longer different by a magnitude of 1000 times. Concentration of calcium and magnesium were updated in Table 6.1-4 to reflect the original units used for data reporting. Numerical values for current and historical data remain the same in Table 6.1-4, but revisions include concentration units for calcium and magnesium from original sources (Attachment 2, Supplement to the Study 5.5 SCR).
Objective 2		
NMFS_pp5.5-5_ph4	*Modification 3-1[part 1]: NMFS recommends collecting an additional year of stream temperature data when the additional year of water quality data is collected.*	As explained below in Section 2.2.1.2.1.1, AEA requests FERC not adopt this proposed Study Plan modification. This modification is the same as SRC et al. Modification; the estimated cost of this modification is $1,000,000 to $1,500,000 for the temperature data only.
SRC_etal_WATER_pp4_ph3	*[Modification]: … we urge FERC to approve this modification request and mandate AEA to collect a full year (including winter sampling) of additional temperature data to fill data gaps and reduce model uncertainty.*	As explained below in Section 2.2.1.2.1.1, AEA requests that FERC not adopt this proposed study plan modification. This modification is the same as NMFS Modification 3-1, part 1; the estimated cost of this modification is $1,000,000 to $1,500,000 for the temperature data only.
USFWS_pp5.5-17_ph4	*SCR, Page 2, Section 4.1 (last paragraph) – "baseline temperature data were spaced at approximately 5-mile intervals…" According to Table 4.1.-1 (page 36), there are several 30-mile gaps on the river with no temperature data (for example no stations between PRM 59.9 and 87.3). AEA should explain how the lack of the data in this section may have affected calibration of the hydrodynamic model.*	See Section 2.2.1.2.1.1.
TNC_pp7_ph4	*Temperature Data Collection* *The report notes that thermistors could not be deployed at 10 of the 37 sites that were originally planned due to access restrictions, leaving a data gap for more than 65 river miles. The report indicates that data will be interpolated; however, such an approach could introduce significant uncertainty if local conditions change considerably. The best way to remedy this situation is to potentially deploy thermistors at a subset of the originally proposed locations to the extent that*	Temperature monitoring was conducted at all of these sites in 2012. See Section 2.2.1.2.1.1 for further detail.

Reference Number	Comment or Study Modification Request	AEA's Response
	access can be gained. Alternative locations from those originally proposed that eliminate access restrictions should be considered where feasible, even if it results in thermistors being deployed at locations not previously used. If site access eliminates the possibility of installing thermistors at alternative locations in this reach, then a detailed discussion of the methodology for developing temperature conditions in this reach should be provided and the uncertainties it carries for establishing baseline conditions, model calibration, and validation should be discussed.	
SRC_etal_WATER_pp3_ph3	*Missing temperature data for some stations between 2012 and 2014. In particular, the lack of access in 2013 that resulted in no temperature data at eight sites between Project River Mile (PRM) 145.6 and PRM 209.2.6*	See Section 2.2.1.2.1.1.
USFWS_pp5.5-13_ph2	*Section 7.2, page 4 – water temperature data collection, second bullet: It is stated that "continuous temperature data collection…will be partitioned". More details should be provided on how that will be done.*	More detail is provided in Study 5.5 ISR Part C, Section 7.2. The reference to partitioning of temperature data for model development distinguishes between: 1) continuous temperature data collected for calibrating the water quality model, and 2) single measurement temperature data collected during each site visit to baseline water quality and Focus Area monitoring sites. The second type of temperature data are single measurements recorded during site visits and used for validating model performance following calibration. Validation of model performance must use a data set not used for calibrating the temperature model, hence the need to "partition" data; calibration and validation temperature data sets.
USFWS_pp5.5-17_ph5	*SCR, Page 5, Section 4.2.1, 2nd paragraph – additional collection of data at some meteorological stations is appreciated, but the hydrodynamic model should utilize simultaneous meteorological data (from different stations) for best calibration and spatial representation.*	See Section 2.2.1.2.2.1.
SRC_etal_WATER_pp46_ph6	*At one of the meteorological stations, ESM-1, located at the Watana Dam site, the planned rain gage could not have been installed in 2013 because site access was restricted. This gage, which was not installed until October 2014, is continuing to collect data. However, the other two gages installed in 2012, ESM-2 and ESM-3, began collecting precipitation data in 2013 but were discontinued in August 2015. Thus, there was less than a year of precipitation data collected contemporaneously at the three meteorological stations. According to the Study Completion Report for baseline water quality (AEA, 2015b, Study 5.5, p. 5), "This data will be used for calibrating the temperature model for the reservoir and river and for calibrating the ice model in the reservoir." The few months of contemporaneous*	See Section 2.2.1.2.2.1.

Reference Number	Comment or Study Modification Request	AEA's Response
	precipitation at the three meteorological stations will increase uncertainty in the modeling, and may influence the calibration of the water quality model.	
TNC_pp7_ph5	*Meteorological Data Collection* *Six meteorological stations were proposed in the study plan, but only three have been installed. National Oceanic and Atmospheric Administration data are anticipated to be used for the downstream riverine portions. We agree that good meteorological data for the reservoir portion of the study site are more critical to modeling than for the riverine portions. It is not evident from the data presentations whether the entire meteorological dataset needed for temperature modeling is available for the downstream, riverine sections. Any limitations on the data available from other sources should be discussed.*	AEA relied on data gathered at three MET stations installed by AEA as well as three existing sites in the basin for a total of six sites. See Section 2.2.1.2.2.1 for further detail.
USFWS_pp5.5-13_ph4	*Vegetation monitoring and meteorological monitoring are to be carried out. There is no information within the QAPP about quality assurance and control for the monitoring carried out under these studies.*	Field and laboratory performance requirements for each parameter analyzed from vegetation monitoring are listed in the QAPP (Study 5.5 ISR Part B, Attachment 1, Section B.2.2, Table 12a). See Section 2.2.1.2.3.1.
	Objective 3	
NMFS_pp5.5-4_ph3	*Modification 1-1: NMFS recommends that additional data be collected to eliminate spatial discontinuities in both grab samples and continuous in-situ sampling. Collection of these data will help in the development of more accurate hydrodynamic and water quality models, which is necessary for NMFS to accurately assess project impacts and develop necessary mitigation measures. There was no continuous water data collected downstream of Project River Mile (PRM) 90, and there are several 30+ mile reaches in the river above PRM 90, where no data have been collected due to access issues. The study was not conducted as provided for in the approved study plan because the distances between sample points were too large.*	As explained below in Section 2.2.1.3.1.1 AEA requests FERC not adopt this proposed Study Plan modification. This modification request is the same as USFWS Modification 4, part 1; the estimated cost of this modification is $2,000,000 to $2,500,000 and $5,500,000 to $6,500,000 if an entire year of data was to be collected across the entire study area as requested in NMFS Modification 3-1 Part 2 and USFWS Modification 1.
USFWS_pp5.5-1_ph5A	*Modification 4, part 1: Collect data to eliminate spatial and temporal discontinuities. There are no continuous data in the river collected downstream of PRM 90, and there are several 30+ mile reaches in the river where no data have been collected due to access issues.* *Collection of these data will help in development of more accurate hydrodynamic and water quality models.*	As explained below in Section 2.2.1.3.1.1, AEA requests FERC not adopt this proposed Study Plan modification. This modification request is the same as NMFS Modification 1-1; the estimated cost of this modification is $2,000,000 to $2,500,000 and $5,500,000 to $6,500,000 if an entire year of data was to be collected across the entire study area as requested in NMFS Modification 3-1 Part 2 and USFWS Modification 1.
USFWS_pp5.5-17_ph9	*SCR, Page 9, Section 4.3.2 – How can the assumption that there is little difference in physical and chemical conditions between PRM 235.2 and PRM187.2 be verified? What were the limits established to suggest samples values are similar or different? Also in 2014 the Watana Dam site was not sampled due to limited accessibility. Monitoring occurred*	See Section 2.2.1.3.1.1.

Reference Number	Comment or Study Modification Request	AEA's Response
	several miles downstream. Since this is the proposed siting of the dam, additional data should be collected from this location.	
NMFS_pp5.5-12_ph2	*The document states that there is little difference in physical and chemical conditions between PRM 235.2 and PRM 187.2. NMFS questions this conclusion; additional detail needs to be provided on what limits were established to discern whether samples values were similar or different. Also, in 2014, the Watana Dam site was not sampled due to limited accessibility and monitoring occurred several miles downstream. Since this is the proposed location of the dam, NMFS recommends that additional data should be collected from this location.*	See Section 2.2.1.3.1.1.
NMFS_pp5.5-2_ph6	*Modification 3-1, part 2: Collect another complete year of water chemistry, water quality, and groundwater data at all sampling sites and focus areas because the majority of water chemistry data collected in 2013 was disqualified due to quality control problems.*	As explained below in Section 2.2.1.3.2.1. AEA requests FERC not adopt this proposed Study Plan modification. This modification is the same as USFWS Modification 1; the estimated cost of this modification is $5,500,000 - $6,500,000.
USFWS_pp5.5-1_ph2	*Modification 1: Collect another year of water chemistry, water quality, and groundwater data. The majority of water chemistry data collected in 2013 was disqualified due to quality control problems. It is therefore recommended that data collection be extended for another year to compensate for the inadequacy of 2013 data.*	As explained below in Section 2.2.1.3.2.1, AEA requests FERC not adopt this proposed Study Plan modification. This modification is the same as NMFS Modification 3-1, part 2; the estimated cost of this modification is $5,500,000 - $6,500,000.
USFWS_pp5.5-6_ph9	*Concern 2: AEA provided a consistent summary of all data collected during the 2013 and 2014 sampling seasons, laboratory data reports, and quality control sheets; explained on how this data was contaminated, rejected, and consequently resampled (SCR, pp 15-16). While USFWS looked through this information, we did not have time to conduct quality control of these results. However, we noticed a significant discrepancy in the percentage of the rejected samples (9% - 30%, according to Table 5.1-1), compared to 90% of rejected samples according to our analysis of the 2013 metadata. Thus, AEA should explain why the 2013 data previously rejected, have now been accepted in the analysis. Non-conformance with this objective, if confirmed, is significant.*	AEA provided the entire 2014 dataset to licensing participants in November 2015. See Section 2.2.1.3.2.1 for AEA's method for determining the percentage of rejected samples.
NMFS_pp5.5-5_ph9	*(3.2) AEA provided a summary of all data collected during the 2013 and 2014 sampling seasons, laboratory data reports, and quality control sheets and explained how data was contaminated, rejected, and consequently resampled (SCR, pp 15-16). While NMFS looked through this information, our contractors did not have time to conduct quality control of these results. However, we noticed a significant discrepancy in the percentage of the rejected samples (9% - 30%, according to Table 5.1-1), compared to 90% of rejected samples according to our analysis of the 2013 metadata (February 25, 2014 Technical Memo, USFWS and NMFS consultants, Ramboll Environ). Thus,*	AEA provided the entire 2014 dataset to licensing participants in November 2015. See Section 2.2.1.3.2.1 for AEA's method for determining the percentage of rejected samples.

Reference Number	Comment or Study Modification Request	AEA's Response
	NMFS recommends that AEA should explain why the 2013 data previously rejected, have now been accepted in the analysis. Non-conformance with this objective, if confirmed, is significant.	
USFWS_pp5.5-16_ph6	*ISR -Part D: Specific Comment - Page 8, last paragraph – our analysis of the 2013 metadata identified significant quality control issues with the 2013 data (February 25, 2014 Technical Memorandum from Ramboll Environ) affecting most (97%) of the water quality results for mercury analysis. The paragraph on page 8 identified a sample preservative as a culprit that contaminated majority of the results. Nothing was stated about contamination of samples by glacial flour, although it was discussed during the latest post-ISR meeting.*	See Section 2.2.1.3.2.1.
USFWS_pp5.5-7_ph6	*Additional water quality sampling occurred in 2014 at selected locations and for parameters for which 2013 samples were qualified as either "rejected" or "estimated". However, all the 2014 samples were "single grab sample-types" based on the conclusion that there was no horizontal or vertical variability at sample locations (from 2013 samples). USFWS questions the validity of that conclusion, as it could have been based on the 2013 samples that were previously rejected.*	See Section 2.2.1.3.2.2.
USFWS_pp5.5-8_ph1	*Another decision made based on the 2013 data was to conduct sampling in 2014 using a single grab sampling method. All the 2014 samples were "single grab sample-types" based on the conclusion that there was no horizontal or vertical variability at sample locations. The problems with the data collection in 2013 may have led AEA to an erroneous conclusion because it is difficult to assess variation using questionable data. Additional water quality sampling occurred in 2014 at selected locations and for parameters for which 2013 samples were qualified as either "rejected" or "estimated". We question the validity of the lack of variation in the data, as it was based on 2013 samples that were rejected.*	See Section 2.2.1.3.2.2.
USFWS_pp5.5-13_ph1	*Section 7.1.2, page 2* *AEA should provide the data analysis that indicates a lack of horizontal or vertical variability in the water quality results for 2013.*	See Section 2.2.1.3.2.2.
USFWS_pp5.5-17_ph3	*ISR Part D, Page 8, last paragraph, last sentence: …given the lack of horizontal and vertical variability in the results for 2013…, only a single grab sample was collected at each site transect in 2014,….While the RSP allows change in the sampling protocol under these conditions, we are questioning the interpretation of the 2013 results. If it is known that the majority of 2013 samples were either contaminated or rejected, how was that conclusion (about spatial non-variability) reached? If that conclusion was based on the analysis of the rejected samples, the*	See Section 2.2.1.3.2.2.

Reference Number	Comment or Study Modification Request	AEA's Response
	conclusion is not valid, and no deviation from sampling methodology should have been allowed.	
USFWS_pp5.5-17_ph6	*SCR, Page 7, Section 4.3 – Does the rationale for reducing number of samples collected in 2014 seem adequate based on the data provided in Figures 6.1-4, 6.4-2 and 6.4-5?*	See Section 2.2.1.3.2.2.
NMFS_pp5.5-6_ph7	*Additional water quality sampling occurred in 2014 at selected locations and for parameters for which 2013 samples were qualified as either "rejected" or "estimated". However, all the 2014 samples were "single grab sample-types" based on the conclusion that there was no horizontal or vertical variability at sample locations (from 2013 samples). NMFS questions the validity of that conclusion, as it could have been based on the 2013 samples that were previously rejected.*	See Section 2.2.1.3.2.2.
SRC_etal_WATER_pp46_ph8	*Some water quality samples at some locations were validated as "rejected" or "estimated" in 2013. In general, sampling occurred in 2014 at select locations and for parameters that were rejected or estimated in 2014. While the missing data in 2013 result in a water quality dataset that is not synoptic, the resampling in 2014 did fill some of the data gaps created by the data with quality control problems.*	See Section 2.2.1.3.2.2.
USFWS_pp5.5-12_ph7	*ISR, Section 7.1.2, page 2* *AEA notes that "the strategy for additional sampling was based on comparison of 2013 results with applicable criteria or thresholds (RSP Section 5.5.4.4)." The comparison of 2013 results to thresholds should be provided.*	The requested comparison is provided in Study 5.5 SCR. Both the 2013 and 2014 finalized data results were compared to applicable thresholds and criteria in Study 5.5 SCR Section 5.4 (Baseline Water Quality Monitoring) and Study 5.5 SCR Section 5.5 (Focus Area Monitoring). Results exceeding thresholds or criteria were reported in each of these SCR sections.
SRC_etal_WATER_pp3_ph5	*Water quality samples were not collected in the Susitna River below Tsusena Creek and collected only in the winter of 2013/2014 above Tsusena Creek.[8] In addition, although Tsusena Creek is an important tributary, the creek was only sampled during the summer of 2013. This leaves very little data to evaluate the baseline water quality in the creek.*	Monitoring in Tsusena Creek was scheduled for continuous temperature monitoring as reported in Study 5.5 RSP Section 5.5.4.1, Table 5.5-1. Winter sampling at this site was limited to characterization of water quality in support of the Fish and Aquatics Instream Flow Study 8.5 SIR Section 5.5.6.2. Tsusena Creek was not sampled for continuous temperature or water quality due to extremely shallow water depth during winter conditions at the location identified in the RSP. Temperature monitoring equipment could not be secured to an onshore object in Tsusena Creek to prevent loss. This site was not one of the seventeen transects identified for collection of water quality data in support of calibrating the water quality model. Although very little baseline water quality information in Tsusena Creek is available, the lack of baseline water quality

Reference Number	Comment or Study Modification Request	AEA's Response
		information in this creek does not have any influence on assessing Project effects. The model is initially calibrated using water temperature data and this has been collected at sites above (PRM 184.8) and below (PRM 183.1) Tsusena Creek (see Attachment 2, Supplement to the Study 5.5 SCR, Table 4.1-1) accounting for any influence Tsusena Creek has on main channel Susitna River water quality.
FERC_ppA-1_ph2	*Conflicting information presented in section 4.3 of the Study Completion Report (SCR) makes it difficult to interpret baseline water quality monitoring efforts and results.... Please clarify where water quality samples were collected and reconcile it with the tables. Please include a description of where continuous water temperature and other baseline water quality monitoring occurred, and whether each sites was a mainstem, off-channel, or tributary site.*	In order to clarify information presented in the sample location tables, Study 5.5 SCR Table 4.1-1 and Table 4.3-1, the tables were updated and presented in a Supplement to the Study 5.5 SCR (Attachment 2 of this filing).
TNC_pp8_ph1	*Water Quality Monitoring* *For the focus area monitoring, all locations that remained uncharacterized are on the upper portions of the river, but are proposed for sampling in the second year. The impacts of developing baseline conditions from different years should be discussed. If project budget and schedules would allow, one or more of the previously characterized areas should be sampled again in the second year to provide a basis for comparison to the sites that were sampled in 2013. Other than these, the variances described do not pose a significant risk to achieving the study objectives.*	See Section 2.2.1.3.3.1.
USFWS_pp5.5-17_ph7	*SCR, Page 7, Section 4.3 – What criteria were used to establish acceptable limits for precision between the two analytical laboratories, SGS and ARI. How was the subset of sites selected for resampling in 2014? What specifically was the method used to estimate concentration by eliminating interfering elements?*	See Section 2.2.1.3.3.2.
USFWS_pp5.5-12_ph6	*ISR, Section 7.1.2, page 2* *The Final ISR should explain measures proposed to correct data quality issues in 2013 for water samples (i.e., sample preservative affecting detection of the target analyte, bottles of reagent water were contaminated with the target analyte(s). AEA has performed split sample analysis with multiple laboratories, although other steps (pre-analysis of reagent water and sample preservative) may be useful.*	See Section 2.2.1.3.3.2.
NMFS_pp5.5-12_ph1	*NMFS recommends that providing additional details regarding the criteria that were used to establish acceptable limits for precision between the two analytical laboratories, SGS and ARI, an explanation on how the subset of sites were selected for re-sampling in 2014, and the specific method used to estimate concentration by eliminating interfering elements.*	See Section 2.2.1.3.3.2.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.5-1_ph8	*Application of the total phosphorus (TP) correction factor is questionable. The issues associated with the 2013 data are multiple and diverse. The application of this factor will not correct all of them.*	See Section 2.2.1.3.3.2.
USFWS_pp5.5-7_ph2	*Concern 3: AEA has provided an explanation of the total phosphorus (TP) conformance factor; however, some of the values in Tables 4.5-3 and 4.5-4 are dubious: corrected TP was calculated as -0.065 (Table 4.5-3); estimate % of TP that is due to TSS was calculated as 128.8%, raising questions on the methodology applied. If there were only one consistent and explainable quality control issue associated with the 2013 data results, the application of a correction factor might be appropriate, after careful review of the procedure to be used. However, the issues associated with the 2013 data are multiple, and diverse, so the application of the TP Correction Factor may be inappropriate.*	See Section 2.2.1.3.3.2.
NMFS_pp5.5-6_ph2	*(3.3) AEA has provided an explanation of the total phosphorus (TP) conformance factor, however, some of the values in Tables 4.5-3 and 4.5-4 are doubtful [corrected TP was calculated as -0.065 (Table 4.5-3), estimate % of TP that is due to TSS was calculated as 128.8%], raising questions on the methodology applied. If there were only one consistent and explainable quality control issue associated with the 2013 data results, the application of a correction factor might be appropriate, after careful review of the procedure to be used. However, the issues associated with the 2013 data are multiple, and diverse, so NMFS believes that the application of the TP Correction Factor may be inappropriate.*	See Section 2.2.1.3.3.2.
USFWS_pp5.5-14_ph2	*QAPP, Section 2, Table 12a* *The maximum holding time for Total Phosphorus (TP) was specified as 48 hours (if not field preserved) and at 28 days if preserved. AEA should provide additional information on the TP holding time for the TP sent to the AR and SGS laboratories that conducted split sample analysis for the data collected in August 2013 and for which preliminary results were presented at the December 2, 2013 TWG meeting. If the holding time was adequate for August 2013 samples, was an appropriate preservation method used according to this table? Explanation of this discrepancy in laboratory results has been noted during TWG meetings, but never explained.*	See Section 2.2.1.3.3.2.
USFWS_pp5.5-7_ph7	*The TP detection limit of 3.1 micrograms per liter (used in 2013 samples) was lowered to 2.0 micrograms per liter in processing 2014 samples. USFWS agrees that this lower detection limit will improve accuracy.*	As USFWS acknowledges, the lower TP detection limit was an improvement in detecting lower concentrations of phosphorus in surface water. Being able to detect lower concentrations results in a broader range of useable data for calibrating the water quality model.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.5-1_ph3	*Modification 2: Describe data quality issues in a report. The approach used to resolve data quality issues with suspended solids, holding times and temperatures was not sufficiently described.*	As explained below in Section 2.2.1.3.3.3, AEA requests FERC not adopt this proposed Study Plan modification. This modification request is the same as NMFS Modification G-1; the estimated cost of this modification is $30,000 to $40,000.
NMFS_pp5.5-10_ph12	*Modification G-1: NMFS recommends that data quality issues and the approach used to resolve data quality issues with suspended solids, holding times and temperatures be described in greater detail in a data quality report. Data quality issues are not currently described in sufficient detail for NMFS to determine if the study was conducted as provided for in the approved study plan.*	As explained below in Section 2.2.1.3.3.3, AEA requests FERC not adopt this proposed Study Plan modification. This modification request is the same as USFWS Modification 2; the estimated cost of this modification is $30,000 to $40,000.
USFWS_pp5.5-1_ph4	*Modification 3: Make the study completion report into a stand-alone document that provides information about quality control and describes analytical methods and how data will be used in modeling.*	As explained below in Section 2.2.1.3.3.3, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of this modification is $25,000.
TNC_pp6_ph4	*The study methodology appears to have followed standard environmental data collection protocols. The water quality data collected are generally consistent with the objectives of establishing baseline conditions. However, we found the information to be poorly organized, making it difficult to find the information needed in the reports and appendices. The final study report should either repeat discussions of the methods for each study component or provide clear ... references (e.g., a citation or link to the location of descriptions of field methods, quality assurance/quality control [QA/QC] procedures, etc.). Additional issues specific to each study component are noted in the full reviews.*	See Section 2.2.1.3.3.3.
USFWS_pp5.5-18_ph8	*SCR, Page 15, Section 5.1.1 – Data quality issues with TSS, holding time and temperature exceedances - the approach has not been sufficiently described, questioning the interpretation of the data. USFWS did not have time to review data reports (field data reports, laboratory data reports) summarizing field data collected during 2013 and 2014 monitoring seasons, and/or conduct any quality control. Thus, we cannot assure data quality provided in the data reports.*	See Section 2.2.1.3.3.3.
TNC_pp7_ph2	*In general, interpretation of data collected is lacking. If the intent of the report is to simply present data, then it should be noted in the introduction that a detailed report with interpretations of the baseline conditions will follow. In Section 6 of the report it is noted that data interpretation and analysis will follow a complete and quality reviewed dataset, and that data will be interpreted based on water quality standards, which would be a useful first step in informing the reader whether the designated uses are being met under baseline conditions.*	See Section 2.2.1.3.3.3.
USFWS_pp5.5-13_ph3	*Nowhere in the documentation issued to date has there been an appropriate discussion of the overall ecological health of the river and tributaries. There is significant*	See Section 2.2.1.3.3.3.

Reference Number	Comment or Study Modification Request	AEA's Response
	discussion of water quality parameters and some of this relates to species present in the project area. The overall documentation would therefore benefit from, at least, a qualitative statement on species present, relative abundance and habitat health.	
USFWS_pp5.5-6_ph8; NMFS_pp5.5-5_ph7	*Concern 1: The 50-mile reach of Susitna River (including Tsusena Creek), previously inaccessible due to land ownership issues, was successfully sampled in summer of 2014. Winter monitoring was not conducted in that reach and should be included.*	AEA disagrees. As noted in the SCR Table 4.1-1 and 4.3-1, and the revised tables in the Supplement to the Study 5.5 SCR, winter water quality sampling was conducted at PRM 184.8 (Susitna River above Tsusena Creek) during January 2014 and March 2014 and summer sampling occurred in the Susitna River at the dam site (PRM 187.2) in both 2013 and 2014. Summer temperature monitoring was conducted at PRM 183.1 (Susitna below Tsusena Creek) during 2012 and 2014. The FERC-approved Study Plan indicated that Tsusena Creek was one of the tributaries identified for sampling (Study 5.5 RSP Section 5.5.4). Temperature monitoring occurred in the main channel at PRM 183.1 (Susitna River below Tsusena Creek) during summer 2012 (Supplement to the Study 5.5 SCR, Table 4.1-1). Tsusena Creek was not sampled for continuous temperature or water quality due to extremely shallow water depth during winter conditions at the location identified in the RSP. Temperature monitoring equipment could not be secured to an onshore object in Tsusena Creek to prevent loss.
FERC_ppA-2_ph2	*Throughout the SCR, conductivity and specific conductivity appear to be used interchangeably. ... Please clarify your use of conductivity or specific conductivity in the SCR.*	In this study, field measurements were of specific conductivity, standardized at 25°C. In the Study 5.5 SCR, all instances of the term "conductivity" should read "specific conductance" or "specific conductivity" (see Supplement to the Study 5.5 SCR for corrections).
	Objective 4	
USFWS_pp5.5-15_ph2-6; NMFS_pp5.5-11_ph8	*Focusing on the column for "most stringent water quality standards, sediment thresholds and designated uses," NMFS is concerned that the values listed for the following factors are inappropriate:* • *Barium: Should be 3.9 µg/L, based on chronic aquatic life criteria. http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf* • *Beryllium: Should be 0.66 µg/L based on chronic aquatic life criteria. http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf*	NOAA SQuiRT values do not represent official policy, criteria or clean-up levels. Values in Study 5.5 ISR, Part B Attachment 1 QAPP, Table 6, representing the most stringent criteria were included in the following order of importance: 1) criteria, 2) clean-up levels, and 3) screening levels or thresholds. The most stringent water quality standards are used in Table 6 (Study 5.5 ISR Part B, Attachment 1 QAPP) representing water quality criteria and reference to designated beneficial uses, when available. In the absence of adopted criteria for protection of beneficial uses, like criteria for protection of aquatic life in sediments,

Reference Number	Comment or Study Modification Request	AEA's Response
	• *Cobalt: Should be 3.0 µg/L based on chronic aquatic life criteria. http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf* • *Vanadium: Should be 19 µg/L based on chronic aquatic life criteria. http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf*	Screening Quick Reference Tables (SQuiRT) values were used in Study 5.5 ISR Part B, Attachment 1 QAPP, Table 6.
USFWS_pp5.5-15_ph8	*QAPP page 16 – The statement "The ADEC limit for mercury in fish tissue that protects human health consumption is 0.3 mg/kg." is incorrect. ADEC does not establish the health-protective value for mercury in fish; the Alaska Division of Public Health does.*	AEA concurs. (see Supplement to the Study 5.5 SCR).
USFWS_pp5.5-15_ph9	*QAPP page 17 – objective A.5.3, paragraph 2: The goal of the Water Quality and Mercury Assessment is also to protect aquatic biota and piscivorous wildlife. NOAA SQuiRT chronic screening levels for protection of health of aquatic biota should be used, per the FERC-approved study plan.*	NOAA SQuiRT lowest effect screening levels are used for interpretation of sediment quality data where metals content were analyzed (Study 5.5 ISR, Part B Attachment 1 QAPP, Table 6). NOAA SQuiRTs for determining chronic effects of metals in surface water are also used for interpretation of results (Study 5.5 SCR Table 6.3-3).
USFWS_pp5.5-18_ph6	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.1.
USFWS_pp5.5-14_ph3	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.3.
USFWS_pp5.5-14_ph5; NMFS_pp5.5-11_ph5	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.3.
USFWS_pp5.5-14_ph4; NMFS_pp5.5-11_ph4	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.3.
NMFS_pp5.5-8_ph4A	*Modification 4-1, part 1: This NMFS modification request and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.4.
USFWS_pp5.5-1_ph5B	*Modification 4, part 2: This USFWS modification request and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.4.
USFWS_pp5.5-10_ph4	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.4.
TNC_pp8_ph2	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.5.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.5-13_ph6	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.2.5.
USFWS_pp5.5-13_ph7	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.3.1.
USFWS_pp5.5-15_ph1	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.3.1.
NMFS_pp5.5-11_ph7	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.3.1.
NMFS_pp5.5-8_ph4B	*Modification 4-1, part 2: This NMFS modification request and associated response relate to sampling for Study 5.7-Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.3.2.
USFWS_pp5.5-14_ph6; NMFS_pp5.5-11_ph6	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.4.1.
USFWS_pp5.5-15_ph10	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.5.1.
USFWS_pp5.5-16_ph4	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.5.2.
USFWS_pp5.5-16_ph3	*This comment and associated response relate to sampling for Study 5.7- Mercury Assessment and Potential for Bioaccumulation and are addressed in Section 2.2.3.*	See Section 2.2.3.2.5.2.
Objective 5		
NMFS_pp5.5-9_ph9	*Modification 5-1: NMFS recommends that the Thermal Infrared Remote Sensing (TIR) be completed as originally planned for 2014.*	As explained below in Section 2.2.1.5.1, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of this modification is $120,000 to $160,000.
USFWS_pp5.5-16_ph5	*ISR -Part D: Specific Comment - No explanation was provided on why the Thermal Infrared Remote (TIR) sensing study was terminated and not continued in 2014, although it was identified as one of the main project objectives (pages 2-3). The TIR was also identified in the study plan modifications (page 9), but was never conducted on the remaining portion of the Lower Susitna River in 2014.*	See Section 2.2.1.5.1.
USFWS_pp5.5-11_ph7-8	*Caution should be exercised in interpretation of results from remote sensing applications, especially where there is potential for anomalous results. A clear distinction should be drawn between the use of TIR for identifying areas where there is strong potential for surface water – groundwater interaction at certain times of the year and in-situ field data for baseline water quality monitoring.*	See Section 2.2.1.5.2.

Reference Number	Comment or Study Modification Request	AEA's Response
	There is no information in the ISR about other potential means of determining groundwater surface water interactions such as hydrochemical tracers.	
USFWS_pp5.5-18_ph3	*SCR, Page 10, Section 4.4 – Why were additional groundwater samples not collected in 2014 if the data collected in 2013 was suspect and required additional sample collection to further support 2013 data collection efforts?*	Groundwater sample collection was required in Focus Areas for one year and coordinated with the Instream Flow Study (Study 8.5) and the Groundwater Study (Study 7.5). Collection of samples was required every 2 weeks within a period of six weeks (RSP Section 5.5.4.5). Groundwater was required to be sampled for one year (Study 5.5 RSP, Section 5.5.4.4.2). Additional groundwater samples were not collected in 2014 (as per the FERC-approved Study Plan) because 2013 lab results met all QA acceptance limits and will be used for calibrating the Focus Area water quality models. Groundwater samples collected in 2013 were not affected by high levels of suspended solids that interfered with estimates for select water quality parameters as occurred in surface waters. This example further affirms that suspended solids (i.e., fine suspended material in surface water) is a major factor in overestimates of the nutrient parameter total phosphorus.
	Objective 6	
USFWS_pp5.5-16_ph3	*This comment and associated response have been moved to Study 5.7- Mercury Assessment and Potential for Bioaccumulation.*	See Section 2.2.3.2.5.2.
	Objective 7	
NMFS_pp5.5-10_ph8	*Modification 7-1: NMFS recommends that a table of actual TRV values should be provided. Without knowing the Toxicity Reference values that the applicant is trying to arrive at (or stay below) the license participants will not be able to interpret model results. TRVs have not been described or discussed. The FERC recommendations from their Determination (4/1/2013) have not been followed and therefore the study was not conducted as provided for in the approved plan.*	As explained below in Section 2.2.1.7.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan and will be reported in the USR for Study 5.6 and Study 5.7, as applicable, as well as the License Application. As such, there is no additional cost for implementing this modification.
USFWS_pp5.5-13_ph5	*AEA has noted that "TRVs for surface water ecological receptors and TRVs calculated for community measurement receptors in sediment will be determined as outlined in EPA (1999)". EPA (1999) TRVs were not explicitly listed by AEA in Section 5.5, and it is difficult to discern which TRVs would be selected for decision-making, and which of the project species would be assessed. For example, while EPA (1999) provides a TRV for mercury chloride and methylmercury for mammals and birds, and it is unclear whether AEA will assess both mercury and methylmercury separately.*	See Section 2.2.1.7.1.

Reference Number	Comment or Study Modification Request	AEA's Response
General		
USFWS_pp5.5-17_ph1	*ISR Part D, Page 8, last paragraph, the hyper-link identifying the summary table of the lab results could not be accessed at the time of the review (week of February 15, 2016).*	It appears there was a typographical error in the link noted in the ISR Part D, however, the correct link was provided in the SCR. All results from the Study 5.5 Baseline Water Quality Monitoring Program have been accessible through hyperlinks provided in Study 5.5 SCR Table 5.1 since November 2015. These links have been verified for access to data that have passed QA inspection and met acceptance limits.
USFWS_pp5.5-17_ph2	*ISR Part D, Page 8, last paragraph, "as modification was implemented"... It is not clear which modification AEA is referring to.*	Re-sampling in 2014 was a Study Plan modification; this new data filled in the gap where 2013 results for select parameters were rejected. 2014 data collection represents implementation of the Study Plan Modification (Study 5.7 ISR, Part C Section 7.1.2.1).
USFWS_pp5.5-18_ph9	*SCR, Page 23, Section 5.4.7 – We recommend showing graphs of the dissolved metals accepted for analysis – only one example is shown in Figure 5.4-8.*	Graphs of dissolved metals were included in documents if results were used to identify exceedances of water quality criteria or SQuiRT thresholds. If results showed no exceedances then AEA did not include graphs with this information as there are over 3,000 graphs generated from water quality results. Data ranges have been provided for all dissolved metals results from 2013 and 2014 (Study 5.5 SCR Table 6.1-4) for each of the seventeen Baseline Water Quality Monitoring and the data is available on the Project website.
USFWS_pp5.5-19_ph1	*SCR, Page 24, Section 5.4.8 – The TDS concentrations were shown in graphs, but TSS concentrations were not.*	Examples of TSS results from 2013 sampling are shown in Figure 6.4-1 and Figure 6.4-2 for individual sites (Section 6.4, Study 5.5 SCR). These graphs demonstrate how concentrations for TSS vary along a transect at two of the seventeen sites visited during that year. Not all graphs were included in the Study 5.5 ISR/SCR, but data for examining TSS concentrations are found at: http://gis.suhydro.org/Post_ISR/05-Water_Quality/5.5-Baseline_Water_Quality/ISR-MTG_5_5_WQ_2013%20Lab%20Data/ (2013 Baseline Lab Data).

2.2.1.1. Objective 1

Study Objective 1: Document Historical Water Quality Data and Combine with Data Generated from this Study. The combined dataset will be used in the Water Quality Modeling Study to predict Project impacts under various operations.

No proposed modifications to the FERC-approved Study Plan were submitted pertaining to Objective 1.

2.2.1.2. Objective 2

Study Objective 2: Collect stream temperature and meteorological data to supplement the existing data.

2.2.1.2.1. Water Quality Data Integrity – Spatial Gaps in Data Collection

2.2.1.2.1.1. Response to Modification Request to Collect Additional Water Temperature Data

NMFS (Modification 3-1, part 1; NMFS_pp5.5-5-ph4) and SRC et al. (SRC_etal_WATER_pp4_ph3) request FERC to require AEA to collect an additional year of stream temperature data. SRC et al. (SRC_etal_WATER_pp4_ph3) added that additional sampling, which should include winter sampling, will then fill data gaps and reduce model uncertainty to be able to reliably model changes in summer and winter temperatures in off-channel habitats. USFWS (USFWS_pp5.5-17_ph4) also comments that AEA should explain how the lack of water temperature data between PRM 59.9 and 87.3 may have affected calibration of the hydrodynamic model. SRC et al. (SRC_etal_WATER_pp3_ph3) noted the lack of water temperature monitoring during 2013 at eight sites between PRM 145.6 and PRM 209.2. In addition, the TNC (TNC_pp7_ph4) commented that thermistors were not deployed at 10 of the 37 sites that were originally planned due to access restrictions, leaving a data gap for more than 65 river miles, and expressed concern that the data would be interpolated, introducing significant uncertainty.

AEA requests that FERC not adopt the NMFS and SRC et al. proposed Study Plan modification because the objectives of the FERC-approved Study Plan have been met without the proposed modifications, and neither NMFS nor SRC et al. present evidence to the contrary. Though there were variances associated with the period and location of water temperature data collection due primarily to access issues that relate to the modification request, these variances did not interfere with AEA's ability to meet study objectives. As summarized in the Study 5.5 SCR Sections 4.1.1 addressing these variances:

> *The volume of data and period of record among all sites are sufficient to construct a temperature profile with the EFDC model where records are missing. The study results are not impacted by the missing record and the data collected are sufficient to meet study plan objectives.*

As described in RSP Section 5.5.4.1, water temperature monitoring was initiated in June 2012 and would be continued during 2013 and 2014. Water temperature probes were to be deployed at all sites during the years following 2012 acknowledging the potential for data loss due to vandalism, logistical issues or physical interruption from sedimentation.

The Water Temperature Monitoring program collected continuous data from 36 sites over a three-year period. Due to logistical access issues at the 37th site, the Susitna River near Cantwell, only spot measurements were collected during the winter of 2013/2014. The periods and locations of data collected at sites during the years 2012 through 2014 are reported in the Supplement to the Study 5.5 SCR, Table 4.1-1 (Attachment 2). As stated in Study 5.5 RSP, Section 5.5.4.1, temperature monitoring was interrupted by logistical issues (site access restrictions in 2013) and by environmental conditions (e.g., flooding or ice break-up). Continuous temperature monitoring data was collected from 30 sites in 2012, 28 sites in 2013, and from 36 sites during the final year of monitoring in 2014 as described in Study 5.5 SCR, Section 4.1. The assertion (TNC_pp7_ph4 and SRC_etal_WATER_pp3_ph3) that there is a 65 river mile data gap in temperature monitoring based on the site access restriction in 2013 is incorrect. Temperature probe deployment and data retrieval were accomplished in 2012 from sites between Devils Canyon and below the Dam Site and were at PRMs 152.2, 152.3, 152.7 and 183.1. Data from these sites acquired during 2012 complete the record and eliminate any need to interpolate data between sites.

Re-deploying the probes every year from 2012 through 2014 ensured that a data record was collected for at least one year from each of the proposed sites and met the goal of the FERC-approved Study Plan. As stated in the Study 5.5 SCR Section 4.1.1, not obtaining the year of data from one of the 37 sites was not unexpected and did not interfere with AEA’s ability to meet study objectives:

> *The purpose for including many monitoring sites throughout the river and multiple years of temperature monitoring was to acquire as complete a data record as possible for each of the sites, while acknowledging that an incomplete data set was likely to occur for some sites due to the three issues noted above, but collectively would be representative of the river.*

In addition, in reference to the lack of continuous data for the Cantwell site at PRM 225.5 in the discussion of the variance, the SCR states, “Temperature data collected downstream of this site (Cantwell) at PRM 209.2 and upstream at PRM 235.2 bracket this site and provide sufficient information to calibrate the temperature component of the EFDC model.”

In response to USFWS_pp5.5-17_ph4, the lack of water temperature data between PRM 59.9 and 87.3 will not affect calibration of the hydro-dynamic model. As an initial matter, temperature monitoring results for PRM 59.9 and 87.3 (June through September 2013 and 2014) when compared were virtually identical, showing no indication that local influences would be a factor based on distance between the sites or that there would be an influence in calibration of the temperature model. Temperature monitoring results from 2013 and 2014 are compared in the graphs below (Figures 2.2.1-1 and 2.2.1-2).

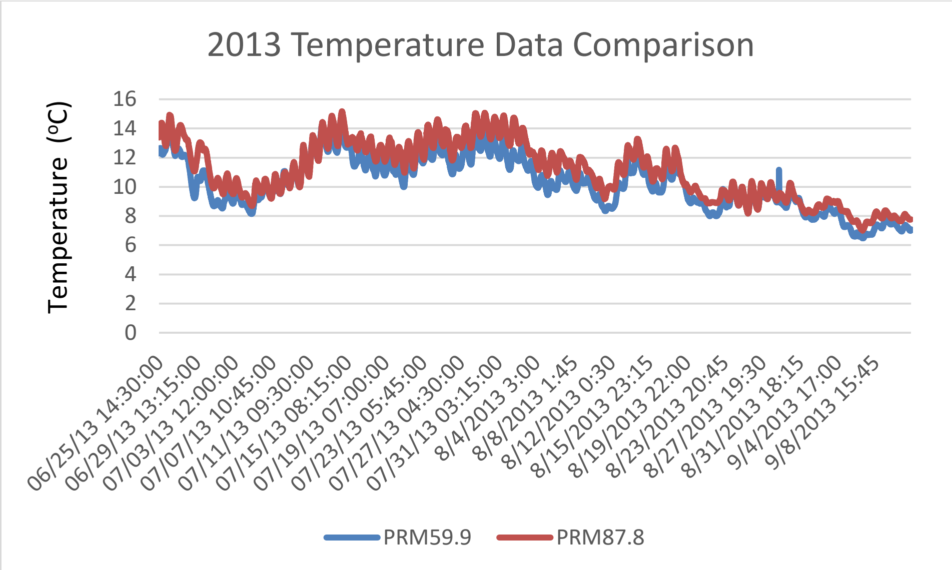

Figure 2.2.1-1. 2013 Temperature Data at PRM 59.9 and 87.8

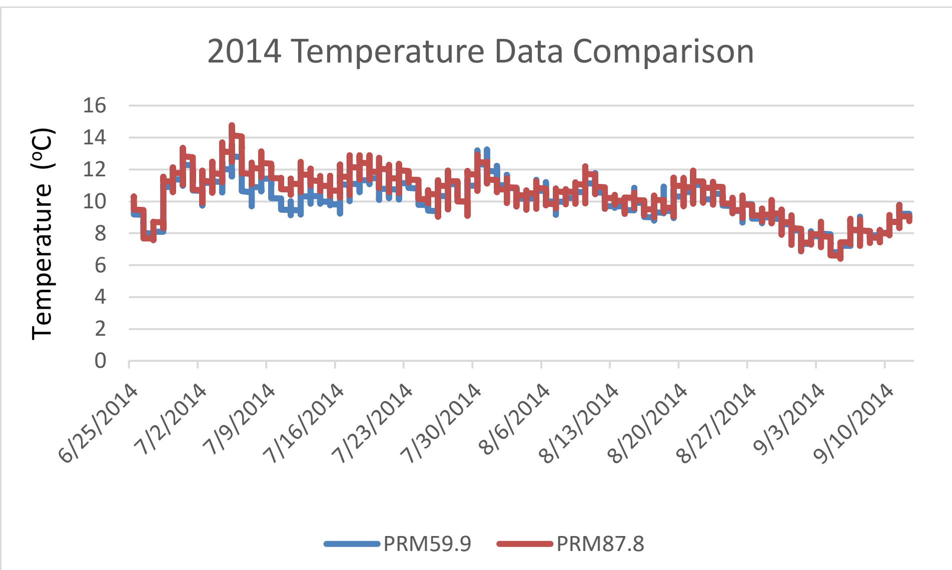

Figure 2.2.1-2. 2014 Temperature Data at PRM 59.9 and 87.8

Continuous temperature data collected from PRM 87.8 and PRM 59.9 showed similar patterns in magnitude and timing from June through September in 2013 and 2014. The largest difference in temperature collected at the same time and compared between the two sites was approximately 2 °C occurring during the first half of August in 2013 and was noted in only a few data records. Otherwise, most of the temperature records showed a difference of less than 1 °C between PRM 87.8 and PRM 59.9 for both 2013 and 2014 data sets.

Since these locations on the river are below the Three Rivers Confluence, Project effects are significantly attenuated and differences in temperature conditions unaffected by lack of significant contribution from any tributaries between PRM 59.9 and PRM 87.8.

Initial construction of the riverine model involves calibration of the hydrodynamic module and temperature module. The riverine model has been calibrated using a 60-year period of flow records generated from long-term USGS gaging stations for the period 1950–2010 used to calibrate the hydrodynamic module in EFDC throughout the Susitna Basin in order to reflect a wet, dry, and average flow period (April 2014 TWG Meetings, Proof of Concept Model Runs). Current continuous temperature data (2012 and 2013) were combined with the long-term record to fill in gaps between the long-term existing sites and this resulted in a water quality model with higher spatial resolution. Results from 2014 temperature monitoring will be used to further validate the current full river temperature model and to further refine the current reservoir temperature model, if necessary. Additional details will be included in the Study 5.6 USR.

As shown in temperature calibration results, the 2012/2013 model catches the observed spatial-temporal variation in temperature pretty well (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). Even though data is only available at limited locations, the model is capable of generally reproducing observed conditions at these locations and it shows that the model is correctly representing the underlying dynamics/physics. A complete description of model calibration, validation and uncertainty will be provided in the Study 5.6 USR.

The estimated cost of implementing this modification to collect another year of water temperature data only is $1,000,000 to $1,500,000 and is not necessary to calibrate the model.

2.2.1.2.2. Water Quality Data Integrity – Missing Data

2.2.1.2.2.1. Response to Comments Regarding Concurrent Meteorological Data

The USFWS (USFWS_pp5.5-17_ph5) and SRC et al. (SRC_etal_WATER_pp46_ph6) commented on the need for simultaneous meteorological data from different stations for best calibration of the hydrodynamic model and spatial representation. SCR et al. expressed concern over uncertainty in the model because precipitation data was only concurrently collected at all three AEA-installed meteorological (MET) stations between October 2014 and August 2015. In its comment, TNC (TNC_pp7_ph5) stated that the FERC-approved Study Plan proposed six meteorological stations and that only three were installed. TNC noted that it was not clear whether the entire meteorological dataset needed for temperature modeling is available for the downstream, riverine sections and requested that any limitations on the data available from other sources be discussed.

Precipitation data collected from ESM-1, ESM-2 and ESM-3 was adequate for calibration of both the reservoir model and the riverine model. To clarify, as described in the Study Plan (RSP Section 5.5.4.2), data from three existing meteorological sites and three new sites were installed by AEA for this study. Three new meteorological stations were successfully installed and data was gathered over a three-year period (ESM-1; PRM187.1, ESM-2; PRM 235.2, and ESM-3; PRM 142.2). ESM-1 and ESM-2 MET Stations are used for reservoir modeling while ESM-3 is used for riverine modeling. Three existing meteorological stations (Study 5.5 ISR, Section 4.2, Table 4.2-1) at approximately PRM 51.0, PRM 83.8, and PRM 99.6 bring the total to six stations. These latter three stations had gathered a limited number of core data at routine time intervals (15 minute intervals) and will be used for riverine modeling. Basic meteorological parameters collected by the existing MET Stations were used in development of the riverine model. The expanded parameter set was only necessary for development of the reservoir model.

Even though one-year of precipitation data was collected at two of the three sites and an entire suite of simultaneous data might not be available, it is still possible to evaluate the model's capability in representing the general trend and pattern through a comparison with observed instream data for the same period or different period.

Study 5.6 RSP Section 5.5.4.2 states that data records from other studies will be used, wherever available, to help generate information for the required parameters needed for construction of the water quality models. The linkage between historical records and continuing data records may be used in evaluating the utility of 1980s temperature data for modeling.

The goal for collecting more than one year of MET Station data at each of the new sites was under an assumption that: 1) meteorological patterns vary from year-to-year, and 2) interruption in the data collection effort for an individual parameter like precipitation could occur from circumstances beyond AEA's control. A longer record of meteorological data is helpful in understanding seasonal timing for ice formation and breakup as well as for timing of mixing in the reservoir. Gaps in the meteorological record at a site (i.e., precipitation) were identified as data was downloaded, processed and screened for quality assurance. Gaps in precipitation data were estimated for the new MET Stations (ESM-1, ESM-2, and ESM-3) by correlating existing data from new sites with the long-term record at the existing MET Stations near Talkeetna (Study 5.5 ISR, Table 4.2-1).

For Susitna, the EFDC results show that the model performs sufficiently well in generally reproducing observed spatial and temporal variabilities in the river, suggesting that the data used for calibration are adequate in evaluating whether the model correctly represents the underlying dynamics/physics (Study 5.6 SIR Section 5 and Study 5.6 SIR Appendix A). Data used, based on the preliminary evaluation of model performance is adequate and calibration and uncertainty statistics will be presented in Study 5.6 USR.

2.2.1.2.3. Water Quality Data Integrity – Concerns of Quality Assurance

2.2.1.2.3.1. Response to Comment on Quality Assurance of Vegetation and Meteorological Monitoring

USFWS (USFWS_pp5.5-13_ph4) is concerned there is no information within the QAPP about quality assurance and control for the vegetation and meteorological monitoring.

Field and laboratory performance requirements for each parameter analyzed from vegetation monitoring are listed in the QAPP (Study 5.5 ISR Part B, Attachment 1, Section B.2.2, Table 12a). Methods for meteorological monitoring and equipment used to collect MET data are included in Study 5.5 RSP Section 5.5.4.2 and in Study 5.5 ISR Part A, Section 4.2. Inspection of data before archiving is described in Study 5.5 RSP Section 5.5.4.3.2. Calibration and maintenance of the MET Station equipment is based on several checks and include the following:

- Wind speed and direction compared against periods where temperatures are sub-zero; data collected during sub-zero temperatures or appear to be fluctuating are flagged or removed from the useable data set.
- Mean monthly wind velocity is calculated to compare against previous months in order to identify instrument "drift" over time.
- Graphical plots are used for all MET parameters where patterns are reviewed for believability (comparison against nearby MET Stations) and need to compare results from external MET Stations like that from Talkeetna Airport.
- Sudden changes in: air temperature, relative humidity, and barometric pressure indicate a problem with instrumentation.

The Campbell Scientific Instruments are calibrated by the manufacturer before deployment in the field and are consistent for a period of two-three years before requiring re-calibration. Protocols for evaluating quality of data include visual review of continuous records and identification of erratic data logging patterns or instantaneous rise or fall in measurements. These data records are flagged for cautionary use and in some cases, not included in the finalized data set. Diagnosing data issues begins with examination of battery voltage patterns and the internal data logger temperature. Battery power influences logger memory and ultimately readings received from sensors (e.g., sensor readings can fluctuate due to low battery power). Wind speed and direction readings are influenced easily by ice build-up from air humidity occurring at freezing temperatures. The propeller measuring wind speed should not be inactive for more than one hour. Equipment checks using examples above are part of the quality assurance review for results downloaded from the data logger. Specific data checks as part of the quality control program include: 1) identification of "spikes" (sharp changes in the up or down direction), and 2) comparison of MET station records with nearby long-term meteorological station data. Precipitation sensors are one of the more easily affected sensors primarily through physical manipulation by animals or people and readings can be evaluated based on the two types of data checking described above.

Quality assurance and quality control for vegetation monitoring is characterized by field sampling design and by laboratory performance requirements. Field precision was determined based on results from five replicate samples within each of ten different locations of the inundation zone of the reservoir (Study 5.7 ISR Part A, Section 4.2.1). All samples planned for collection were retrieved and analyzed (100 percent of planned sampling was completed). All vegetation samples analyzed by the laboratory met performance requirements as described in Study 5.5 ISR Part B, Attachment 1 QAPP, Table 6.

2.2.1.3. Objective 3

Study Objective 3: Develop a monitoring program to adequately characterize surface water physical, chemical, and bacterial conditions in the Susitna River within and downstream of the proposed Project area.

2.2.1.3.1. Water Quality Data Integrity – Spatial Gaps

2.2.1.3.1.1. Response to Modification Request for Additional Water Quality Data

NMFS (Modification 1-1; NMFS_pp5.5-4_ph3) and USFWS (Modification 4, part 1; USFWS_pp5.5-1_ph5A) recommend that additional data be collected to eliminate spatial discontinuities in both grab samples and continuous in-situ sampling. The Services state that no continuous water data were collected downstream of Project River Mile (PRM) 90, and there are several 30+ mile reaches in the river above PRM 90, where no data have been collected due to access issues. Additionally, the Services (USFWS_pp5.5-17_ph9; NMFS_pp5.5-12_ph2) ask how the assumption that there is little difference in physical and chemical conditions between PRM 235.2 and PRM 187.2 will be verified and specifically, what limits were established to determine if sample values are similar or different. The Services also suggest additional data be collected at the Watana Dam site because the site was not sampled in 2014 due to limited accessibility. NMFS argues that the study was not conducted as provided for in the approved Study Plan because the distances between sample points were too large.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" supporting this proposed modification. Though there were three variances associated with the period and location of continuous water temperature data collection due primarily to access issues that relate to the modification request, these variances did not interfere with AEA's ability to meet study objectives, and the Services have not provided evidence to the contrary.

The study objectives were met through AEA's implementation of the Study Plan with the variances discussed in SCR Section 4.3.2 and above. Sample sites were initially identified in Study 5.5 RSP Section 5.5.4.4 and RSP Section 5.5.4.5 and data was collected between PRM 19.9 and PRM 235.2. Sample sites were comprised of both grab sampling and continuous in-situ sampling. The distinction between the type of sampling (i.e. grab versus continuous) is described in Study 5.5 RSP Section 5.5.4.4 (grab) and Study 5.5 RSP Section 5.5.4.1 (continuous). The extent of data necessary to develop the hydrodynamic model is described in Study 5.6 RSP Section 5.6.2 and Section 5.6.3. The location and time period for all sites that were sampled are presented in the SCR and as revised in the Supplement to the Study 5.5 SCR, Table 4.1-1 (Attachment 2).

As summarized in the Study 5.5 SCR Section 4.3.2, the inability to collect summer time water quality samples at Cantwell (PRM 225.2), did not interfere with AEA's ability to meet study objectives, since data were collected at PRM 235.2. Between these sites, the basin is undeveloped, there are no significant tributaries entering the Susitna River and, moreover data show there is very little difference in physical and chemical water quality conditions between PRM 235.2 and PRM 187.2. The other two variances were very minor differences in the sample period, sampling in the winter of 2013/2014 occurred in January rather than in December as indicated in the Study Plan and in the same winter, sampling occurred at PRM 185 rather than at PRM 187.2 (Watana Dam Site). In the former case, the intent of the sampling to collect data during ice cover conditions was still fulfilled and in the latter case, there is no significant tributary inflow between the two sampling points.

The Services' assertion that no continuous water data was collected downstream of PRM 90 is incorrect. There are several mainstem Susitna River stations below PRM 90 where continuous temperature data have been collected in 2012, 2013 and 2014: PRM 19.9, PRM 29.9, PRM 33.6, PRM 59.9, PRM 87.8, and PRM 88.3. The hydrodynamic model has been calibrated using these continuous temperature data for the Middle and Lower River (Study 5.6 SIR Section 5.2).

Additionally, the Services' assertion that there are several 30+ mile reaches in the river above PRM 90, where no data have been collected due to access issues, is also incorrect. Not only are there no 30+ mile reaches absent of both continuous and point temperature data upstream of PRM 90, there are no 30+ mile reaches absent of continuous or point data in the entire Project area (PRM 19.9 to PRM 235.2). In fact, the maximum distance between adjacent sites upstream of PRM 90 is 26 miles (PRM 209.2 and PRM 235.2). Below PRM 90 temperature monitoring results for PRM 59.9 and 87.3 were virtually identical showing no indication that local influences would be a factor based on distance between the sites or that there would be an influence in calibration of the temperature model. Grab sample data had greater distances between them, however, the water quality model is initially developed using the hydrodynamic and temperature data and then individual water quality parameters are correlated with temperature in order to complete calibration. Additionally, historical water quality and temperature data will be used to supplement the current data set as conditions have been determined to be the same (Study 5.5 SCR, Table 6.1-1 through Table 6.1-3 and Supplement to the Study 5.5 SCR, Table 6.1-4). All the sample sites were previously presented in Study 5.5 SCR, Table 4.1-1 and Table 4.3-1 while updated versions of these tables are presented in Supplement to the Study 5.5 SCR.

NMFS is also incorrect in stating that the study was not conducted as provided for in the FERC-approved Study Plan based on distances between sampling sites that were too large. RSP Section 5.5.4 states that monitoring sites are spaced at *approximately* five-mile intervals so that the various *factors that influence water quality conditions are captured* and support the development (and calibration) of the water quality model. These sites were located to capture localized effects from tributaries and from past and current human activity and comparisons between sites with longer distances showed no difference in water quality conditions as described for PRM 59.9 and PRM 87.3. Data available and used in preliminary model calibration showed that the model is capable of generally reproducing observed conditions at all locations, and it shows the model is correctly representing the underlying dynamics/physics.

Visual comparison between chemical concentrations at PRM 235.2 and 187.2 show almost no difference between these two Baseline Water Quality Monitoring locations (Study 5.5 SCR, Figure 5.4-2, Figure 5.4-3 and Figure 5.4-5). Variability in replicate samples for most of the lab analyzed parameters is expected to be ±20% and this margin for error was used to determine if differences between PRM 235.2 and PRM 187.2 were significant or within a natural range of variability described for field samples (Study 5.5 RSP, Attachment 5-1, QAPP, Table A4-1). Examples of similarity in water quality conditions occur for parameters like total dissolved solids (Study 5.5 SCR, Figure 5.4-11), uranium concentration (Study 5.5 SCR, Figure 5.4-18), and oxidation-reduction potential (Study 5.5 SCR, Figure 5.4-16).

The Services are incorrect in stating that data collected from the Watana Dam site was not collected in 2014 due to limited accessibility. In fact, water quality data was collected in both 2013 and 2014 at PRM 187.2 (Dam Site), as well as historically. And, while continuous water temperature data was only collected one year at the Dam Site, it was collected from 2012 through 2014 at PRM 209.2, and there is no significant difference in the water temperature between the two sites. All data collected at PRM 187.2 is summarized in Supplement to the Study 5.5 SCR, Table 4.1-1.

For these reasons, AEA maintains that the objectives of the water quality study have been met with the existing data gathered from 2012 through 2014 as supplemented with the historic data record, and therefore that the Services' proposed Study Plan modification is unnecessary and should not be adopted by FERC. The cost of collecting additional samples to fill in data gaps is estimated to be $2,000,000 to $2,500,000 and will not improve AEA's ability to meet the objectives of the study. The cost of one year of data collection for the entire study area is estimated at $5,500,000-$6,500,000.

2.2.1.3.2. Water Quality Data Integrity – Concerns of Rejected or Missing Data

2.2.1.3.2.1. Response to Modification Request to Collect Additional Water Chemistry, Water Quality and Groundwater Data

USFWS (Modification 1; USFWS_pp5.5-1_ph2) and NMFS (Modification 3-1, part 2; NMFS_pp5.5-2_ph6) request FERC to require AEA to collect another year of water chemistry, water quality, and groundwater data, asserting that the majority of water chemistry data collected in 2013 was disqualified due to quality control problems. Based on the Services' analysis of the 2013 metadata, they assert that 90% of the 2013 samples were rejected rather than the 9% - 30% rejection rate noted in Table 5.1-1 (USFWS_pp5.5-6_ph9; NMFS_pp5.5-5_ph9) and request AEA to explain why the 2013 data previously rejected, have now been accepted in the analysis. Additionally, USFWS (USFWS_pp5.5-16_ph6) comments that nothing was stated about contamination of samples by glacial flour, although it was discussed during the latest post-ISR meeting.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification.

The Services incorrectly assert that 90 percent of the 2013 samples were rejected and it is unclear how their estimate was developed. It's possible the Services' higher estimate considered all database records with the "Qualifier" notation as "rejected". AEA's estimate for the percentage of "rejected" samples is based on total number of observations collected from each type of water quality monitoring (e.g., Baseline Water Quality Monitoring and Focus Area Monitoring) and the number of samples actually "rejected", rather than all of the samples noted with a qualifier which may be suitable for further use. AEA's estimate for total number of rejected samples is further differentiated as Baseline or Focus Area Monitoring (Study 5.5 SCR, Table 5.1-1 and Table 5.1-2). AEA's method for calculation of rejected data shows how the percentage was calculated in Study 5.5 SCR, Section 9, Table 5.1-1 and Table 5.1-2. Qualifiers are used when sample analysis results are subject to the following issues: 1) undetected concentration in a sample, 2) an estimate of a concentration in a sample, 3) concentration may be detectable below the reporting limit, and 4) rejection of a sample when analytical results are nonsensical (Study 5.5 ISR Part B, Attachment 1 QAPP, Section D.2.1). Data marked with the qualifier "rejected" should not be used under any circumstances. Data with all other qualifiers may be used without restriction or with minor restrictions as discussed in the Data Validation/Verification Report or in the Study 5.5 SCR, Section 5.1. Calculation of useable data should only be made by examining metadata in the database that says “rejected”.

In total, 13 percent of all 2013 samples collected from both the Baseline Water Quality and Focus Area monitoring programs were rejected; categorized by monitoring program, 9 percent of the non-Focus Area samples (Baseline Water Quality Monitoring program) and 33 percent of the Focus Area monitoring samples were rejected. The total number of 2013 samples and percentage of rejected samples are reported in Study 5.5 SCR, Table 5.1-1. Among the rejected samples are data that did not meet QA acceptance limits: total phosphorus, total metals, (excluding calcium and magnesium), and dissolved aluminum (Study 5.5 SCR, Section 5.4). No rejection of samples occurred for other reasons like transport container temperatures or holding time exceedance in either 2013 or 2014.

Rejected 2013 data was replaced with new data collected in 2014. Quality assurance review for 2014 data had substantially lower rejection rates in both the Baseline Water Quality Monitoring and Focus Area Monitoring (Study 5.5 SCR Table 5.1-2). The number of 2013 observations collected as part of the Focus Area Monitoring was 4,217 versus 1,040 observations collected in 2014. Sampling in 2014 collected fewer samples as a replacement data set because there was evidence that horizontal and vertical variability in water quality conditions at each transect was very low and reduced sampling was deemed acceptable. Determination for spatial variability of water quality conditions along each transect is described in Section 2.2.1.3.2.2 below. A much smaller proportion and number of water quality observations were rejected in 2014 than in 2013. Results flagged as “rejected” from 2013 samples are included in the database, but are not used for interpretation of water quality baseline conditions or for calibrating the water quality models. Water quality data that were accepted following quality assurance review were combined from both 2013 and 2014 to form a single, unified data set for use in describing baseline conditions in the Susitna Basin and for calibrating the water quality models. This single, unified data set will meet study objectives.

In regards to USFWS’s comment on contamination of samples by glacial flour, some explanation for effects of high turbidity on total phosphorus (TP) sample analysis was provided in Study 5.5 SCR, Section 6.2. The level of detail for how fine particles act as interference elements using the method for estimating TP is not provided in the report, but can be found by reviewing a description of analytical methods as identified in Study 5.5 ISR Part B, Attachment 1, QAPP, Table 6. A more detailed explanation for how fine particles form a complex with reagents that capture phosphorus as part of the laboratory sample analysis is found on pages 136-140 in the March 23, 2016 ISR Meeting Transcript.

If this proposed modification was implemented, the estimated total cost of collection, analysis and reporting is $5,500,000 - $6,500,000.

2.2.1.3.2.2. Response to Comments Regarding the 2014 Water Quality Sampling

USFWS (USFWS_pp5.5-7_ph6, USFWS_pp5.5-8_ph1), NMFS (NMFS_pp5.5-6_ph7), and the SRC et al. (SRC_etal_WATER_pp46_ph8) comment that additional water quality sampling occurred in 2014 at selected locations and for parameters for which 2013 samples were qualified as either "rejected" or "estimated". The SRC et al. comments that while the missing data in 2013 resulted in a water quality dataset that is not synoptic, the resampling in 2014 did fill some of the data gaps created by the 2013 data with quality control problems. However, USFWS and NMFS comment that all the 2014 samples were "single grab sample-types" based on AEA's conclusion that there was no horizontal or vertical variability at sample locations (from 2013 samples). USFWS questions the validity of that conclusion, as it could have been based on the 2013 samples that were previously rejected. USFWS (USFWS_pp5.5-13_ph1) requests that AEA provide the data analysis that indicates a lack of horizontal or vertical variability in the water quality results for 2013. USFWS (USFWS_pp5.5-17_ph3) also notes, that if that conclusion was based on the analysis of the rejected samples, the conclusion is not valid, and no deviation from sampling methodology should have been allowed. USFWS (USFWS_pp5.5-17_ph6) questions if the rationale for reducing the number of samples collected in 2014 seem adequate based on the data provided in Figures 6.4-1, 6.4-2 and 6.4-5.

A discussion of rejected 2013 samples is found in Section 2.2.1.3.2.1 above. No rejected data from 2013 were used to evaluate the spatial (horizontal and vertical) variability of water quality conditions along a transect. Water quality parameters other than total metals (except for Ca and Mg), dissolved aluminum, and total phosphorus met acceptance limits at all 17 of the 2013 transects (Baseline Water Quality Monitoring Sites; Supplement to the Study 5.5 SCR, Table 4.1-1). Spatial variability was then evaluated for lab analyzed water quality parameters that showed greatest variability during any one sample date among the 17 site transects that met quality control standards (Lower River PRM 29.9 and Susitna near Gold Creek PRM 140). This was previously stated in Study 5.5 ISR Part A, Section 5.4.1 (Baseline Water Quality Characterization): horizontal and vertical changes along each transect were examined using scatter plots with data that passed QA/QC acceptance limits. Variability along a transect (both vertical and horizontal) was determined to be low based on visual interpretation from the example scatter plots (Study 5.5 SCR Figure 6.4-1, Figure 6.4-2, and Figure 6.4-5).

Figure 6.4-1, Figure 6.4-2, and Figure 6.4-5 (Study 5.5 SCR, Section 10) are scatterplots combining horizontal and vertical results for each of the four sample dates from transects at PRM 29.9 and PRM 140.1. Total suspended solids and total zinc concentrations are presented in these figures that show combined spatial variability for parameter results along a transect. A visual analysis of these scatterplots was completed in order to determine if spatial variability was low along a transect and if variability of water quality conditions was within a margin for error of ±20% as defined by relative percent difference (RPD) in results from replicate samples (Study 5.5 ISR, Part B Attachment 1 QAPP, Table 6). An RPD of ±20% was applied to lab analyzed data for surface water samples that is more stringent than some of the RPD acceptance limits for select water quality parameters (e.g., RPD of 25% for ammonia and total phosphorus, RPD of 30-35% for methylmercury; Study 5.5 ISR Part B Attachment 1 QAPP, Table 6). In cases where water quality results are very low (e.g., <10µg/L), differences between replicate samples along a transect were confirmed if RPD was an order of magnitude (e.g., >10 times). The rationale for determining variability of both horizontal and vertical measurements along a transect was based on comparison of replicate samples (i.e., pooled vertical and horizontal sample results). Replicate samples are considered the same when within a ±20% relative percent difference (RPD). This was the case for transect data and the basis for reducing sample collection in 2014 to a single observation per transect.

In conclusion, only 2013 data that passed quality assurance standards was used to assess water quality spatial variability across a transect. All 2013 water quality data (both rejected and accepted) is posted in Study 5.5 SCR, Section 9, Table 5.1 (2013 Baseline Water Quality Laboratory Data) at:

http://gis.suhydro.org/Post_ISR/05-Water_Quality/5.5-Baseline_Water_Quality/ISRMTG_5_5_WQ_2013%20Lab%20Data/.

This spatial variability assessment revealed that horizontal and vertical variability between replicate samples was within the acceptable relative percent difference standard. This data and conclusion supports AEA's decision to only collect single grab samples during 2014.

2.2.1.3.3. Water Quality Data Concerns - Sampling Location or Methods

2.2.1.3.3.1. Response to Comment on Developing Baseline Data from Different Years

TNC (TNC_pp8_ph1) expressed concern over sampling Focus Areas in different years. TNC requests, if Project budget and schedules allow, to sample one or more Focus Areas that were sampled in a previous year in order to provide a comparison to data from sites collected in previous years.

All Focus Areas selected for monitoring in 2013 were visited and sampled (Study 5.5 RSP, Section 5.5.4.5). A second set of samples were collected in the 2014 FAs to replace data rejected from examination of the laboratory performance results (Study 5.5 SCR, Section 4.3.2). Results from 2014 met acceptance limits for all water quality measurements. Baseline and Focus Area water quality field work and data collection per the approved Study Plan and the Study 5.5 Study Completion Report has been filed. Within the Focus Areas, the goal for sampling was to complete three visits to each site over a six-week period in 2013. There were some data that did not meet QA acceptance limits in 2013 and the same sites were sampled in 2014 for water quality parameters not meeting QA acceptance limits the year before. Data was collected in 2014 using the same frequency and timing as in 2013 and met QA acceptance limits. The 2013 and 2014 baseline water quality data that met acceptance limits, was combined into one comprehensive data set that will be used to calibrate the water quality model in Study 5.6.

There is no impact of collecting data from different years for describing baseline water quality conditions. This combined data set is used to compare future water quality conditions with a dam in place and to calibrate the water quality models. This area of the watershed is undeveloped. Results for comparison of water quality conditions from historical 1980s data with current conditions (2013/2014) did not show a difference (Study 5.5 SCR, Section 9, Table 6.1-1 through Table 6.1-4). The comparison between historical and current conditions indicates water quality parameters show little change in this drainage over the long-term and that by combining data sets from different years (historical and current) baseline conditions are adequately described.

2.2.1.3.3.2. Response to Comments on Laboratory Methods, the TP Correction Factor, and TP Holding Times

USFWS (USFWS_pp5.5-17_ph7; USFWS_pp5.5-12_ph6) and NMFS (NMFS_pp5.5-12_ph1) request the criteria used to establish acceptable limits for precision between the two analytical laboratories, SGS and ARI. Additionally, the Services ask how the subset of 2014 sample sites was selected and the method used to estimate concentration by eliminating interfering elements. Further, the Services believe that the application of the total phosphorous (TP) correction factor proposed by AEA may be inappropriate, noting that the issues associated with the 2013 data are multiple and diverse and the application of this factor would not correct all of them. USFWS (USFWS_pp5.5-7_ph2) and NMFS (NMFS_pp5.5-6_ph2) contend that some of the values in Tables 4.5-3 and 4.5-4 are dubious: corrected TP was calculated as -0.065 (Table 4.5-3); estimate percent of TP that was due to TSS was calculated as 128.8%. Lastly, USFWS (USFWS_pp5.5-14_ph2) notes that the maximum holding time for Total Phosphorus (TP) was specified as 48 hours (if not field preserved) and at 28 days if preserved. USFWS asks for AEA to provide additional information on the TP holding time for the TP sent to the AR and SGS laboratories that conducted split sample analysis for the data collected in August 2013 and for the preliminary results that were presented at the December 2, 2013 TWG meeting. USFWS notes that a discrepancy in laboratory results has been noted at TWG meetings, but never explained, and requests AEA to describe if an appropriate preservation method was used.

Criteria used to establish acceptable limits for precision between the two analytical laboratories were based on laboratory performance expectations for duplicate sample analysis (e.g., relative percent difference; RPD) listed for each parameter in Study 5.5 SCR, Part B, Attachment 1, QAPP, Table 6. The sub-set of sites selected had a broad range of water quality conditions determined by 2013 results that met QA acceptance limits. Examples include main channel Susitna River sites and tributary sites (e.g., Study 5.5 SCR Table 4.5-1). Most of the sites for laboratory split samples collected in 2014 were influenced by glacial meltwater (high level of suspended silt and fines), represented off-channels from the mainstem, and were located in clear water tributaries to the mainstem Susitna River. Analytical results for TP concentrations were compared between the laboratories at eight of the 2014 sites (replicates were collected from 2 sites and sent to both laboratories). These sample sites were selected to represent both turbid glacial meltwater conditions in the main channel and clear water conditions characteristic of some tributaries. This contrast in amount of suspended sediments from different water types was used to confirm the overestimation of total phosphorus in turbid water. The sub-set of sites was chosen from the Middle River and in close proximity to each other so that sample holding time and cooler transport temperatures would not introduce any issues with lab analysis results.

The specific method for determining interference of the suspended fine sediments in the water samples is described in Study 5.5 SCR, Section 4.5. ARI performed additional research on the eight 2014 samples by using two different analytical methods to estimate TP concentrations; i.e. isolating Total Suspended Solids (TSS) and re-estimating how much of the isolated TSS was misidentified by the analytical instrumentation (see Study 5.5 SCR, Section 4.5, TP Correction Factor). A step-wise process is described as follows: Step A- Determine TP in the Sample, Step B- Determine TP Resulting from Suspended Solids Alone, Step C- Correct the 10 whole sample estimates of TP for effect of TSS, Step D- Estimate the percent of TP in the whole sample that was due to TSS interference, and Step E- Develop Correction Factor.

Correction factor development reported in the Study 5.5 SCR sections were applied to the SGS analyzed data collected in 2014 as this data set represented the same seventeen Baseline Water Quality Monitoring sites and the same Focus Area sites visited in 2013.

The correction factor developed from the 2014 data was not used to correct any TP results from the 2013 data set. Corrected 2014 data was verified by comparing against chlorophyll *a* data. There were no additional quality assurance issues with 2014 parameters that required a correction factor. The major issue causing overestimation of the TP concentrations in samples was the presence of high TSS concentrations. The single factor influential in overestimating TP and how evaluation of the analytical method identified the source of the problem is described in Study 5.5 SCR, Section 6.2.

Interpretation of the corrected TP concentration of -0.065 mg/L using the EPA 200.8 Method is a hypothetical value versus an actual observation (Study 5.5 SCR Table 4.5-3). The negative concentration estimated for this sample meant that TSS did not have as great an influence in overestimation of TP by laboratory method EPA 200.8 in contrast to method EPA 365.1. Since this method predicted a lower TP concentration than that accounted for by TSS, and TSS accounted for more than that estimated by the method, the 128.8% meant that the TP sample result was influenced to a greater degree by TSS than the method EPA 200.8 was able to detect. Two accredited analytical methods were used for determining TP in order to account for variability that occurs between methods and with different types of water quality conditions (spatial variability). This is a well-known laboratory sample analysis issue that requires a step-wise process for isolating the major cause(s) for overestimation of TP in highly turbid water samples as was accomplished in Study 5.5.

A description of the TP holding times used for the data sent to the AR and SGS laboratories is provided in Study 5.5 SCR, Section 9 (Table 5.1-2). The same field handling and transport procedures were used with TP samples submitted to both laboratories (SGS & AR). Unpreserved nutrient samples were received by the labs within the 48 hour holding time. Additional information about TP samples that exceeded holding times is included in Study 5.5 SCR Table 5.1-2 and further described in Study 5.5 SCR Section 5.1.2. Samples preserved in the field were delivered to the lab and analyzed within the 28 day holding time period identified in the QAPP (Study 5.5 RSP Attachment 5-1, Section B.2.2, Table 21a).

The USFWS (USFWS_pp5.5-14_ph2) asks for additional information in relation to holding times on TP and other samples. In response to this comment, 2013 data and all samples met QA standards related to field sample preservation that were within acceptable limits defined by measurement quality objectives (Study 5.5 ISR, Part B Attachment 1 QAPP, Section A.7.2). Holding times were exceeded in 0.03 percent of samples collected during 2013 baseline monitoring from a total number of samples of more than nineteen thousand (Study 5.5 SCR, Section 9, Table 5.1-1). Use of the small number of water quality data points affected by holding time exceedance is very small and should be evaluated for further use on a case-by-case basis (Study 5.5 SCR, Section 5.1.1). Sample data that did not meet holding time requirements included six ortho-phosphate and six nitrate+nitrite-nitrogen observations. There were no TP data points that exceeded holding time requirements (Study 5.5 SCR, Section 9, Table 5.1-1). USFWS notes a discrepancy in laboratory results reported at the December 3, 2013 TWG meetings. At this meeting, results for select parameters from the 2013 sampling effort that were rejected following a quality assurance review had been discussed and subsequently reported in Study 5.5 ISR, Part C Section 7.1.2 along with a proposed strategy for collecting replacement samples during the 2014 season.

2.2.1.3.3.3. Response to Modification Requests for Additional Reporting

USFWS (Modification 2; USFWS_pp5.5-1_ph3) and NMFS (Modification G-1; NMFS_pp5.5-10_ph12) request FERC require AEA to describe data quality issues in a report, stating that the approach used to resolve data quality issues with suspended solids, holding times, and temperatures has not been sufficiently described. USFWS (Modification 3; USFWS_pp5.5-1_ph4) specifically requests AEA to make the Study Completion Report into a stand-alone document and both USFWS and TNC (TNC_pp6_ph4) recommend the document to repeat or explicitly describe information about quality control, analytical methods and how data will be used in modeling. Additionally, USFWS (USFWS_pp5.5-18_ph8) and TNC (TNC_pp7_ph2) assert that the interpretation of the collected data is lacking and USFWS (USFWS_pp5.5-13_ph3) comments that there has not been an appropriate discussion of the overall health of the river and tributaries and at the very least, a qualitative statement on species present, relative abundance, and habitat health would be beneficial. TNC continues, that if AEA's intent of the report is to simply present data, then it should be noted that a detailed report with interpretations of baseline conditions will follow.

AEA requests that FERC not adopt these proposed study plan modifications for additional reporting under Study 5.5 because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification. To the contrary, as detailed below, the information requested is already provided in the Study 5.5 SCR and associated technical memoranda or, in the case of interpretation of the water quality data in terms of ecological health of the system, will be provided in the License Application and as applicable in the Updated Study Reports of interrelated studies such as Studies 5.6 (Water Quality Modeling Study), 8.5 (Fish and Aquatics Instream Flow Study) and 9.8 (River Productivity Study). Providing alternative presentation of the information as requested in the modifications would add study costs without contributing to meeting study objectives.

The approach to assessing TSS data quality, holding time, and temperature exceedances is sufficiently described with the Data Validation/Verification Reports (DVRs). The DVRs are provided at the following locations:

- 2013 Data Validation/Verification Reports
  http://gis.suhydro.org/isr/05-Water_Quality/5.5-Baseline_Water_Quality/ISR_5.5_2013_Lab_Data_Validation_Reports/
- 2014 Data Validation/Verification Reports
  http://gis.suhydro.org/suwareports/Post_ISR/05-Water_Quality/5.5-Baseline_Water_Quality/ISR-MTG_5_5_WQ_2014_LabData/SuWa%20WQ%202014%20Lab%20DVRs%20QC1/

As performing quality assurance between the field data and laboratory data reports would be unreasonable and unnecessary for all the data collected, a subset of data was analyzed for quality assurance as is the conventional approach for water quality studies. Roughly ten percent of sites sampled in 2013 and roughly ten percent of sites sampled in 2014 were selected for QA (data validation/verification) and included within the DVRs. The sub-set of sites for data validation/verification was selected based on criteria that described representative site categories. The representative site categories were based on the following descriptive criteria: 1) sites from each segment of the river (Lower River, Middle River, Upper River), 2) selecting at least one clear water (non-glacial meltwater influence) along with other sites that were influenced by glacial meltwater, and 3) baseline water quality monitoring sites versus Focus Area monitoring sites. The final list of sites where DVRs were completed were randomly selected from the three categories. Three quality assurance issues were identified in this processes (i.e. high concentration of fines in samples, sample holding time exceedance, sample transport temperature exceedance). A description of each QA issue and how it affects results is summarized in the DVRs. Notes contained within the DVRs should be applied to all results from this project where one of the three QA issues is identified.

Currently, the Study 5.5 SCR contains a summary of water quality conditions at both the Baseline Water Quality (Study 5.5 SCR Section 5.4) and Focus Area sites (Study 5.5 SCR Section 5.5). Analysis of data is based on comparison to ADEC Water Quality Criteria, SQuiRTs, and TRVs (where available). Water quality results are discussed if observations exceed any of the applicable criteria or if there is an identifiable pattern (spatial or temporal) in water quality conditions. Content of this report addressed all objectives for Study 5.5 (Study 5.5 SCR Section 2). Remaining results will be generated by the water quality model (EFDC) and data interpreted in the Study 5.6 USR. Characterization of the baseline conditions and with-Project conditions will be provided in the License Application.

The modification request that AEA report study results differently is not necessary to meet Study objectives. The method used to correct data quality issues with Total Phosphorus (TP) was described in Study 5.5 SCR Section 4.5. A discussion on the corrected TP results is described in Study 5.5 SCR Section 6.2. A detailed discussion of how fine suspended material in the Susitna River water causes overestimation with analytical testing for determination of TP concentration is included in the March 23, 2016 Initial Study Report Meeting transcript (pp. 138-140). Results for TSS and metals data collected in 2014 met QA acceptance limits without use of a correction factor.

Data collected in 2014 met QA acceptance limits and was combined with 2013 data that met QA acceptance limits to form a complete data set and will be used for water quality model calibration. Flow data records for the period 1950–2010 were used to calibrate the hydrodynamic module in EFDC and continuous temperature data calibrated with records from 2012–2013. The 2014 continuous temperature data will be used for riverine model validation. Calibration and validation of the reservoir model with collected data is not possible so model output will use information from a literature survey to acquire parameterization schemes for the model. An uncertainty analysis approach will also be developed to account for the lack of data for calibration, therefore enhancing the reliability of reservoir model predictions (Study 5.6 RSP, Section 5.6.4.8).

Design of field sampling, characterization of water quality conditions, and preparation of support documents followed conventional technical guidance. For example, preparation of a detailed Quality Assurance Project Plan (QAPP) included a complete description of all the elements for a study producing high quality data. Formal evaluation of a sub-set of water quality results (Data Validation/Verification Reports) ensured that all reported results were of known quality (a requirement of the Alaska Department of Environmental Conservation).

The ILP includes preparation and distribution of progress reports while the implementation of the FERC-approved Study Plan continues. In order to provide licensing participants with the most current information while the licensing schedule was extended, AEA produced multiple documents (e.g., Study 5.5 ISR, Study 5.5 SCR, and Technical Memoranda), building upon the body of information previously provided and reviewed by licensing participants. The volume of information being gathered for this Project is substantial and it is not practical or cost-effective to reproduce information already submitted to FERC and licensing participants, meeting the ILP deadlines, concurrently while studies are being implemented. The purpose of the licensing studies is to gather baseline information to facilitate Project impact assessment and the development of PM&Es. The information will be comprehensively synthesized and discussion of the ecological significance of changes in water quality will be presented in the Exhibit E of the License Application.

Objectives for Study 5.5 do not include interpretation of data with a focus on describing ecological health. A related objective (Study 5.5 SCR Section 2) includes characterizing current water quality conditions (chemical, physical, and bacteriological attributes). The information generated from Study 5.5 will be used in Study 8.5 Fish and Aquatics Instream Flow and Study 9.8 River Productivity (Study 5.5 RSP, Section 5.5.4.5). This baseline of information will also be used for later comparison with water quality modeling predictions in order to identify changes due to project operations. Flow data records for the period 1950–2010 were used to calibrate the hydrodynamic module in EFDC and continuous temperature data calibrated with records from 2012–2013. The 2014 continuous temperature data will be used for model validation. The reservoir and riverine model output will include: nutrient and algae concentrations, estimates for sediment transport, metals concentrations, integration between temperature and ice dynamics models, and capability of representing local effects (e.g., Focus Area level of resolution). The reservoir model will predict vertical stratification in the water column when the dam is present. Resolution of model output will be at two scales: large-scale model is 250m to 1km longitudinally Study 5.6 ISR Part A, Section 4.4), and Focus Area models is 100m (Study 5.6 ISR Part A, Section 4.3). Actual cell size ranges of the grid network for the reservoir and riverine models are summarized in Study 5.6 SIR, Section 4.1.4.

The estimated cost to implement USFWS Modification 2 and NMFS Modification G-1 modification is $30,000 to $40,000. The estimated cost to implement USFWS Modification 3 is $25,000.

2.2.1.4. Objective 4: Measure Baseline Metals Concentrations in Sediment and Fish Tissue

Study 5.5 Objective 4, measure baseline metals concentrations in sediment and fish tissue for comparison to state criteria, was developed to support, in part, the mercury modeling study (Study 5.7; RSP Section 5.7.4.2). Objective 2 of the Mercury Assessment Study (Study 5.7) is intended to characterize the baseline mercury concentrations of the Susitna River and tributaries. This included collection and analyses of vegetation, soil, water, sediment porewater, sediment, piscivorous birds and mammals, and fish tissue samples for mercury and other metals. The reservoir and riverine EFDC models will be developed using some of this information for calibration and to predict concentrations of mercury and other metals under different operational scenarios (Study 5.6 RSP Section 5.6.4.8).

To reduce redundancy and increase readability, the majority of comments and all requests for study modifications under Study 5.5 Objective 4 have been presented and addressed under Study 5.7 Objective 2 (Section 2.2.3.2).

2.2.1.5. Objective 5: Perform Thermal Infrared Remote Sensing

Study Objective 5: Perform thermal infrared imaging (TIR) assessment of a portion (between Talkeetna and Devils Canyon) of the Susitna River and use this data to map the groundwater discharge and possible extent of thermal refugia.

2.2.1.5.1. Response to the Modification Request for Additional TIR

NMFS (Modification 5-1; NMFS_pp5.-5-9_9) requests that the Thermal Infrared Remote Sensing (TIR) be completed as originally planned for 2014. USFWS (USFWS_pp5.5-16_ph5) comments that no explanation was provided on why the Thermal Infrared Remote (TIR) sensing study was terminated and not continued in 2014, although it was identified as one of the main study objectives (Study 5.5 ISR Part A, pages 2-3. The TIR was also identified in the study plan modifications (Study 5.5 ISR Part D, page 9), but was never conducted on the remaining portion of the Lower Susitna River in 2014.

AEA requests that FERC not adopt this proposed study plan modification because the objectives of the FERC-approved Study Plan were met without the requested modification. Although there was a variance associated with collection of 73% rather than 100% of the TIR data in the Lower River identified in Study 5.5 ISR Part A, Section 4.7.1 and a modification proposed by AEA in Study 5.5 ISR Part C, Section 7.2.1 to complete collection of the Lower River TIR in 2014, as explained in Study 5.5 SCR Section 4.8.1, the TIR data already collected is sufficient to fulfill the needs of the studies using it (Studies 7.5 and 8.5). Therefore, collection of the remaining TIR data in the Lower River is not needed to meet the objectives of this study component.

The FERC-approved Study Plan required that a pilot thermal imaging assessment be completed in the Middle River (Study 5.5 RSP Section 5.5.4.9). Since the pilot TIR assessment was successful when first implemented in the Middle River, continuation into the Lower River was planned. However, the TIR would be discontinued in the Lower River if the imagery could not be collected for one of the following reasons: 1) poor timing for the data acquisition flight, 2) insufficient differences in temperature between groundwater and surface water, or 3) complex missing or dilution of the groundwater signal (Study 5.5 RSP Section 5.5.4.9). Even though a complete 2013 TIR record was not collected due to persistent, cloudy flight conditions in the Lower River (73% of the planned distance), it was determined to be sufficient by studies using the TIR data to determine locations of groundwater upwelling, (Groundwater Study (7.5) and the Fish and Aquatics Instream Flow (8.5)). Three general categories of upwelling/springs using a broad-scale mapping strategy were identified that required multiple data sources: 1) photographs taken during the winter that depicted areas of open-water leads, 2) aerial photography and aerial videography of the ice-free period showing turbid and clear water habitats, and 3) thermal infrared imagery (TIR) (Study 7.5 SIR, Section 4.4). Even though TIR data could not be collected in a portion of the Lower River, the other data sources were successfully used to identify location of upwelling and springs. The TIR study was characterized as a pilot study, with the option to expand the study if successful. While the pilot portion of the study was successful due to ideal conditions in 2012, not all the river could be imaged in 2013 due to adverse weather conditions. Acquisition of the data requires the air temperature to be cold (near freezing), with no wind, with no ice on the river, and no precipitation. Despite six weeks of effort during October and November of 2013, approximately five days of usable data were recovered. Further explanation of the discontinuation of TIR into 2014 is described in Study 5.5 SCR, Section 4.8.1. Since the data collected fulfills the needs of the studies that the TIR data is intended to support, collection of TIR in less than 100 percent of the Lower River will not interfere with AEA's ability to meet study objectives (Study 5.5 SCR Section 4.8.1).

The estimated cost of implementing this modification is $120,000 to $160,000 and there is no guarantee the environmental conditions would be suitable for successful TIR data collection.

2.2.1.5.2. Response to Comment Regarding the Interpretation of TIR Results

USFWS (USFWS_pp5.5-11_ph7) recommends that a clear distinction be drawn between the use of TIR for identifying areas where there is strong potential for surface water-groundwater interaction at certain times of the year and in-situ field data for baseline water quality monitoring. Additionally, USFWS asserts that there is no information in the ISR about other potential means of determining groundwater-surface water interactions such as hydrochemical tracers.

Thermal imaging assessment of a portion of the Susitna River was a pilot study (Study 5.5 RSP Section 5.5.4.9). Thermal imagery data using Forward Looking Infra-Red (FLIR) technology of the entire Middle River Segment of the Susitna River was collected in October 2012. The data from the thermal imaging was ground-truthed and the applicability and resolution of the data determined in terms of identifying water temperatures and thermal refugia/upwelling.

TIR is one of several techniques deployed to identify influence of groundwater on surface water. Remote sensing covers a large area of the basin in a short time period and was intended as a pilot study.

Hydrochemical tracers were not used in Study 5.5 to detect groundwater-surface water interactions. Hydrochemical tracers will be used in determining the influence of groundwater under the operational scenarios once predicted surface water conditions are available and reported in Study 5.6 USR. Influence of groundwater chemistry in FA-104 (Whiskers Slough), FA-113 (Oxbow I), and FA-128 (Slough 8-A) will be reported in the Study 5.6 USR and contrasted with baseline conditions to identify differences, if any, are due to groundwater influence. This simple comparison in Study 5.6 will not supplant identification of groundwater influence on surface water that will be reported in Study 7.5 USR. More detailed description of groundwater upwelling and methods for determining effects of Watana Dam/Reservoir are described in Study 7.5 SIR Section 4. Data sources used to identify upwelling/springs were as follows: 1) photographs taken during the winter that depicted areas of open-water leads, 2) aerial photography and aerial videography of the ice-free period showing turbid and clearwater habitats, and 3) thermal infrared imagery (TIR) (Study 7.5 SIR, Section 4.4).

Current studies for identifying surface water-groundwater interaction include direct measurement of vertical gradients using piezometers, measurement of vertical stream bed fluxes using seepage meters, and evaluation of geomorphic features that may influence vertical gradient and flux (Study

7.5 SIR). Methods used for identification of groundwater influence on surface water under Study 7.5 is more detailed and is the preferred approach to understanding groundwater-surface water interactions. Although stream bed flux field work is still underway, vertical gradient data is available and is currently being analyzed. This work focuses on spatial extrapolation of existing gradient data, which requires determining the similarity between reference points in well-studied areas – where an understanding of groundwater processes has been sufficiently developed – to relational points in less studied regions. The geohydrologic process domain framework assumes that geomorphological characteristics, universally observable among reference and relational points, can be used to infer unobserved hydrologic processes such as the location and persistence of groundwater upwelling.

Groundwater modeling is most advanced in FA-128 (Slough 8A), although other preliminary models are being developed at FA-113 (Oxbow I), FA-115 (Slough 6A), and FA-138 (Gold Creek). Preliminary analysis of relational and reference river points suggests that certain sections of the Middle Susitna River are not suitable for geomorphological/hydrological comparison to Focus Area 128, where groundwater modeling efforts are furthest advanced. Data collected in FA-128 (Slough 8A) are generally characterized by island and slough geomorphic regions but with little upland data points. Other Focus Areas such as FA-115 (Slough 6A) have a greater proportion of upland wells. Once groundwater modeling is complete in these other Focus Areas, the results will be combined to evaluate whether a more complete extrapolation is possible.

2.2.1.6. Objective 6: Implementation of Environmental Protection Agency Methods

Study Objective 6, implementation of Environmental Protection Agency (EPA) 1631E method for laboratory analysis of total mercury in water, sediments, and fish tissue, and EPA Method 1630 for laboratory analysis of methylmercury in water and fish tissue, and application of Method 1669 (Clean Hands/Dirty Hands) for all mercury field sampling (EPA 1996), was recommended by FERC in the April 1, 2013 Study Plan Determination and adopted by AEA. One comment was made that pertains to Study 5.5 Objective 6 that was essentially the same as a comment made to Study 5.7 Objective 2. To reduce redundancy and increase readability, the one comment in Study 5.5 pertaining to Objective 6 has been presented and addressed under Study 5.7 (Section 2.2.3 of this document).

2.2.1.7. Objective 7: Utilization of Toxicity Reference Values

Objective 7: Utilization of Toxicity Reference Values (TRVs) as an additional benchmark when evaluating the need for additional baseline water quality data collection.

2.2.1.7.1. Response to Modification Request for a Table of TRV Criteria

NMFS asserts that the FERC recommendations from the Study Plan Determination (4/1/2013) have not been followed and therefore the study was not conducted as provided for in the approved plan. Both NMFS and USFWS (USFWS_pp5.5-13_ph5) comment that TRVs have not been explicitly listed or discussed. For example, writes USFWS, while EPA (1999) provides a TRV for mercury chloride and methylmercury for mammals and birds, it is unclear whether AEA will assess both mercury and methylmercury separately (USFWS_pp5.5-13_ph5). NMFS comments that without knowing the Toxicity Reference Values modeling results cannot be interpreted. NMFS therefore recommends that a table of actual TRV values be provided (Modification 7-1; NMFS_pp5.5-10_ph8).

AEA requests that FERC not adopt this proposed modification under Study 5.5 as this pertains to the Mercury Assessment and Potential for Bioaccumulation Study RSP Section 5.7. This modification is not necessary to meet the objectives of Study 5.5 and this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. TRVs are used in predictive risk analysis (Study 5.7 RSP Section 5.7.4.6) for comparison with methylmercury measured in fish tissue. As indicated in Study 5.7 SIR Section 7, results from the predictive risk analysis and comparison to TRVs will be reported in Study 5.7 USR.

As FERC noted in its April 1, 2013 SPD (page B-8) regarding TRVs:

> *Evaluation of Baseline Mercury Measurements in Water*
>
> *NMFS and FWS state that Toxicity Reference Values (TRVs) are not included as a component of determining the need for additional baseline sample collection in Study 5.5. However, the agencies recognize that Study 5.7 (mercury assessment) does incorporate TRVs for assessing the potential impacts of the project on mercury in specific species of piscivorous birds and aquatic furbearers.*

The FERC SPD recommended that AEA utilize the TRVs as an additional benchmark when evaluating the need for additional baseline water quality data collection.

AEA adopted FERC's recommendation and will use TRVs for comparison of mercury concentration in fish tissue as an additional benchmark to ADEC WQ Criteria and SQuiRTs. As indicated in Study 5.5 ISR Part B Attachment 1 QAPP (Section B.1.1): "Toxicity Reference Values (TRVs) will be used for evaluating potential effects on ecological receptors in the aquatic environment. TRVs for surface water ecological receptors and TRVs calculated for community measurement receptors in sediment will be determined as outlined in EPA (1999)." AEA has presented several approaches for use of TRVs in evaluation of mercury bioaccumulation in tissue of aquatic receptors and for piscivorous fish and aquatic furbearers, should transfer of mercury from the reservoir to terrestrial wildlife occur.

RSP Section 5.5.4.8 presents a description on how AEA intends to predict and report methylmercury formation and peak mercury concentrations in fish. TRVs will be used to compare tissue concentrations of methylmercury in piscivorous birds and aquatic furbearers should transfer of mercury from reservoir to terrestrial wildlife be identified (Study 5.7 RSP Section 5.7.4.6). As indicated in Study 5.7 SIR Section 7, results from predictive risk analysis and comparison to TRVs will be reported in Study 5.7 USR.

In evaluating potential impacts of mercury on aquatic life, TRVs from Suter and Tsao (1996), including those for surface water and sediments will be used. All updated information to this list of TRVs will be acquired through a web-based search in order to use current toxicity reference values published in the peer-reviewed literature. AEA acknowledges that literature updates occur periodically and that current TRVs will be used when the pathway analysis (Study 5.7) is initiated.

Interpretation of results will occur under Study 5.7 using TRVs and the values will be reported in the Study 5.7 USR.

TRVs for mercury and methylmercury will be assessed separately for effects to aquatic receptors. However, water quality criteria when available will be used first to compare results with thresholds or criteria. The endpoint for receptors using pathway analysis (evaluating potential for bioaccumulation of mercury) are fish tissue results collected within the inundation zone. Fish samples (Study 5.7 ISR Part A, Figure 4.2-16) collected at or near sediment sampling sites (10 sites; Study 5.5 RSP Section 5.5.4.6) will be used as receptors, in combination with sediment results and water quality results in the reservoir environment using pathway analysis to determine potential for bioaccumulation.

Riverine receptors will be evaluated based on TRVs for target fish species found below the dam. Specific TRVs are used in toxicity assessments and exposure to a chemical of potential concern (mercury and methylmercury) for evaluation of effects on fur-bearers and piscivorous birds (Study 5.7 RSP, Section 5.7.4.6). Riverine receptors (fish) will be evaluated for potential transfer of methylmercury and bioaccumulation using the Phosphorus Release Model and the Harris and Hutchinson Model (Study 5.7 RSP Section 5.7.4.7.1).

There is no additional cost for implementing this modification request as it is already part of the FERC-approved Study Plan.

2.2.1.8. References Cited

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Suter, G.W, II, and C.L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision.* Oak Ridge National Laboratory, ES/ER/TM-96/R2, Oak Ridge National Laboratory, Oak Ridge, TN.

2.2.2. Study 5.6 – Water Quality Modeling Study

As established in the Study Plan (RSP Section 5.6.1), the overall the goal of the water quality modeling study is to utilize the extensive information collected from the Baseline Water Quality Study (Study 5.5) to develop a model(s) that evaluates the potential impacts of the proposed Project and operations on the Susitna River watershed.

The study objectives as established in the Study Plan (Section 5.6.1) are as follows:

- Implement (with input from licensing participants) an appropriate reservoir and river water temperature model for use with past and current monitoring data.

- Using the data developed as part of the Baseline Water Quality Study (Study 5.5), model water quality conditions in the proposed Watana Reservoir, including (but not necessarily limited to) temperature, DO, fine suspended sediment and turbidity, chlorophyll-a, nutrients, ice, and metals.
- Model water quality conditions in the Susitna River from the proposed site of the Watana Dam downstream, including (but not necessarily limited to) temperature, DO, fine suspended sediment and turbidity, chlorophyll-a, nutrients, and ice processes (in coordination with the Ice Processes Study 7.6).

Data collection has been completed (Study 5.5), spatial configuration of the Environmental Fluid Dynamics Code (EFDC) model has been completed and calibration of the model is ongoing. The decision point from the RSP to not extend the EFDC modeling below PRM 29.9 has been made, as outlined in the *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum* (September 30, 2014) (Tetra Tech, Inc. 2014a).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 23, 2016, AEA plans no modifications of the methods of this study.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS, USFWS, NPS, and SRC et al. (Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center) submitted 12 study modification proposals (8 from NMFS, 7 from USFWS, and one each from SRC et al. and NPS) for Study 5.6; five of the Services' modification requests were the same. AEA also received many comments on Study 5.6 from these licensing participants as well as ADEC, ADF&G, and the Nature Conservancy (TNC). Two commenters (NMFS and USFWS) disagreed with the decision not to extend the model downstream past PRM 29.9, while one (ADF&G) agreed with the decision, as outlined in the *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, which was filed with FERC in September 2014.

AEA's responses to the licensing participants' comments and study modification requests can be found in Table 2.2.2-1 and below. AEA's responses to comments and study modification requests are organized into subsections by study objectives, which is how NMFS and USFWS organized their comments. Each subsection states the objective as described in RSP Section 5.6. The subsections are further organized into discussions based on overarching comment topics. The following are the discussion topics under each objective.

- Objective 1: Model Linkage/Integration; Conceptual Model/Model Approach; Model Setup; Model Data; Model Uncertainty
- Objective 2: Reservoir Model Setup
- Objective 3: General; Riverine Model Calibration/Validation; Mercury Modeling; Riverine Model Expansion

Table 2.2.2-1. Study 5.6 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADEC_pp3_ph2	*The Alaska Department of Environmental Conservation supports timely completion of Study 5.6 and agree with the Alaska Energy Authority (AEA) that the remaining steps to complete the study include: 1…8…* *While all of the remaining steps to complete the study are important for DEC to be able to evaluate the projects potential impacts, there is one item in particular. Item 8, "Conduct simulations in reservoir and riverine models to evaluate water quality and sediment transport impacts under various alternative operational scenarios." The ability to examine the modelled impacts of various alternative operational scenarios is critical to conduct a robust analysis for evaluating the project for its Section 401 Water Quality Certification. Without completion of Study 5.6 there will be insufficient information to submit a robust application for the Section 401 Water Quality Certification.*	AEA concurs. The completion of Study 5.6 (including Item 8) will provide AEA with sufficient information to prepare a robust application for Section 401 Water Quality Certification.
ADNR_ADFG_pp8_ph3	*We agree with Alaska Energy Authority's (AEA) decision that extension of the water quality model downstream of PRM 29.9 is not warranted.*	AEA appreciates and agrees with ADF&G's recognition that the extension of the EFDC model below PRM 29.9, as described in the Decision Point TM and presented in the ISR, is not warranted.
ADNR_ADFG_pp8_ph4	*Based upon the work completed, we believe the data is sufficient to complete the modeling and objectives for the Water Quality Monitoring Study and therefore no additional field work is needed to meet FERC-approved study objectives.*	AEA agrees. AEA appreciates ADF&G's comprehensive review and ongoing involvement as a licensing participant in the implementation of the FERC-approved Study Plan.
	Objective 1	
NMFS_pp5.6-3_ph5	*Modification 1-1: Demonstrate how the water quality model integrates with other models. This modification will best be accomplished by a New Study for Model Integration. The request for this new study is included in a separate enclosure.*	As explained below in Section 2.2.2.1.1, the requested modification is already part of the FERC-approved Study Plan. To the extent that NMFS is seeking modifications which are not part of the Study Plan, AEA requests FERC not adopt this proposed Study Plan modification. Although characterized as a proposed study plan modification, this is a request for a new study, which should be evaluated under the criteria established in 18 CFR 5.15(e). This request does not meet that criteria for the reasons stated in Section 3.4. If considered a proposed modification, this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan.
USFWS_pp5.6-1_ph3	*Modification 2: Provide a Model Integration Study Plan to document modeling methods*	As explained below in Section 2.2.2.1.1, the requested modification is already part of the FERC-approved Study Plan.

Reference Number	Comment or Study Modification Request	AEA's Response
	and show how the water quality model integrates with other models.	To the extent that NMFS is seeking modifications which are not part of the Study Plan, AEA requests FERC not adopt this proposed Study Plan modification. Although characterized as a proposed study plan modification, this is a request for a new study, which should be evaluated under the criteria established in 18 CFR 5.15(e). This request does not meet that criteria for the reasons stated in Section 3.4. If considered a proposed modification, this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan.
NMFS_pp5.6-2_ph7	*The model does not provide a detailed simulation of ice dynamics and/or groundwater processes. Close coordination with the Ice Modeling and Groundwater Study teams will be required.*	See Section 2.2.2.1.1.
NMFS_pp5.6-3_ph1; USFWS_pp5.6-5_ph5	*The integration of the Water Quality Model with the Groundwater Model assessments is not reported.*	See Section 2.2.2.1.1.
NMFS_pp5.6-3_ph2	*The ISR report should provide a detailed discussion regarding the integration of the Water Quality Model with the Groundwater Model, Ice Processes Model, Geomorphology Model, and other models and their connection (i.e. which model parameters and results are being transferred from the Water Quality Model).*	See Section 2.2.2.1.1.
SRC_etal_WATER_pp49_ph4	*It appears that the output from the ice processes model will be used as input to the water quality model, and the output from the water quality model will be used as input to the ice processes model. The documents do not detail how this linkage between the models will be accomplished.*	See Section 2.2.2.1.1.
SRC_etal_WATER_pp4_ph4, SRC_etal_WATER_pp6_ph3	*The Water Quality Modeling Study should be modified to require AEA to develop a transparent, detailed conceptual water quality model, clearly describe linkages/coupling between the water quality model, groundwater model and ice processes model and address sources of uncertainty.*	As explained below in Sections 2.2.2.1.1; 2.2.2.1.4; and 2.2.2.1.9, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA has already expended several million dollars reviewing available data, collaborating with licensing participants and developing a detailed EFDC model, as well as the other riverine models.
NPS_pp2_ph2	*We request that resource model calibration, validation, and integration between the multiple resource studies that rely on modeling be completed prior to TNYOS* [the next year of study] *and prior to the Updated Study Reports (USR). Consistent time horizons should be*	As explained below in Section 2.2.2.1.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. AEA will conduct these tasks as part of the implementation of the FERC-approved Study Plan

Reference Number	Comment or Study Modification Request	AEA's Response
	used as the models are integrated and run. It should be clear whether predictions involve point-in-time conditions, at say year 50 post impoundment, and when and if steady-state conditions are expected to develop.	during the next year of study. AEA anticipates that to the extent model calibration, validation, and integration results identify data gaps, additional data collection would also occur during the next year of study. AEA will provide the results of model calibration, validation and integration in the USR, as well as the results of model runs for existing conditions and one operating scenario. While there is no additional cost to complete the tasks themselves since they are already part of the FERC-approved Study Plan, there would be additional costs in extending the schedule to complete the FERC-approved studies and extending the schedule could impact the data and analysis already gathered and completed for other FERC-approved studies.
NMFS_pp5.6-6_ph6	*Modification 3-4: Explain how the differences in grid resolution between Water Quality and Groundwater models will be resolved while maintaining the accuracy of the data.*	As explained below in Section 2.2.2.1.3, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp5.6-6_ph7	*It is unclear whether the EFDC modeling grid provided adequate accuracy to model lateral habitats. It would be useful if AEA would provide tables identifying grid sizes used in a) the main Susitna River, b) target focus areas-main channels, and c) the target focus areas - lateral side channels and sloughs.*	See Section 2.2.2.1.3.
NMFS_pp5.6-6_ph8	*The grid resolution seems to neither match the scale of localized groundwater upwelling nor significant changes in the thermal energy map assessment.*	See Section 2.2.2.1.3.
SRC_etal_WATER_pp5_ph5, SRC_etal_WATER_pp48_ph2	*Groundwater data from the FAs are providing input data for EFDC, but it is it unclear how these data are informing the EFDC model input, and what assumptions are being made about groundwater/surface water interactions in areas where no groundwater data are available. Thus, the sufficiency of the groundwater data for these purposes cannot be evaluated.*	See Section 2.2.2.1.3.
USFWS_pp5.6-6_ph3	*It is unclear whether the EFDC modeling grid provided adequate accuracy to model lateral habitats.*	See Section 2.2.2.1.3.
USFWS_pp5.6-6_ph4	*It will be necessary to show how the selection of this particular grid resolution improves the accuracy of capturing groundwater upwelling and the thermal stratification reflected in the thermal image assessment maps.*	See Section 2.2.2.1.3.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.6-6_ph9	*Provide better integration between the groundwater and Water Quality Models, making sure that accuracy and resolution is preserved when defining groundwater upwelling areas. Specifically, the potential lateral transport of groundwater as affected by changes in river stage associated with various load following scenarios needs to incorporate into modeling efforts for lateral side channels and sloughs. A revised plan for incorporating and addressing this phenomenon should be incorporated into the Study Plan.*	See Section 2.2.2.1.3.
SRC_etal_WATER_pp5_ph7, SRC_etal_WATER_pp48_ph6	*We were unable to find a description of the model boundary conditions used in space and time or model calibration statistics for temperature and water levels. Modeling methods are not fully described in any reports.*	The model is developed using observed weather data, upstream flow and temperature data, tributary flow, and temperature data. Pre-Project river flow and temperature were used as upstream boundary conditions for the reservoir model (Study 5.6 SIR, Section 5.1). The pre-Project conditions upstream river temperature boundary was based on a 3-year synthesized temperature record that correlated observed temperatures with time of year and river flow (Study 5.6 SIR, Section 5.2). More detailed information on the boundary conditions will be included in the USR. The model was calibrated with 2012 and 2013 instream observed temperature data. In general, the data are used directly without extra correction for short-term spikes and variability because the purpose of this modeling is to catch the general trend and underlying physics instead of short-term local variability. Additional details will be included in the USR. EFDC was determined to be the preferred model in the May 2012 technical memorandum, *Water Quality Modeling Study: Model Selection* (Tetra Tech 2012). This document is available at http://www.susitna-watanahydro.org/type/documents/ under the "Initial Licensing Analyses and Planning Documents" > "Briefings and Technical Documents" header. For additional information on modeling methods, see Section 2.2.2.1.4. For comment on calibration, see Section 2.2.2.3.2.
SRC_etal_WATER_pp5_ph9, SRC_etal_WATER_pp48_ph8	*We have been unable to find a description of a detailed conceptual model incorporating the data that have been collected to date. A conceptual framework for the models that are under development should be prepared and expressed to ensure that the numerical models are consistent with the conceptual models.*	See Section 2.2.2.1.4.
TNC_pp415_ph2	*The report does not provide any information on how boundary conditions were developed for the initial model runs, and how they will be developed for model calibration and validation. There are no hydrographs for mainstem or*	See Section 2.2.2.1.4.

Reference Number	Comment or Study Modification Request	AEA's Response
	tributary inflows; there are no loading curves for solids, nutrients, and contaminants; meteorological inputs described in the water quality studies report (Section 5.5) were probably used here, but no reference has been provided; and references described in Section 7.1 of the report on how the reservoir will be operated should also be provided in Section 4.2.	
USFWS_pp5.6-6_ph7	*AEA did not provide sufficient information to reliably assess the proposed modeling approach.*	See Section 2.2.2.1.4.
NMFS_pp5.6-4_ph3, USFWS_pp5.6-4_ph6	*An explanation of how chlorophyll-a will be included in the EFDC model has not been provided.*	Chlorophyll *a* is part of the nutrient modeling that will be performed using EFDC. EFDC contains an algal simulation module that will be used to model chlorophyll *a*. The algal simulation is coupled with the modules that simulate carbon, nitrogen, and phosphorus. The interactions between the nutrient and algae will be internally represented in the EFDC framework.
TNC_pp8_ph4	*…overall the choice of the modeling framework [EFDC] and the principal modeling components selected [hydrodynamics (including temperature), fine sediment transport, water quality, and sediment-water column interactions] are all necessary for meeting the objectives of this project. However, details on how these components are represented in the model are lacking, which precludes a determination as to whether the processes represented in the model are at a resolution that is sufficient to meet the project objectives. In addition to the lack of details on the processes represented in the model, the report is either missing information or lacking in detail on most of the standard model development steps.*	AEA is currently in the initial study reporting phase of the licensing process, and the studies are not intended or expected to be completed at the time of this interim report. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The water quality modeling has not yet been completed. The modeling approach follows the RSP without any variances. See Section 2.2.2.1.4 for discussion on the modeling approach and conceptual model. Additional information on these components will be included in the USR.
NMFS_pp5.6-3_ph3	*AEA has not released a summary table of selected EFDC model parameters used in different parts of the model, and state model variables and outputs have been only partially summarized the ISR, Parts A and B, although they were presented in one of the previous technical meetings.*	See Section 2.2.2.1.5.
TNC_pp413_ph2	*1. How are riparian and topographic shading represented in the EFDC model? What information is available to develop riparian shading?*	Shading is expected to play a limited role in the riverine portion of the model, especially in the Lower River, where the channel widens. The current riverine model is calibrated for temperature and replicated observed temperature values, without specifically considering shading. Similarly, shading is not expected to play a large role in the reservoir model. Therefore, shading was

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		not included in the EFDC models and is not planned to be included. The EFDC model has the capability of representing topographic and riparian shading. The current EFDC model takes into account solar radiation, but does not take into account riparian or topographic shading. Incorporating shading into EFDC was not included as an objective or in the methodology of Study 5.6 in the RSP and Study Plan, because it has a limited influence. In order to represent shading in EFDC, first the topographic and riparian data will need to be pre-processed to determine the necessary changes in the solar radiation. Then the EFDC solar radiation model input must be modified either through a modification to the EFDC source code that would read a new shading input file and internally adjust solar radiation, or the existing solar radiation input file would need to be manually updated. Riparian shading requires detailed data on riparian conditions including canopy density, canopy height, and seasonal variation of canopy density. Riparian information on the mapped forest class with percent forest cover and the seasonal variation is available. This is the current riparian conditions and might not represent the conditions when the reservoir is in place. Tree canopy height is currently not available and is not included in the objectives for Studies 11.5, 11.6, or 11.7. This information is required for incorporating shading into EFDC. Information needed for topographic shading is available, but that data requires extensive processing to be used in the model. When specific data are not available, shading is used as a calibration parameter when calibrating spatial temperature variation in riverine systems.
TNC_pp413_ph2	*2. Is sediment transport coupled with hydrodynamics? Is the model capable of simulating downstream bathymetry changes and their effects on hydrodynamics resulting from reservoir construction and operation?*	The water quality model couples sediment transport of fine, suspended sediments with hydrodynamics. Bathymetry changes are not included because these sediments have very little interaction with the channel bed. The Fluvial Geomorphology Modeling Study (Study 6.6) couples the transport of sand and coarser sediments with hydrodynamics and does include bathymetry changes related to reservoir operation. This information will be provided in the USR.
TNC_pp413_ph2	*3. How many sediment classes are represented in the model? Does the model simulate only a single fine-grained sediment class (less than 125 micrometer)?*	The EFDC model is capable of simulating an infinite number of sediment size classes and multiple sediment size classes will be used to simulate the settling and resuspension of sediment. The particle size distribution from existing monitoring data will be evaluated and the final number of sediment size classifications will be determined during model calibration. This information will be documented in the USR.
TNC_pp413_ph2	*4. How are reservoir and riverine sediment processes coupled between the sediment*	Details of the sediment model are still under consideration and will be reported in the USR. The

Reference Number	Comment or Study Modification Request	AEA's Response
	transport model, water quality model, and toxics model?	modeling of bed material load (sand and larger materials) will be performed in Study 6.6 – Fluvial Geomorphology Modeling and used to represent changes in the channel bed geometry (erosion and deposition) and bed material size gradation. The EFDC model will be used to model the finer sediments, silt and clay, which will be used to interpret changes in turbidity. The mercury will be completed in future phases of the project.
TNC_pp413_ph2	− *How do the erosional and depositional fluxes affect water/sediment concentrations of model state variables?*	In EFDC, sediment transport is not closely coupled with water quality model, therefore, except for the state variable PO4, other water quality state variables are simulated independent of the erosional and depositional fluxes.
TNC_pp413_ph2	− *How does the model simulate particulate organic carbon (POC)/nitrogen/phosphorus transport and settling? Are these coupled with the water column sediment class(es) or are these represented as separate state variables in the water quality model?*	The particulate organic matter are simulated independently with specified organic matter settling velocity.
TNC_pp413_ph2	− *What are the state variables for the sediment diagenesis model? Is this capable of simulating redox conditions in sediments? Other than diagenesis, what other ... sediment processes are simulated? How many reactive classes are used for particulate organic matter?*	The sediment diagenesis model has 27 state variables. It does not explicitly represent the redox condition in sediments but approximates it with the dissolved oxygen (DO) condition. For particulate organic matter, the model is divided into three classes—G1 for labile, G2 for moderately labile, and G3 for inert.
TNC_pp413_ph2	− *It is indicated that the toxics model will simulate total, elemental, and methylmercury. Does the model simulate methylation and demethylation? How does it determine the redox conditions in the sediments? Is this coupled to the sediment diagensis model?*	No methylation and demethylation is available in EFDC. It is a simplified representation with simple adsorption/desorption with first order loss.
TNC_pp413_ph2	*5. What is the basis for selecting two plankton species? The water quality studies indicate relatively low chlorophyll-a levels in the river under baseline conditions. What is the composition of the planktonic community under these conditions? How would this shift in the future under with-reservoir conditions? Would two species be sufficient, particularly for the reservoir model?*	The basis for selecting two plankton species for representation in the EFDC model was to represent algal groups (one adapted to high temperatures and one adapted to low temperatures) to identify potential seasonal succession due to temperature changes associated with the reservoir operation. The change in the composition of the plankton community will be documented in the USR.
TNC_pp413_ph2	*6. Does the model simulate light attenuation and scattering? Is this coupled to water temperature simulation?*	Light attenuation is simulated through the detailed representation of algal processes in the eutrophication module of EFDC. A separate, simplified routine which captures solar radiation is included to represent its effect on water temperature.
TNC_pp415_ph1	*On the maps showing the model segments, contours along the floodplain showing the 50- and 100-year floods (if available) would be*	These maps can be added to the reports of the 50- and 100-year floodplain extents from the Fluvial Geomorphology Modeling Study (Study 6.6) results in

Reference Number	Comment or Study Modification Request	AEA's Response
	useful. Ideally, the model segments should cover most or all of the floodplain. The report should also describe existing hydraulic structures (such as culverts, bridges, etc.), and how these will be represented in the model.	the USR. There were no hydraulic structures explicitly included in the EFDC except for the outfall from the dam. There are only two bridges crossing the river in the entire study area (Railroad at Gold Creek and Parks Highway at Sunshine) and deck of both of these structures are well above the 100-year water surface elevation. Additional text on the dam outfall can be included in the USR.
TNC_pp415_ph3	*There is no information on how initial conditions will be developed for the water column and sediments in the reservoir and riverine sections.*	The water column initial conditions for the riverine section have insignificant impacts to model results because of the short retention time (i.e., outside conditions, such as upstream flow or runoff, quickly change the conditions in the river); therefore, it can be set to a reasonable value estimated using monitored data. For the riverine section, the bed initial condition would be set to an estimated value using experience, and then the model will be run for 2 to 3 years to produce the results, which will help refine the estimated initial condition. A sensitivity analysis of the impact of initial condition will be conducted to evaluate the implication to decision making. The reservoir initial condition will be set using a model 3- to 6-year warm-up period, until the water column reach near steady state. The end state will be used as initial condition. Due to the deep nature of the reservoir, the bed will not be simulated as an active component; therefore, there is not a need for a bed initial condition. Sediment inflow to the reservoir will be supplied from the Geomorphology Study (6.5) in the form of sediment rating curves (sediment discharge vs. water discharge) developed from data collected by the USGS in Study 6.5 (2012–2014) and collected by the USGS in the 1980s.
TNC_pp415_pp5A	*In Section 4.2, the report provides a cursory indication that literature review was conducted to develop parameterization. Furthermore, it is indicated that an uncertainty analysis will be developed to account for the lack of calibration. A table of model parameters with literature-reported ranges (that are appropriate for these settings) should be developed, and a rationale for selection of the base parameter values should be provided.*	Additional information on parameterization and model parameters will be provided in the USR. See Section 2.2.2.1.9 for a discussion of model uncertainty analysis.
USFWS_pp5.6-7_ph2	*State the specific operating scenarios and associated time steps to be evaluated by each of the models.*	Results for existing conditions and one operational scenario will be provided in the USR. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests and address issues including the downstream water temperature. The results of Existing Conditions, Maximum Load Following, Intermediate Load Following

Reference Number	Comment or Study Modification Request	AEA's Response
		and Run-of-River operational scenario will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions. The EFDC water quality model operates on a sub-hourly time step (4 seconds) and the model is output on an hourly average time step.
NMFS_pp5.6-3_ph7, USFWS_pp5.6-1_ph6	*NMFS Modification 1-2; USFWS Modification 5:* *Describe the effects of missing or inadequate water quality data on model performance.*	As explained below in Section 2.2.2.1.7, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp48_ph4	*The lack of temperature data throughout the reach in 2013 will increase uncertainty and may hamper the ability to calibrate the model to observed conditions, or changes in habitat quality under operational conditions.*	To clarify, a complete set of temperature data was collected in 2012 throughout the entire reach not accessible in 2013. As shown in temperature calibration result plots, the model catches the 2012–2013 observed temperature spatial-temporal variations well (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). Even though data is only available at limited locations, the model is capable of generally reproducing observed conditions at these locations and it shows that the model is correctly representing the underlying dynamics/physics. Additional discussion on missing data is in Section 2.2.2.1.7. Additional discussion on model calibration is in Section 2.2.2.3.2.
TNC_pp415_ph4	*There is no detail on the calibration strategy for the riverine section of the model (including how the baseline without-reservoir model will be calibrated for the present upstream riverine portions). The report should provide detailed discussions on the calibration datasets available and identify data gaps for calibration. A strategy for assessing the sensitivity of the model calibration, and the uncertainty associated with data gaps identified, should be described.*	See Sections 2.2.2.1.7 and 2.2.2.1.9.
SRC_etal_WATER_pp48_ph4	*It is not clear how this lack of synchronous data will be handled in the water quality model.*	The focus of a water quality model is to reflect the general underlying dynamics/physics such that the model can simulate results at locations and time beyond the available data. Ideally, water quality model should be developed with entire suite of boundary condition data and instream calibration data for the same period. In the case of lacking synchronous data, assumptions need to be made using patterns identified in data during other periods and then derive data using the assumption to complete the model.

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		Even though an entire suite of synchronous data might not be available, it is still possible to evaluate the model's capability in representing the general trend and pattern through comparing with observed instream data for the same period or different period. For the Susitna River, the EFDC results show that the model performs sufficiently well in generally reproducing observed spatial and temporal variabilities in the river, suggesting that the data are adequate in evaluating whether the model correctly represents the underlying dynamics/physics (Study 5.6 SIR, Section 5.0; Study 5.6 SIR, Appendix A).
TNC_pp414_ph6	*The report does not provide a discussion of the data used for developing the reservoir and river model cross-sections. It appears that the reservoir model sections were developed using LiDAR-based digital elevation model (DEM), but there are no details on the resolution. A comparison of the elevation-to-volume relationship should be provided between the DEM-based inundation footprint and how those volumes are represented in the model.*	See Section 2.2.2.1.8.
TNC_pp414_ph7	*For developing the river model, there is a statement that 88 cross-sections were surveyed in 2012 and additional cross-sections were surveyed in 2013, but there is no discussion or a reference to these surveys. It will be useful to present an elevation profile of the thalweg from upstream to downstream and how the model is segmented longitudinally. It will also be helpful to show representative cross-sections both for the reservoir and river models, so that a determination can be made as to whether the lateral and vertical features are appropriately represented in the model. Specifically, a determination should be made as to whether the use of three lateral rectangular cells adequately represents the riverine sections.*	See Section 2.2.2.1.8.
USFWS_pp5.6-7_ph3	*Provide evidence of empirical data used in each modeling assumption.*	The model is developed using observed weather data, upstream flow and temperature data, tributary flow, and temperature data. Pre-Project river flow and temperature were used as upstream boundary conditions for the reservoir model (Study 5.6 SIR, Section 5.1). The pre-Project conditions upstream river temperature boundary was based on a 3-year synthesized temperature record that correlated observed temperatures with time of year and river flow (Study 5.6 SIR, Section 5.2). More detailed information on the boundary conditions will be included in the USR. The model was calibrated with 2012 and 2013 instream observed temperature data. In general, the data are used directly without extra

Reference Number	Comment or Study Modification Request	AEA's Response
		correction for short-term spikes and variability because the purpose of this modeling is to catch the general trend and underlying physics instead of short-term local variability. Additional details will be included in the USR.
TNC_pp415_ph5B	*The methodology for uncertainty analyses should be outlined. There is no discussion on what metrics (model outputs) are important to inform the impacts of the project. Such metrics should be developed and discussed, and uncertainty in model predictions should be presented from the context of these metrics.*	See Section 2.2.2.1.9.
USFWS_pp5.6-2_ph8	*While some modeling results have been provided in the Final ISR, no sensitivity analysis of different operating scenarios has been conducted.*	Analysis of different operating scenarios is premature at this stage of licensing. The sensitivity analysis methods and results for one operating scenario will be presented in the USR. The remainder of the operating scenarios will be presented in the Draft and Final License Applications. Calibration involves varying the bottom roughness height, solar radiation adjustment factor, air-water heat transfer coefficients within a reasonable range, and simulated temperature was compared against the observed data. The performance of the model showed only negligible sensitivity to those parameters, and the temperature boundary conditions from the major tributaries contribute more significant impact. Therefore, all the parameters were restored to the default values, which still allows a good match between the simulated and observed temperature. The cause of the insensitivity of river water temperature to those parameters might be due to the character of the river as fast moving with high volume, which would show more sensitivity to tributary flows and temperature than to other external factors that would need sufficient exposure time to impose the effect. In the subsequent work, a more formal sensitivity analysis will be conducted to evaluate how downstream temperature/ water quality would respond to the variability in temperature/flow/water quality at the dam due to different operations.
SRC_etal_WATER_pp5_ph3, SRC_etal_WATER_pp47_ph6	*Uncertainty in modeling needs to be addressed. We have not seen a presentation describing how the uncertainties in boundary conditions will be addressed. It is not common practice to use "visual comparison" to evaluate model performance, nor is it clear how this visual comparison will be done, and whether model uncertainty will be addressed in a quantitative fashion.*	See Section 2.2.2.1.9 for a discussion on uncertainty and Section 2.2.2.3.2 for a discussion on calibration.
	Objective 2	
NMFS_pp5.6-1_ph11, USFWS_pp5.6-1_ph8	NMFS *Modification 2-1;* USFWS *Modification 7:* *Provide evidence that the use of the 20-layer*	As explained below in Section 2.2.2.2.1, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is

Reference Number	Comment or Study Modification Request	AEA's Response
	model (not a 40-layer model) with the bottom layer thickness of 25 meters retains accuracy in predicting thermal stratification in the future reservoir.	$800,000 for the development of the model and 4 scenarios.
NMFS_pp5.6-4_ph2, USFWS_pp5.6-4_ph4	*The proposed thickness of the bottom layer (in the 20-layer vertical grid) is too high (82 feet/25 meters) to accurately capture the reservoir temperature stratification. Results supporting "adequate simulations under ice-free conditions" using the 20-layer and 40-layer configurations should be presented to allow for an appropriate review of the modeling results.*	See Section 2.2.2.2.1.
	Objective 3	
USFWS_pp5.6-1_ph2	*Modification 1: Complete the Water Quality Modeling Study. The items completed since the June 2014 ISR report were actually completed ahead of the April 2014 Proof of Concept (POC) meeting.*	As explained below in Section 2.2.2.3.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. Requesting a FERC-approved Study Plan to be completed does not constitute a modification to the Study Plan and submitting this as a request reflects disregard for the ILP regulations, as well as the current ISR stage of this licensing effort. As such, there is no additional cost for implementing this "modification".
NMFS_pp5.6-4_ph3, USFWS_pp5.6-4_ph6	*Although reservoir simulations showing changes in water temperature have been described, simulations for other variable are missing.*	AEA is currently in the initial study reporting phase of the licensing process, and the studies are not intended or expected to be completed at the time of this interim report. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The water quality modeling has not yet been completed. Modeling results for other parameters will be included in the USR for baseline conditions and one operational scenario and additional scenarios will be provided in the License Application.
NMFS_pp5.6-5_ph1, USFWS_pp5.6-1_ph5	NMFS *Modification 3-1;* USFWS *Modification 4:* *Calibrate and validate the riverine model for the focus areas, and provide summary statistics that quantify model fit.*	As explained below in Section 2.2.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. This information will be provided in the USR, as applicable.
NMFS_pp5.6-5_ph5, USFWS_pp5.6-1_ph7	NMFS *Modification 3-2;* USFWS *Modification 6:* *Provide "preliminary calibration" results of the water quality model incorporating hydrodynamics, water quality results, model*	As explained below in Section 2.2.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved

Reference Number	Comment or Study Modification Request	AEA's Response
	parameterization, and goodness of fit statistics for selected locations, dates, and times.	Study Plan. As such, there is no additional cost for implementing this modification. This information will be provided for baseline and one operational scenario in the USR.
SRC_etal_WATER_pp49_ph2	*To date, the FA modeling has only evaluated temperature in the summer.*	See Section 2.2.2.3.2.
SRC_etal_WATER_pp5_ph7, SRC_etal_WATER_pp48_ph6	*To date, only discharge and temperature have been simulated, so it is not possible to evaluate other parameters, such as dissolved oxygen.*	See Section 2.2.2.3.2.
TNC_pp8_ph5	*In Sections 6 and 7, it is concluded that the model demonstrated stability on historical and proposed project flow scenarios. No results have been provided to support this conclusion. The majority of the model calibration is yet to be completed. Therefore, the conclusion in the executive summary in Section 7 (Part C) that the model calibration will meet study objectives is unverifiable.*	See Section 2.2.2.3.2.
USFWS_pp5.6-4_ph6	*Although the model was calibrated, no results demonstrating success of the calibration have been presented in the report.*	See Section 2.2.2.3.2.
NMFS_pp5.6-3_ph8, USFWS_pp5.6-4_ph2	*We suggest a longitudinal profile of the model be displayed graphically to evaluate how well the model predicts conditions at locations on the river where there is a greater distance between data collection sites. The specific reach in question is: Reach Project River Mile (PRM) 143.6- PRM 209.2 (no water temperature data were collected during summer 2013 and winter 2013-2014).*	To clarify, the riverine water quality model extends downstream from the dam site at PRM 187.1; no riverine model is available above the proposed dam site, as the baseline condition was represented with the upstream boundary condition determined below the dam site at Tsusena. AEA agrees that longitudinal plots can be informative for understanding the longitudinal variability and could be produced for more densely located stations along the river, however, they do not provide much information for evaluating model performance. The spatial representative of model performance is shown by comparing the model result at multiple locations stretching along the length of the river, which show spatial variability of the model (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2).
NMFS_pp5.6-6_ph1	*Modification 3-3:* *Incorporate mercury into the Environmental Fluid Dynamics Code (EFDC) water quality model.*	As explained below in Section 2.2.2.3.3, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
USFWS_pp5.6-6_ph2	*Further details are needed regarding incorporation of the mercury model into the EFDC.*	See Section 2.2.2.3.3.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp5.6-7_ph1, USFWS_pp5.6-1_ph4	NMFS *Modification 3-5;* USFWS *Modification 3:* *Expand the geographic extent of the water quality modeling studies below project river mile 29.9.*	As explained below in Section 2.2.2.3.4, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $1,000,000 for the extension of the EFDC model beyond PRM 29.9 including data collection, calibration of EFDC, and running 4 scenarios.

2.2.2.1. Objective 1: Develop Riverine and Reservoir Temperature Models

Objective 1. With input from licensing participants, implement an appropriate reservoir and river water temperature model for use with past and current monitoring data (RSP Section 5.6.1).

Model Linkage/Integration

2.2.2.1.1. Response to Modification Request for a New Model Integration Study

NMFS Modification 1-1 (NMFS_pp5.6-3_ph5) and USFWS Modification 2 (USFWS_pp5.6-1_ph3) requested a modification to Study 5.6 to perform a new study for Model Integration to demonstrate how the water quality model integrates with other models. Besides the modification request for a new study, commenters requested information on specific model linkages: demonstration of linkage between the groundwater model, open water flow routing model, and ice cover model (NMFS_pp5.6-2_ph7); integration assessment for water quality model with the groundwater model (NMFS_pp5.6-3_ph1 and USFWS_pp5.6-5_ph5); description of linkage between the water quality model, groundwater model and ice processes model (SRC_etal_WATER_pp4_ph4, SRC_etal_WATER_pp6_ph3, SRC_etal_WATER_pp49_ph4); and discussion regarding which model parameters and results are being transferred from the water quality model to the groundwater model, ice processes model, geomorphology model, and other models and their connection (NMFS_pp5.6-3_ph2). NMFS also requested (NMFS_pp5.6-2_ph7) that the water quality modeling study maintain close coordination with the ice modeling and groundwater study teams.

AEA requests that FERC not adopt this as a modification to Study 5.6 or as a new study request. As discussed in Section 1.3 above, FERC's ILP regulations establish a high threshold for licensing participants to justify new studies at this point in the licensing process. A new study request must not only demonstrate "good cause," but the requestor must also include a statement explaining the following:

- any material changes in the law or regulations applicable to the information request;
- why the goals and objectives of any approved study could not be met with the approved study methodology;
- why the request was not made earlier;
- significant changes in the project proposal or that significant new information material to the study objectives has become available; and
- why the new study request satisfies the study criteria in 18 C.F.R. § 5.9(b).

As explained in Section 3.4, this new study request is not warranted, and the Services have not met their burden to justify the need for additional studies, as they failed to establish good cause or establish how their requested new study meets each of the 5 elements above. Modeling integration is already part of the FERC-approved Study Plan (RSP Section 8.5.4.8.1). As such, AEA also disagrees with the Services request for model integration as a new study.

The RSP as approved by FERC does not require this information to be available at the current ISR stage. Model integration has been occurring and is ongoing. As described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1), the Model Integration and Decision Support System (DSS) and supporting software will be completed after the initial results of the various modeling efforts are available. AEA will demonstrate how the water quality model integrates with the other models in the USR, including the groundwater model. The approach being developed has been described to licensing participants.

A riverine modelers meeting was held with licensing participants on November 13-15, 2013 to provide a forum to review and discuss modeling and study integration efforts. A follow-up Proof of Concept (POC) meeting was held April 15-17, 2014 to advance the understanding of riverine process modeling (i.e., WQ (study 5.6), FGM (Study 6.6), GW (Study 7.5), Ice (Study 7.6) and fish habitat modeling (Study 8.5)) by demonstrating the application of the models specific to two key biological metrics (i.e., effective salmon spawning-incubation habitat and juvenile salmonid rearing habitat) at Middle River Focus Area 128 (Slough 8A) (Study 8.5 ISR Part C, *Appendix N: Middle River Fish Habitat and Riverine Modeling Proof of Concept*). These meetings were held early in the study implementation process to allow potential data gaps or format inconsistencies among the various riverine models to be identified and resolved. Integration of riverine process models is an ongoing process. The modelers meet on a regular basis throughout the implementation of the Study Plan and actively work on integrating the models. Preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).

The presentations from both of the riverine modelers meetings are available on AEA's website (http://www.susitna-watanahydro.org/meetings/past-meetings/). These presentations demonstrate the linkages between the models and how individual model outputs will be used in evaluating Project effects for each resource discipline. The meeting notes for the two meetings provide a clear record of the major topics discussed and stakeholder questions pertaining to model integration. Indeed, one of the comments provided at the end of the April 2014 meeting by a USGS representative suggested that the modeling and model integration efforts were moving in the right direction – "…. thought it was a great meeting and that the studies are making good progress. Feels that there has been tremendous amount of focus on where the problem areas are and are a lot further along than in November 2013." Since then, the resource modelers have continued working in a collaborative fashion on each of the respective models.

The riverine EFDC model will provide surface water conditions from different locations as boundary conditions for the groundwater model. This process is still in development. The riverine EFDC will also be linked to the ice models. The Ice Processes Study (Study 7.6) will support water quality model development with information about timing and conditions for ice formation and ice break-up (RSP Section 5.6.7). The following is an example of the linkage between EFDC and the 1D ice model at FA-128 (Slough 8A). The 1D ice model provides ice cover information, which

EFDC is able to read after processing the 1D ice model results. The 1D ice model also provides inflow and water temperature boundary conditions to the FA-128 (Slough 8A) model in EFDC. The 1D ice model outputs results at cross sections. The cross sections above FA-128 (Slough 8A) can be extracted and provided to the EFDC model. Additional discussion of model linkage and data transfers is provided in RSP Section 7.6.4.7 and in the Study 5.6 ISR Part C, Section 7.1. The EFDC model results are then provided to the fish habitat model as input. Figure 5.6-2 from the RSP presents the interdependencies between the water resources studies.

In the reservoir, ice cover will be predicted using surface water temperatures simulated by the EFDC reservoir model and observed air temperatures. The initiation of the reservoir ice cover will be determined as a function of the number of accumulated freezing degree days (air temperature) following the decrease of the surface water temperature to $0^{O}C$. A post-processing tool will be developed to extract the number of days at a water temperature of zero degrees for the EFDC model surface cells from EFDC reservoir results based on past observations from several lakes in southcentral Alaska that will be compiled in Study 7.6. These results will be used to calculate the number of cumulative days of zero degrees water temperature. Finally, empirical equations will be used to estimate the ice cover and ice thickness with time using this information and the accumulated freezing degree days.

2.2.2.1.2. Response to Modification Request for Model Calibration, Validation and Integration to be Completed Prior to the USR

The NPS requests (NPS_pp2_ph2) that resource model calibration, validation, and integration between the multiple resource studies that rely on modeling be completed prior to the next year of study and prior to the USR. NPS states that consistent time horizons should be used as the models are integrated and run and that it should be clear whether predictions involve point-in-time conditions and when and if steady-state conditions are expected to develop.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NPS has not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan.

Model calibration and validation and modeling integration are already part of the FERC-approved Study Plan (RSP Section 5.6.4.8; RSP Section 8.5.4.8.1). AEA has been and will continue to conduct these tasks as part of the implementation of the FERC-approved Study Plan during the next year of study. AEA anticipates that to the extent model calibration, validation, and integration results identify data gaps, additional data collection would also occur during the next year of study. AEA will provide the results of model calibration, validation and integration in the USR, as well as the results of model runs for existing conditions and one operating scenario.

The Study 5.6 SIR Section 5.2 includes calibration results for temperature. Modeling is currently ongoing and will include additional parameters. Temperature calibration had to be completed before additional parameters were calibrated, because many of those parameters are dependent on temperature. The USR will contain a discussion on the modeling calibration and validation approach and results for additional parameters (e.g., sediment, dissolved oxygen, total organic carbon). The next phase of modeling, to be conducted during the next year of study, will include calibration for more complex parameters (e.g., nutrients, mercury).

Model integration has been occurring and is ongoing. As described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1), the Model Integration and supporting software will be completed after the initial results of the various modeling efforts are available. At the time of model integration, all models that communicate with each other will be configured for the same time horizons. The EFDC model runs on a 4-minute time step and is output on an hourly time step. Additional information regarding model integration is in Section 2.2.2.1.1.

While there is no additional cost to complete the tasks themselves since they are already part of the FERC-approved Study Plan, there would be additional costs to AEA in extending the schedule to complete the FERC-approved studies and extending the schedule could impact the data and analysis already gathered and completed for other FERC-approved studies.

2.2.2.1.3. Response to Modification Request Regarding Model Grid Resolution

NMFS (Modification 3-4, NMFS_pp5.6-6_ph6) requests that AEA explain how the differences in grid resolution between water quality and groundwater models will be resolved while maintaining data accuracy. Both NMFS and USFWS (NMFS_pp5.6-6_ph7 and USFWS_pp5.6-6_ph3) commented that it is unclear whether the EFDC modeling grid provided adequate accuracy to model lateral habitats and suggested AEA provide tables identifying model grid sizes. USFWS requests that AEA provide better integration between the groundwater and water quality models, making sure that accuracy and resolution is preserved when defining groundwater upwelling areas (USFWS_pp5.6-6_ph9). Specifically, USFWS states that the potential lateral transport of groundwater as affected by changes in river stage associated with various load following scenarios needs to be incorporated into modeling efforts for lateral side channels and sloughs. Both NMFS and USFWS (USFWS_pp5.6-6_ph4 and NMFS_pp5.6-6_ph8) suggested that scaling the grid resolution to the level of resolution needed to represent groundwater upwelling and ice dynamics is necessary to show how the selection of this particular grid resolution improves accuracy of capturing groundwater upwelling and the thermal stratification reflected in the thermal image assessment maps. SRC et al. stated (SRC_etal_WATER_pp48_ph2) that groundwater data from the Focus Areas are providing input data for EFDC, but it is it unclear how these data are informing the EFDC model input, and what assumptions are being made about groundwater/surface water interactions in areas where no groundwater data are available.

In response, AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan or under anomalous conditions. AEA disagrees with NMFS assertion that the study is not being implemented as provided for in the FERC-approved Study Plan. The modeling is following the FERC-approved Study Plan without any variances. The purpose of the ISR process is to evaluate AEA's progress in carrying out the Study Plan approved by FERC. At the time of the report, modeling was still ongoing so full documentation could not be provided.

Grid resolutions, including those for the water quality model and the groundwater model, are a topic of consideration identified by modelers while setting up the model integration. The EFDC model has 2-D elements in each of the Focus Areas representing the important lateral habitats of interest. Each of the models need to be completed and calibrated before integration can occur. AEA is in the process of refining the 3-D MODFLOW model and calibration targets in the refined model to include both shallow groundwater elevations and groundwater fluxes to side sloughs. Details of the refined model and requested information and justification will be provided in the USR (See Section 2.4.1 below and Table 2.4-1, Comment IDs USFWS_pp7.5-20_ph02 and NMFS_pp7.5-20_ph04). The water quality model output, including results in the lateral habitats, will be provided to the groundwater model (Study 7.5) in a format in which it can be interpolated to accommodate the finer-scale groundwater model grid. Simulated water quality parameters do not vary significantly across a finer grid resolution and can be easily interpolated to the finer groundwater grid resolution. Groundwater upwelling will be able to be similarly handled by aggregating the finer scale output. The statistics for the EFDC grid are provided below.

EFDC grid size information was provided in the SIR (Study 5.6 SIR, Section 4.1.4). The reservoir has 20 layers and 1,420 horizontal cells ranging from 109–900 meters longitudinally and 61–533 meters laterally. The riverine model has 1 layer and 1,236 horizontal cells ranging from 325–672 meters longitudinally and 26–173 meters laterally. Focus Area FA-128 (Sough 8A) has 1 layer and 8,372 horizontal cells ranging from 31–70 meters longitudinally and 15–27 meters laterally. Complete information on the grid will be provided in the USR.

Conceptual Model/Model Approach

2.2.2.1.4. Response to Modification Request to Develop Conceptual Water Quality Model

SRC et al. request FERC to require AEA to develop a transparent, detailed conceptual water quality model, clearly describe linkages/coupling between the water quality model, groundwater model and ice processes model and address uncertainties in boundary conditions, data, model parameters and conceptualizations (SRC_etal_WATER_pp6_ph3, SRC_etal_WATER_pp4_ph4). SRC et al., as well as USFWS (USFWS_pp5.6-6_ph7), state that AEA provided insufficient explanation of the conceptual model or the modeling approach and methods.

In response, AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. has not established “good cause” for the modification or demonstrated the study was not implemented as provided by the approved Study Plan. The proposed modification is not necessary to meet Study 5.6 objectives. The reservoir and riverine modeling approaches were developed in consultation with the licensing participants during 2012 and the first half of 2013. The modeling approaches are further described in ISR Part A, Section 4.2. AEA continued with the modeling approaches as described in the ISR. Focus area (FA) modeling was described in ISR Part A, Sections 4.3 and 5.4. Modeling integration is already part of the FERC-approved Study Plan (RSP Section 8.5.4.1.). The purpose of the ISR process is to determine AEA’s progress in carrying out the Study Plan as approved by FERC. At the time of the ISR, modeling was still under development so full documentation could not be provided. The modeling approach follows the RSP without any variances.

Test data sets for water temperature generated in 2012 have been used in both the reservoir and riverine models, which are capable of decade time scale simulations. POC modeling was presented in April 2014 (Study 5.6 SIR, Section 5.0; Study 5.6 SIR, Appendix A), but temperature calibration had not been fully completed by that time. After the POC meeting, the river model was calibrated using temperature data from 2012 and 2013. The 2014 data will be used for future model validation. (Study 5.6 SIR, Section 6) The reservoir and riverine modeling approaches are described in the Study 5.6 ISR Part A, Section 4.2. AEA continued with the modeling approaches as described in the ISR.

The April 2014 POC model runs simulated reservoir discharge and temperature to show how model results would be transferred to other study components. The results from the POC were discussed at the April 2014 Technical Work Group meetings (Study 5.6 SIR, Section 5.1; Study 8.5 ISR Part C, Appendix N, Section 1.1). The model runs simulated the 1974–1976 period (a dry period with a large pool drawdown) and the 1979–1981 period (a wet period with a small pool drawdown). The POC indicated that the river model was stable and had an acceptable run-time performance for decadal time scale simulations (Study 5.6 SIR, Section 5.2; Study 8.5 ISR Part C, Appendix N, Section 1.2). Section 1.3 of Study 8.5 ISR Part C Appendix N contains a discussion of the POC FA-128 (Slough 8A) results. Plots from the POC model runs are provided in Appendix A of the SIR (Study 5.6 SIR, Appendix A). The POC model runs indicated that the models are robust and provide physically realistic simulation of water surface elevation, velocity, and temperature (Study 5.6 SIR, Section 6). The USR will describe modeling framework, parameterization, and model performance (calibration, sensitivity analyses and operational scenarios). Additional information regarding model integration and linkages between the models is in Section 2.2.2.1.1, above.

Model Setup

2.2.2.1.5. Response to Comment Regarding Model Parameters

NMFS (NMFS_pp5.6-3_ph3) comments that AEA has not released a table of EFDC model parameters used in the model and that state model variables and outputs have been only partially summarized in the ISR, Parts A and B, although they were presented in previous technical meetings.

AEA is currently implementing the FERC-approved Study Plan. At this ISR stage of the ILP, the study has not been completed. Modeling is currently ongoing and the final model will include additional parameters (e.g., nutrients, chlorophyll *a*, DO, suspended sediment, turbidity, metals) as indicated in the FERC-approved study. The USR will describe modeling framework, parameterization, and model performance (calibration, validation, sensitivity analyses and operational scenarios).

The water quality models will use a reduced set of the full set of “state” variables, which are variables that are used to describe the mathematical “state” of a dynamic model. The current set under consideration includes (Study 5.6 ISR Part A, Section 5.1):

- Two phytoplankton species
- Periphyton

- Dissolved oxygen
- Dissolved and particulate organic carbon
- Dissolved and particulate organic nitrogen
- Nitrite plus Nitrate
- Ammonia Nitrogen
- Dissolved and particulate organic phosphorous
- Dissolved and particulate inorganic phosphorous

These categories of parameters represent 14 “state” variables. The standard set of sediment organic and nutrient variables in the diagenesis module will be used. Reaction rates and particulate settling velocity will be based on analysis of observational data and literature values for high latitude reservoirs and rivers. As indicated in the Study 5.6 ISR Part B, the primary reaction rates and parameters which can be adjusted during calibration include:

- Optimum growth temperatures and reference growth rates of phytoplankton species and periphyton
- Half saturation levels for light and nutrient limitations on phytoplankton and periphyton growth
- Mortality and predation rates for phytoplankton and periphyton and settling rates for phytoplankton
- Reareation rate for dissolved oxygen
- Optimum decay temperature and reference decay rates for dissolved and particulate organic carbon
- Optimum decay temperature and reference decay rates for dissolved and particulate organic nitrogen
- Nitrification rate relating Nitrate and ammonia nitrogen
- Optimum decay temperature and reference decay rates for dissolved and particulate organic phosphorous
- Partition coefficient relating dissolved and particulate inorganic phosphorous
- Settling velocities for phytoplankton species and dissolved organic matter.

2.2.2.1.6. Response to Comment Requesting Additional Information on Model Set Up

TNC (TNC_pp415_ph2) comments that the report does not provide any information on how boundary conditions were developed for the initial model runs, and how they will be developed for model calibration and validation. TNC states that there are no hydrographs for mainstem or tributary inflows; there are no loading curves for solids, nutrients, and contaminants; there are no references for meteorological inputs; and that references described in Section 7.1 of the report on how the reservoir will be operated should also be provided in Section 4.2.

The ISR is a progress report in implementing the FERC-approved Study Plan. It includes a description of data collected, explanations of any variance from the Study Plan and schedule, and any AEA-proposed modifications to the Study Plan. The study has not been completed at this stage of the ILP. The requested information will be provided as appropriate, when the study is completed in the USR.

The riverine model is calibrated for the reach downstream of the proposed dam with available data from 2012 and 2013. The data was used to configure the flow and temperature boundary conditions for the reservoir as stated in Section 5.1 of the Study 5.6 SIR. The corresponding temperature was set using available data from adjacent tributaries for lateral boundary conditions when temperature data was not available. These are used in the initial model runs along with model calibration and for future model runs.

Hydrographs and parameter loading curves will be presented in the USR, as applicable. Information on reservoir operation is premature at this stage of the study and the licensing effort. Baseline data is currently being gathered and undergoing analysis. Information on the modeling approach and the results of one operational scenario will be included in the USR, when applicable.

Meteorological data were identified from various agency sources for six stations. Three of the meteorological stations were installed specifically during September 2012 to be used for modeling the proposed Susitna Reservoir (Susitna River at Indian River, Susitna River at Watana Dam, Susitna River above Oshetna). Fifteen-minute data were available from these three stations for approximately a year up to October 2013. In addition, data were also acquired from three additional existing meteorological stations – two hourly stations from NOAA's National Climate Data Center (NCDC) (Willow Airport WBAN 26560; Talkeetna Airport: FAA/NOAA Station WBAN 26528) and one from Alaska's Road Weather Information System (RWIS) (Talkeetna RWIS: Parks Highway @ Talkeetna Rd. MP 98.7), which provided sub-hourly data for the various required parameters. This information will be included in the USR.

Model Data

2.2.2.1.7. Response to Modification Request to Describe Effects of Missing Data

NMFS (Modification 1-2; NMFS_pp5.6-3_ph7) and USFWS (Modification 5; USFWS_pp5.6-1_ph6**)** request AEA describe the effects of missing or inadequate water quality data on model performance. TNC further requested that the report provide discussions on the available calibration datasets and identify data gaps (TNC_pp415_ph4). SRC et al. stated that lack of temperature data throughout the reach in 2013 will increase uncertainty and could hamper model calibration (SRC_etal_WATER_pp48_ph4). In contrast, ADF&G stated staff believed that, based upon the work completed, the data is sufficient to complete the modeling and meet the objectives for the Water Quality Monitoring Study and therefore no additional field work is needed to meet FERC-approved study objectives (ADNR_ADFG_pp8_ph4).

AEA requests that FERC not adopt the Services' proposed study plan modification to describe the effects of missing or inadequate data on model performance because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, this task is already part of the FERC-approved Study Plan and AEA will describe the effects of "missing" or inadequate data, model performance and uncertainty in the USR. As described in RSP Section 5.6.4.8, "An uncertainty analysis approach will also be developed to account for the lack of data for calibration, therefore enhancing the reliability of reservoir model predictions."

The uncertainty associated with missing data will be described in the USR, as indicated above in Section 2.2.2.1.1. AEA disagrees with SRC et al. that the lack of water temperature data in the reach between the proposed dam site and Devils Canyon will increase uncertainty and hamper model calibration such that AEA will not meet the study objectives. Water quality data collection from 2012–2013 and 2014 contributed to a single and complete description of conditions in the study area for the purpose of model development and calibration. Data collection began in late summer 2012. Some of the water quality data from the 2013 sampling effort was rejected for select parameters; these rejected samples were replaced with water quality samples collected in 2014 at some locations and sampled for the same select parameters (see Study 5.5 SCR). The 2014 samples met quality assurance acceptance limits. Missing or poor quality data generated from monitoring programs is expected to occur and is why a quality assurance (QA) measure for "completeness" of a data set is described in the Water Quality and Mercury Assessment Quality Assurance Project Plan (QAPP) (Study 5.5 ISR, Part B - Attachment 1).

As described in Section 6.6 of the Study 5.5 SCR, based on similarity of temperature data collected at each of the sites from 2012 through 2014 and in comparison to historic temperature data, the current data set is considered adequate to finalize calibration of the temperature water quality model. Acceptable data available from 2012– 2014 water quality results met all QA acceptance criteria and will be used for model development. The first two years of temperature data (2012 and 2013) were used to calibrate the water quality model and the 2014 temperature data is being used as an independent data set for verification of model accuracy. Further information on available data is presented in the SCR for Study 5.5, which concluded, "the entire data set is more than sufficient to generate and support the water quality model (Study 5.6)" (Study 5.5 SCR, Section 5.5). Information on which monitoring locations had temperature data collected in 2012, 2013, and 2014 is provided in Table 4.1-1 in the Study 5.5 Supplement to the SCR (Attachment 2).

The focus of a water quality model is always put on constructing the model that reflects the general underlying dynamics/physics such that the model can simulate results at locations and time beyond the available data. For Susitna, the EFDC results show that the model performs sufficiently well in generally reproducing observed spatial and temporal variabilities in the river, suggesting that the data are adequate in evaluating whether the model correctly represents the underlying dynamics/physics (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). Even though data is only available at limited locations, the model is capable of generally reproducing observed conditions at these locations, and it shows that the model is correctly representing the underlying dynamics/physics. That being said, the data from 2012 to 2014, as well as historic data, will be used for continued model development.

2.2.2.1.8. Response to Comment Requesting Cross Section and Elevation Data

TNC comments (TNC_pp414_ph6) that the report does not provide a discussion of the data used for developing the reservoir and river model cross-sections. TNC states that it appears that the reservoir model sections were developed using LiDAR-based DEM, but there are no details on the resolution. TNC states that a comparison of the elevation-to-volume relationship should be provided between the DEM-based inundation footprint and how those volumes are represented in the model.

Additionally, TNC comments (TNC_pp414_ph7) that for developing the river model, there is a statement that 88 cross-sections were surveyed in 2012 and additional cross-sections were surveyed in 2013, but there is no discussion or a reference to these surveys. TNC states that it will be useful to present an elevation profile of the thalweg from upstream to downstream and how the model is segmented longitudinally; it will also be helpful to show representative cross-sections both for the reservoir and river models, so that a determination can be made as to whether the lateral and vertical features are appropriately represented in the model. Specifically, TNC states that a determination should be made as to whether the use of three lateral rectangular cells adequately represents the riverine sections.

In response, AEA agrees that the requested information is important and it will be provided and described in the USR, as part of implementing the FERC-approved Study Plan. Some additional information is provided herein.

Within the Lower and Middle Susitna River Segments, channel geometry was surveyed at selected cross sections during (1) the 2012 summer field season, (2) late September/October 2012 post-flood event, and/or (3) the 2013 field season. The surveyed extent at each section was generally between the banks of the main channel(s). The overbank geometry was derived from the Matanuska-Susitna (MatSu) LiDAR mapping collected in 2011 and indexed to the NAVD88 (feet) in 2013. LiDAR data was collected at a 1-meter resolution. The 1-meter DEM was merged and clipped to the proposed shoreline for processing. The LiDAR data covered the entire proposed shoreline except for a small portion of the shallow outer portion of the southern arm where Kosina Creek feeds into the proposed reservoir and a small area near the outer extents of the shallow northern arm where Jay Creek feeds into the proposed reservoir. Since the LiDAR mapping does not include below-water geometry, the field-surveyed geometry was merged into the LiDAR geometry for the riverine portions of the model. (No cross sections have yet been surveyed within the proposed reservoir zone.) Each surveyed point was projected onto the transect line and a horizontal station value was determined. Reservoir volume and surface area statistics are provided below.

Volumes estimated below Normal Pool 2,050 ft

- DEM (1 m) using ArcGIS 3D analyst (5.17 million ac-ft)
- EFDC model Bathymetry
  - Interpolated depths (5.26 million ac-ft)
  - Adjusted depths (5.25 million ac-ft)
- December 2012 RSP Section 1.3 (5.2 million ac-ft)
- Engineering Feasibility Report (MWH 2014) Table 1.8-1 (5.17 million ac-ft)

Surface Area estimated below Normal Pool 2,050 ft

- DEM (1 m) using ArcGIS 3D analyst (2D area = 23,133 acre)
- EFDC model Bathymetry (23,926 ac)
- December 2012 RSP Section 1.3 (23,546 ac)
- Engineering Feasibility Report (MWH 2014) Table 1.8-1 (23,500 acres)

The EFDC hydrodynamic model currently contains bathymetry from 88 cross sections surveyed in 2012 as described in Section 4.1.2.9.1 of Study 6.6 ISR Part A and Section 5.3 of Study 5.6 ISR Part A, with 75 of the cross sections in the Middle River and the remaining 13 in the Lower River. There are 29 cross sections in the Middle River and 51 cross sections in the Lower River from the 2013 surveys that have also been used in the model development. In the next year of study, the model will be updated and additional cross sections surveyed in 2014 will be added to the model. There are 47 cross sections in the Middle River and 2 cross sections in the Lower River from the 2014 surveys.

Additional cross section will be surveyed in the Susitna River channel in the upper reaches of the reservoir as discussed in Section 7.2.3 of the Study 6.5 SIR. These cross sections will be used in Study 6.5 to develop a 1-D bed evolution model for the portion of the Susitna River in the reservoir fluctuation zone and the portion of the Susitna above the reservoir that may be affected by reservoir depositions to determine the depositional characteristics of the sand and larger sediment fraction of the sediment inflow to the reservoir. These Study 6.5 cross sections will be used to supplement the 2014 LiDAR in developing the updated reservoir model geometry. These cross sections will provide details for the portion of the upper reservoir river channel inundated during the LiDAR acquisition mission. The remainder of the reservoir geometry will be updated using the 2014 LiDAR.

The model currently uses the 2011 indexed Mat-Su Borough LiDAR for terrestrial elevations. LiDAR from 2013 will be used to update the model from PRM 65 to PRM 106.7, and LiDAR from 2014 will be used to update the model from PRM 106.7 up to the dam site at PRM 187.

Once the EFDC model geometry is updated, a profile showing the thalweg elevation and locations of cross section surveys will be developed and distributed. A plan view that shows the lateral extents of the cross sections used and the various LiDAR sources will also be developed and provided.

Please refer to the responses to Section 2.2.2.1.3 for more information on the grid. This information will also be included in the USR.

Model Uncertainty

2.2.2.1.9. Response to Comments Regarding Model Uncertainty

SRC et al. stated that the Water Quality Modeling Study should address sources of uncertainty (SRC_etal_WATER_pp4_ph4). SRC et al. request a description on how the boundary conditions uncertainties will be addressed (SRC_etal_WATER_pp47_ph6). TNC requested that a methodology for uncertainty analyses be outlined. TNC stated that there is not a discussion on what model outputs are important to inform the impacts of the Project. TNC indicated that these should be developed and discussed, and uncertainty in model predictions should be presented from the context of these metrics (TNC_pp415_ph4, TNC_pp415_ph5B).

In response, AEA agrees that an uncertainty analysis should be conducted. These tasks will be completed as part of implementing the FERC-approved Study Plan; as described in RSP Section 5.6.4.8, "An uncertainty analysis approach will also be developed to account for the lack of data for calibration, therefore enhancing the reliability of reservoir model predictions." The modeling is following the FERC-approved Study Plan without any variances to the methods. At the time of the ISR, modeling was still ongoing so full documentation could not be provided.

Given the scale and complexity of the Susitna model a limited uncertainty analysis based on sensitivity analysis will be performed and will be documented in the USR.

2.2.2.2. Objective 2: Reservoir Water Quality Modeling

Objective 2. Using the data developed in Sections 5.5 (Baseline Water Quality Study) model water quality conditions in the proposed Susitna-Watana Reservoir, including (but not necessarily limited to), temperature, DO, suspended sediment and turbidity, chlorophyll-a, nutrients, ice, and metals (RSP Section 5.6.1).

2.2.2.2.1. Response to Modification Request for Evidence Supporting the Adequacy of a 20-layer Model

NMFS (Modification 2-1; NMFS_pp5.6-1_ph11) and USFWS (Modification 7; USFWS_pp5.6-1_ph8) request that AEA provide evidence that the use of the 20-layer model (not a 40-layer model) with the bottom layer thickness of 25 meters retains accuracy in predicting thermal stratification in the future reservoir. Both NMFS (NMFS_pp5.6-4_ph2) and USFWS (USFWS_pp5.6-4_ph4) assert that the proposed thickness of the bottom layer (in the 20-layer vertical grid) is too high (82 feet/25 meters) to accurately capture the reservoir stratification and recommend that AEA present results supporting "adequate simulations under ice free conditions" using both the 20-layer and 40-layer configurations.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan.

AEA disagrees with the Services' comments regarding the thickness of the bottom layer. The reservoir as represented in EFDC is hypothetical. EFDC results (using 20 layers) demonstrate the validity in representing the entire dynamics of stratification and overturn with seasons, providing a basis for understanding the response of water temperature and water quality to the proposed dam (Study 5.6 ISR Part A, Section 5.2). The reservoir hydrodynamic model has been tested using the 1984 historical inflow and a corresponding load following outflow. The model successfully simulated the one-year period, which has an approximately 45-meter variation in pool level. Preliminary temperature simulation for ice-free conditions indicated that the 20-layer configuration adequately represents vertical stratification (Study 5.6 ISR Part A, Section 5.2). The 20 layers is adequate and the Proof of Concept (POC) results demonstrate the model's ability to represent the dynamics of reservoir layers (POC *Reservoir Water Quality Modeling* April 15-17, 2014 presentation). The Services do not provide any supporting evidence to the contrary.

A 40-layer configuration is impractical. EFDC becomes extremely unstable with increased layers (resolution) and can quickly crash at a higher resolution, such as 40-layers. This hinders a quantitative evaluation of the model behavior using a 40-layer resolution. The current 20-layer configuration is fully capable of simulating the operation of shutters from multiple elevations to determine optimal draw down levels to minimize impacts on downstream temperatures. Therefore, the 40-layer configuration is not necessary to meet the study objectives or assess Project impacts and may not be practical. The estimated cost of this modification is on the order of $800,000 for the development of the model and 4 operating scenarios due to the complexity associated (i.e., model instability, model run time) with expanding the current 20-layer model to a 40-layer model and the added cost will not improve AEA's ability to assess Project impacts.

2.2.2.3. Objective 3: Riverine Water Quality Modeling

Objective 3. Model water quality conditions in the Susitna River from the proposed site of the Susitna-Watana Dam downstream, including (but not necessarily limited to) temperature, suspended sediment and turbidity, and ice processes (in coordination with the Ice Processes Study) (RSP Section 5.6.1).

General

2.2.2.3.1. Response to Modification Request to Complete the Water Quality Modeling Study

USFWS Modification 1 (USFWS_pp5.6-1_ph2) requests AEA to complete the Water Quality Modeling Study and states that the items completed since the June 2014 ISR report were actually completed ahead of the April 2014 POC meeting.

AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Requesting the FERC-approved Study be completed is not a modification of the Study Plan and characterizing it as a modification is inconsistent with the FERC regulations.

AEA disagrees with the USFWS assertion that the items AEA noted as being completed since the June 2014 ISR were completed prior to the April 2014 POC. At the time of the April 2014 POC meeting, model calibration had not been completed. Only preliminary temperature results were presented at the POC meeting. Since the POC meeting and the June 2014 ISR, temperature calibration has been completed (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). The FERC-approved Study Plan will be completed and results will be provided in the USR.

Riverine Model Calibration/Validation

2.2.2.3.2. Response to Modification Requests to Perform and Report Water Quality Calibration and Validation

NMFS (Modification 3-1; NMFS_pp5.6-5_ph1) and USFWS (Modification 4; USFWS_pp5.6-1_ph5) recommend AEA calibrate and validate the riverine model for the focus areas, and provide summary statistics that quantify model fit. Similarly, in other modifications associated with Objective 3, NMFS (Modification 3-2; NMFS_pp5.6-5_ph5) and USFWS (Modification 6; USFWS_pp5.6-1_ph7) request AEA provide calibration results of the water quality model incorporating hydrodynamics, water quality results, model parameterization, and goodness of fit statistics for selected locations, dates, and times. TNC state that because model results were not provided, AEA's conclusion that the model calibration will meet study objectives is unverifiable (TNC_pp008_ph5). NMFS, USFWS, and SRC et al. noted on multiple occasions (e.g., NMFS_pp5.6-4_ph3, USFWS_pp5.6-4_ph6, SRC_etal_WATER_pp5_ph3) that the modeling calibration, validation, and results have not been provided. Additional commenters asked about the status of calibration for other parameters, such as dissolved oxygen (SRC_etal_WATER_pp48_ph6) or locations, such as Focus Areas (SRC_etal_WATER_pp49_ph2). SRC et al. further stated that it is not common practice to use 'visual comparison' to evaluate model performance, nor is it clear how this visual comparison will be done, and whether model uncertainty will be addressed in a "quantitative fashion" (SRC_etal_WATER_pp47_ph6).

AEA requests that FERC not adopt these proposed study plan modifications. These requests do not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as model calibration and validation is already part of the FERC-approved Study Plan (RSP Section 5.6.4.8). The Services have not demonstrated the study was not implemented as provided by the approved Study Plan nor have they established "good cause" for the modification. AEA is currently at the ISR stage of the ILP and the study has not yet been completed as indicated in the ISR, the SIR and the ISR meetings. Modeling is currently ongoing and will include additional parameters (e.g., nutrients, chlorophyll *a*, DO, suspended sediment, turbidity, metals). The USR will contain a discussion on the model parametrization along with modeling calibration and validation approach and results, as described below. These are standard practice in reporting modeling and modeling results. As already described herein, the USR will also address missing data (Section 2.2.2.1.7) and include model uncertainty analyses (Section 2.2.2.1.9).

Model calibration results for many parameters have not been provided, because, as clearly reported by AEA, modeling is still ongoing. The model has been calibrated for temperature, which is considered a hydrodynamic parameter as presented in Section 5.2 of the SIR. The riverine model calibration uses 2012–2013 temperature data (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). Flow data records for the period 1950–2010 were used to calibrate the hydrodynamic module in EFDC and continuous temperature data calibrated with records from 2012–2013 (see description in Section 5.2 of the *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum* filed with FERC September 2014) (Tetra Tech 2014a). The model results predicted temperature conditions acknowledging year-to-year variability as reflected in the period of record used to initially calibrate the module (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). As described in the SIR, the 2014 data will be used for model validation.

The spatial representation of model performance is shown by comparing the model results at multiple locations stretching along the length of the river, which show spatial variability of the model (Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2). There is no other way of further evaluating the spatial representativeness of the model other than comparing with data at different locations.

As per the FERC-approved Study Plan (RSP Section 5.6.4.8.1), model calibration/validation for the Focus Areas will be completed in the next phase of modeling. The calibration/validation results for the Focus Areas will be included in the USR. Water quality data (e.g., nutrients, temperature, DO, chlorophyll *a*) from 2013 and 2014 are available for FA-104 (Whiskers Slough), FA-113 (Oxbow I), FA-115 (Slough 6A), FA-128 (Slough 8A), FA-138 (Gold Creek), FA-141 (Indian River), and FA-144 (Slough 21). The calibration of the riverine model in Focus Areas has the benefit of a more complex sampling strategy that is based on multiple transects that reflect unique riverine habitats in each. These habitats, and locations for transects, were selected based on requirements for constructing higher resolution models that represent important salmon habitat. Validation uses grab sample data collected for aquatic resource studies, which are independent of the calibration data generated in Study 5.5 (Baseline Water Quality Monitoring).

AEA disagrees with the SRC et al. comment regarding visual model calibration comparisons not being common practice. NMFS and USFWS also requested a study modification for goodness of fit statistics. As previously stated, model calibration is currently ongoing and statistics were not included in the ISR or SIR, but will be included in the USR, as is typical in reporting modeling results. When reviewing EFDC calibration modeling results, visual comparison (e.g., time series plots) is a standard practice for evaluating water quality model performance because it can capture temporal and spatial trends. This was done for the Indian Creek TMDL (Tetra Tech, 2008) and the San Diego Bay Shorelines toxics TMSL (SDRWQB, 2013) and described in the CE-QUAL-W2 User Manual (Cole, T.M. and S.A. Wells, 2016).

Statistics can provide a secondary measurement to evaluate the model performance and information on the magnitudes of model errors and are used as guidelines to supplement the visual evaluation of model-data plots for model calibration (Dynamic Solutions 2013). However, statistical analyses are only meaningful when there is enough data to make meaningful conclusions and need to be carefully interpreted when there is limited data. It should be noted that statistics (including mean error, relative mean error and root square mean) will be included in the USR, as appropriate. Statistics can be misleading when there is a slight time shift between the model results and data. During a time shift, the model is unable to match the exact timing of observed data (even by as little as an hour), so calculating error statistics would not be useful and would not tell the full story that the model is predicting parameter fluctuations and ranges, because the timing is slightly off. The model's capability to mimic the general trend/pattern is more informative than error statistics. In addition, statistics are of limited use in discerning spatial and temporal trends along with responses to the external driving forces. These elements are important in water quality modeling and are evaluated through visual inspection of time series plots.

Mercury Modeling

2.2.2.3.3. Response to Modification Request to Incorporate Mercury into the EFDC Model

NMFS (Modification 3-3; NMFS_pp5.6-2_ph5) recommends incorporating mercury into the EFDC water quality model. Both NMFS and USFWS (USFWS_pp5.6-6_ph2) indicate the need for further details regarding the incorporation of the mercury model into the EFDC.

AEA requests that FERC not adopt this proposed study plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan (RSP Section 5.6.4.8 and April 1, 2013 FERC SPD Appendix B). The FERC-approved Study Plan (April 1, 2013 FERC SPD Appendix B) requires this information to be developed following the hydrodynamic calibration (which includes temperature). Mercury modeling will occur after calibration of the nutrient cycling model (Study 5.6 ISR Part D, Section 8). The incorporation of the mercury into EFDC model will be implemented as described in the RSP (Section 5.6) and reported in the USR. Before mercury can be included, the hydrology and water quality calibration need to be complete. Mercury will be modeled in both the EFDC riverine and reservoir water quality models. In the case of the riverine EFDC model, mercury will be modeled from the reservoir outlet downstream to PRM 29.9 (Susitna Station).

Modeling of mercury concentrations in dissolved and in methylated form will be done by updating the 3-D reservoir water quality model to simulate three sorptive toxic variables representing mercury (Hg) states. As stated in Section 4.2 of the Study 5.6 ISR Part A, algorithms have been successfully used with the 3-D reservoir water quality model in other watersheds and will be modified to account for potential sources of mercury as the reservoir is filled (e.g., soils, vegetation, air deposition). A suggested approach for estimating toxicity mixtures would be to develop a weight of evidence (WOE) algorithm that produces a weighting factor for re-calculating the potential chronic and acute toxic effects of a mixture (Mumtaz et al. 1998). While the EFDC riverine mercury model can be calibrated, the mercury reservoir model cannot be calibrated; however, a sensitivity simulation will be conducted to span the range of realistic parameters. The primary reaction parameters—based on literature values—in the mercury-cycling model include (Study 5.6 ISR Part B):

- Methylation and demethylation rates
- Oxidation and reduction rates
- Volatilization rate and equilibrium concentration
- Photoreduction rate
- Partition coefficient

Riverine Model Expansion

2.2.2.3.4. Response to Modification Request to Extend the Water Quality Model Below PRM 29.9

NMFS (Modification 3-5; NMFS_pp5.6-7_ph1) and USFWS (Modification 3; USFWS_pp5.6-1_ph4) request the geographic extent of the water quality modeling studies be expanded below PRM 29.9 and that prior to finalizing that decision, an assessment is needed to evaluate how EFDC will represent a multiple braided river. In contrast, ADF&G agrees with AEA's decision that extension of the water quality model downstream of PRM 29.9 is not warranted (ADNR_ADFG_pp8_ph3).

AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS and USFWS have not established "good cause" for the proposed modification. The Services have not demonstrated that AEA's decision to not extend the EFDC water quality model downstream of PRM 29.9 is not warranted. AEA has shown that continuing the model downstream would add little additional understanding of Project effects as Project-related changes in water quality at PRM 29.9 are minimal and would further attenuate downstream of PRM 29.9 (Tetra Tech 2014a). In addition, the cost of continuing the EFDC modeling an additional 10 miles downstream to PRM 19.9, as originally proposed in the Study Plan, is estimated to be on the order of $1,000,000 including data collection, calibration of EFDC, and running at least 4 scenarios with little gain in terms of quantifying Project effects.

AEA disagrees with NMFS that the study was not implemented as provided for in the approved Study Plan. The Study Plan originally had a downstream limit of PRM 19.9 (RM 15.1) (Study 5.6 RSP Section 5.6.3). This downstream extent was determined at the outset of the Study effort before any water quality modeling had been conducted. Subsequently, to be consistent with the Fluvial Geomorphology Modeling Study (Study 6.6) as both modeling efforts share much of the same data to construct the models, primarily the LiDAR, surveyed cross sections and hourly flows, a decision point parallel to the one in Study 6.6 was introduced in the Study 5.6 ISR Part C, Section 7.1.1.1 on whether to extend the downstream limit of the EFDC water quality modeling below PRM 29.9. The earlier decision to extend these modeling efforts to PRM 29.9 was documented in two technical memorandums (R2 Resource Consultants [R2] 2013a and 2013b) and summarized in Study 6.6 ISR Part A, Section 3.1.

The decision to not extend the water quality model lower than PRM 29.9 was made using the results of the EFDC model and were presented to the licensing participants in the Baseline Water Quality S*tudy (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum* filed with FERC September 2014 (Tetra Tech 2014a). The decision was discussed in the October 16, 2014 ISR meeting for Study 5.6 (Water Quality Modeling) and the March 23, 2016 ISR meeting for Study 5.6 (Water Quality Modeling). It was further reported in the Study 5.6 SIR (Section 3, Section 4.1.2, and Section 6). The parallel decision to not extend the 1-D Bed Evolution Model (BEM) downstream of PRM 29.9 was presented in the Study 6.6 SIR Sections 3 and 7.1 and thoroughly documented in *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9. Technical Memorandum* (Tetra Tech 2014c). The Study 6.6 decision was also presented at the October 16, 2014 and March 23, 2016 ISR meetings.

AEA also disagrees with the Services' suggestion that prior to finalizing this decision, an assessment of how the EFDC model will be used to represent a multiple braided river is required. Although a model grid has not been developed for a braided channel in the Lower River, EFDC has been used to represent FA-128 (Slough 8A), which is a braided stream network in the Middle River. The bathymetry data from this section identifies a main channel and numerous side channels and sloughs. The bathymetry data were applied in grid development and allow for the representation of channels as well as shallow or dry depositional areas and island features. These features can be similarly represented in any section of the Susitna River. The April 2014 POC meeting included a presentation on Proof of Concept EFDC model runs using a higher resolution grid for FA-128 (Slough 8A) that showed EFDC can be used in a braided channel environment (POC *Riverine Water Quality Modeling FA-128* April 15-17, 2014 presentation). In addition, EFDC has been successfully used for braided networks to model hydrodynamic and sediment transport in the Kalamazoo River (LimnoTech 2015), Sheep River water quality model (Tetra Tech 2014b), and to study PCB contamination in the Housatonic River (Weston Solutions 2006).

Water quality modeling was conducted from the proposed dam site at PRM 187.1 downstream to PRM 29.9 to determine the potential Project effect on the three parameters identified, temperature, dissolved oxygen (DO), and total suspended solids (TSS), for basing the decision on whether to extend the EFDC model downstream of PRM 29.9. These three parameters are appropriate metrics to apply in the decision on whether to extend the EFDC model downstream of PRM 29.9. DO was selected because it is an important water quality indicator and is directly related to fish health and aquatic life. Water temperature was selected because of the possibility it could be affected by the reservoir due to the longer residence time of water in the reservoir and its importance to aquatic life. Finally, TSS is the most important indicator of pollutant transport from the watershed land surface and to the river. As discussed below, the model has shown minimal changes in water temperature at PRM 29.9. Since DO saturation is dependent on temperature, DO saturation will also have minimal changes; therefore, DO will not change appreciably due to low level of nutrients and organic matter. TSS will be slightly reduced due to the trapping of silt and clay by the reservoir; however, the watershed contributions will remain the same. In the watershed and EFDC model, nutrients and metals behave similarly to TSS, therefore the decision made on modeling extent by reviewing the water temperature, DO, and TSS results can be applied to these other parameters and did not require all parameters to be modeled in EFDC.

Modeling indicated that water temperature at PRM 29.9 showed little or no change in temperature patterns over the year (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 6.2) (Tetra Tech 2014a). Modeling was conducted using operations scenario OS-1b that represented a most extreme load following condition (Study 8.5 ISR Part C, Section 7.4.1). OS-1b had lower flows and greater daily flow fluctuations during May and June compared to the intermediate load following scenario ILF-1.

Initial model results comparing Existing Conditions to operating scenario OS-1b indicated that dissolved oxygen concentrations tend to be near saturation in the Lower River and saturation conditions were expected to show no significant change between pre- and post-Project conditions at PRM 29.9. Modeling also indicated that water temperature at PRM 29.9 showed little or no change in temperature patterns over the year (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 6.2). Even under the most extreme operating scenario of OS-1b (Study 8.5 ISR Part C, Section 7.41), water temperature differences at PRM 29.9 were less than 1 °C and exhibited a random mode rather than consistently higher or lower differences between pre- and post-Project scenarios (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 5.2, Figures 6.2-1 through Figure 6.2-4). The maximum 1 °C temperature differences are based on instantaneous hourly values, with the 3-year average difference being less than 0.5 °C. The difference between pre-Project and post-Project temperatures on a specific day are typically similar to or less than the diurnal temperature variation of a given day.

Figures 6.2-3 and 6.2-4 in the Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum* (Tetra Tech 2014a) show correlation plots and regression results indicating on average, post-Project temperatures at PRM 29.9 exceed pre-Project temperatures by approximately one percent. It is important to recognize and acknowledge the significant influence of the Yentna River, which comprises about 40 percent of the average annual Susitna River discharge, on Susitna River temperature and other water quality variables below its confluence.

Since effects from Project operations on temperature were calculated to be minimal at PRM 29.9, temperature was expected to be unchanged further downstream by Project operations (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 6.2). DO concentrations in the mainstem of the Susitna River tend to be near saturation, particularly in the lower 90 miles of the river (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 5.2, Figure 6.2-5). DO saturation concentration is primarily a function of water temperature and saturation concentrations are not expected to change significantly in the Lower River post-Project. The observed saturation conditions are expected to show no significant change between pre- and post-Project conditions at PRM 29.9 (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 5.2).

In terms of the third parameter considered in the decision, TSS, preliminary simulations of the silt and clay fraction of sediment transport through the reservoir showed that the depth of the reservoir and the current proposed surface outflow makes the reservoir a highly efficient settling basin. It has been estimated that the dam site load of silt and clay contributes approximately 12 percent of the total silt and clay load estimated at Susitna Station. Thus a conservative estimate is that the silt and clay load would be reduced by 1 percent below Susitna Station (PRM 29.9) when assuming a 90 percent trap efficiency. The lower silt and clay based TSS and corresponding turbidity change upstream of this site (Study 5.6, September 2014, *Baseline Water Quality Study (Study 5.5) and Water Quality Modeling Study (Study 5.6), Water Quality and Lower River Modeling Technical Memorandum*, Section 5.2).

Section 1.5.3 (*Response to Requests to Extend Studies to Lower Susitna River*) provides additional discussion on the expansion of this study as well as others below PRM 29.9, and in relation to other water-dependent resources.

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2.2.3. Study 5.7 – Mercury Assessment and Potential for Bioaccumulation Study

Previous studies have documented increased mercury concentrations in fish and wildlife following the flooding of terrestrial areas to create hydroelectric reservoirs. As established in the Study Plan (RSP Section 5.7.1), the overall goal of the Mercury Assessment and Potential for Bioaccumulation Study is to assess the potential for such an occurrence in the proposed Project area.

The study objectives as established in the Study Plan (Section 5.7.1) are as follows:

- Summarize available and historic mercury information for the Susitna River basin, including data collection from the 1980s Alaska Power Authority (APA) Susitna Hydroelectric Project.
- Characterize the baseline mercury concentrations of the Susitna River and tributaries. This will include collection and analyses of vegetation, soil, water, sediment porewater, sediment, piscivorous birds and mammals, and fish tissue samples for mercury.
- Utilize available geologic information to determine if a mineralogical source of mercury exists within the inundation area.
- Map mercury concentrations of soils and vegetation within the proposed inundation area. This information will be used to develop maps of where mercury methylation may occur.
- Use the water quality model to predict where in the reservoir conditions (pH, dissolved oxygen [DO], turnover) are likely to be conducive to methylmercury (MeHg) formation.
- Use modeling to estimate MeHg concentrations in fish.
- Assess potential pathways for MeHg to migrate to the surrounding environment.
- Coordinate study results with other study areas, including fish, instream flow, and other piscivorous bird and mammal studies.

As part of FERC's Study Plan Determination (4/1/2013), the eight study objectives established in the RSP were approved with two additional recommended study objectives:

- In regards to AEA's use of the Harris and Hutchinson and Environmental Fluid Dynamics Code (EFDC) models for mercury estimation, FERC recommends that AEA use the more sophisticated Phosphorus Release Model to predict peak methylmercury levels in fish tissue, regardless of the outcome of the other two models.
- In regards to mercury effects on riverine receptors, FERC recommends that AEA include likely riverine receptors (i.e., biota living downstream of the reservoir that may be exposed to elevated methyl mercury concentrations produced in the reservoir and discharged to the river) as part of the predictive risk analysis.

Many components of the study have been completed (e.g., data collection, preliminary pathways analysis, Harris and Hutchinson Model); the remaining steps will occur after the EFDC modeling (Study 5.6) has been completed.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 23, 2016, AEA plans three modifications to the methods of this study:

1. No additional sampling will occur for the fish species that are either not present or present in only very low numbers (Humpback Whitefish, Rainbow Trout and Stickleback).
2. Consolidation of all the study objectives related to tissue sampling of piscivorous wildlife for mercury analysis from other studies (10.11, 10.14, 10.15 and 10.16) within this study (Study 5.7). The objectives consolidated into Study 5.7 from other studies are listed below.
   - Review available information on food habits and diets of piscivorous furbearers (river otter and mink) as background for Study 5.7, Mercury Assessment and Potential for Bioaccumulation (Study 10.11).
   - Collect hair samples from river otters and mink to characterize baseline tissue levels of mercury for Study 5.7, Mercury Assessment and Potential for Bioaccumulation. (Study 10.11).
   - Provide information on the distribution, abundance, food habits, and diet of piscivorous (fish eating) raptors; feather samples for characterization of mercury levels; and information on the effects of methylmercury on piscivorous raptors, for use in Study 5.7, Mercury Assessment and Potential for Bioaccumulation Study (Study 10.14).
   - Review available information to characterize food habits and diets of piscivorous waterbirds documented in the study area as background for Study 5.7, Mercury Assessment and Potential for Bioaccumulation Study (Study 10.15).
   - Review the literature on the foraging habits and diets of piscivorous and partly piscivorous landbird and shorebird species, which will be used to inform Study 5.7 Mercury Assessment and Potential for Bioaccumulation Study (Study 10.16).
3. Need for further mercury analysis of wildlife tissue will be re-evaluated based on the predictive modeling results (reservoir and riverine EFDC models) and potential for transfer from the aquatic environment to the terrestrial environment using pathway analysis models. If piscivorous bird sampling is determined to be necessary, blood and feather samples from nestlings of the 4 target species (Bald Eagle, Common Loon, and Red-breasted and Common mergansers) will occur based on each species' abundance within the study area and the likelihood of obtaining usable samples.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS, USFWS, and TNC filed comments for Study 5.7. NMFS and USFWS also submitted 7 and 5 study modification proposals for Study 5.7, respectively. Note that NMFS and USFWS had 3 requests that were essentially the same. NMFS submitted two additional comments for which they stated they did not have adequate time to develop into modification requests (NMFS_pp5.7-10_ph5 and NMFS_pp5.7-10_ph6). AEA's responses to the comments can be found in Table 2.2.3-1 and below.

Responses to requests for study modification and comments for Study 5.7 are organized by study objective then technical issue. When applicable, comments that provide background on a study modification are included with the modification.

As previously described, there is significant overlap between Study 5.5 Objective 4 and the Mercury Assessment and Potential for Bioaccumulation Study 5.7 Objective 2 (RSP Section 5.7.4.2) and to a lesser extent between Study 5.5 Objective 6 and Study 5.7 Objective 2. To reduce redundancy and increase readability, AEA's responses to comments pertaining to Study 5.5 Objective 4 and Study 5.5 Objective 6 have been consolidated herein under Study 5.7 Objective 2 (Section 2.2.3.2). Comments that were actually submitted under Study 5.5 are identified below in Table 2.2.3-1 with "(Study 5.5)" in the Reference Number column.

Table 2.2.3-1. Study 5.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
	Objective 2	
NMFS_pp5.7-6_ph2	*Modification 2-1: NMFS recommends that a replacement year of field sampling be completed due to invalidity of the 2013 data set.*	As explained below in Section 2.2.3.2.1.1, AEA requests FERC not adopt this proposed Study Plan modification. This modification is the same as USFWS Modification 3; the estimated cost of implementing this modification is $300,000 to $400,000.
USFWS_pp5.7-1_ph4	*Modification 3: We have indicated in previous memoranda that the 2013 mercury data were of inadequate quality and are inappropriate for use in characterizing preproject baseline. We have suggested that a full comprehensive summary of the analytical issues encountered and how these issues were addressed needs to be provided to stakeholders. Without agreement on the validity of the 2013 analytical data set, we recommend that a replacement year of field sampling be conducted.*	As explained below in Section 2.2.3.2.1.1, AEA requests FERC not adopt this proposed Study Plan modification. This modification is the same as NMFS Modification 2-1; the estimated cost of implementing this modification is $300,000 to $400,000. It is unclear what memoranda is referenced in this modification request. Description of the strategy for re-sampling or water quality in 2014 is discussed in Study 5.5 ISR, Part C, Section 7.1.2. Data generated for missing 2013 results are included in Study 5.5 SCR and a description of how a total phosphorus correction factor was developed for that single parameter is included in Study 5.5 SCR, Section 4.5. Another separate document is not necessary to meet study objectives.
USFWS_pp5.7-1_ph5	*Modification 4: AEA should describe how the 2013 data were reviewed for quality. We maintain that mercury sampling has not yet been completed in accordance with the study plan. See also our comments on Section 5.5.*	As explained below in Section 2.2.3.2.1.1, AEA requests FERC not adopt this proposed Study Plan modification. There is no estimated cost for implementing this modification as monitoring and QA of mercury results has already been completed in accordance with the FERC-approved Study Plan.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.7-2_ph7; NMFS_pp5.7-3_ph4	*We maintain that use of the correction factor is not appropriate in this case. Sampling for mercury should ultimately provide at least two years of representative data to document baseline. The use of a data correction factor is not appropriate given the additional issues associated with the 2013 data. There were numerous other problems in the QA/QC control (field or method blank data contamination, bottle, or suspect bottle contamination, and/or preservative contamination, failure to meet specified holding times), so the TP correction factor should not have been used.*	These statements are factually incorrect. See Section 2.2.3.2.1.1 for further detail.
USFWS_pp5.5-18_ph6 *(Study 5.5)*	*SCR, Page 14, Section 4.6.1 – Change in sample collection from Ekman Dredge and van Veen to hand auger and or stainless steel spoon. AEA should describe comparability of sample collection methods, particularly for capturing fine grained sediments.*	See Section 2.2.3.2.2.1.
NMFS_pp5.7-10_ph6	*Using a single soil digestion method be used for samples is the preferred scientific method. Since the data has been collected we suggest the applicant apply both methods to a five equally split samples and present how much they vary.*	See Section 2.2.3.2.2.2.
USFWS_pp5.5-14_ph3 *(Study 5.5)*	*QAPP, Section B.2.3, page 72* *The Final ISR should include the depth of probe insertion for porewater extraction. In addition, describe procedures and additional measurements to confirm that the probe did not short-circuit (i.e., confirm it sampled sediment porewater and did not pull in surface water). Additional description of how the sample containers were filled (i.e. no headspace) is required. Headspace in sediment porewater sampling containers can alter mercury/methylmercury speciation.*	See Section 2.2.3.2.2.3.
USFWS_pp5.5-14_ph5; NMFS_pp5.5-11_ph5 *(Study 5.5)*	*QAPP, Section B.2.3, page 73* *AEA should confirm that sediment sample containers were filled entirely (without headspace). The presence of headspace can result in changes to mercury speciation and alter methylmercury levels.*	See Section 2.2.3.2.2.3.
USFWS_pp5.5-14_ph4; NMFS_pp5.5-11_ph4 *(Study 5.5)*	*QAPP, Section B.2.3, page 72* *For the porewater method, it is possible to have a "short circuit" in which surface water (rather than sediment porewater) is extracted by the device. AEA should comment on and provide more detail on the procedures that are being followed to ensure no short circuiting is taking place during sampling, and how chemistry results are being evaluated to ensure that short circuiting did not occur.*	See Section 2.2.3.2.2.3.
NMFS_pp5.5-8_ph4A *(Study 5.5)*	*Study 5.5 Modification 4-1, part 1: NMFS recommends collecting sediment samples in slack water areas to determine baseline metals concentrations and to assist with the understanding of mercury methylation potential. A*	As explained below in Section 2.2.3.2.2.4, AEA requests FERC not adopt this proposed Study Plan modification. This request is the same as USFWS Study 5.5 Modification 4, Part 2. It is

Reference Number	Comment or Study Modification Request	AEA's Response
	target water condition and a single sampling method should be selected and then used consistently.	unclear what is being requested in this modification as all sediment samples were collected in slack water areas in 2013 and 2014. The estimated cost of resampling sediment for metals analysis is $150,000 to $250,000.
USFWS_pp5.5-1_ph5B *(Study 5.5)*	*Study 5.5 Modification 4, part 2: Sediment should be sampled in slack water areas to determine baseline metals concentrations and assist with the understanding of mercury methylation potential.*	As explained below in Section 2.2.3.2.2.4, AEA requests FERC not adopt this proposed Study Plan modification. This request is the same as NMFS Study 5.5 Modification 4-1, Part 1. It is unclear what is being requested in this modification as all sediment samples were collected in slack water areas in 2013 and 2014. The estimated cost of resampling sediment for metals analysis is $150,000 to $250,000.
USFWS_pp5.5-10_ph4 *(Study 5.5)*	*There is no analysis or explanation why sampling avoided slack and pool channel areas. The SCR confirms that all surface water sample collection avoided pools or slack water while sediment samples were taken from slack water areas. There is no comparative water quality analysis to address this discontinuity. Given that fine sediment with higher organic carbon content is often localized in these areas, this avoidance has large implications for baseline metal concentrations and especially for mercury methylation modeling, which depends in part on organic carbon and sulfate concentrations in sediment. If an appraisal of leaching of metals from sediments into water is carried out, then this will need to recognize that the impact would be directly to water in pools/slack water areas and not necessarily to the main river flow. No supporting discussion or revision to sediment sampling to address this issue has been provided. This is a problem and should be corrected in a subsequent year of sampling.*	See Section 2.2.3.2.2.4.
TNC_pp8_ph2 *(Study 5.5)*	*Sediments Samples for Mercury/Metals in Reservoir Area: Four of the eight sites proposed were not sampled due to access restrictions. These sites are proposed to be sampled in the second year. While sediment conditions are less likely to be affected by year-to-year variations, if project schedule and budget allows at least one of the locations sampled this year should be resampled next year along with the locations that were not sampled this year. This would provide a basis for comparing the datasets between the two years.*	The sites not accessible in 2013 were sampled in 2014 as reported in the SIR. See Section 2.2.3.2.2.5 for additional information.
USFWS_pp5.5-13_ph6 *(Study 5.5)*	*QAPP, Section B.1.2, page 54* *The paired soil and vegetation samples appear clustered in the middle section of the reservoir. AEA should provide information on how plants and soils in this area will be representative of the other (unsampled) areas.*	See Section 2.2.3.2.2.5.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp5.7-10_ph5	*At the dam structure location water quality samples should be taken from both banks and the center.*	The location of water quality sampling at the dam site adequately characterized conditions using the existing sampling protocol. The water quality conditions in 2013 at the single site sampled at PRM 187.2 were identical with those described from mainstem river sites further downstream (e.g., PRM 152.7 and PRM 142.3) where transects were sampled both vertically and horizontally. The Susitna River at PRM 187.2 was well-mixed and the samples collected on one bank were representative of water quality conditions. There is no information to support the need to sample multiple points across the transect. Data is accessible at the following web site: http://gis.suhydro.org/Post_ISR/05-Water_Quality/5.5-Baseline_Water_Quality/ISRMTG_5_5_WQ_2013%20Lab%20Data/
USFWS_pp5.5-13_ph7 *(Study 5.5)*	*QAPP, Section B.2.1, page 65* *AEA should specify which fish tissues were collected. A footnote on page 37 suggests fillet samples will be analyzed from all fish. Although samples of fillet are appropriate to evaluate human health risks, concentrations of mercury in whole body samples are generally used for evaluated ecological risks to piscivorous wildlife. Wildlife generally consumes the entire fish, and concentrations of mercury in fillet do not equal concentrations of mercury in whole body, since mercury can preferentially accumulate in organ tissue.*	See Section 2.2.3.2.3.1.
USFWS_pp5.5-15_ph1 *(Study 5.5)*	*QAPP, Appendix D-4, page 1* *AEA should identify the method(s) of fish collection. We could not find anything in the documents on how AEA is capturing fish from the river. All we could find was "Clean nylon nets and polyethylene gloves will be used during fish tissue collection" (D-4, page 1)*	See Section 2.2.3.2.3.1.
NMFS_pp5.5-11_ph7 *(Study 5.5)*	*NMFS recommends that AEA identify the specific method(s) of fish collection. Details were not provided in the documents on how AEA is capturing fish from the river. The only specification provided was that "Clean nylon nets and polyethylene gloves will be used during fish tissue collection" (D-4, page 1).*	See Section 2.2.3.2.3.1.
NMFS_pp5.5-8_ph4B *(Study 5.5)*	*Study 5.5 Modification 4-1, part 2: NMFS recommends that AEA should specify which fish tissues were collected for metal analysis and in the future grind up and analyze the whole fish.*	As explained below in Section 2.2.3.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification. AEA implemented the sampling as provided for in the FERC-approved Study Plan. There is no estimated cost associated with this modification as NMFS did not request recollection of samples.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp5.7-6_ph5	*Modification 2-2: NMFS recommends that entire fish should be analyzed for mercury rather than specific muscle tissues. Teflon sheets rather than polyurethane are important.*	As explained below in Section 2.2.3.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification. AEA implemented the sampling as provided for in the FERC-approved Study Plan. There is no estimated cost associated with this modification as NMFS did not request recollection of samples.
NMFS_pp5.7-6_ph8	*Modification 2-3: NMFS recommends that additional fish be collected and sampled to document baseline mercury concentrations and arrive at the RSP sample size of 10 fish per species.*	As explained below in Section 2.2.3.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. AEA implemented the sampling as provided for in the FERC-approved Study Plan. The estimated cost of implementing this modification is $100,000.
NMFS_pp5.7-3_ph3	*AEA has requested that the limited sampling of fish performed to date be considered adequate. NMFS does not agree with this (See modification 2-4).*	AEA implemented the sampling as provided for in the FERC-approved Study Plan. Sample goals were not met for two species that are not present in the Upper River and one rare species. See Section 2.2.3.2.3.2.
USFWS_pp5.5-14_ph6; NMFS_pp5.5-11_ph6 *(Study 5.5)*	*QAPP, Section B.2.3, page 73 AEA should provide additional details about which plant tissues will be collected. Root tissue should be collected in addition to shoots/leaves, as roots can exhibit higher concentrations of mercury compared to other plant tissues (Boening, 2000). Additionally, below-ground plant tissue will be subject to anoxic conditions in sediment following inundation, encouraging the formation of methylmercury.*	See Section 2.2.3.2.4.1.
USFWS_pp5.7-1_ph6	*Modification 5: Wildlife samples are an important component of understanding mercury transport and bioaccumulation. We recommend that AEA collect samples of tissues from piscivorous birds and mammals to document baseline mercury concentrations in wildlife. These samples were not collected in 2014 or thereafter; therefore they are an important data gap for the project.*	As explained below in Section 2.2.3.2.5.1, AEA requests FERC not adopt USFWS's proposed Study Plan modification. As described in ISR Part C Section 7.1.2.6, AEA proposed a modification to the FERC-approved Study Plan to add a decision point to the Study Plan to evaluate the need for piscivorous wildlife sampling based on the predictive modeling results (reservoir and riverine models) and potential for transfer from the aquatic environment to the terrestrial environment using pathway analysis models. The estimated cost of collecting piscivorous wildlife samples is $300,000.
USFWS_pp5.5-15_ph10 *(Study 5.5)*	*QAPP Table 5 page 23 – The issue of whether to sample fur and feathers for mercury in piscivorous wildlife should not depend on the pathways analysis. Per the FERC-approved study plan, AEA is committed to sampling fur and feathers. It is not consistent with the FERC approved study plan to delay the fur and feather sampling, nor to substitute a "mercury pathways analysis" for actual biota*	As described in ISR Part C Section 7.1.2.6, AEA proposed a modification to the FERC-approved Study Plan to add a decision point to the Study Plan to evaluate the need for piscivorous wildlife sampling based on the predictive modeling results (reservoir and riverine models) and potential for transfer from

Reference Number	Comment or Study Modification Request	AEA's Response
	samples collected within the Project area. Performing the survey only if the results from pathways analysis indicate transfer of mercury/methylmercury from the aquatic to the terrestrial environment is not an option due to the lack of representative data collected to date (2013 rejection of all water quality mercury sampling) and the fact that models can be inaccurate. Given the lack of data it may not be possible to generate an adequate pathway analysis. Furthermore, fur sampling should not be conducted in the summer; it should be conducted in the winter (see QAPP appendix D-5). The QAPP is internally inconsistent in body vs. appendices.	the aquatic environment to the terrestrial environment using pathway analysis models. See Section 2.2.3.2.5.1 below.
USFWS_pp5.7-18_ph2	*Identify the pathway analysis/modeling methods and decision criteria to be applied to the 2013 and 2014 aquatic sample data in order to decide the need for the possible additional sampling of piscivorous wildlife.*	Details for the methylmercury pathway analysis method are in the *Mercury Assessment Pathways Analysis Technical Memorandum*, which is included in Study 5.7 SIR, Appendix A. See also Section 2.2.3.2.5.1 below.
USFWS_pp5.7-2_ph5	*We maintain that AEA should collect wildlife tissue (fur and feather) samples from piscivorous wildlife, regardless of model results. Especially when model input is based on data that has been flagged during quality assurance review, additional effort should be expended to collect baseline data especially for birds and mammals.*	To clarify, data flagged during quality assurance review will not be used in the model. See Section 2.2.3.2.5.1.
USFWS_pp5.7-5_ph6	*An insufficient mercury sampling program was conducted for piscivorous birds and mammals. No fur or feather samples were collected for methylmercury analysis in 2013. AEA was unable to collect any bird/feather samples in 2014 and only a limited number of fur samples were collected which included one river otter pelt and two mink pelts from a trapper in the Chulitna River/Indian River area (exact location unknown). Hair snare results were also limited to four hairs from a single river otter at one site. Further sampling should be conducted for these biota groups.*	See Section 2.2.3.2.5.2.
USFWS_pp5.5-16_ph4 *(Study 5.5)*	*QAPP Appendix D-6 does not reflect the strategy to collect blood from bald eagle nestlings rather than attempting to collect feathers from the ground below nests.*	See Section 2.2.3.2.5.2.
USFWS_pp5.7-11_ph2	*Similarly, no fur samples were collected for methylmercury analysis in 2013, also due to the absence of targeted species in the proposed inundation area. The ISR stated that alternate methods for collecting fur samples from piscivorous mammals were needed. These may include targeted trapping or expansion of the proposed study area. The USFWS prefers non-lethal sampling methods for wildlife for this project, and these should be feasible if project contractors who know how to sample blood from birds and perform the correct mercury analysis (the Direct Mercury Analyzer (DMA-80) method) on fur samples collected from snags.*	See Section 2.2.3.2.5.2.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.7-12_ph2	*For piscivorous birds, AEA plans to engage specialty contractors with extensive experience in capturing live birds to obtain blood and feather samples for mercury analysis. If lethal trapping is employed to collect piscivorous mammals, additional analysis can be performed to enable a more thorough interpretation of baseline results. For example, age of the animals collected should be recorded (e.g., via cementum annuli analysis) because mercury concentrations in piscivorous mammals are correlated with age (Yates et al., 2005). These age data would be useful in understanding baseline results and aiding in comparisons to data from other areas, tissue levels associated with effects, or data collected from the project area in potential future studies. Also, since the samples could be easily obtained from carcasses, AEA should analyze soft tissue samples (e.g., liver and/or muscle) for mercury and methylmercury, or at least collect and archive samples for future analysis.*	See Section 2.2.3.2.5.2.
USFWS_pp5.5-16_ph3 *(Study 5.5)*	*QAPP Appendices D-5 and D-6 does not acknowledge the method that was agreed to in a technical conference call on July 3, 2013. Verbrugge (USFWS) presented evidence for the superiority of EPA method 7473 (Direct Mercury Analyzer) when sample size is very small (as with a hair snag). The consultants and AEA agreed to consult with Verbrugge and strongly consider using EPA 7473 when only small hair or feather samples are obtained (less than 0.5 g). This would lead to usable data rather than a "non-detect" from EPA method 1631, which has a higher detection limit.*	See Section 2.2.3.2.5.2.
USFWS_pp5.7-11_ph3	*In prior meetings with AEA the USFWS discussed the use of a more sensitive analytical method if only a few hairs were available from a snag (using a Direct Mercury Analyzer). Despite our agreement that the contractor would consult with the USFWS and consider using that method if a small sample from a snag was collected, the contractor did not communicate with the USFWS when they collected such a sample, nor did they use the sensitive method.*	See Section 2.2.3.2.5.2.
	Objective 3	
USFWS_pp5.7-14_ph2; NMFS_pp5.7-7_ph8	*Co-occurrence of elevated mercury concentrations in multiple samples may indicate a mercury hotspot or area of concern. Such hotspots would need to be evaluated explicitly in future modeling or risk estimation exercises, as they may result in localized post-project mercury risks. The presentation of the data is insufficient for a full understanding of mercury conditions in the project area, because simple averages obscure the spatial patterns. This is a situation where the variance is more important than the mean. Mercury concentrations range over two orders of magnitude, with maximum values for fish, sediment, and water that exceed the screening criteria.*	See Section 2.2.3.3.1.

Reference Number	Comment or Study Modification Request	AEA's Response
	Because of the exceedances and wide variability in the data, it may not be appropriate to treat the project area as a simple homogenous unit. The raw data should be mapped as well as shared in tables and figures that describe the range in concentrations, as well as measures of central tendency. Percentiles are often used to describe non-normally distributed environmental data. No variances were identified in the methodology section of the ISR concerning the methods used to determine if a mineralogical source of mercury exists within the inundation area.	
	Objective 4	
NMFS_pp5.7-8_ph2	*Modification 3-1: NMFS recommends mercury concentration data collected from stationary sources, such as native soils and vegetation, should be mapped and hot spots should be investigated. Protocols for these location specific investigations should be developed.*	As explained below in Section 2.2.3.4.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. These will be provided in the USR.
USFWS_pp5.7-17_ph3	*Provide maps of mercury concentrations in soils and vegetation within the proposed inundation area, to identify areas where mercury methylation may occur.*	These will be provided in the USR. See Section 2.2.3.4.1 below.
	Objective 5	
USFWS_pp5.7-2_ph1	*Modification 6: Use the water quality model to predict where in the reservoir conditions (pH, dissolved oxygen, turnover) are likely to be conducive to methylmercury formation. To our knowledge this task has not been completed.*	As explained below in Section 2.2.3.5.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. This will be provided in the USR for one operational scenario and in the License Application.
	Objective 6	
NMFS_pp5.7-8_ph11	*Modification 6-1: NMFS recommends all elements set forth in the SIR including the phosphorus release modeling and modeling of mercury concentrations in fish and piscivorous wildlife (including Beluga) over time post-impoundment be completed.*	As explained below in Section 2.2.3.6.1 AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
USFWS_pp5.7-1_ph2	*Modification 1: We recommend AEA complete all elements set forth in the study implementation report (SIR) including the mercury pathways assessment that was presented in Section 5.7.4 of the RSP 5.7. Other incomplete elements include the phosphorus release*	As explained below in Section 2.2.3.6.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as the

Reference Number	Comment or Study Modification Request	AEA's Response
	modeling and the measurement of mercury in biota, fur and feathers pre-project, and modeling of mercury concentrations in fish and piscivorous wildlife over time post-impoundment.	implementation of the modeling and pathways assessment are already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. A portion of this modification request is redundant to USFWS's Modification 5; the estimated cost of sampling piscivorous wildlife is $300,000 and is addressed in Section 2.2.3.2.5.1.
	Objective 7	
USFWS_pp5.7-1_ph3; NMFS_pp5.7-9_ph3	*USFWS Modification 2; NMFS Modification 7-1:* *We recommend that AEA conduct the Mercury Assessment Pathways Analysis. It should be noted that the pathway analysis should not preclude collection of baseline data and in particular fur and feather sampling must be conducted to meet the FERC-approved study plan objectives.*	As explained below in Section 2.2.3.7.1, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan as implementation of the Mercury Assessment Pathways Analysis is already part of the FERC-approved Study Plan. A portion of this modification request is redundant to USFWS's Modification 5; the estimated cost of sampling piscivorous wildlife is $300,000 and is addressed in Section 2.2.3.2.5.1.
USFWS_pp5.7-17_ph6	*Provide details in the potential pathways for methylmercury to migrate to the surrounding environment, and provide an expanded literature survey on these pathways to ensure applicability to the conditions expected in the future impoundment.*	Details for description of how the methylmercury pathway analysis works is found as a component of the diagrams in Section 4.2 of the *Mercury Assessment Pathways Analysis Technical Memorandum*, which is included as Appendix A of the Study 5.7 SIR (November 2015). Factors that promote formation or migration of methylmercury are found in Figure 1-1 in the Study 5.7 *Evaluation of Continued Mercury Monitoring Beyond 2014 Technical Memorandum* (September 2014). These factors include reducing and low oxygen conditions, increased nutrients, increased temperature, microbial respiration, and dissolved organic carbon (see discussion in Study 5.7 SIR Section 6.1.2). A detailed description for how mercury (including total, dissolved, and methylmercury forms) pathway analysis works is in Study 5.7 SIR, Appendix A (November 2015). An extensive literature review is included and a summary of points with conclusions relevant to development of the conceptual mercury pathway models for a newly-formed reservoir, mature reservoir, and a riverine model. Literature citations are up to date (as of October 2015) including those from recent peer-reviewed publications.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.7-18_ph1	*Identify the additional riverine receptors to be evaluated in the risk analysis as well as the receptor specific TRVs to be used in analyzing model results.*	See Section 2.2.3.7.2.
	Objective 9	
USFWS_pp5.7-6_ph6	*AEA should provide a table in the SIR report showing the model inputs and outputs so the results can be reviewed and verified. For example, the Harris and Hutchinson model (2008) should be showed in its entirety so readers can conduct and verify the analysis.*	AEA agrees in the importance of providing the requested information and will do so in the USR. However, it could not be done in the SIR because the study has not yet been completed. With respect to the Harris and Hutchinson model, in response to a comment raised during the March 2016 ISR Meeting, AEA filed the model inputs, outputs and calculations as Attachment 9 of the ISR Meeting Summary with the Commission April 22, 2016. Data used to construct the riverine and reservoir EFDC models along with the Harris and Hutchinson model will be included in the Study 5.6 USR. When the modeling is performed in the next year of study, the data source will be referenced in the Study 5.7 USR or, in the case where the data set would be too large or cumbersome to include in the report, with a web link so that reviewers can perform verification checks on calculations appearing in tabular form. Model output will be provided in summary form (graphs and/or tables) with complete output provided with a web link if too large or cumbersome to effectively include in the report.
USFWS_pp5.7-17_ph5	*Describe the models (Harris and Hutchinson, EFDC, and Phosphorus Release Models) and calibration results to be used to predict reservoir conditions conducive to methylmercury formation and the uptake and accumulation of mercury in fish.*	A detailed description of the Harris and Hutchinson Model and the Phosphorus Release Model can be found in Study 5.7 RSP Section 5.7.4.7 and a detailed description of the EFDC Model in Study 5.6 RSP Section 5.6.4.5. Calibration results for temperature available for the EFDC Model are presented in Study 5.6 SIR, Section 5.2, Figure 5.2-1 and Figure 5.2-2. The calibration for other parameters will be completed under the next year of study. (See Section 2.2.2.3.2.) EFDC User Manuals can be accessed at the following web address: https://www.epa.gov/exposure-assessment-models/efdc-manuals.
	Objective 10	
NMFS_pp5.7-2_ph12	*Modification 10-1:* *Analyze the mercury pathways to quantify the possibility that mercury will bio-accumulate to toxic levels in Cook Inlet beluga whales (CIBW) as they are a federally listed*	This modification request involves Study 5.7 and Study 9.17 and is duplicative to NMFS's Study 9.17 Modification 2 (NMFS_pp9.17-3_ph1). As explained below in Section

Reference Number	Comment or Study Modification Request	AEA's Response
	species. Since NMFS does not want CIBW approached or sampled, alternative means would need to be investigated.	2.2.3.10.1 and in Section 2.6.13.4.1 (Study 9.17), AEA requests FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the modification. Though AEA believes there is no practical function served by extending the mercury bioaccumulation assessment to address the requested modification related to the CIBW, the considerable cost of doing so would include approximately $1,000,000 for extending the EFDC water quality model, the phosphorus release model, and the Hutchinson and Harris model downstream of PRM 29.9; and approximately another $200,000 to sample for mercury in the surface water and tissue of aquatic organisms.
	General	
USFWS_pp5.7-15_ph1	*Additional literature references are needed for general statements. References are required for mercury accumulation on soils, sediments and biota, particularly in section 4.2.3 of the riverine model of the SIR Appendix A. For example, we address several poorly supported statements below. "The largest proportion of methyl-mercury (MeHg) is produced and resides in flooded soils and not mobilized into the water column (Hall et al., 2009)". Few studies have examined the total mass of MeHg in different compartments of reservoir ecosystems. It is much more common to examine MeHg concentrations without extrapolating to total mass, and even mass balance studies tend to focus on MeHg inflows and outflows from reservoirs rather than the mass distribution of MeHg within the reservoir. Because there are few studies on the subject, it would be appropriate for AEA to qualify their statements about the pools of MeHg in reservoirs, to state that the findings of Hall et al. (2005, 2009) are based on studies from the experimental creation of reservoirs in three basins with different levels of preimpoundment organic carbon stores.*	It is true that few studies that examine pools of MeHg in reservoirs are available to compare against the Susitna project. Since the reservoir does not exist, hypothetical concepts like analysis of metals that transfer between compartments in the aquatic ecosystem are heuristic tools available for making reasonable predictions. The citation used to make a statement about pools of MeHg in soils suggests one of several possibilities that can occur in the reservoir area of this project. Citations and use of existing literature will be included in the Study 5.7 USR to help in making predictions about and interpretation of overlying water quality conditions in the reservoir.
USFWS_pp5.7-16_ph8	*The last two sentences in this paragraph, including the sentence quoted above, are a misinterpretation of the results of Hall et al. (2005, 2009). Indeed, Hall et al. (2009) concluded that "our study confirmed the results of previous studies that flooding of terrestrial catchments invariably results in large increases in MeHg concentrations in zooplankton." From a risk perspective, it is the concentrations of MeHg in biota that are critical, not the distribution of MeHg mass among compartments of the system.*	See Section 2.2.3.11.1.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp5.7-6_ph3	*The SIR Report tables are not specific. AEA should state whether concentrations in the SIR Report tables are total or methyl mercury. All data should be properly labeled and any use of the data into models should be clearly defined.*	All Study 5.7 SIR Tables indicate the form of mercury reported. Specifically, Table 4.2-1 is a summary table indicating forms of mercury reported for each type of media. Historical data reported in Table 5.1-1 through Table 5.1-3 show results for mercury as filtered (dissolved mercury) and unfiltered (total mercury). These tables also report results for mercury in sediments with the form determined by referring to Table 4.2-1 (mercury in sediments: Total Mercury). Concentrations of methylmercury were not reported in the historical data for water or fish tissue analysis. Calibration of the riverine and reservoir models has not been initiated for mercury and other forms of this parameter. Identification of mercury, and other forms, used for model construction will be included in Study 5.6 USR.
USFWS_pp5.7-6_ph4	*AEA should provide sources of the data in the bullet items that summarize total mercury concentrations. For example, were data generated from the means provided in Tables 5.3-1 through Table 5.7-8. Are all the data in Table 5.3-1 used to generate a mean total mercury value in soils and which EPA method was used to generate data? More detail on how sediment/porewater values were obtained is needed. In addition, details on which fish species were placed into non-piscivorous and piscivorous categories is not provided.*	Means reported for total mercury in soils from Section 5.3 of the Study 5.7 SIR are derived from results in Table 5.3-1. All of the data in Table 5.3-1 were used to generate concentration means reported in Section 5.3 and laboratory analytical method is located at the top of each results column in Table 5.3-1. Analytical methods are also reviewed for compliance with acceptance limits reported in Table 6 (Study 5.5 ISR Part B, Attachment 1 QAPP, Section A.7.2). Classification of guild for fish species was based on reference to the following web site: http://www.adfg.alaska.gov/index.cfm?adfg=animals.listfish. Two of the species, Lake Trout and Burbot, (Table 5.7-1 and Tables 5.7-5 and 5.7-6) are considered piscivorous. The remaining data tables represent the following non-piscivorous fish species: Longnose Sucker, Dolly Varden, Arctic Grayling, Slimy Sculpin and whitefish sp. Further reference to individual fish species will include designation as either piscivorous or non-piscivorous and included in the Study 5.7 USR.

2.2.3.1. *Objective 1: Summarize Available and Historic Mercury Information*

No comments or study modification requests were submitted that pertain to Objective 1.

2.2.3.2. Objective 2: Characterize the Baseline Mercury Concentrations of the Susitna River and Tributaries

Objective 2 of the FERC-approved Study Plan for Study 5.7 is to characterize the baseline mercury concentrations of the Susitna River and tributaries. This included collection and analyses of vegetation, soil, water, sediment porewater, sediment, piscivorous mammals, and fish tissue samples for mercury. Samples of piscivorous birds have yet to be collected. As the intent of the Baseline Water Quality Study 5.5 Objective 4 (Section 2.2.1.4) was to measure baseline metal concentrations in sediment and fish tissue for comparison to state criteria as part of the pathways analysis, the majority of comments and all requests for study modifications made to Study 5.5 pertaining to Objective 4 are included and addressed herein under Study 5.7 Objective 2. As the intent of the Baseline Water Quality Study 5.5 Objective 6 is to implement the Environmental Protection Agency (EPA) 1631E method for laboratory analysis of total mercury in water, sediments, and fish tissue, and EPA Method 1630 for laboratory analysis of methylmercury in water and fish tissue, and application of Method 1669 (Clean Hands/Dirty Hands) for all mercury field sampling (EPA 1996), the one comment addressed to Study 5.5 Objective 6 is also included here and addressed under Study 5.7 Objective 2.

2.2.3.2.1. Water Quality Data Concerns – Missing or Rejected Data

2.2.3.2.1.1. Response to Modification Request for Additional Data Collection and Reporting

NMFS (Modification 2-1; NMFS_pp5.7-6_ph2) and USFWS (Modification 3; USFWS_pp5.7-1_ph4) request FERC to require AEA to collect an additional year of data to replace the 2013 data because they consider the 2013 data invalid. The USFWS further requests (Modification 3; USFWS_pp5.7-1_ph4; Modification 4; USFWS_pp5.7-1_ph5) AEA to describe how the 2013 data were reviewed for quality in a full comprehensive summary of the analytical issues encountered and how these issues were addressed. Additionally, the Services (NMFS_pp5.7-3_ph4; USFWS_pp5.7-2_ph7) disagree with the use of a total phosphorous (TP) correction factor for the mercury data based on suspended solids loads. They comment that there were multiple issues associated with the 2013 data set and the use of a correction factor does not address all of the data quality issues (blank contamination, preservative contamination, cooler temperature, filter breakthrough, and shipment breakage). The Services contend that sampling for mercury should ultimately provide at least two years of representative data to document baseline.

In response, AEA requests that FERC not adopt these proposed study plan modifications because the requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan.

Contrary to USFWS's statement, mercury sampling has been completed in accordance with the Study Plan. As proposed, AEA collected mercury samples at 17 baseline water quality monitoring sites monthly from June through September 2013, once in January 2014 and once in March 2014, which constitutes one year of sampling. The Services suggested that a long-term monitoring plan be implemented in order to validate proposed mercury models, to allow ecological assessments, and for a long-term assessment of piscivorous birds and fur-bearing animals. FERC stated in its SPD that long-term effects of the proposed Project on mercury methylation potential would be accomplished with model predictions of water column mercury concentrations from EFDC.

AEA proposed a modification to the Baseline Water Quality Study 5.5 (Study 5.5 ISR Part C, Section 7.1.2) to collect total mercury samples of surface water in 2014 to complete the set of data required by the FERC-approved Study Plan that was previously incomplete due to 2013 laboratory results that did not meet quality assurance standards. Due to rejection of all 2013 laboratory results for total mercury for not meeting quality assurance standards, recollection of the entire total mercury data set was required. Thus the proposed modification was implemented in 2014 to recollect the required mercury samples (Study 5.5 ISR Part C, Section 7.1.2). The combination of 2013 (dissolved) and 2014 (total) mercury data are sufficient to conduct the mercury pathways analysis and the reservoir and riverine EFDC water quality models and therefore meet the study objectives.

The modification request that AEA provide a full comprehensive summary of the analytical issues encountered and how they were addressed is not necessary as this was already performed as part of the Study Plan. AEA described the analytical issues associated with the 2013 data in Study 5.5 SCR Section 6.5. The analytical issues were described and addressed in Study 5.5 SCR Sections 5.1.1 (2013 data) and 5.1.2 (2014 data). In general, all data, including mercury data, advance through a review process described in the Baseline Water Quality Monitoring QAPP (Study 5.5 ISR Part B, Attachment 1, Quality Assurance Project Plan for Water Quality and Mercury Assessment). Section D.2 of the Water Quality QAPP describes the process for evaluation of laboratory results. Samples and results were reviewed for quality assurance issues identified in the field and then laboratory performance was reviewed to ensure results meet acceptance limits. Field and laboratory results were compared against data quality objectives (DQOs) described in Section A.7 of the Water Quality QAPP, including sample handling and analysis issues (Study 5.5 ISR Part B, Attachment 1, Section B.3-Section B.5). These were the minimum performance measures that needed to be met before data passed the Quality Assurance inspection. The procedures for data quality review were fully described in these sections of the Water Quality and Mercury Assessment QAPP.

AEA followed the FERC-approved Study Plan. In FERC's April 1, 2013 Study Plan Determination, staff recommended that one year of mercury data combined with modeling is sufficient to address the long-term effects of mercury on aquatic and terrestrial receptors. In the Study Plan Determination for Study 5.7 FERC stated:

> *AEA proposes to assess the long-term effects of the proposed project on mercury methylation potential by model predictions of water column mercury concentrations from EFDC, two separate investigations focused on predicting mercury fish tissue levels, and a predictive risk analysis for piscivorous birds and fur bearing mammals in the vicinity of the reservoir. The combined use of a mechanistic water quality model such as EFDC, an empirically-based fish tissue model from other hydroelectric impoundment studies in North America, and the predictive risk analysis based on established TRVs is a reasonable and accepted approach (section 5.9(b)(6)) for evaluating the anticipated level of mercury input to both the reservoir and ecological receptors after initial reservoir filling, and*

> *should provide the information necessary to evaluate project effects (section 5.9(b)(5)), and develop any future license conditions to address mercury methylation.*
>
> *No modifications to the study plan are recommended.*

As described in the FERC-approved Study Plan (RSP Section 5.7.4.2.3), mercury data was to be collected for one year, and not two as the Services are suggesting. As described in the RSP, one year of sampling was planned and recommended in the FERC-approved Study Plan. FERC staff recommendations above indicate in response to the one-time baseline survey the proposed approach by AEA is adequate for evaluating Project effects over the long-term from initial reservoir filling and on ecological receptors. The EFDC modeling results predicting water column concentrations of mercury will be used in assessing the potential for bioaccumulation of mercury in fish tissue which will be reported in the USR.

AEA disagrees that all of the 2013 mercury samples were either rejected or had significant quality control issues as the Services assert. Mercury data results for methyl mercury and dissolved mercury met acceptance limits from all media collected in 2013 (surface water, porewater, sediment, and fish tissue). Only 2013 total mercury data was rejected for not meeting QA acceptance limits in laboratory performance analysis. The rejected 2013 total mercury data will not be used in calibrating the riverine water quality EFDC model. The 2014 total mercury results, which were collected to replace the rejected 2013 total mercury samples, met QA acceptance limits and will be used in calibrating the reservoir and riverine water quality model.

In regards to the Services' reference to the use of the TP correction factor in relation to mercury samples, there appears to be a misunderstanding. As explained in Study 5.5 SCR, Section 5.4.4, a correction factor was used only for the 2014 total phosphorus (TP) results. All 2013 TP data were rejected for failure to meet quality assurance acceptance limits and the TP correction factor was not applied to the 2013 TP results. In contrast, to replace the total mercury results in 2013 that were rejected, samples were re-collected in 2014 and the resulting data all met quality assurance standards. Therefore, a correction factor was not developed for or applied to the 2014 total mercury data. The total mercury data recollected in 2014 completed the mercury data set. This data set is comprised of the dissolved mercury results from 2013 that met all quality assurance acceptance standards and 2014 total mercury data that met all quality assurance acceptance standards.

Sample handling and analysis issues the Services assert were not taken into account with development of the TP correction factor were: blank contamination, preservative contamination, cooler temperature, filter breakthrough, and shipment breakage. The assertion that these issues were not taken into account on data used to develop a correction factor for TP is incorrect. None of the data used to develop the correction factor had any sample handling and analysis issues. Minimum performance requirements that describe percentage of useable data following quantification of sample handling and analysis issues as outlined in Study 5.5 SCR, Section A.7.2 were met in the portion of the data set not rejected. AEA demonstrated clearly the effect of total suspended solids (TSS) on estimation of total phosphorus results using the method described in Study 5.5 SCR, Section 4.5 as the dominant factor causing overestimation of TP results in 2013.

As the FERC-approved Study Plan was successfully implemented and the combination of 2013 (dissolved) and 2014 (total) mercury data met QA acceptance limits, there is no need to replace the mercury data as requested in the Services' modification requests.

The estimated cost of implementing this modification is $300,000 to $400,000 for one additional year of mercury data.

2.2.3.2.2. Sampling Location or Methods

2.2.3.2.2.1. Response to Comment on Sediment Sampling Method

USFWS (USFWS_pp5.5-18_ph6) notes that there was a change in AEA's sediment sample collection method from the Ekman Dredge and van Veen to a hand auger and or stainless steel spoon. USFWS would like a description of the comparability of sample collection methods, particularly for capturing fine grained sediments.

The change in sample collection devices from an Ekman Dredge or van Veen sampling device to a hand auger or stainless steel spoon was used as hand augers and stainless steel spoons are generally better at capturing fine grained sediments at locations where fine, depositional sediments were observed. These are comparable methods to the Ekman Dredge or van Veen sampling devices for collection of sediment samples for description of low-level metals samples as outlined by EPA (2000). EPA (2000) recommends the upper 15 cm as the horizon of interest when characterizing metals in sediment. A hand auger and stainless steel spoon was used per EPA (2000) guidance to collect sediment cores of 15 cm depth and equal sediment volume at each site (Study 5.5 ISR, Section 4.5). QA procedures required proper cleaning of each device before sampling each day and collection of samples following the EPA (1996) Method 1669 (clean hands/dirty hands technique).

2.2.3.2.2.2. Response to Comment Regarding Single Soil Digestion

NMFS (NMFS_pp5.7-10_ph6) suggested that using a single soil digestion method for samples is the preferred scientific method. Since the data has been collected, NMFS suggests that AEA apply both methods to five equally split samples and present how much they vary.

A comparison of both soil analysis methods (EPA Method 1631; digestion of mineral soil with Aquaregia or digestion of organic soils with HNO3/H2SO4 then using BrCl for oxidizing either type of sample) was made on individual soil samples and resulted in little difference for total mercury concentrations (Study 5.7 SIR, Section 5.3, Table 5.3-1). Relative percent difference (RPD) between soil digestion methods when analyzing five equally split soil samples varied by 1 percent to 8 percent difference for total mercury results. However, MeHg concentrations were up to 3 times higher using the organic extraction method (Study 5.7 SIR, Section 5.3, Table 5.3-1). Relative percent difference (RPD) between soil digestion methods when analyzing five equally split soil samples varied by 42 percent (one-half times) to 168 percent (3 times higher) using the organic extraction method for measuring methylmercury concentrations. Using both methods to analyze the same soil sample aids in the identification of hot spots as discussed in Section 2.2.3.4.1 below. Description of MeHg results based on extraction method used will assist in constructing a comprehensive map of potential sources of mercury in the inundation zone of the Project area.

2.2.3.2.2.3. Response to Comments on Porewater Sediment Sampling Method

USFWS (USFWS_pp5.5-14_ph3) comments that the Final ISR should include the depth of probe insertion for porewater extraction. In addition, USFWS (USFWS_pp5.5-14_ph4; NMFS_pp5.5-11_ph4) suggests providing more detail on the procedures that ensure no short circuiting is occurring during sampling. The Services (USFWS_pp5.5-14_ph5; NMFS_pp5.5-11_ph5) would also like AEA to confirm that sediment sample containers were filled entirely (i.e., without headspace).

The ISR provides the information. A hand auger was used to collect sediment cores of approximately 15 cm depth at each site (Study 5.5 ISR Section 4.5). Samples collected were held intact by suction seal as the auger was removed from the aquatic sediments. Porewater was collected using stainless steel push points, peristaltic pump, and disposable tubing prior to collection of a sediment sample (Study 5.5 ISR, Part B Attachment 1, Section B.2.3 and Appendix C Form 6) so there was no “short circuiting” that occurred during sampling.

Specific methods for handling of sediment samples are in Study 5.7 ISR Part A, Section 4.2.4. Sediment samples were collected using a hand auger or stainless steel spoon. Two field staff collected samples; one handling sampling equipment (dirty hands) while the other received the sediment sample in collection jars and prepared labeling (clean hands) (EPA 1996). All sediment samples were collected by wading into shallow nearshore areas of each tributary site. Samples were collected from the top 6 inches (15 cm) of sediment. All the sediment samples were photographed. At all locations the sample jar was not overfilled, the sediment was covered by water, and at least the top two inches of sediment was collected. Sediment collection and filling of sample jars using the hand auger and stainless steel spoon preferentially collected fine sediments and porewater in the sediments. Water covering sediments originated from porewater as no surface water was collected with sediments. Sediment porewater was collected for each of the sites from sediments in the field laboratory using a pump apparatus to draw porewater from each of the replicate samples. This method of sediment collection and handling prevented “short circuiting.”

Sediment sample containers were filled to the top of the sample container without headspace as per laboratory instructions. Sample analysis EPA Method 1631E describes how to fill sediment sample and porewater sample containers and stipulates no headspace in the container (Study 5.5 ISR Part B – Attachment 1 QAPP, Section A.7.1, Table 6). The field crews adhered to these procedures.

2.2.3.2.2.4. Response to Modification Request for Sampling in Slack and Pool Channel Areas

NMFS (Study 5.5 Modification 4-1, part 1; NMFS_pp5.5-8_ph4A) and USFWS (Study 5.5 Modification 4, part 2; USFWS_pp5.5-1_ph5B) recommend collecting sediment samples in slack water areas to determine baseline metals concentrations and to assist with the understanding of mercury methylation potential, further recommending a target water condition and a single sampling method be selected and consistently applied. USFWS (USFWS_pp5.5-10_ph4) asserts that there is no analysis or explanation why sampling avoided slack and pool channel areas. USFWS states that all surface water sample collection avoided pools or slack water, while sediment samples were taken from slack water areas and that there is no comparative water quality analysis to address this discontinuity.

In response, AEA requests FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Avoidance of pools and slack water areas only occurred at surface water monitoring sites (e.g., baseline water quality monitoring and Focus Area monitoring). These sites were deliberately selected as flowing water areas that would be used to characterize a riverine environment and for calibrating the riverine model (Study 5.6). Other water quality characteristics like organic carbon were measured in surface water samples from flowing water areas and represented a riverine habitat. The flowing water monitoring programs had a different purpose than the sediment sampling program which targeted pools and slack water areas. Sediment sampling was conducted in areas of the proposed inundation zone and at the confluence of tributaries or downstream of islands in this zone where fine sediment deposits occurred and were continually present. Sediment transport in the Susitna River is high and water fluctuation from two feet to six feet occurs daily so that fine sediment is likely to be suspended in the water column and not deposited for long periods of time in the main river channel unless in areas like the confluence with tributaries or downstream of islands where sediment sampling occurred. This is where AEA targeted sampling of fine sediments in the inundation zone from slackwater areas or pools. Water quality parameters in overlying surface water was measured at each of the sediment sampling sites. A description for how these data are used is included in the explanation below.

The sampling of porewater in sediments and sampling of surface waters is adequate to meet the objectives of the Study Plan. The objectives for sampling of sediment, porewater, and surface water for mercury concentrations was to characterize baseline conditions at locations in the inundation zone of the reservoir and to determine if a mineralogical source of mercury exists within these areas. Results showed the rock types and mineralization were not found to be significant sources in the proposed inundation zone (Study 5.7 SIR, Section 6.1.1) and atmospheric sources are the likely contributor accounting for current conditions. Concentrations of mercury in sediments within the proposed inundation zone are low (Susitna-Watana Dam Site, 6.7 ng/g dw) when compared to freshwater streams and rivers (30 ng/g dw - 480 ng/g dw) around Cook Inlet (Study 5.7 SIR, Section 6.5). These results directly address the objectives for sediment sampling in the proposed inundation zone.

Study 5.5 SCR, Section 4.6 (paragraph 1) states "...all sediment samples were taken from sheltered backwater areas, downstream of islands, and in similar riverine locations in which water currents are slowed, favoring accumulation of finer sediment along the channel bottom." Sampleable fines (i.e., deposits on the bed) were not found in areas of moving river water. Transfer of metals under reducing conditions usually occurs in quiescent areas of the aquatic environment where respiration dominates and oxygen depletion in overlying surface water occurs. Study 5.7 RSP Section 5.5.4.6 states that the goal for sediment sample collection is in areas where the water is moving slowly or is still. Current sampling strategy limited analysis of water samples to characteristics of porewater quality (Study 5.5 SCR, Part B, Attachment 1 QAPP, Section B.1.3, Table 11). Water quality parameters analyzed in porewater were limited to factors that mobilize metals so it was not an exhaustive list. AEA expects a more direct and measureable change in overlying surface water in the reservoir so the focus for characterizing chemical and physical conditions of sediments was in porewater that is directly influenced by overlying surface water. Surface water sampling was conducted at PRM 209.2 and PRM 187.2 during four months (June through September) in each of the sampling years in order to measure pre-Project water quality characteristics of the area that will be inundated.

Sediment sampling results are at inundation zone locations of the reservoir. The reason for collection of sediment from these locations is to eventually use the EFDC reservoir model for predicting condition of overlying surface water and determine if there is potential for metals to transfer from sediment to surface water at these inundation zone locations. Current surface water conditions at each of these sediment sampling sites will no longer exist once the location is inundated by the reservoir. Since higher metals concentrations occur in backwater areas, these were identified as locations where transfer between media would likely occur under low dissolved oxygen and in a reducing environment that is characteristic of an established reservoir.

AEA used a single sampling method and used it consistently in collecting sediment and porewater samples. Study 5.5 ISR Part A, Section 4.5.1 describes the use of the hand auger and stainless steel spoon combination, as a variance in sample method used (instead of the van Veen sampling device or Ekman Dredge), for collecting sediment at the ten locations at inundation zone locations of the reservoir. The same volume of sediments was collected from each location using a combination of hand auger and stainless steel spoon. Sediment samples were collected from points at each location (Study 5.5 SCR, Section 10, Table 4.6-1 through Table 4.6-6). The stainless steel spoon was used for sediments temporarily exposed to air (water level fluctuates daily) and hand auger used when sediments were covered by water and used consistently to collect the same volume of sediments from three points at each location. Comparability of sampling devices for collection of sediments included above is explained in the response to the USFWS comment on sediment sampling methods in Section 2.2.3.2.2.1 above. Use of the combination hand auger and stainless steel spoon for collecting sediments at each location is comparable because characterization of sediments was done consistently based on volume of sediment sampled and sampling depth (15cm).

The estimated cost of implementing the proposed modification is $150,000 to $250,000 and the data would not improve AEA's ability to meet the study objectives.

2.2.3.2.2.5. Response to Comment on Sediment and Vegetation Sampling in Reservoir Area

USFWS (USWFS_pp5.5-13_ph6) comments that the paired soil and vegetation samples appear clustered in the middle section of the reservoir and suggest AEA provide information on how plants and soils in this area will be representative of the other (unsampled) areas. Additionally, TNC (TNC_pp8_ph2) comments that four of the eight sites proposed were not sampled due to access restrictions and instead were proposed to be sampled in the second year. TNC notes that while sediment conditions are less likely to be affected by year-to-year variations, if project schedule and budget allows, at least one of the locations sampled this year should be resampled next year along with the locations that were not sampled this year.

The purpose of the sampling was to find soils that might be particularly vulnerable to releasing organics, and mercury bound to the organics, to the reservoir. Soil sampling sites were selected based on presence of fine organics subject to easy degradation by bacteria and fungi. For example, sites that may have organics subject to easy degradation may be sites with soils with few existing trees, sites with mineral soils, or sites with rocks).

The locations for collecting vegetation/soil samples were selected to represent the variety of plant and tree types as well as the soil types in the reservoir inundation zone and collecting replicates from the immediate area. Five replicates from ten different locations were collected to represent the plant community types and soils from the inundation zone as described in Study 5.7 RSP Section 5.7.4.2.1 (vegetation) and Section 5.7.4.2.2 (soil). The types of vegetation known to bioaccumulate mercury in tissues are found in plant and tree species described in RSP Section 5.7.4.2.

AEA found little variation in vegetation types or mercury concentrations between the 50 samples collected from 10 locations that were distributed over 11 miles. This suggests that the inclusion of additional areas would not have influenced the range of results from mercury analysis.

The reservoir narrows considerably upstream of the middle section of the reservoir and past sampling site 8, the reservoir does not inundate areas with organic soils (Study 5.7 ISR Part A, Figure 4.2-1). Sampling of these areas would result in little, if any, target locations that would be inundated and have organic soils that would release mercury into the overlying water.

As planned, sediment sampling was completed in 2014 and is reported in the SIR. While no repeat sampling of 2013 sediment sampling sites was implemented, any inter-annual variation at a site was not expected to be larger than within-site spatial variation for sediment metals concentrations. Since 3 samples were collected from each site, adequate description of variation in metals concentrations was captured.

2.2.3.2.3. Reporting Data Collection: Fish Tissues

2.2.3.2.3.1. Response to Comments on Fish Tissue Sampling

USFWS (USFWS_pp5.5-15_ph1) and NMFS (NMFS_pp5.5-11_ph7) commented that they could not find anything in the documents on how AEA is capturing fish from the river, and therefore suggest AEA identify the method(s) of fish collection. Additionally, USFWS (USFWS_pp5.5-13_ph7) suggests AEA specify which fish tissues were collected.

Fish collection methods are in Study 5.5 RSP, Attachment 5-1, Section B.2.3 (Baseline Metals in Fish Tissue Sampling Methods). As described in the ISR and the SIR, AEA collected fish tissues from the following species of fish: Lake Trout, Longnose Sucker, Dolly Varden, Arctic Grayling, Burbot, Slimy Sculpin, whitefish, stickleback, and Rainbow Trout. Target species were sport fish for the purpose of consumption so the primary concern was health risk to humans. The only applicable criteria for comparison with mercury concentrations in fish relate to human health risks. The Alaska Division of Public Health issues the human health risk levels for mercury and is based on analysis of fillets in sport fish. The highest concentrations of methylmercury are found in muscle tissue of adult predatory fish which are the likely group to show more immediate effects from release of mercury during filling of the reservoir and bioaccumulation several years following (Study 5.7 RSP, Section 5.7.4.6.1). Other studies in Alaska measuring mercury concentrations in fish focused on fillets and have been used to compare results with those collected from the Susitna Basin (Study 5.7 SIR, Section 6.7).

2.2.3.2.3.2. Response to Modification Request for Additional Fish Samples and Analysis of Entire Fish

NMFS (Modification 2-2; NMFS_pp5.7-6_ph5) recommends that the entire fish be analyzed for mercury rather than specific muscle tissues or fillets and recommends the use of Teflon sheets rather than polyurethane sheets. NMFS (Study 5.5 Modification 4-1 part 2; NMFS_pp5.5-8_ph4B) also recommends that AEA should specify which fish tissues were collected for metal analysis and in the future grind up and analyze the whole fish. Further, NMFS (Modification 2-3; NMFS_pp5.7-6_ph8) recommends that additional fish be collected and sampled to document baseline mercury concentrations and arrive at the RSP sample size of 10 fish per species. NMFS states that not all targeted fish species were collected in the study area during 2013, and the effort was discontinued in 2014. NMFS (NMFS_pp5.7-3_ph3) disagrees that the sampling is adequate and does not agree with AEA's modification request for no additional sampling of fish species that are either not present or present in only very low numbers (Humpback Whitefish, Rainbow Trout and Stickleback).

AEA requests that FERC not adopt these proposed study plan modifications because these requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for their requested modifications or demonstrated the study was not implemented as provided by the approved Study Plan.

AEA implemented the sampling as provided for in the FERC-approved Study Plan (Study 5.5 RSP Section 5.5.4.7). Sampling the entire fish is unnecessary and contrary to established sampling practice. The highest concentrations of methylmercury are found in muscle tissue of adult predatory fish (Frenzel 2000) which are the likely group to show more immediate effects from release of mercury during filling of the reservoir and bioaccumulation several years following (see RSP Section 5.7.4.6.1). AEA has collected a representative sample of each fish species including the different sizes (age classes) present at a site. The variety of age classes informs on different levels of metals bioaccumulation in fish tissue and informs on the most vulnerable components of the fish population to metals bioaccumulation as well as the transfer rate of metals from smaller fish to larger fish. Other studies in Alaska measuring mercury concentrations in fish (ADEC 2012) focused on fillets and have been used to compare results with those collected from the Susitna Basin (Study 5.7 SIR, Section 6.7).

Fish tissue wrapped in polyethylene sheets (not polyurethane as stated by NMFS in modification request 2-2) was reported in Table 12a of the Baseline Water Quality Monitoring QAPP as the holding material for each of the fish samples (Study 5.5 ISR Part B – Attachment 1 QAPP, Section B.2.2). This is the same material used to collect water samples (e.g., HDPE hoses and sample bottles) for analysis of low-level metals concentration. This method for sample handling of fish tissue conforms to the FERC-approved Study Plan.

Teflon™ is the trade name for Polytetrafluoroethylene; a fluorinated plastic. The only difference between Teflon and polyethylene is that the latter has a lower melting point. This was not an issue in transporting cooled fish samples from the field for immediate same day freezing (per sample handling protocol) at the laboratory.

Mercury samples from fish were proposed to be collected from seven adult individuals from each species (Study 5.5 ISR Part B – Attachment 1 QAPP, Section B.2.3). NMFS's assertion that the Study Plan requires collection of 10 fish per species is incorrect. The FERC-approved Study Plan states that seven to ten fish would be collected for each species for analysis of mercury in tissue (RSP Section 5.7.4.6.1). AEA satisfied the FERC-approved Study Plan with collection of a minimum of seven fish of each species, except the three species that are either rare or not present in the Upper Basin (Study 5.7 SIR, Section 5.7, Table 5.1-4).

Objectives for collecting fish species and counts were met, with the exception of Humpback Whitefish as this species appears to be very rare in the study area; and stickleback and Rainbow Trout for which no specimens were collected in the inundation zone despite intensive sampling. Accordingly, AEA proposed to discontinue fish tissue sampling, as explained in ISR Part C Section 7.1.2.5. The lack of numbers of Humpback Whitefish collected from the study area should not impact the study objectives since sufficient Round Whitefish were captured in the area, and there should be little variation in the feeding habits or mercury accumulation rates between these two species. The lack of capture of the stickleback and Rainbow Trout should not impact the study, since these fish do not appear to be present in the inundation zone. The sampling is representative of the existing fish assemblage in the Upper River. Although not included in the FERC-approved Study Plan, Slimy Sculpin were found to be present in large numbers in the Upper River and were therefore sampled (Study 5.7 ISR, Section 4.2.6.1).

As the fish sampled are representative of the species assemblage currently present in the Upper Basin, there is no need to modify the Study Plan to collect additional fish specimens in the next year of study (Study 5.7 ISR Part A, Section 4.2.6.1). The objectives of the study were established prior to intensive fish sampling in the Upper River and should be revised to reflect the existing fish assemblage. Rainbow Trout and sticklebacks were not found and have never been documented in the mainstem of the Upper River, and Humpback Whitefish were rare in the Upper River with only three collected in mainstem habitats in 2013 and eight in 2014 (Study 9.5 ISR Part A, Section 5.1.1, Table 5.1-2; and Study 9.5 SIR, Section 5, Table 5-1). All other species including Lake Trout, Arctic Grayling, Dolly Varden, Round Whitefish, Burbot, and Longnose Sucker met or exceeded the seven adult fish minimum requirement for collection (Study 5.7 SIR, Section 5.7, Table 5.1-4).

The estimated cost of implementing Modification 2-3 is $100,000. There is no cost associated with implementing Modification 2-2 and Study 5.5 Modification 4-1, part 2 as these modification requests did not indicate to recollect past samples; therefore, it is assumed that the modification to the tissue sampling procedure is intended to apply to the requested future sampling and the cost is captured in Modification 2-3.

2.2.3.2.4. Reporting Data Collection: Plant Tissues

2.2.3.2.4.1. Response to Comment on Plant and Root Tissues

The Services (USFWS_pp5.5-14_ph6; NMFS_pp5.5-11_ph6) suggest AEA provide additional details about which plant tissues will be collected. The Services argue that root tissue should be collected in addition to shoots/leaves, as roots can exhibit higher concentrations of mercury compared to other plant tissues (Boening 2000).

Study 5.7 RSP Section 5.7.4.2.1 provides this detailed information. Hydro Quebec (2003) indicates that woody portions of plants decay more slowly in cold water and production of methylmercury through decay of this organic material is slow. Contribution of methylmercury, especially once roots are inundated, will be minimal even under anoxic conditions as decay rate in cold water is very slow (Study 5.5 RSP Section 5.7.4.2.1).

Vegetative tissue collected were leaves and needles from plant species at each of the study plots (Study 5.7 RSP, Section 5.7.4.2.1). Stems (woody material) and roots from vegetative material were not collected as part of this characterization since contribution of methylmercury from decay of woody material and roots is minimal once inundated by the reservoir.

2.2.3.2.5. Fur and Feathers from Piscivorous Wildlife

2.2.3.2.5.1. Response to Modification Request to Collect Piscivorous Wildlife Tissue

USFWS (Modification 5; USFWS_pp5.7-1_ph6) recommends AEA collect samples of tissues from piscivorous birds and mammals to document baseline mercury concentrations in wildlife. USFWS (USFWS_pp5.7-2_ph5; USFWS_pp5.5-15_ph10) is concerned that not enough wildlife sampling was conducted and asserts that AEA's proposed modification to limit sampling of fish and piscivorous birds and mammals to the aquatic environment and analysis of wildlife tissues be performed after model predictions of mercury exposure is based on 2013 rejected water quality mercury sampling. USFWS (USFWS_p5.5-15_ph10) states that the issue of whether to sample fur and feathers for mercury in piscivorous wildlife should not depend on the pathways analysis. USFWS commented on the need to identify the pathway analysis/modeling methods and decision criteria to be applied to the 2013 and 2014 aquatic sample data in order to decide the need for the possible additional sampling of piscivorous wildlife (USFWS_pp5.7-18_ph2).

AEA requests that FERC not adopt USFWS's proposed study plan modification. Rather, AEA requests FERC adopt AEA's proposed modification to the Study Plan to re-evaluate the need for further mercury analysis of wildlife tissue based on the predictive modeling results (reservoir and riverine models) and potential for transfer from the aquatic environment to the terrestrial environment using pathway analysis models. The pathway analysis/modeling methods and decision criteria to be applied to the 2013 and 2014 aquatic sample data in order to decide the need for the possible additional sampling of piscivorous wildlife has been described in Study 5.7 SIR, Appendix A. Analysis of results from pathway analysis and interpretation that leads to a determination for additional sampling that includes piscivorous wildlife is found in Study 5.7 SIR, Appendix A, Section 5. If piscivorous bird sampling is determined to be necessary, blood and feather samples from nestlings of the 4 target species (Bald Eagle, Common Loon, and Red-breasted and Common mergansers), as determined during TWG consultation with USFWS on March 7, 2014, will occur based on each species' abundance within the study area and the likelihood of obtaining usable samples. Specialty contractors with extensive experience in capturing live Bald Eagles and waterbirds would be engaged to obtain blood and feather samples for mercury analysis. If additional piscivorous mammal sampling occurs, attempts will be made to snag hairs within the study area. If this does not provide adequate samples, a third approach may become necessary, in which a dedicated trapper would be hired for lethal collection of animals in the study area to obtain tissue samples for mercury analysis, as was discussed in the wildlife technical meeting on March 7, 2014.

AEA's proposed modification to analyze the predicted modeling results and evaluate a decision point on whether to further sample piscivorous mammals will not affect implementation of the study objective because piscivorous wildlife sampling would be dependent on results of the pathway analysis, but is not precluded from being implemented if a potential for mercury transfer from the aquatic to the terrestrial environment is likely (Study 5.7 ISR Part C Section 7.1.2.6). Study objectives will be met by first determining the level of bioaccumulation of mercury in fish tissue when the reservoir is inundated. Assessing the need to conduct additional sampling of piscivorous mammals and birds is dependent on the concentration of mercury in fish tissue. The reservoir and riverine models will predict water quality conditions that could make mercury bioavailable to aquatic receptors and this information will be used to complete mercury pathways analysis in the aquatic environment. If there is a potential for mercury to transfer from the aquatic to the terrestrial environment, additional sampling may be performed (Study 5.7 ISR Part C Section 7.1.2.6).

Contrary to the USFWS's statement, none of the EFDC water quality model predictions will be based on 2013 rejected water quality mercury sampling (Study 5.5 SCR, Section 6.5). Adequacy of data used to support water quality modeling included 2013 data that met quality assurance standards and 2014 replacement data that met quality assurance standards (Study 5.5 SCR, Section 6.5). Concerns regarding rejection of 2013 water quality data which includes mercury, are discussed in Section 2.2.1.3.2.1 (Study 5.5, Objective 3).

Details for the methylmercury pathway analysis method are in the *Mercury Assessment Pathways Analysis Technical Memorandum*, which is included in Study 5.7 SIR, Appendix A. This technical memorandum is an overview of steps for evaluating data with the pathway model (Study 5.7 SIR, Section 5, Appendix A). Study 5.7 SIR, Section 5, Appendix A provides an example of decision criteria and how these will be used to interpret results in sediment, porewater, and surface water. A description for examination of factors that increase the potential for bioavailability as predicted by the EFDC reservoir model includes, but is not limited to: pH condition, dissolved oxygen concentrations, total suspended solids concentration, dissolved organic carbon, and redox potential. The combination of these data sets (i.e., mercury concentrations and factors that mobilize mercury) identify where transfer of mercury is likely to occur and if there is potential for exposure of aquatic biota to mercury through ingestion or absorption through respiratory tissues (direct contact). Mercury concentrations in each of the media (e.g., sediment, porewater, surface water, fish tissue) will be compared against available water quality criteria, SQuiRTs or Toxicity Reference Values (TRVs) to determine if mercury is in a form and quantity that would be transferable. Exceedance of water quality criteria, SQuiRTs or TRVs (Section 5 of the *Mercury Assessment Pathways Analysis Technical Memorandum*, which is included as Appendix A of the Study 5.7 SIR, November 2015) are thresholds for determining if transfer for each form of mercury is likely and if harmful to aquatic life. The decision point for additional sampling of tissue from piscivorous wildlife will be based on the results from the pathways analysis.

The estimated cost of sampling piscivorous mammals and birds is $300,000 and requires special permits and highly-qualified researchers with highly-specialized experience.

2.2.3.2.5.2. Response to Comments Regarding Piscivorous Wildlife Sampling

USFWS (USFWS_pp5.7-5_ph6) comments that no fur or feather samples were collected for methylmercury analysis in 2013 and that AEA was unable to collect any bird/feather samples in

2014 and only a limited number of fur samples were collected. Hair snare results were also limited to four hairs from a single river otter at one site and (USFWS_pp5.5-16_ph4) there does not appear to be a strategy to collect blood from bald eagle nestlings rather than attempting to collect feathers from the ground below nests. USFWS (USFWS_pp5.7-11_ph2) proposes alternate methods for collecting fur samples from piscivorous mammals which may include targeted trapping or expansion of the proposed study area. The USFWS prefers non-lethal sampling methods for wildlife for this project, and these should be feasible if project contractors who know how to sample blood from birds and perform the correct mercury analysis (Direct Mercury Analyzer (DMA-80) method) on fur samples collected from snags. However, USFWS (USFWS_pp5.7-12_ph2) notes if lethal trapping is used to collect piscivorous mammals, additional analysis can be performed. Additionally, USFWS (USFWS_pp5.5-16_ph3; USFWS_pp5.7-11_ph3) expresses concern that there is no acknowledgement for the mercury laboratory analysis method that was agreed to in a technical conference call on July 3, 2013 in which Verbrugge (USFWS) presented evidence for the superiority of EPA method 7473 (Direct Mercury Analyzer) when sample size is very small (as with a hair snag). USFWS comments that the consultants and AEA agreed to consult with Verbrugge and strongly consider using EPA 7473 when only small hair or feather samples are obtained (less than 0.5 g) because this would lead to usable data rather than a "non-detect" from EPA method 1631, which has a higher detection limit.

AEA's proposed modification presented in ISR Part C Section 7.1.2.6 regarding alternative methods for sampling piscivorous wildlife was developed in consultation with the wildlife TWG, including the USFWS, during the March 7, 2014 meeting (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014-03-07TT_Wildlife_Notes.pdf). The proposed modifications do not expand the study area to support collection of these samples.

As agreed to by the March 7, 2014 meeting participants, if piscivorous bird sampling is determined to be necessary, blood and feather samples from nestlings of the 4 target species (Bald Eagle, Common Loon, and Red-breasted and Common mergansers) will occur based on each species' abundance within the study area and the likelihood of obtaining usable samples. It was also agreed that specialty contractors with extensive experience in capturing live Bald Eagles and waterbirds would be engaged to obtain blood and feather samples for mercury analysis.

With respect to piscivorous mammals, RSP Sections 5.7.4.5 and 10.11.4.3 indicated that hair samples from river otters and mink would first be sought from animals harvested by trappers in the study area. The Study Plan specified that if this approach did not produce hair samples in 2013, then hair would be sought by placing hair-snag "traps" (nonlethal, breakaway cable snares) on tributary streams draining into the proposed Watana reservoir inundation zone. However, as described in AEA's proposed modification to sampling piscivorous mammals (Study 5.7 ISR Part C, Section 7.1.2.6), these methods did not provide adequate samples. Accordingly, a third approach may become necessary, in which a dedicated trapper would be hired for lethal collection of animals in the study area to obtain tissue samples for mercury analysis, as was discussed in the wildlife technical meeting on March 7, 2014. AEA agrees with USFWS if lethal trapping is used to collect piscivorous mammals, additional analysis can be performed (USFWS_pp5.7-12_ph2).

AEA acknowledges that USFWS suggested using the EPA method 7473 (Direct Mercury Analyzer) when only small samples are obtained (less than 0.5 g) because this would lead to usable data rather than a "non-detect" from EPA method 1631, which has a higher detection limit. AEA originally proposed to use EPA Method 7470A (a variant of EPA Method 7473) for analysis of total and dissolved mercury in water and total mercury in sediments (Study 5.5 RSP Table 5.5-3).

However, in its April 1, 2013 SPD for Study 5.5, FERC recommended the following:

> *Standard Operating Procedures (SOP) and Quality Assurance Project Plan (QAPP)*
>
> 1. *We recommend that AEA employ EPA Method 1631E for laboratory analysis of total mercury in water, sediments, and fish tissue, and EPA Method 1630 for laboratory analysis of methylmercury in water and fish tissue. We recommend that AEA apply Method 1669 (Clean Hands/Dirty Hands) for all mercury field sampling.*

Accordingly, AEA proceeded with the FERC-approved laboratory analytical methods for analysis of samples in 2013 and 2014 (see Study 5.5 ISR, Part B, Attachment 1 QAPP, Section A.7.2). AEA would consider use of USFWS's suggested EPA method 7473 (Direct Mercury Analyzer) if approved by FERC.

2.2.3.3. Objective 3: Utilize Available Geologic Information

Objective 3: Utilize available geologic information to determine if a mineralogical source of mercury exists within the inundation area.

2.2.3.3.1. Response to Comment on the Presentation of Data and Results

The Services (USFWS_pp5.7-14_ph2; NMFS_pp5.7-7_ph8) comment that co-occurrence of elevated mercury concentrations in multiple samples could indicate a mercury hotspot or area of concern, which would need to be evaluated explicitly in future modeling or risk estimation exercises, as they could result in localized post-Project mercury risks. The Services feel that because simple averages obscure the spatial patterns, the presentation of the data is insufficient for a full understanding of mercury conditions in the Project area. The Services suggest that because of the screening criteria exceedances and wide variability in the fish, sediment, and water data, it might not be appropriate to treat the Project area as a simple homogenous unit and the raw data should be mapped as well as shared in tables and figures that describe the range in concentrations and measures of central tendency. The Services noted that variances were not identified in the methodology section of the ISR concerning the methods used to determine if a mineralogical source of mercury exists within the inundation area.

To clarify, co-occurrence of elevated mercury concentrations in multiple samples to indicate a "hotspot" of concern was not an objective of the FERC-approved Study. Sampling of sediment, water, and fish tissue was designed to be representative of conditions throughout the Susitna River basin and so did not have multiple sites that were clustered. Multiple samples taken from an individual site were replicates intended to measure precision of the sampling routine and to account for site variability. The sampling designs for each of the media (i.e., water, sediment, fish) were specifically for use in describing baseline conditions, calibrating the EFDC water quality model, and providing input to the Harris and Hutchinson Model and input for the Phosphorus Release Model. Identifying hotspots of mercury concentrations would require a different sampling design.

Although averages were used in graphs for describing mercury concentrations, variances were also reported for data like fish tissue results (Study 5.7 SIR, Section 9, Table 5.1-4) and are available for sediment samples by calculating an average and variance from three replicate samples collected from each of the ten sediment sampling sites. Dissolved mercury concentrations collected in 2013 from multiple locations along each baseline monitoring transect and Focus Area transects can also be used to generate an average and a variance by combining all observations from each water quality transect. The 2013 data for calculating averages and variance are available at the following web site:

http://gis.suhydro.org/Post_ISR/05-Water_Quality/5.5-Baseline_Water_Quality/ISRMTG_5_5_WQ_2013%20Lab%20Data/

The 2014 data for calculating averages and variance are available at the following web site:

http://gis.suhydro.org/Post_ISR/05-Water_Quality/5.5-Baseline_Water_Quality/ISR-MTG_5_5_WQ_2014_LabData/SuWa%20WQ%202014%20Baseline%20Summer%20Lab%20Data%20QC3/

Mercury "hotspots" do not occur in the terrestrial portion of the proposed inundation area as reflected by uniformity of mercury concentration in vegetation and soil sampling results (Study 5.7 SIR, Section 9, Table 5.2-2 and Table 5.3-1, respectively). Water quality results show different concentration ranges among sites depending on location in the basin (Study 5.7 SIR, Section 9, Table 5.4-1) as do the sediment results (Study 5.7 SIR, Section 9, Table 5.5-1). Fish tissue results do not identify hotspots because individual fish are mobile and can bioaccumulate mercury over long periods of time from various locations. Discussion about mineralogical sources of mercury appears in Study 5.7 SIR, Section 6.1.1, where sources of mercury in the Susitna basin are presented. Given the rock types and mineralization in the proposed inundation zone, they do not appear to contain significant sources of mercury. However, other sources for atmospheric deposition of mercury include volcanic eruptions, forest fires, and coal burning.

Interpretation of effects of mercury will be determined, in part, once the riverine EFDC water quality model is calibrated. Post-Project mercury risks will also be conducted through the pathway analysis model taking into account variability of conditions in some media (e.g., fish, sediment, water) and partitioning the Project area into distinct units that have unique influences on water quality conditions from surrounding terrain and tributaries to account for spatial variability (Study 5.7 SIR, Appendix A, Section 4.4). Data for mercury conditions have been presented in tables and graphs for sediment and porewater (Study 5.7 SIR, Section 5.5), and fish (Study 5.7 SIR, Section 5.7). Interpretation and use of the data will be performed in the next year of study and presented in the Study 5.7 USR. See Section 2.2.3.4.1 for information on the mapping of mercury sampling results.

2.2.3.4. Objective 4: Map Mercury Concentrations of Soils and Vegetation within the Proposed Inundation Area

Objective 4: Map mercury concentrations of soils and vegetation within the proposed inundation area and use this information to develop maps of where mercy methylation may occur.

2.2.3.4.1. Response to Modification Request to Provide Maps of Mercury Concentrations

NMFS (Modification 3-1; NMFS_pp5.7-8_ph2) and USFWS (USFWS_pp5.5-17_ph3) recommend AEA provide maps of mercury concentrations in soils and vegetation within the proposed inundation area, to identify areas where mercury methylation might occur.

AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Soil and vegetation was already sampled for mercury content from the proposed reservoir area and will be used to develop maps of mercury concentrations within the proposed inundation area. The maps will be used to visually determine the spatial extent of mercury presence in soils and vegetation and for estimating area where potential transfer of mercury into reservoir surface water would occur through decay of vegetation, once inundated, and would contribute to release of phosphorus into the reservoir. Maps describing sampled mercury concentrations in soil and vegetation within the proposed inundation area will be prepared at the outset of the next year of study. Maps will then be prepared that identify vegetation zones similar to those sampled for mercury and to identify other locations in the Project area that have potential for methylation of mercury as vegetation decays once inundated. Hotspots will be identified as areas where convergence of mercury source (i.e., soils, vegetation) and water quality condition of overlying surface water would promote release into the reservoir. This information will be presented in the Study 5.7 USR.

2.2.3.5. Objective 5: Use the Water Quality Model for Predictions

Objective 5: Use the water quality model to predict where in the reservoir conditions (pH, dissolved oxygen [DO], turnover) are likely to be conducive to methylmercury (MeHg) formation.

2.2.3.5.1. Response to Modification Request for a Mercury Water Quality Model

USFWS (Modification 6; USFWS_pp5.7-2_ph1) recommends that AEA use the water quality model to predict where in the reservoir conditions (pH, dissolved oxygen, turnover) are likely to be conducive to methylmercury formation.

AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan (Study 5.7 RSP, Section 5.7.4.7). Specifically, this modification request is a re-statement of Objective 5 of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

As indicated in the Study 5.7 ISR, AEA intends to implement the Mercury Assessment Pathways Analysis during the next year of study, so this requested modification is not necessary and should not be adopted. This Task has not been completed as it is part of the next year of study and is further described in Study 5.7 RSP, Section 5.7.4.10.

Mercury water quality modeling will predict water quality conditions (e.g., pH, dissolved oxygen, turnover) from the riverine and reservoir EFDC models and will be used to determine potential for bioaccumulation of mercury during post-Project scenarios by inserting these data into the pathways assessment model (Study 5.6 ISR Part A, Section 4.2). A separate pathways assessment for mercury will use the predicted water quality conditions to evaluate potential for bioaccumulation during each operational scenario in the reservoir and immediately below the dam (Study 5.7 ISR Part D, Section 7 and Study 5.7 SIR Sections 6.8.3 and 7).

2.2.3.6. Objective 6: Use Modeling to Estimate MeHg Concentrations in Fish

Objective 6: Use modeling to estimate MeHg concentrations in fish.

2.2.3.6.1. Response to Modification Request to Complete the Phosphorous Release Model, and Sample Fish and Piscivorous Wildlife

USFWS (Modification 1; USFWS_pp5.7-1_ph2) and NMFS (Modification 6-1; NMFS_pp5.7-8_ph11) recommend AEA complete all elements set forth in the study implementation report (SIR) including the phosphorus release modeling and the measurement of mercury in biota, fur and feathers pre-project, and modeling of mercury concentrations in fish and piscivorous wildlife over time post-impoundment.

AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as the portion of the request relating to the modeling component is already part of the FERC-approved Study Plan and is clearly identified by AEA as steps to complete the study. As indicated in the Study 5.7 ISR, AEA intends to implement these modeling efforts during the next year of study, so this requested modification is not necessary and should not be adopted. The mercury modeling tools (phosphorus release model; Study 5.7 SIR, Section 6.8.2) are planned for the next year of study and will be applied when future Project scenarios are defined and the reservoir and riverine EFDC water quality models generate predicted water quality conditions (Study 5.7 SIR, Section 7). Fish tissue sampling has already been completed. As proposed by AEA as a modification to the FERC-approved Study Plan, additional piscivorous wildlife tissue monitoring will be conducted if mercury pathways assessment indicates a strong likelihood for transfer of mercury into the terrestrial environment (Study 5.7 ISR Part C, Section 7.1.2.6).

The selected Harris and Hutchinson model (Harris and Hutchinson 2008) in Study 5.7 RSP Section 5.7.4.7.1 will be used to predict mercury concentrations in fish tissue under future operational scenarios. The phosphorus release model will use data generated by the reservoir and riverine EFDC water quality model (Study 5.6 ISR Part A, Section 4.2) to generate outcomes for each operational scenario. These are all activities that will be conducted in the next year of study (with the exception of the additional piscivorous wildlife tissue sampling, which is dependent on the results of then mercury pathways assessment) (Study 5.7 ISR Part C, Section 7.1.2.6 and Study 5.7 SIR Sections 6.8.3 and 7).

The portion of the Services' modification request that pertains to measurement of biota, fur and feathers relates to characterization of baseline mercury concentrations in wildlife (Objective 2) and is therefore addressed within Objective 2 above in Section 2.2.3.2.5.1. The cost of additional piscivorous wildlife sampling is estimated at $300,000.

2.2.3.7. Objective 7: Assess Potential Pathways

Objective 7: Assess potential pathways for MeHg to migrate to the surrounding environment.

2.2.3.7.1. Response to Modification Request to Conduct the Mercury Assessment Pathways Analysis

NMFS (Modification 7-1; NMFS_pp5.7-9_ph3) and USFWS (Modification 2; USFWS_pp5.7-1_ph3) request AEA to conduct the Mercury Assessment Pathways Analysis and that the pathway analysis should not preclude collection of baseline data. USFWS (Modification 2; USFWS_pp5.7-1_ph3) adds that in particular fur and feather sampling must be conducted to meet the FERC-approved Study Plan objectives.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan as completing a Mercury Assessment Pathways Analysis is already part of the FERC-approved Study Plan. As indicated in the Study 5.7 ISR, AEA intends to implement the Mercury Assessment Pathways Analysis during the next year of study, so there is no additional cost of implementing this portion of the proposed modification request. The portion of the request to sample piscivorous wildlife is redundant to USFWS's Modification 5 and is addressed in Section 2.2.3.2.5.1.

The pathway analysis will be completed and reported in the USR for one operational scenario and others will be presented in the License Application (Study 5.7 RSP, Section 5.7.4.9). This analysis will be completed for locations that will be inundated by the reservoir. The completed EFDC reservoir model will be used to describe overlying water quality conditions at each of the ten sediment monitoring locations and this information will be used in the pathways analysis to determine the potential for transfer of mercury from sediment, vegetation and porewater to surface water. Sources that contribute to potential for bioaccumulation of mercury in fish tissue will be identified and may prompt sampling of fur and feathers of piscivorous wildlife if pathway analysis indicates potential for transfer of mercury from the aquatic environment to the terrestrial environment.

The estimated cost of sampling fur from piscivorous mammals and feathers from birds is $300,000 and requires special permits and highly-qualified researchers with highly-specialized experience.

2.2.3.7.2. Response to Comment on Riverine Receptors

USFWS (USFWS_pp5.7-18_ph1) asked AEA to identify the additional riverine receptors to be evaluated in the risk analysis as well as the receptor specific TRVs to be used in analyzing model results.

The endpoint for receptors using pathway analysis (evaluating potential for bioaccumulation of mercury) are fish tissue results collected within the inundation zone. Ten fish sampling locations (Study 5.7 ISR Part A, Figure 4.2-16,), which are at or near sediment sampling sites (Study 5.5 RSP Section 5.5.4.6), will be used as receptors, in combination with sediment results and water quality results in the reservoir environment using pathway analysis to determine potential for bioaccumulation.

Riverine receptors (fish) will be evaluated based on TRVs for target fish species found below the dam. Specific TRVs are used in toxicity assessments and exposure to a chemical of potential concern (mercury and methylmercury) for evaluation of effects on piscivorous fur-bearers and piscivorous birds (Study 5.7 RSP Section 5.7.4.6). Riverine receptors (fish) will be evaluated for potential transfer of methylmercury and bioaccumulation using the Phosphorus Release Model and the Harris and Hutchinson Model (Study 5.7 RSP Section 5.7.4.7.1).

AEA is focused on determining potential impacts of mercury on aquatic life and will use Suter and Tsao (1996), which is the primary document containing TRVs. All updated information to this list of TRVs will be acquired through a web-based search in order to use current toxicity reference values published in the peer-reviewed literature. AEA acknowledges that literature updates occur periodically and that current TRVs will be used when pathway analysis is initiated.

2.2.3.8. Objective 8: Coordinate Study Results with Other Study Areas

Objective 8: Coordinate study results with other study areas, including fish, instream flow, and other piscivorous bird and mammal studies.

There were no comments or modifications submitted to FERC pertaining to this Objective.

2.2.3.9. Objective 9: EFDC Models for Mercury Estimation

Objective 9: Use of the Harris and Hutchinson and Environmental Fluid Dynamics Code (EFDC) Models for Mercury Estimation: In its Study Plan Determination, FERC recommended that AEA use the more sophisticated Phosphorus Release Model to predict peak methylmercury levels in fish tissue, regardless of the outcome of the other two models. AEA adopted FERC's recommendation.

Comments that pertain to Objective 9 are included in Table 2.2.3-1. There were no modification requests submitted that pertain to Objective 9.

2.2.3.10. Objective 10: Mercury Effects on Riverine Receptors

Objective 10: Mercury Effects on Riverine Receptors: FERC recommended that AEA include likely riverine receptors (i.e., biota living downstream of the reservoir that may be exposed to elevated methyl mercury concentrations produced in the reservoir and discharged to the river) as part of the predictive risk analysis. The additional study element would have a low cost (section 5.9(b)(7)) because AEA would simply add consideration of additional receptors to the existing analysis. This information is necessary to evaluate potential project effects downstream of the reservoir (section 5.9 (b)(5)).

2.2.3.10.1. Response to Modification Request to Add a Mercury Bioaccumulation Assessment for Cook Inlet Beluga Whales

NMFS (Modification 10-1; NMFS_pp5.7-2_ph12) requests that AEA analyze the mercury pathways to quantify the possibility that mercury will bio-accumulate to toxic levels in Cook Inlet beluga whales (CIBW) as they are a federally listed species. NMFS made the same request as Modification 2 under Study 9.17 (NMFS_pp9.17-3_ph1).

AEA requests that FERC not adopt this proposed Study Plan modification to Study 5.7 because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification. Given the available science on the potential for mercury to be released in the reservoir and the distribution, life history and behavior of CIBW PCE prey species, the potential for consumption of prey by the CIBW that have been contaminated by bioaccumulation of mercury due to the presence and operation of the Project is unmeasurable.

While AEA does not anticipate that mercury bioavailability will be significant based upon the data that has been collected to date, the reservoir is the location, after filling and inundation occur, that represents the most likely source where mercury will become bioavailable. Export of mercury downstream of Watana Dam (PRM 187.1) is unlikely since the river downstream of the dam will be relatively shallow and highly oxygenated, especially downstream of Devils Canyon (~PRM 151).

Risk for bioaccumulation in CIBW would be through consumption of prey like salmon that are exposed to mercury as juveniles and later travel to the Lower River where the CIBW feed. However, bioaccumulation of mercury in salmon below the dam would have to occur at a very high rate to result in biomagnification of mercury in the CIBW through consumption of this food base. This is highly unlikely because of: 1) Chinook Salmon being the only salmon that occurs within 30 miles of the dam and with very low abundance of Chinook Salmon spawning upstream of Devils Canyon, 2) the short exposure time of Chinook Salmon offspring rearing in the mainstem for a maximum of potentially 1.5 years, and 3) the very low proportion of these fish that would actually make it to the Lower River and be preyed upon by CIBW either as juveniles or returning adults. Chinook Salmon are the only salmon species that occur within 30 miles of the proposed reservoir and the salmon upstream of Devils Canyon represent a very small fraction of the total Chinook Salmon population in the river, estimated at <0.02 percent (Study 9.7 SCR, Section 6).

Although more salmon are found downstream of Devils Canyon, the risk of mercury exposure to these fish would be reduced. The reservoir water will travel through Devils Canyon where it will be subject to turbulence, oxygenation, and dilution from tributaries. These conditions will offset any toxic exposure and bioaccumulative potential to the salmon located in the Middle River. Eulachon are not found in either the Middle or Upper Susitna River and their time in the river both as adults and juveniles is on the order of weeks; therefore, risk of mercury exposure to Eulachon from the Susitna Reservoir would be unmeasurable.

Zooplankton offer an indirect pathway for mercury contamination in the reservoir; however, since they are not directly consumed by CIBW they would need to be consumed by juvenile Chinook Salmon in the reservoir that subsequently travel to the Lower River where the CIBW forage. Bioaccumulation of mercury by zooplankton in the reservoir may be so small as to be unquantifiable based on the short exposure time to mercury in dissolved form or through consumption of mercury adsorbed to food particles. Even if juvenile salmon overwinter in the reservoir, there would be a very small chance that a miniscule amount of mercury bioaccumulated in the zooplankton foodbase would be transferred to individual migratory fish. Based on current population estimates for Chinook Salmon spawning in the Upper River (<100) annually versus the estimated total annual escapement of all salmon upstream of the Yentna River that is on the order of 660,000 salmon (see Study 9.7 SCR, Section 6 for salmon species abundance estimates), the amount of bioaccumulated mercury in CIBW by consumption of juvenile salmon originating from the reservoir would be so small as to be unmeasurable. Identifying a link between a mercury source from the reservoir and consumption of outmigrating reservoir salmon by CIBW in the Lower River would be confounded by other sources of mercury, especially those that are marine-derived through bioaccumulation in Eulachon.

Finally, the overall risk of exposure of aquatic life to mercury (total and dissolved) is much lower in riverine reaches downstream of dams because factors that promote exposure like low dissolved oxygen, increased temperature, and nutrients are not expected to change with the presence of the dam (Study 5.6 SIR, Section 6). As such, the modification proposed by NMFS is not necessary to meet the CIBW Study Plan objective or assess the potential effects of the Project.

Though AEA believes there is no practical function served by extending the mercury bioaccumulation assessment to address the requested modification related to the CIBW, the considerable cost of doing so would include approximately $1,000,000 for extending the EFDC water quality model, the phosphorus release model, and the Hutchinson and Harris model downstream of PRM 29.9; and another $200,000 to sample for mercury in the surface water and tissue of aquatic organisms.

2.2.3.11. General Comments

2.2.3.11.1. Response to Comment on Cited Text

USFWS (USFWS_pp5.7-16_ph8) suggested that the statement "Bioaccumulation of MeHg appeared to be sequestered in the existing vegetation and soils and not in the aquatic food web of the newly formed reservoir" is a misinterpretation of the results of Hall et al. (2005, 2009).

The citation of Hall et al. 2009 was not a misinterpretation of results, but confirmation that multiple ecological compartments must be examined in order to use models for prediction of mercury mobilization and bioaccumulation. Compartments of the ecosystem include the consumer compartment in which zooplankton belong.

Objective 2 of Study 5.7 is to assess mercury concentrations in several media (e.g., surface water, sediment, fish tissue) and determine if there is potential for bioaccumulation in biota along the trophic chain. There is evidence that mercury mobilization does occur in newly formed reservoirs and that each has unique quantities of organic carbon stores (correlated with presence of mercury) as has been stated in Hall et al. (2009). The focus for analysis and interpretation of data in Study 5.7 is the potential for bioaccumulation in biota. Baseline conditions are analyzed initially by using the pathway analysis models (Section 4.2 of the *Mercury Assessment Pathways Analysis Technical Memorandum*, in Study 5.7 SIR Appendix A) incorporating predicted water quality conditions from EFDC in order to evaluate "potential" for transfer of mercury into the biotic component of the ecosystem. Characterizing mercury concentrations in compartments of the ecosystem are critical for conducting this analysis to determine where mercury can transfer in the new reservoir, mature reservoir, and out of the reservoir into the riverine environment. The predictive risk analysis (as described in RSP Section 5.7.4.6) is focused on biota and not the mechanism for methylmercury formation in the reservoir and factors promoting this condition as objectives for

Study 5.7 (RSP Section 5.7.1). Hall et al. (2009) conclusions are a confirmation that transfer of mercury occurs to the biotic compartment(s).

2.2.3.12. References Cited

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2.3. Geomorphology

2.3.1. Study 6.5 – Geomorphology Study

As established in the Study Plan (RSP Section 6.5.1), the goal of this study is to characterize the geomorphology of the Susitna River, and to evaluate the effects of the Project on the geomorphology and dynamics of the river by predicting the trend and magnitude of geomorphic response. This will inform the analysis of potential Project-induced impacts to aquatic and riparian habitats. The results of this study, along with results of the Fluvial Geomorphology Modeling below Watana Dam Study (Study 6.6), will be used in combination with geomorphic principles and criteria/thresholds defining probable channel forms to predict the potential for alteration of channel morphology from Project operation. This information will be used to assist in determining whether protection, mitigation, or enhancement measures (PM&Es) may be needed, and if so, what those measures may be.

More specific goals of the Geomorphology Study are as follows:

- Determine how the river system functions under existing conditions.
- Determine how the current system forms and maintains a range of aquatic and channel margin habitats.
- Identify the magnitudes of changes in the controlling variables and how these will affect existing channel morphology in the identified reaches downstream of the dam and in the areas upstream of the dam affected by the reservoir.
- In an integrated effort with the Fluvial Geomorphology Modeling Study (RSP Section 6.6), determine the likely changes to existing habitats through time and space.

The specific objectives of the Geomorphology Study, as described in the RSP (Section 6.5.1), are to:

- Geomorphically characterize the Project-affected river channels and floodplain including:
  - Delineate the Susitna River into geomorphically similar reaches.
  - Characterize and map relic geomorphic forms from past glaciation and debris flow events.
  - Characterize and map the geology of the Susitna River, identifying controlling features of channel and floodplain geomorphology.
  - Identify and describe the primary geomorphic processes that create, influence, and maintain mapped geomorphic features.
- Collect sediment transport data to supplement historical data to support the characterization of Susitna River sediment supply and transport.
- Determine sediment supply and transport in Middle and Lower Susitna River Segments.
- Assess geomorphic stability/change in the Middle and Lower Susitna River Segments.
- Characterize the surface area versus flow relationships for riverine macrohabitat types (1980s main channel, side channel, side sloughs, upland sloughs, tributaries and tributary mouths) over a range of flows in the Middle Susitna River Segment.
- Conduct a reconnaissance-level geomorphic assessment of potential Project effects on the Lower and Middle Susitna River Segments considering Project-related changes to stream flow and sediment supply and a conceptual framework for geomorphic reach response.
- Conduct a phased characterization of the surface area versus flow relationships for riverine macrohabitat types in the Lower Susitna River Segment including:
  - Delineation of aquatic macrohabitat per 1980s definitions for selected sites.

  - Comparison of 1980s versus existing macrohabitat areas at selected sites.
  - Estimate potential change in macrohabitat areas based on initial estimates of change in stage from Project operations.
  - Optional – If Focus Areas are extended into the Lower Susitna River Segment, perform analysis of macrohabitat wetted area versus flow relationships for additional sites and flows.
- Characterize the proposed Watana Reservoir geomorphology and changes resulting from conversion of the channel/valley to a reservoir.
- Assess large woody debris transport and recruitment, their influence on geomorphic forms and, in conjunction with the Fluvial Geomorphology Modeling below Watana Dam Study, effects related to the Project.
- Characterize geomorphic conditions at stream crossings along access road/transmission line alignments.
- Integration with the Fluvial Geomorphology Modeling below Watana Dam Study to develop estimates of Project effects on the creation and maintenance of the geomorphic features that comprise important aquatic and riparian macrohabitats and other key habitat indicators, with particular focus on side channels, side sloughs, and upland sloughs.

Study Components 2, 4, 5 and 7 have been completed as well as data collection in the Middle and Lower River. The rest of the study remains to be completed. Several decision points from the RSP have been made, including the decision to add bed load and suspended-load sediment transport measurements at Susitna Station and Yentna River Gages by the USGS, decision to not acquire additional historic aerial photography in the Middle and Lower Susitna River Segments (1950s and 1980s was deemed sufficient and no other high quality aerial photography was available), decision to not acquire current conditions aerial photography for the Lower River at two additional flows because habitat analysis will not be based on aerial photography, and decision on which tributaries to study for potential delta formation in the proposed reservoir fluctuation zone.

As presented in the Study 6.5 ISR Part D, Section 7.1 four modifications to the Study Plan that had been previously identified as variances (ISR Part A, Sections 4.2.3, 4.3.3, and 4.5.3) and were subsequently requested to move forward as modifications (ISR Part C, Section 7.1.2.2, 7.1.2.3 and 7.1.2.5) are listed below:

- Bed load measurements were terminated at Tsusena Creek in 2013 due to logistical and safety concerns
- Total sediment loads are to be calculated for the 61 years rather than the wet, average and dry years
- Effective Q will be calculated using arithmetic bins for discharge intervals rather than logarithmic (correction of the procedure), and
- Aerial photographs in the Middle River will only be collected at a single discharge rather than three discharges.

As detailed in ISR Part D, Section 7.2 and presented during the ISR meeting for this study held on March 23, 2016, six modifications to the Study Plan were identified since the filing of ISR Part C:

1. effective discharge in the Middle River will not be calculated due to its supply limited nature
2. use of the 1-D bed evolution model sediment transport results to calculate effective discharge in the Lower River instead of using sediment transport rating curves
3. replacement of the Grant et al. (2003) framework for analyzing the downstream impact of the Project with the framework for 1st and 2nd order analysis of dam effects on river morphology
4. elimination of the Modified Braiding Index (MBI) for the Middle River because the planform does not consist of dynamic multiple bar-braided channels within a braid plain
5. elimination of the MBI in the Lower River, and
6. addition of 1-D bed evolution model to determine the depositional characteristics of the sand and larger sediment fractions of sediment inflow to the upper end of the reservoir.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS, USFWS and SRC et al. submitted 11, 11 and 2 proposed Study Plan modifications for Study 6.5, respectively. USFWS and NMFS submitted the same modification requests for Study 6.5. NMFS also submitted a Study Plan modification request in Study 9.17 (Cook Inlet Beluga Whales) relating to the geomorphic reach delineation that is addressed below under Study 6.5. Licensing participants also submitted disagreements with AEA's proposed modifications outlined above to collect aerial photographs at a single discharge instead of three discharges and to eliminate calculation of effective discharge in the Middle River. In addition, many comments were submitted by these entities as well as ADF&G. AEA's responses to the licensing participants' comments and study modification requests can be found in Table 2.3.1-1 and below.

Table 2.3.1-1. Study 6.5 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
	Objective 1	
NMFS_pp6.5-3_ph4; USFWS_pp6.5-3_ph4	*Modification 1-1 Characterize the geomorphology of the watershed as a whole and its Middle River tributaries in relation to the present and expected future sediment yield.*	As explained below in Section 2.3.1.1.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of this modification is $500,000.
NMFS_pp9.17-8_ph4	*Modification 3a Increase sampling in the Lower River to adequately characterize sediment supply and transport in each of the updated reaches based on inadequacy of the current geomorphic reach delineation. Subsequent similar concerns for the Middle River are made resulting in the need to potentially add focus areas.*	As explained below in Section 2.3.1.1.2, AEA requests that FERC not adopt this proposed Study Plan modification. As this modification request has implications for many studies, the cost is significant and likely more than $12,000,000.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.17-11_ph4	*The 2014-2015 Study Implementation Report for the Geomorphology Study released in November, 2015 indicates that this task is ongoing. The conclusions and interim results presented in that report are based on the poorly defined geomorphic reaches and would likely change if better reach breaks were defined.*	See Section 2.3.1.1.2.
NMFS_pp9.17-19_ph1	*The geomorphic reaches defined in the Lower River are too coarse to be of much value. Many of the studies stratify the data collection efforts by geomorphic reach.*	See Section 2.3.1.1.2.
NMFS_pp9.17-8_ph1	*Based on a cursory review of the channel structure, tributary inputs, and changes in stream gradient, the Middle and Lower River should have had more geomorphic reaches.*	See Section 2.3.1.1.2.
NMFS_pp9.17-20_ph5	*The geomorphic reaches defined in the Lower and Middle River, are too coarse to be of much value. Since many of the studies stratify their data collection efforts on geomorphic reach, the poorly defined reaches affect the quality of the data collected by those studies and will subsequently affect the accuracy of the various modelling efforts.*	See Section 2.3.1.1.2.
	Objective 2	
NMFS_pp6.5-3_ph5; USFWS_pp6.5-3_ph5	*Modification 2-1 Provide an assessment of uncertainty in the suspended load and bed load estimates for both reported daily values as well as annual load estimates. This may require conducting additional suspended load and bed load measurements to help define the variability of sediment transport rates at a station over time.*	As explained below in Section 2.3.1.2.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $300,000.
SRC_etal_WATER_pp8_ph4	*AEA did not complete the bed load sampling on the Susitna River at Tsusena Creek.*	See Section 2.3.1.2.1. As described in the ISR and SIR, USGS discontinued bed load sampling in the Susitna River at Tsusena Creek due to safety concerns. However, this did not affect AEA's ability to meet the objectives of the study.
	Objective 3	
NMFS_pp6.5-3_ph6; USFWS_pp6.5-3_ph6	*Modification 3-1 Clarify which size classes of sediments are considered to be supply-limited in the context of this river system and what is meant by sediment transport equilibrium.*	As explained below in Section 2.3.1.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no

Reference Number	Comment or Study Modification Request	AEA's Response
		additional cost for implementing this modification.
NMFS_pp6.5-3_ph7; USFWS_pp6.5-3_ph7	*Modification 3-2 Assess the feasibility of using a morphological approach to estimate long-term bed load transport rates along the Middle and Lower Reaches to provide an independent check on the short-term measurements from samplers.*	As explained below in Section 2.3.1.3.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $500,000.
NMFS_pp6.5-3_ph8; USFWS_pp6.5-3_ph8	*Modification 3-3 Use Information from the 7.7 Glacier and Runoff Study to help predict changes in sediment supply. Substantial modifications to study 7.7 have been requested.*	As explained below in Section 2.3.1.3.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $300,000 to $400,000.
SRC_etal_WATER_pp14_ph3	*Modification: …we request that FERC require AEA collect additional bed load sediment data at Tsusena Creek and other important tributaries where fish are present.*	As explained below in Section 2.3.1.3.4, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $2,000,000 to $4,000,000.
SRC_etal_WATER_pp12_ph3	*AEA lacks the field data necessary to understand the sediment balance in the Middle River.*	See Section 2.3.1.3.4.
SRC_etal_WATER_pp13_ph1	*AEA lacks the data necessary to understand how the morphology and habitat quality of the Susitna River will change at tributary mouths.*	See Section 2.3.1.3.4.
	Objective 5	
SRC_etal_WATER_pp11_ph3	*Modification … we request that FERC require AEA to collect additional aerial photographs of the entire Middle River at low flows and/or collect at least one full year of stage-discharge information for the Middle River to fill important data gaps.*	As explained below in Section 2.3.1.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $400,000 to $600,000.
NMFS_pp6.5-3_ph9; USFWS_pp6.5-3_ph9	*Modification 5-1 Take aerial photos to document the rivers lateral extent in the middle river at the range of flows that AEA intends discharge from the dam. To date the photos are at a single flow, 12,500 cfs.*	As explained below in Section 2.3.1.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $400,000 to $600,000.
SRC_etal_WATER_pp09_ph3	*AEA lacks sufficient data to characterize habitat vs. flow relationships.*	See Section 2.3.1.5.1.
SRC_etal_WATER_pp10_ph1	*AEA lacks data to support a stage-exceedance analysis of habitat v. stage relationship for the Middle River.*	See Section 2.3.1.5.1.
SRC_etal_WATER_pp10_ph4	*The data gap prevents AEA from understanding interactions of ice with main-channel and side-channel habitats and potential impacts to salmon habitat under post-project conditions.*	See Section 2.3.1.5.1.

Reference Number	Comment or Study Modification Request	AEA's Response
	Objective 6	
NMFS_pp6.5-3_ph10; USFWS_pp6.5-3_ph10	*Modification 6-1 Conduct the literature review in the manner of Kellerhals and Gill (1973) to provide case histories and experience related to downstream effects of dams in northern climates. This information should assist in defining potential effects on the Susitna River.*	As explained below in Section 2.3.1.6.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $50,000 to $100,000.
NMFS_pp6.5-4_ph1; USFWS_pp6.5-4_ph1	*Modification 6-2 Use a range of methods gleaned from the literature review, case histories from past projects, and site specific analysis to provide reconnaissance level assessment of project impacts.*	As explained below in Section 2.3.1.6.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $150,000 to $300,000.
	Objective 7	
NMFS_pp6.5-4_ph2; USFWS_pp6.5-4_ph2	*Modification 7-1 Take aerial photos from the Yenta Confluence to Talkeetna to document the rivers lateral extent at the range of flows that are likely post project. To date the photos are at a single flow, 12,500 cfs.*	As explained below in Section 2.3.1.7.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $600,000 to $1,000,000.
	Objective 8	
SRC_etal_WATER_pp13_ph5	*AEA should collect additional data on tributaries above the dam site to evaluate sediment inflows to the reservoir.*	See Section 2.3.1.8.1.
	Objective 11	
NMFS_pp6.5-4_ph3; USFWS_pp6.5-4_ph3	*Modification 11-1 Utilize information from study 6.5 to test and validate the accuracy of long-term (decadal) predictions from the numerical models and utilize geomorphic methods to make predictions of channel response to changes in sediment supply and discharge so as to provide independent checks on the model predictions.*	As explained below in Section 2.3.1.11.1, AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp6.5-4_ph4; USFWS_pp6.5-4_ph4	*Modification 11-2 Provide details about how the lateral channel changes along the Middle River will be predicted if the effective discharge calculation is abandoned.*	As explained below in Section 2.3.1.11.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $100,000 to $200,000.
	Other Comments	
NMFS_pp6.5-3_ph2; USFWS_pp6.5-3_ph2	*Does AEA intend to use existing conditions to represent the future without project effects? If AEA does not intend to use existing conditions to represent the future without the project, NMFS requests: A detailed explanation of predicted changes in channel morphology over the next 100*	NMFS and USFWS are mistaken on the objectives of the Geomorphology Study as listed in the RSP (2012) Section 6.5.1.1. As described in the RSP for Study 6.6, Study Component 2 (Section 6.6.4.2) describe the approach for future with- and without-Project comparisons. The interpretation of these modeling results will involve Study 6.5 as

Reference Number	Comment or Study Modification Request	AEA's Response
	years, and; An evaluation of the uncertainty of the predictions of change.	described in the RSP for Study 6.6 (Study Component 3, Section 6.6.4.3). As described in the RSP Section 6.6.4.2, existing conditions are the starting point for assessing geomorphic change. The selected 50-years of with- and without-Project hydrology and sediment supply are used as input to evaluate geomorphic change. The 50 years correspond to the license application. Uncertainty will be evaluated as part of Study 6.6 (RSP Section 6.6.4.2.2.3).
ADNR_ADFG_pp8_ph4	*The Geomorphology Study focused on characterization of the geomorphology of the Susitna River and evaluation of the effects of the project on the geomorphology and dynamics of the river by predicting the trend and magnitude of geomorphic response. This information has included sediment-transport relationships for the lower and middle river, macrohabitat mapping of the middle river, dam effects on downstream channel, floodplain, and riparian plant communities, and geomorphic reach delineation and characterization for the upper, middle and lower Susitna River segments. The results of this study, along with results of the Fluvial Geomorphology Modeling study to predict the potential for alteration of channel morphology from project operation. This information has provided new insights and understanding to the Susitna River geomorphology and will be used to predict the potential for alteration of channel morphology from project operation and potential project impacts. We believe significant progress has been made and the study is on-track to meet the FERC-approved study objectives.*	AEA appreciates ADF&G's review and support for AEA's implementation of the FERC-approved Study Plan.

2.3.1.1. Objective 1: Geomorphically Characterize the Project-affected River Channels and Floodplain

2.3.1.1.1. Response to Modification Request to Characterize the Geomorphology of the Watershed

NMFS (Modification 1-1; NMFS_pp6.5-3_ph4) and USFWS (Modification 1-1; USFWS_pp6.5-3_ph4) request a modification to require AEA to characterize the geomorphology of the watershed as a whole and its Middle River tributaries in relation to the present and expected future sediment yield.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

As noted in the RSP Section 6.5.1.1 page 6-9, this objective of the Study is to "Geomorphically characterize the Project-affected river channels and floodplain." AEA has implemented the methods in the FERC-approved Study Plan (RSP Section 6.5.4.1.2) to meet this study objective, as described in Study 6.5 ISR Part A, Sections 5.1 (Results) and 6.1 (Discussion) and in the same Sections in the Study 6.5 SIR. There was only one variance from the approved Study Plan and it involved collection of opportunistic water quality data while performing geomorphic reconnaissance (Study 6.5 SIR Section 4.1.1) which was not originally part of the Study Plan. The majority of this study effort has been completed with the only items remaining involving any final update of the Reach Delineation and Characterization TM (Most recent version was provided as Attachment 1 of the Study 6.5 SIR) based on further interaction with other studies, primarily Fluvial Geomorphology Modeling (6.6), Riparian Instream Flow (8.6) and Ice Processes (7.6).

Placing the focus on the river channels is a more efficient and effective way of evaluating present and future sediment yield because the watershed runoff and sediment production is represented by the channels, particularly in the case of bed material load transport which the portion of the total sediment load plays the largest role in controlling the behavior of the channel and associated lateral habitats. Using a watershed-based approach as suggested increases uncertainty by requiring a secondary analysis of sediment delivery, which is a channel process. In addition, results presented in the TM *Update of Sediment-Transport Relationships and a Revised Sediment Balance for the Middle and Lower Susitna River* (Tetra Tech 2014b) and discussed in the Study 6.5 SIR Section 6.3, indicate that very little sediment that is sand-sized and finer is contributed by tributaries other than the three major tributaries (Chulitna, Talkeetna and Yentna rivers) sampled by the USGS. This is further justification to not pursue a watershed approach to sediment yield as it is these finer materials that the watershed controls production and delivery of to the mainstem. Therefore, the FERC-approved Study Plan which AEA implemented is a more direct approach of characterizing geomorphology at the affected river channels and floodplains including addressing the smaller tributaries in terms of their bed material load contribution.

The approach for modeling includes determination of sediment loading from the major tributaries: Chulitna, Talkeetna and the Yentna rivers primarily based on sediment transport data collected in the 1980s and in 2012, 2013 and 2014 by the USGS as described in RSP Section 6.5.4.2 and was presented in Sections 5.2 and 6.2 of both the ISR Part A and the SIR. Contrary to the implications of the modification request, sediment loading from the other smaller tributaries is also being quantitatively addressed. The bed load sediment delivery from the most significant smaller tributaries, a total of 19, is being determined based on data collected in Study 6.6 as described in RSP Sections 6.6.4.1.2.6 (analysis methods) and 6.6.4.1.2.9.3 (data collection). The selection of these tributaries was performed as a decision point in Study 6.6 and documented in ISR Part C Section 7.1.1.1.1 and Table 7.1-1. In addition to the estimation of bed load from the Middle River tributaries, a similar effort on 5 Lower River tributaries is being performed and is also presented in ISR Part C Section 7.1.1.1.1 and was initially presented in *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies—2013 and*

2014 (R2 2013). The bed material loading from 6 of the most significant tributaries discharging into the proposed reservoir will be estimated by the same procedures as for the Middle and Lower river tributaries. This is described in RSP Section 6.5.4.8.2.2 with the section of the tributaries to study presented as a decision point in Study 6.5 ISR Part C Section 7.1.1.8 in Table 7.1-1.

Lastly, after sediment loadings have been estimated from the selected tributaries in the Lower, Middle and Upper Susitna River segments, the sediment balance will be refined and the load assigned to each tributary adjusted to be consistent with the data collected from the USGS at major points in the system. This effort is identified in Study 6.5 SIR Section 6.3.

The estimated cost of implementing this modification is $200,000 to $300,000 for this study component, but the request would also increase the cost of the third Study component of the Geomorphology Study – Sediment Supply and Transport in the Middle and Lower Susitna Rivers (RSP Section 6.5.4.3) which would increase its cost by a similar amount. All told, the requested modification could add over $500,000 to study costs without increasing AEA's ability to determine Project effects or evaluate potential PM&Es.

2.3.1.1.2. Response to Modification Request to Redefine Geomorphic Reaches and Increase Sampling in the Updated Reaches

NMFS in Study 9.17 (Study 9.17 Modification 3a; NMFS_pp9.17-8_ph4) recommends increasing sampling in the Lower River to adequately characterize sediment supply and transport. Their support for this modification is based on NMFS (NMFS_pp9.17-20_ph5) comments that the geomorphic reaches defined in the Lower and Middle River are too coarse to be of much value. NMFS comments (NMFS_pp9.17-8_ph1) that based on a cursory review of the channel structure, tributary inputs, and changes in stream gradient, the Middle and Lower River should have had more geomorphic reaches. In the modification request, NMFS further comments (NMFS_pp9.17-11_ph4) that the conclusions and interim results presented in SIR Study 6.5 are based on the poorly defined geomorphic reaches and would likely change if better reach breaks were defined. NMFS maintains that the use of proper reach breaks is particularly important to the assessment of likely Project effects on salmon spawning and rearing habitat, since those changes are likely to occur on a smaller scale. NMFS states that the geomorphic reaches should be re-defined to reflect the variations in larger scale physical processes in the river. NMFS believes that this would improve the quality of the data collected by several of the studies and will also improve the accuracy of the various modeling efforts.

AEA requests that FERC not adopt any recommendations related to changing the geomorphic reach delineations because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. AEA strongly disagrees with these comments concerning the geomorphic reach delineations in the Middle River and Lower River segments. These reach delineations, as well as those for the Upper River Segment, have been presented and vetted throughout their development with the various licensing participants. The basis of the delineations as well as the reach delineations themselves are robust and serve the objective of this study component. Therefore there is not the need to redefine the reaches or to characterize sediment supply and transport in updated geomorphic reaches.

First of all, AEA would like to point out that it recognized the importance of the geomorphic reach delineations and the need to define and vet them early in the study implementation process as several studies used them to help develop their data collection programs. Therefore, throughout their development, the Geomorphic Reach Delineations have been presented and discussed with the licensing participants. The reach classification system and reach delineation were first presented at the October 23, 2012 (Slides 15, 16 and 17 of the October 23, 2012 TWG meeting presentation; http://www.susitna-watanahydro.org/wp-content/uploads/2012/10/Geomorphology-TWG-2012-10-23.pdf). The RSP filed in December 2012 presented the reach classification system (RSP Section 6.5.4.1.2.2.1) and the reach delineations for the Middle and Lower River segments were presented in RSP Section 6.5.4.1.2.2.2 (Table 6.5-1 and Figures 6.5-3 and 6.5-4). A Technical Memorandum providing a detailed presentation of the Geomorphic Reach Delineation was filed with the Commission in March 2013 (Tetra Tech, 2013a). Based on information collected in 2013, this TM was revised and the updated version was filed with the Commission in May 2014 (Tetra Tech 2014a). The last update of the Geomorphic Reach Delineation TM, based on information collected in 2014, was filed as Attachment 1 of the Study 6.5 SIR (Tetra Tech, 2015a). It is apparent from this history, dating back to 2012, the development and application of the Geomorphic Reach Delineations has been transparent. Prior to the current comments by NMFS, no criticisms of the reach delineations have been made by the licensing participants. The agency has had numerous opportunities to voice their concerns with the reach delineation and have not. The current criticisms are general and without specificity and the current version of the geomorphic reach delineation meets the study objective.

Contrary to NMFS comments that indicate the geomorphic reaches in the Middle and Lower rivers are too coarse, the geomorphic reach delineation that was initially presented in the RSP Section 6.5.4.1.2.2.2 and Table 6.5-1 and most recently updated in Study 6.5 SIR Attachment 1 Section 5.1 and Table 5.1-1 is at the appropriate resolution to support identification of Project effects and evaluation of PM&Es. As stated in Study 6.5 SIR Attachment 1 Section 4.2:

> *Classification of the river segments was required to provide a basis for communication among the various disciplines and to identify relatively homogeneous river reaches that can then be used as a basis for extrapolation of results and findings from more spatially-limited studies.*

The geomorphic reach is only one level of the system used to classify and stratify the Susitna River Classification and subsequent reach and sub-reach delineation of the Project area is scale dependent. Thus, a 4-level hierarchically-tiered classification system has been developed by AEA to meet the scale-dependent needs of the Project components (Study 9.09 SCR Section 4.1.1 and Table 4.1-1). At the highest (coarsest) level, the study area is divided into three segments (UR, MR, LR) that reflect the basin-wide changes in geology, sediment supply, hydrology and Project boundaries. The second level of sub-division, the geomorphic reach, which is based on channel planform characteristics, geologically-defined constraints, valley-floor confinement, channel gradient and bed-material gradation (Study 6.5 SIR Attachment 1 Section 5.1 and Table 5.1-1) was used to subdivide the three segments into 20 relatively homogeneous reaches. The third level of sub-division is based on the presence of defined macrohabitats (geomorphic sub-units) within each geomorphic reach. These sub-units include large-scale habitat types within the main channel and lateral habitats represented by side channels, side sloughs and upland sloughs. At the finest scale, the macrohabitats are divided into smaller scale sub-units referred to as mesohabitat types that include riffles, pools and runs/glides.

This scale-based four level classification system recognizes that there is considerable variability within the individual geomorphic reaches. The geomorphic reach delineation was developed primarily to provide a common framework for the Project and to support extrapolation of results, including from the 2-D BEM, from the Focus Area within a reach to the remainder of the geomorphic reach, not to characterize variability at a fine scale. The classification system that was developed and used in the geomorphic reach delineation incorporated both form and process (Study 6.5 SIR Section Attachment 1 Section 4.2). By considering physical processes, the ability to extrapolate physical process based modeling results within a geomorphic reach is supported.

The sum of the physical processes incorporated into the classification system and subsequent reach delineations and is reflected in the sediment storage within unvegetated bars, floodplain segments, vegetated islands and Holocene-age terraces (Section 4.2. *Geomorphic Reach Delineation and Characterization, Upper, Middle and Lower Susitna River Segments – 2015 Update*; Tetra Tech 2015). Sediment storage within a variety of site specific geomorphic units is reflected in the complex habitat areas within the Middle River segment. These are primarily located upstream of constrictions creating areas of sediment storage expressed physically by the presence of unvegetated bars, floodplain segments, vegetated islands and terraces that provide the macro- and meso-habitats. Sediment storage also relates directly to several of the physical processes that the Project will affect, upstream sediment supply, sediment transport capacity and bed mobility.

The level of sediment storage reflected in the stream classification system that was applied to delineate the geomorphic reaches ranges from single channel (SC) laterally confined with essentially no sediment storage (SC1) to multiple channel (MC) with large amounts of sediment storage within a range of geomorphic sub-units including braid bars (MC1), vegetated islands and floodplain segments (MC2) and anastomosed reaches (MC3). By definition, the delta and its distributary channels are formed and maintained by sediment storage (MC4). Because the level of morphologic response to Project operations within the reaches is largely dictated by the processes that control sediment supply, transport and storage, the classification system and thus the resulting reach delineations reflects the varying level of potential response to the Project. Consequently, the system results in reaches that, contrary to the NMFS comments, are well defined and at an appropriate resolution to evaluate and categorize Project effects within lengths of the Susitna River where the geomorphic responses to Project induced changes will be similar.

To delineate and characterize the geomorphic reaches, seven parameters were determined and applied: gradient, sinuosity, active channel width, valley bottom width, entrenchment ratio, median bed material size and channel branching index. Study 6.5 SIR Attachment 1 Table 5.2-1 provides the geomorphic parameters for the reaches delineated in the Upper (6 reaches), Middle (8 reaches) and Lower (6 reaches) Susitna River segments. Reviewing these parameters in the Middle River, with a few exceptions, there is not a large range in their value between reaches. The exceptions are MR-4 and MR-8. In the case of MR-4, Devils Canyon, it is very steep and vertically and laterally controlled by bedrock (and thus has very low potential for Project effects on its morphology). MR-8 has very little confinement or control as a result of being downstream of the bedrock control and

Pleistocene-age terraces that confined the remainder of the Middle River. The lack of large variability, as well as trends in the parameters from upstream to downstream, is indicative of the geomorphic reach delineation being at a sufficiently fine resolution for differentiating and extrapolating potential Project effects at the reach-scale. Further quantification of potential Project effects uses the Focus Areas to identify the changes in morphology and associated habitat at the macrohabitat and mesohabitat scale. This is why at least one Focus Area is included in each of the reaches that were identified outside Devils Canyon and its influence (Geomorphic Reaches MR-4 and MR-3) to allow extrapolation from the Focus Area to the reach.

The reaches in the Lower River segment are also well defined and at the appropriate resolution as the geomorphic reach delineation reflects the sediment and water supply from the major sediment-contributing tributaries, the Chulitna, Talkeetna and Yentna Rivers, as well as the storage duration (i.e. stability) of the supplied sediments in various geomorphic sub-units (unvegetated bars vs. vegetated islands). Also incorporated are the base-level controls exerted on channel planform (bar-braided-MC1, island-braided-MC2, and anastomosed-MC3) by the tributaries that form valley-constricting fans (Kashwitna and Yentna Rivers). Downstream of the Yentna River confluence (LR-5), the single-channel river planform is controlled by resistant bedrock and consolidated Pleistocene-age sediments. LR-6 comprises the Susitna River delta and tidally-influenced delta distributary channels and isolates the unique physical process in this area.

It is difficult to assign a cost to this requested modification, but it is easily several million dollars as this modification has implications to a variety of studies. For example, for the various modeling efforts, it could result in adding several Focus Areas. It is estimated that data collection, analysis and reporting for geomorphology, water quality, groundwater, ice processes, instream flow, fish and stream habitat in *each* Focus Area is approximately $4,000,000 on average. If the number of reaches are increased by 3 in the Middle River, this would result in over $12M in additional costs. This does not consider the number of operational scenarios to be modeled. In addition, some studies, for example Study 9.6, 9.8, and 9.9, were designed to sample areas both within and outside of Focus Areas to be representative of each geomorphic reach. This modification could lead to additional sampling for those studies outside of Focus Areas as well.

2.3.1.2. Objective 2: Collect Sediment Transport Data to Supplement Historical Data to Support the Characterization of Susitna River Sediment Supply and Transport.

2.3.1.2.1. Response to Modification Request Regarding Uncertainty in the Suspended Load and Bed Load Estimates

NMFS (Modification 2-1; NMFS_pp6.5-3_ph5) and USFWS (Modification 2-1; USFWS_pp6.5-3_ph5) request AEA to provide an assessment of uncertainty in the suspended load and bed load estimates for both reported daily values as well as annual load estimates. This may require conducting additional suspended load and bed load measurements to help define the variability of sediment transport rates at a station over time. Further, SRC et al. (SRC_etal_WATER_pp08_ph4) state AEA did not complete the bed load sampling on the Susitna River at Tsusena Creek.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study

plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was either not implemented as provided by the approved Study Plan or that the variances from the FERC-approved Study Plan as AEA described in the ISR and SIR impacted AEA's ability to meet the study objectives.

AEA disagrees that additional suspended load and bed load measurements are needed to define the variability of sediment transport rates at a location over time. The USGS has collected sufficient data from the 1980s and between 2012 and 2014 to develop sediment relationships along the Susitna River and major tributaries. The recent data are similar to the 1980s data and the combined data were used to update the sediment relationships (Tetra Tech, 2014b). The data did not exhibit variation with time from the 1980s to present. The analysis of the data (Tetra Tech, 2014b) also included the Minimum Variance Unbiased Estimator (MVUE) bias correction (Section 4.3), which uses the variability of the measured data to correct for the bias introduced when the data is log-transformed. As expected, the measured data include significant variability.

To use "by eye" high and low envelope curves of the data would not provide meaningful information to characterize uncertainty and the use of the suggested envelopes as rating curves would indicate that the sediment loads are always either extremely high or extremely low. Meaningful interpretation of the results would be impossible. The data scatter in the USGS measurements is physically realistic and the 1-D bed evolution models reproduce both the scatter and the trends exhibited in the data. It is noted, that the effect of uncertainty analysis in the inflowing sediment loads (magnitude and gradation) as well as the hydraulic and sediment transport parameters that are important in determining sediment transport capacity (channel roughness, bed mobilization parameters) will be conducted per the FERC-approved Study Plan as identified in RSP Section 6.6.4.2.2.4. This would be done through a sensitivity analysis in Study 6.6, primarily conducted on the 1-D BEM, but also for a selected 2-D BEM in a Focus Area. The sensitivity analysis would be performed for the existing conditions and one selected scenario.

NMFS and USFWS either misstate or misinterpret the methods used by the USGS in measuring suspended load. The comment indicates that "A P61 suspended sediment sampler was used at the centroid of the flow, rather than a depth integrated sampler, or a P61 at multiple depths and verticals." In the 1980s, Knott et al. (1987) indicate "Depth-integrated, suspended-sediment samples were collected using a standard point-integrated sampler (Guy and Norman 1970). Samples include those particles (usually finer than 2.0mm) transported in the stream between the water surface and a point about 0.5 ft above the stream bed. Two samples were obtained at each of five selected verticals in the stream section (at the centroids of flow)…" A P61 point-integrating sampler can be used as a depth-integrating sampler, which was stated by Knott et al. (1987), and the sampling included 5 verticals starting at the water surface down to 0.5 ft above the bed. In the recent samples on the Susitna, Talkeetna, Chulitna, and Yentna Rivers, D-95, D-96, and D-96-A1 (all depth integrating samplers) were used depending on depth (Jeff Conaway, USGS, personal communication). As indicated above, the results of the recent sampling are very similar to the 1980s results.

NMFS and USFWS clearly assume that the lower part of the profile is not sampled, but the actual unmeasured distance of the suspended sediment sampler is the bottom 0.5 ft. The 3-inch Helley-Smith bed load sampler includes the bottom 0.25 ft leaving only 0.25 ft unmeasured between the two samplers. The measured bed load rates account for approximately 1 percent of the total load in the Middle River, and are dominated by sand sizes. Therefore, the USGS (Knott et al. 1987) indicated that a 1 percent increase in suspended (sand size) transport could be warranted. No increase in gravel load would be required because the coarser sizes are moving along the bed, not in suspension.

The comment is correct that a 3-inch Helley-Smith was used in the 1980s and for recent measurements (Knott et al. 1987 and Jeff Conaway, USGS, personal communication). The SIR for Study 6.6 includes the suspended and bed load measurements conducted by the USGS in 2012 through 2014. As expected, the measurements are highly variable. The highest discharge when suspended and bed load measurements were performed in the Middle Susitna River occurred on September 25, 2012 (43,700 cfs). The suspended sand load was 33,000 tons/day and entirely less than 1 mm in diameter. Two bed load measurements were performed on that date. The sand bed load from these measurements ranged from 50 to 250 tons/day, and the gravel bed load ranged from 6 to 100 tons/day. The entire gravel load for these two measurements was comprised of particles less than 32 mm in diameter. These Middle Susitna River data are in stark contrast with the samples collected on the Chulitna River. On the Chulitna River in 2012-2014, measured flows did not exceed 35,000 cfs, produced suspended sand loads up to 66,000 tons/day, but produced much more significant gravel loads of between 1,000 and 6,400 tons/day in 11 of 23 measurements and often included particles greater than 32 mm. Clearly the USGS procedures do account for substantial gravel loads, though they are not present in the Middle Susitna River.

Studies 6.5 and 6.6 do not assume, as suggested by NMFS and USFWS, that sediment sampling biases are the same throughout the river system. The studies do conclude that the data collected by the USGS are representative of the bed load and suspended load transport at the sampling locations. Measuring overall bed load and suspended load is very difficult on the Susitna River compared with many other rivers. The overarching objective of Studies 6.5 and 6.6 is to evaluate Project effects on geomorphology along 150 miles of the Susitna River downstream of the proposed dam over the 50-year license period. NMFS and USFWS suggest that AEA should account for very small effects such as locating strips of sand across the 600 ft wide river channel on a seasonal basis. The extreme effort required for such an endeavor does not advance the study objectives for the geomorphology studies.

In the discussion of the modification it is pointed out that there are no bedload measurements at Gold Creek. This is true. The USGS decided to move the bed load measurement from Gold Creek (PRM 140) to the Susitna near Talkeetna (PRM 107). This was done since the conditions at the downstream location provided for collection of higher quality bed load samples. Though 33 miles downstream, the drainage area is very similar as no major tributaries enter the Susitna within this reach of river. The drainage area at Gold Creek is 6,160 sq. mi. and at the near Talkeetna station is 6,320 sq. mi. this compares with the drainage area for the Susitna River above Tsusena of 5,280 sq. mi. The increase in drainage areas at Gold Creek and near Talkeetna compared with above Tsusena Creek are 17 percent and 20 percent, respectively.

The 20 percent increase in drainage area of the Susitna River above Tsusena and near Talkeetna (and very similar 17 percent difference between above Tsusena and at Gold Creek) is also relevant to the request to complete the bed load sampling of the Susitna River above Tsusena Creek. This is a relatively small increase in drainage area, and it is appropriate to use the data from the downstream site to estimate sediment loading at the upstream site. Because of the ability to derive sediment loading from the Susitna River above Tsusena Creek from the data collected for the Susitna River near Talkeetna, the decision to not continue bed load data collection after 2012 above Tsusena Creek is presented as a variance in Study 6.5 ISR Part A, Section 4.2.3 (subsequently identified as a modification request going forward in ISR part C Section 7.1.2.2) with a discussion of the why termination of these measurements, primarily for safety reasons, will not interfere with AEA's ability to meet the study objectives. In the variance discussion, it is pointed out that alternate means are available to determine the bed load passing the dam site for the without Project condition. For with-Project conditions, the bed load passing the dam site will be zero as all bed load will be trapped in the reservoir. For the alternate means of determining the bed load transport at the dam site, there is only a 20 percent difference in the drainage area between the Susitna River above Tsusena Creek and near Talkeetna gages (The variance incorrectly referred to Gold Creek, but this has no bearing on the validity of the variance since the drainage areas are so similar and the methodology still applies), therefore the combination of the considerable bed load data collected for the Susitna River near Talkeetna gage (and some at Gold Creek) in the 1980s, 2012, 2013 and 2014 and the estimates of tributary bed load contributions (See ISR Study 6.6 Part A, Section 4.1.2.6) will support estimation of Susitna River bed load at the Watana dam site for existing conditions. The data that has been collected at Tsusena Creek will be used as a check on these calculations.

Lastly, the number and locations of sediment transport data collected by the USGS in 2012, 2013, and 2014, including bed load, are presented in Study 6.5 ISR Part A, Table 5.2-2. The actual bed load data are presented in Table 5.2-4 of the same document. This is an extensive set of sediment transport data that reflects both current conditions and conditions from three decades ago (1980s) and no further sediment transport data are needed to meet the objectives of this study.

Collection of additional sediment transport data is an expensive, and as documented above, an unnecessary undertaking. It is estimated that the cost of collection, analysis and reporting of each year of transport data at each site is on the order of $50,000. Therefore, adding a complete year of data (five or six measurements) on the Susitna near Talkeetna, the Susitna at Sunshine, the Chulitna, the Talkeetna and the Yentna would cost on the order of $300,000.

2.3.1.3. Objective 3: Determine Sediment Supply and Transport in Middle and Lower Susitna River Segments

2.3.1.3.1. Response to Modification Request for Clarification of Sediment Size Class

NMFS (Modification 3-1; NMFS_pp6.5-3_ph6) and USFWS (Modification 3-1; USFWS_pp6.5-3_ph6) request FERC to modify the Study Plan to require AEA clarify which size classes of sediments are considered to be supply-limited in the context of this river system and what is meant by sediment transport equilibrium.

AEA requests that FERC not consider this request as a study plan modification as it is already part of implementing the FERC-approved Study Plan, though not specifically called out in the RSP. AEA will provide additional clarifications in the next version of the *Sediment Transport Relationships and a Revised Sediment Balance for the Middle and Lower Susitna River Segments* (Tetra Tech 2014b) that is identified in Study 6.5 SIR Section 6.3 for the next year of study. The updated version of the TM will also incorporate additional sediment transport measurements collected during 2014. The 2014 data were presented in the Study 6.5 SIR in Tables 5.2-1 through 5.2-5.

There are no additional costs with providing the requested clarification as it will be performed under the existing Study Plan.

2.3.1.3.2. Response to Modification Request Regarding Long-term Bed Load Transport Rates

NMFS (Modification 3-2; NMFS_pp6.5-3_ph7) and USFWS (Modification 3-2; USFWS_pp6.5-3_ph7) request FERC to require AEA to assess the feasibility of using a morphological approach to estimate long-term bed load transport rates along the Middle and Lower Reaches to provide an independent check on the short-term measurements from samplers.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved study plan or under anomalous conditions.

Furthermore, much of what is being requested in this modification is already planned for Study 6.5, to the extent of the available data, which include mainstem sediment loads, tributary sediment supplies, bed elevation change from the 1980s to present, and sediment eroded and deposited along the channel banks (turnover analysis). The issues identified in this modification request are addressed in two study components that are not fully complete. These are described in the Study 6.5 ISR Part C Section 7.2.1.3 and 7.2.2.3, which include a more detailed sediment balance for the Middle Susitna River Segment and further review of the sediment transport data to include data collected in 2014.

To clarify, the Services' discussion supporting this request for modification misrepresents the information provided in the ISR. The Services indicate that "The ISR states, in Section 4.3.2.1, the reach is in sediment transport equilibrium for coarse load (gravel and cobble)." Section 4 of the ISR is a methods section, not a results or discussion section. The first paragraph of Section 4.3.2.1 actually states that "The initial sediment balance for the Middle River Segment was developed based on the assumption that this reach is in sediment transport equilibrium for the coarse (gravel and cobble) size fractions…" This was describing the initial methods for estimating sediment loads and sediment balance. The third paragraph goes on to indicate that "A more detailed sediment balance will be developed in the next year of study for the Middle Susitna River Segment between the proposed Watana Dam site (PRM 187.1) and the Three Rivers Confluence (PRM 102.4) using available data, and when available, the hydraulic and sediment transport modeling results for this portion of the study reach."

In the modification request, the Services suggest a morphological approach be used as to estimate long-term bed load transport stating "The method … requires only historic aerial photos and periodic cross sections to estimate sediment volumes and fluxes…" As indicated in the third paragraph of Study 6.5 ISR Part A Section 4.3.2.1, "The volume of sediment from bank erosion will be estimated by comparing the channel location and areas developed in the Assess Geomorphic Change in the Middle and Lower Susitna River Segments study component and comparison of cross-sections surveyed from the 1980s with the 2012 cross sections" which is in fact part of the sediment balance derived from a morphological approach.

It is noted that the data available for the historical cross section comparison is limited and represents the sections surveyed in the 1980s. Initial comparison of current and 1980s cross sections was presented in the TM *Susitna River Historical Cross Section Comparison* (Tetra Tech, 2014c). The cross sections and bed profile comparisons showed relatively little bed change from the 1980s to present, indicating that this is a minor component of the sediment budget. The primary data source for developing the volume of sediment from bank erosion will be the turnover analysis presented in the TM *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials* (Tetra Tech, 2014d).

The Services conclude that "License participant [sic] have no way of knowing whether the study was conducted under anomalous sediment supply and transport conditions or not." However, the Services do not suggest the conditions actually were anomalous, and apparently do not consider the consistency of the data collected in the 1980s and in the last few years of sediment loads (Tetra Tech 2014b) and cross sections (Tetra Tech 2014c) as evidence to the contrary.

The estimated cost of implementing this modification is $500,000.

2.3.1.3.3. Response to Modification Request Regarding Accounting for Changes in Sediment Supply Due to Receding Glaciers

NMFS (Modification 3-3; NMFS_pp6.5-3_ph8) and USFWS (Modification 3-3; USFWS_pp6.5-3_ph8) request FERC to require AEA to use information from the implementation of the modifications the Services requested to the Glacier and Runoff Study (RSP Section 7.7) to help predict changes in sediment supply. In particular, the request states that the study was not conducted per the approved study plan because a potentially major source of changes in sediment supply (glaciers receding) was ignored.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

As an initial matter, AEA would like to point out that the contribution of glacial runoff to the Middle River is relatively small. Approximately 5.9 percent of the basin area above the proposed Watana Dam site is covered by 5 major and about 50-60 small glaciers that produce about 13 percent of the annual flow at Gold Creek. Therefore, the contribution of additional sediment supply from the recession of glaciers is also relatively small. Secondly the current and historical (1980s) sediment transport measurements performed by the USGS inherently to some extent account for recent and current rates of glacial recession. The glaciers in the basin have been in a state of retreat from their Neoglacial maxima for the last 100-200 years (Molnia 2008). Based on USGS measurements at the Denali Highway gauge, the average annual suspended sediment load derived from the Susitna glaciers is about $3.6x10^6$ tons, the concentrations vary from about 100 mg/l to 6,000 mg/l (annual average 1000 mg/l) and the composition is 57 percent silt and clay and 43 percent sand. The coarser fractions (gravels and above) are deposited in the braid plains proximal to the glacier termini and this was confirmed by field reconnaissance of the Upper River from the Denali Bridge to the Watana Dam site (Tetra Tech 2015a). Further retreat of the glaciers will merely displace the zone of gravel deposition closer to the glacier terminus and the existing downstream geologically-controlled sediment deposition zones (inland deltas) will still control the downstream sand-sized sediment flux. Evaluation of the potential sedimentation effects of glacier surges (Tetra Tech 2014e) clearly demonstrated that even an assumed order of magnitude increase in sediment concentration for an entire open-water season would have minimal effects on sediment supply and reservoir longevity. If sediment yields are increased from the tributary glaciated basins (Talkeetna, Chulitna and Yentna Rivers), they will tend to further offset reductions on the mainstem Susitna.

The estimated cost of implementing this modification is $300,000 to $400,000.

2.3.1.3.4. Response to Modification Request to Collect Sediment Transport Data on Tributaries

SRC et al. (SRC_etal_WATER_pp12_ph3) comment that AEA lacks the field data necessary to understand the sediment balance in the Middle River. Additionally, they comment (SRC_etal_WATER_pp13_ph1) that AEA lacks the data necessary to understand how morphology and habitat quality of the Susitna River will change at tributary mouths. They therefore request (Modification; SRC_etal_WATER_pp14_ph3) that given the importance of tributaries and off channel habitats to salmon in the Susitna system, AEA should not rely on 30-year old sediment bed load data for only 2 out of 22 tributaries in the Middle River to model impacts to these critical habitats. To properly evaluate potential post-Project effects on habitat in the mainstem and the tributaries and meet the FERC-approved study objectives for 6.5 and 6.6, SRC et al. state that AEA should collect actual sediment transport data on each of the tributaries where fish are present and request that FERC require AEA collect additional bed load sediment data at Tsusena Creek and other important tributaries where fish are present.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

The modification request is not necessary because Study 6.5 Study Component 3 is ongoing and the sediment loading from the small, ungaged tributaries will be accounted for as part of the sediment balance in the Middle River. As indicated in the RSP Section 6.5.4.3.2.2, "Tributary sediment loading will be estimated as part of the Fluvial Geomorphology Modeling Study (see RSP Section 6.6.4.1.2.6)." To accomplish this, as described in RSP Section 6.6.4.1.2.6, AEA will perform "Surveys of tributary channel geometry and sampling of the bed material gradation will be coupled with an appropriate bed material transport function to calculate sediment yield rating curves." AEA has collected surface (armor) and subsurface bed material samples at 22 Middle and Lower River tributaries. The subsurface samples were collected at the tributary fans and represent the gradation of the tributary supply that will be used as input to the 1-D bed evolution model and 2-D bed evolution models for tributaries within Focus Areas. The armor limits sediment transport in the tributaries until flows exceed the threshold for bed mobilization. Bed load transport can be reasonably estimated based on bed load calculation, and therefore, AEA has collected cross sections and bed material samples to allow calculation of bed load transport rates over a range of flows. The Model Development TM (Attachment 1 to the Study 6.6 SIR) includes an example of the method for evaluating the morphology of tributary mouths, including sediment transport, for existing and with-Project conditions. The example (Skull Creek) was performed using 1-D and 2-D methods to demonstrate that the results are consistent.

This approach being implemented by AEA is mischaracterized by SRC et al. in their modification request, which indicates that rating curves from 2 tributaries (Indian River and Portage Creek) will be applied to all tributaries. In fact, each of the 22 tributaries have channel surveys and bed material samples that will be used with appropriate transport functions to calculate individual sediment rating curves. Indian River and Portage Creek have measured data that will be used to validate the procedure, but their rating curves will not be applied to the other twenty tributaries.

It is also unclear why SRC et al. considered Tsusena Creek to be important to fish resources in the Susitna River. Tsusena Creek is a relatively small clearwater tributary to the Susitna River at PRM 184.6, upstream from Devils Canyon above which only a few Chinook Salmon and no other anadromous fish pass. It has a drainage area of 145 square miles and an average wetted width of 11.4m (37.4 ft) (Study 9.9 SCR). While Chinook Salmon, Arctic Graying, Dolly Varden, Longnose Sucker, Sculpin, and Round Whitefish have all been documented (Study 9.6 SIR, Table 5.1-1) in the lowermost reach, there is an approximately 60-foot high waterfall at about TRM 3.8 completely blocking any upstream passage (Study 9.12 ISR Table 4.3-2).

Most importantly, collecting additional bedload data at tributaries is also unlikely to provide useful data. This is because the tributary beds are generally not mobilized except for very high flow conditions. Mobilizing for field work at a large number of tributaries at a brief period of sufficiently high flow is not feasible. Therefore, the methodology presented in RSP Section 6.6.4.1.2.6 represents the more robust and implementable methodology than that in the SRC et al. modification request.

The cost of attempting to conduct this study to collect meaningful data would be on the order of $2,000,000 to $4,000,000 assuming data were collected over a 2-year period and 10 to 20 tributaries were sampled 4 to 5 times per year.

2.3.1.4. Objective 4: Assess Geomorphic Stability/Change in the Middle and Lower Susitna River Segments.

There were no comments or modifications for Objective 4.

2.3.1.5. Objective 5: Characterize the Surface Area Versus Flow Relationships for Riverine Macrohabitat Types (1980s Main Channel, Side Channel, Side

Sloughs, Upland Sloughs, Tributaries and Tributary Mouths) over a Range of Flows in the Middle Susitna River Segment

2.3.1.5.1. Response to Modification Requests to Collect Additional Aerial Photography to Document the Lateral Extent of the River

The SRC et al. (SRC_etal WATER_pp11_ph3), NMFS (Modification 5-1; NMFS_pp6.5-3_ph9) and USFWS (Modification 5-1; USFWS_pp6.5-3_ph9) request AEA to take aerial photos to document the Susitna River's lateral extent in the Middle River at the range of flows that AEA intends to discharge from the dam. To date the photos are at a single flow, 12,500 cfs. The SRC et al. (SRC_etal_WATER_pp09_ph3) further comments that AEA lacks sufficient data to characterize habitat versus flow relationships and (SRC_etal_WATER_pp10_ph1) AEA lacks data to support a stage-exceedance analysis of habitat versus stage relationship for the Middle River. The SRC et al. therefore requests that AEA should, in addition to, or in lieu of, collecting additional aerial photography in the Middle River at low flows, collect at least one full year of stage-discharge information for the Middle River to fill important data gaps. The SRC et al. (SRC_etal_WATER_pp10_ph4) comments that the lack of aerial photography at low flows or winter flows creates a data gap and prevents AEA from understanding interactions of ice with main-channel and side-channel habitats and potential impacts to salmon habitat under post-Project conditions.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Further this request is not necessary to meet the objective of this Study to "Characterize the surface area versus flow relationships for riverine macrohabitat types over a range of flows in the Middle Susitna River Segment". In the RSP, the methodology to achieve this was identified as using aerial photography at various flow ranges. However, as explained in the variance presented in Study 6.5 ISR Part A, Section 4.5.3 and Study 6.5 SIR Section 4.5.1, alternative methods are available to achieve this objective using the 1-D reach-scale and 2-D local-scale modeling identified in RSP Sections 6.6.4.1 and 6.6.4.2. AEA's proposed method will meet this study plan objective and avoid the additional expense associated with the Services' and SRC et al.'s proposed modification.

The information requested in the above modification was part of the Study Plan (RSP Section 6.5.4.5.2.1) which had included plans to collect aerial photography at flows of approximately 23,000, 12,500 and 5,100 cfs in the Middle River in order to develop wetted macrohabitat versus flow relationships to support the Fish and Aquatics Instream Flow Study (8.5). However, as implementation of the Geomorphology Studies and the Fish and Aquatics Instream Flow Study progressed, it was evident that development of the wetted habitat area versus flow relationships from aerial photography were not necessary given the current approach to apply two-dimensional (2-D) modeling in Focus Areas to quantify the aerial distribution of habitat conditions in the main channel and lateral habitats of the Middle River. Therefore, a variance was identified in the Study 6.5 ISR Section 4.5.3 and subsequently proposed as a modification by AEA to Study 6.5 (ISR Part C Section 7.1.2.5) that the aerial photography in the Middle River to quantify habitat versus flow relationships would only be collected at the single flow. To develop the habitat versus area relationships, the 2-D model results quantifying habitat area versus flow in the Focus Area will be extrapolated to the remainder of the Middle River using the habitat mapping developed in the

Characterization of Aquatic Habitats Study (9.9), water surface elevations from the 1-D model and the breaching flow elevation surveys to be conducted throughout the Middle River (Study 6.6 ISR Part C, Executive Summary, page v). The variance and the alternative approach were presented at both the September 25, 2013 and December 2, 2013 Technical Work Group meetings.

The use of aerial photography to develop macrohabitat versus flow relationships originally identified in the RSP and requested in the above modification was used in the 1980s when extensive numerical modeling was not available. In contrast, 1-D and 2-D models have been developed for the Middle River as a whole and for the FA's, respectively. These calibrated models provide the necessary information to establish the lateral extent of the various macrohabitat types over a range of flows throughout the Middle River segment. The use of combined 1-D and 2-D modeling approach provides the ability to analyze the macrohabitat versus area over a larger range of flows than the originally proposed aerial photography and is also compatible with the application of the 2-D bed evolution modeling which may be used to adjust the geometry in the Focus Areas over the 50-year analysis period. The aerial photography based approach assumes conditions will not change over time and is therefore not compatible with the overall analysis approach which recognizes the habitat area versus flow relationships may not be temporally static.

The SRC et al. modification request also contends that the aerial photographs are needed to accurately calibrate the HEC-RAS model. AEA does not agree that this use of the aerial photography is necessary. AEA has developed a robust set of data to calibrate the 1-D HEC-RAS model (Tetra Tech 2015b, Appendix A, Sections 2.4 and 3.4) as well as the 2-D Hydraulic and BEM models (Tetra Tech 2015b, Appendix B, Sections 2.3). The data includes individual point-in-time water surface elevations as well as continuous water surface elevation recordings throughout the Middle River, including in the Focus Areas. AEA has demonstrated the success in calibrating the hydraulic models using the data set flows spanning the range of observed open water flow period discharges (Tetra Tech 2015b).

The SRC et al. comment that collection of aerial photography is needed to characterize winter-time conditions is not valid. The use of aerial photography collected during the open water flow period would be of no use in characterizing flow conditions in the winter under ice as the effect of "staging" from the added resistance of the ice, creates much higher water surface elevations during the ice cover period than the open water period. On the other hand, collection of aerial photographs in the winter would not reveal the extent of area that is inundated as this is hidden by the ice cover. Instead, AEA's approach is detailed in the Ice Processes Study (7.6) and combines the use of the 1-D ice processes model with the 2-D ice process model in the Focus Areas to determine the extent of inundation and potential breaching of lateral habitats for various Project operational scenarios (RSP Study 7.6 Section 7.6.4.6 through Section 7.6.4.8 and RSP Study 8.5 Section 8.5.4.6.1.1).

AEA does not agree with this modification request. The objectives of the study component will be met without collecting the additional aerial photography over a range of flows requested in the above modification. As stated above, the approach to only collect aerial photography at a single flow was originally presented at the September 25, 2013 and December 2, 2013 Technical Work Group meetings, identified by AEA as a variance in the Study 6.5 ISR Part A, Section 4.5.3, subsequently proposed by AEA as a modification in Study 6.5 ISR Part C Section 7.1.2.5.

The estimated cost of implementing this modification is $400,000 to 600,000.

2.3.1.6. *Objective 6: Conduct a Reconnaissance-level Geomorphic Assessment of Potential Project Effects on the Lower and Middle Susitna River Segments Considering Project-related Changes to Stream Flow and Sediment Supply and a Conceptual Framework for Geomorphic Reach Response*

2.3.1.6.1. *Response to Modification Request to Perform a Literature Review in the Manner of Kellerhals and Gills*

NMFS (Modification 6-1; NMFS_pp6.5-3_ph10) and USFWS (Modification 6-1; USFWS_pp6.5-3_ph10) request AEA to perform a literature review in the manner of Kellerhals and Gill (1973) in order to provide case histories and experience related to downstream effects of dams in northern climates.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

The Services' comments on the *Dam Effects on Downstream Channel and Floodplain Geomorphology and Riparian Plant Communities and Ecosystems – A Critical Literature Review TM* (R2 Resource Consultants, Inc. and Tetra Tech, Inc. 2014) under Study 8.6 are contradictory to this request. The Services provided the following comments to the Riparian IFS Study 8.6 (USFWS_pp8.6-1_ph5 and NMFS_pp8.6-2_ph3): "Objective 1: Literature Review of Dam effects on Downstream Vegetation - Study methods are appropriate, and merging the review with the Fluvial Geomorphology Study (6.6) review into a single technical memorandum (R2 Resource Consultants, Inc. and Tetra Tech, Inc. 2014) resulted in a better product."

Notwithstanding this apparent contradiction, AEA believes that the approach to include ice effects (first order) 4-level hierarchical approach (Burke et al. 2009) that was employed in the *Dam Effects TM* (R2 Resource Consultants, Inc. and Tetra Tech, 2014) provides a better and more robust framework with which to evaluate the likely downstream geomorphic effects of dams in general and the proposed Watana Dam in particular than the use of case studies as identified in the modification request. As noted in the Services' review, the inability to precisely predict downstream dam impacts is largely due to the presence of exogenous factors including geological controls and the geomorphic history of the river as was clearly demonstrated by Grant et al. (2003). The extensive literature review does encompass the world-wide literature on dams and their downstream effects in northern climates, including the extensively cited results of years of research and observations on the Peace River in Canada (Church and Christopher 2015). Reliance on case histories and experience with other rivers (Kellerhals and Gill 1973) to predict the effects of the Watana Dam on the Susitna River downstream of the proposed dam site is inherently hampered by the singularity of each river (Schumm 1991; Grant et al. 2003), especially given the complexity and multiplicity of controls that have been documented for the Susitna River (Tetra Tech, 2015a). Consequently, AEA does not agree with this modification request.

The estimated cost of implementing this modification is $50,000 to $100,000 without any additional value in meeting the objective of the FERC-approved Study Plan.

2.3.1.6.2. Response to Modification Request to Use Case Studies to Provide Reconnaissance Level Assessment of Project Effects

NMFS (Modification 6-2; NMFS_pp6.5-4_ph1) and USFWS (Modification 6-2; USFWS_pp6.5-4_ph1) request AEA to use a range of methods from the literature review, case histories from past projects, and site-specific analysis to provide reconnaissance level assessment of Project impacts.

The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. This request raises questions with the Study Plan itself, and not AEA's implementation. AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan.

AEA has already provided a reconnaissance level assessment of Project impacts based on the hierarchical assessment in Tables 5.11-1, 5.11-2 and 5.11-3 in Study 6.5. SIR. Table 5.11-1 provides the key used in the two following tables. Table 5.11-2 characterizes the likely First Order effects on river morphology for the three river segments and Table 5.11-3 characterizes the likely Second Order effects on river morphology for the three river segments. Information on Project effects presented so far in the Study 6.5 and 6.6 SIR and various technical memoranda is initial in nature and has been primarily used to illustrate analysis approaches and to support refinement of data collection and Study Plans such as the decisions on the downstream limits of the Fluvial Geomorphology Modeling Study (6.6). AEA will continue to develop more detailed assessment of Project effects through the combination of application of bed evolution modeling in the Fluvial Geomorphology Modeling Study (6.6) Component 2 *Model Existing and with-Project Conditions*, integration with the Geomorphology Study (6.5) under Study Component 11 *Integration of Fluvial Geomorphology Modeling with the Geomorphology Study* (RSP Section 6.5.4.11), and Study 6.6 Study Component 3 *Coordination and Integration of Model Results*. In making the request for the modification, it appears the Services have ignored the work that will be performed in Study 6.6 to model the mainstem and tributary fans in the Middle and Lower Susitna River segments and the integration with Study 6.5. The tasks in Study 6.5 are not the sole basis for evaluating Project effects. In fact, a significant purpose of Study 6.5 purpose is to provide a geomorphic context to help in interpreting the model results. Project effects will be evaluated after the studies have been completed and will be provided in the License Application.

The estimated cost of implementing this modification is $150,000 to $300,000, without any improvement in meeting the objectives of the FERC-approved Study Plan. The FERC-approved studies are designed to gather baseline data. Comprehensive analyses from all data gathered from interrelated studies will occur to assess potential Project analysis. The impact assessment will be presented in the License Application.

2.3.1.7. Objective 7: Conduct a Phased Characterization of the Surface Area Versus Flow Relationships for Riverine Macrohabitat Types in the Lower Susitna River Segment

2.3.1.7.1. Response to Modification Request to Collect Additional Aerial Photography in the Lower River

NMFS (Modification 7-1; NMFS_pp6.5-4_ph2) and USFWS (Modification 7-1; USFWS_pp6.5-4_ph2) request the collection of additional aerial photos from the Yenta Confluence to Talkeetna to document the rivers lateral extent at the range of flows that are likely post project

AEA requests that FERC not adopt this proposed study plan modification because this request is not necessary to meet the objective of this Study to "Conduct a phased characterization of the surface area versus flow relationships for riverine macrohabitat types in the Lower Susitna River Segment." As a phased approach, this Study had a decision point as to whether to continue efforts to develop habitat area versus flow relationships for the Lower River. As explained in Study 6.5 SIR Section 7.1.1.7, AEA concluded this information is not necessary.

The purpose of collecting multiple aerial photography is to develop habitat versus flow relationships. However, there are no plans in the Fish and Aquatics IFS (8.5) to evaluate either existing conditions or with-Project conditions habitat in the Lower River through the use of habitat versus flow relationships. In the RSP Section 6.5.4.7 it is stated:

> *The goal of this study component is to conduct an initial assessment of the potential for Project effects associated with changes in stage to alter Lower Susitna River Segment riverine habitat. This effort was conducted in 2012. If the decision is made to continue detailed studies of Project effects into the Lower Susitna River, then this effort will be expanded to include mapping of the 1980s aquatic macrohabitat type in the Lower Susitna River Segment and the development of the wetted macrohabitat versus flow relationships.*

The initial assessment was performed and presented in the technical memorandum *Synthesis of 1980s Aquatic Habitat Information. Susitna-Watana Hydroelectric Project* (Tetra Tech 2013b) and it was decided that a detailed assessment of Project effects similar to that being conducted in the Middle River was not warranted in the Lower River and aerial photography at two additional discharges would not be collected. The decision is presented in the Study 6.5 ISR Section 4.7.2.5 and SIR Section 7.1.1.7. It is also explained in Study 6.5 ISR Part A, Section 4.7.3 that not collecting aerial photography at multiple discharges is not considered a variance from the FERC-approved Study Plan as it was an optional task dependent on the results.

The estimated cost of implementing this modification is $600,000 to $1,000,000.

2.3.1.8. Objective 8: Characterize the Proposed Watana Reservoir Geomorphology and Changes Resulting from Conversion of the Channel/Valley to a Reservoir

2.3.1.8.1. Response to Comment Recommending Additional Tributary Data Collection above the Dam Site

SRC et al. (SRC_etal_WATER_pp13_ph5) comments that additional data on tributaries above the dam site should be collected in order to evaluate sediment inflows to the reservoir and that the data should consist of actual measurements of sediment transport.

This comment is similar to the modification request by the SRC et al. (SRC_etal_WATER_pp14_ph3) to collect actual sediment transport measurements on the tributaries in the Middle River. AEA's response is similar to that provided to the modification request in Section 2.3.1.3.4. Rather than collecting actual sediment transport measurements as suggest by SRC et al., AEA will characterize sediment inflow in the reservoir tributaries by surveying cross sections and collecting bed material samples in order to calculate bed load transport (RSP Section 6.5.4.8.2.2). Collecting actual bedload data at tributaries, as suggested by SRC et al. is unlikely to provide useful data. This is because the tributary beds are generally not mobilized except for during brief periods of very high flow conditions. Mobilizing for field work at a large number of tributaries at a brief period of sufficiently high flow is not feasible. Additionally, the likelihood of sufficient number of flows to create meaningful sediment transport rating curves occurring in the next year of study is low. Therefore, the methodology presented in RSP Section 6.5.4.8.2.2 represents the more robust and implementable methodology than that suggested by SRC et al.

2.3.1.9. Objective 9: Assess Large Woody Debris Transport and Recruitment, Their Influence on Geomorphic Forms and, in Conjunction with the Fluvial Geomorphology Modeling below Watana Dam Study, Effects Related to the Project

There are no comments or requests pertaining to Objective 9.

2.3.1.10. Objective 10: Characterize Geomorphic Conditions at Stream Crossings Along Access Road/Transmission Line Alignments

There are no comments or modification requests pertaining to Objective 10.

2.3.1.11. Objective 11: Integration with the Fluvial Geomorphology Modeling below Watana Dam Study to Develop Estimates of Project Effects on the Creation and Maintenance of the Geomorphic Features that Comprise Important Aquatic and Riparian Macrohabitats and Other Key Habitat Indicators, with Particular Focus on Side Channels, Side Sloughs, and Upland Sloughs

2.3.1.11.1. Response to Modification Request to Use Information from Study 6.5 to Validate Model Predictions

NMFS (Modification 11-1; NMFS_pp6.5-4_ph3) and USFWS (Modification 11-1; USFWS_pp6.5-4_ph3) request AEA to utilize information from Study 6.5 to test and validate the accuracy of long-term (decadal) predictions from the numerical models and utilize geomorphic methods to make predictions of channel response to changes in sediment supply and discharge so as to provide independent checks on the model predictions.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the independent checks on the model results suggested in the modification request are already incorporated in the FERC-approved Study Plan, so this study modification is unnecessary.

Study 6.5 Component 11 *Integration of Fluvial Geomorphology Modeling with the Geomorphology Study* and the corresponding Study 6.6 Component 3 *Coordination and Interpretation of Model Results* were established in the RSP to accomplish what is the Services are requesting as a modification to the Study Plan. RSP Section 6.5.4.11.2 states "Results from the previously described Geomorphology Study components will be compiled and used by the Fluvial Geomorphology Modeling Study team to guide development of the models and interpretation of the model results." RSP Section 6.6.4.3 states "The goal of this study component is to ensure that the information from the Geomorphology Study is properly considered and incorporated into the modeling studies, that the results of the modeling studies are used to update and refine the understating of key processes identified in the Geomorphology Study…" The interaction is not limited to just Study Component 11, but is part of the each of the Study 6.5 study components.

In the discussion associated with this modification request, the Services make several unfounded criticisms of the geomorphology study such as lack of integration with the Fluvial Geomorphology Study (6.6) including assessment of whether the system is in dynamic equilibrium, failure to define key geomorphic processes to help guide Study 6.6, and conflicting assessment of potential Project effects, none of which are supported by the record.

AEA strongly disagrees with these criticisms. As an example of the interaction between Study 6.5 and 6.6, in order to evaluate whether the identified segments (Upper, Middle and Lower) of the Susitna River are currently in a state of dynamic equilibrium, the Geomorphology Study 6.5 expended considerable time and resources to making field observations and measurements from upstream of the actual Project reach starting at the Denali Highway Bridge (PRM 292) downstream to Cook Inlet (PRM 3). Data and observations from the field work were integrated with the output from 1- and 2-D hydrodynamic models (Study 6.6) to assess the question of dynamic equilibrium. This included a 10-day raft-based reconnaissance by AEA's (Tetra Tech) lead geomorphologist and field crew from the Denali Highway crossing of the Susitna River (PRM 292) to the Watana Dam site (PRM 187). As part of this effort, lateral controls of the channel planform, sediment storage zones and the caliber of the stored sediments, erosional areas, and areas of active landslides (sediment sources), tributary sediment contributions and ice effects were mapped for the entire Upper Susitna River Segment (Study 6.5 SIR Section 5.1.3). A major conclusion from the Upper River segment work was that the primary sediment size delivered to the proposed reservoir is sand that is mainly derived from the active glaciers in the Susitna River headwaters and lateral erosion by the river of Pleistocene-age glacio-fluvial and glacio-lacustrine deposits. This helps explain and is consistent with the observation from the Fluvial Geomorphology Modeling Study (6.6) that sediment transport is dominated by sand sized sediment in the Middle River (Tetra Tech, 2015b).

Table 4.6-1 of Appendix A of the FGM Development TM (Tetra Tech 2015b) shows that USGS measured bed material sediment transport rates were 99 percent sand. Figure 4.6-1 compares the sediment transport to the bed material gradations. The bed material is predominantly gravel and cobble sized material but the sediment in transport is predominantly sand.

Field investigations by boat and on the ground of the entire Middle River Segment, including the 10 Focus Areas, as well as a substantial portion of the Lower River segment, were used to identify, locate and characterize geologic (bedrock) and geomorphic (alluvial fans and relic coarse grained and primarily ice-derived deposits) controls, sediment sources and the sizes of sediments delivered to the river by tributaries and lateral erosion of primarily Pleistocene-age glacial, fluvio-glacial and glacio-lacustrine deposits, the elevations and sediment composition of bar, vegetated island, floodplain and terrace geomorphic surfaces, gradations of bar head and bank sediments, the effects of ice on channel and floodplain morphology and sedimentology, the relationship between geomorphic surfaces and the age and composition of the riparian vegetation.

All of the field-derived observations and data were integrated to develop an understanding of the existing geomorphic conditions within the Upper, Middle and Lower river segments (Study 6.5 ISR Part A Section 5.1.3, Study 6.5 SIR Section 5.1.3, and Tetra Tech, 2015a). Of great significance to the effort is the level of vertical and lateral control in the Middle River. The results of the Fluvial Geomorphology Modeling Study (6.6) have been consistent with these observations based on the initial 50-year simulations showing that there is very little vertical change in the channel identified in the 1-D BEM for both existing and with-Project conditions (Tetra Tech 2015b, Section 5.1.3, Bed Change).

Field mapping of identified and dendrochronologically-dated geomorphic surfaces throughout the Middle River segment, including the 10 Focus Areas, was integrated with the water-surface elevations for various return period peak flows developed by the 1-D hydraulic model (Study 6.5 ISR Part A, Section 5.1.3.5.5 and Study 6.5 SIR, Section 5.1.3) to identify the late –Holocene, post Little Ice Age, dynamics of the river. This analysis indicated that the river degraded to its present elevation throughout the Middle River in the last few hundred years and that extensive areas of the valley bottom are in fact terraces that are higher than the 100-year open water-surface elevation. This effort has been closely integrated with the Riparian IFS (Study 8.6).

Integration of the observations and results of the Geomorphology studies (Study 6.5 and 6.6) as well as the Riparian IFS (Study 8.6) and Ice Processes study (Study 7.6) has enabled the role of ice as a geomorphic agent to be established for the three segments of the Susitna River. The Upper River segment is ice-dominated and ice-driven. Vegetation trim lines are frequently observed at elevations 15-20 feet above the summer open-water surface elevations. The Middle River segment has a mixed ice and fluvial regime. Field identification of geomorphic surfaces in the valley bottom (Study 6.5) coupled with the results of 1- and 2-D hydrodynamic (Study 6.6) modeling has shown that the bankfull capacity of the channel greatly exceeds the 1.5 to 5-yr recurrence interval peak flows that are generally associated with a fluvially dominated river system. Field observations and the results of the Riparian IFS (Study 8.6) and Ice Processes (Study 7.6) studies have clearly demonstrated that floodplain vertical accretion and vegetated island and terrace dissection are, depending on location, strongly influenced by ice processes that include ice-jam formation and backwater flooding as well as ice-jam dam break flooding. The Lower River segment is fluvially dominated because of the extensive width of the valley bottom that mitigates the hydraulic and sedimentological effects of local ice-jam formation and failure. Hydraulic modeling (Study 6.6) showed that the bankfull capacity of the channel is on the order of the 2-yr peak discharge (Model Development TM, 2015) which when coupled with the aggradational status of the segment argues strongly for a fluvially-dominated regime in the Lower River.

Comparative thalweg data (1980s and 2013/2014) show the bed elevation to be vertically very stable over the last 30 years (Tetra Tech, 2014c), which is entirely consistent with the geomorphic observations in the Middle River segment (Study 6.5 ISR Part A, Section 5.1.3.1) and the results of incipient motion from Study 6.5 (Tetra Tech 2014b) and sediment transport modeling conducted in Study 6.6 (Tetra Tech 2015b). Turnover analysis in the Middle River (Tetra Tech 2014d) also indicates that the rates of erosion and deposition have been very low over the last 60 years, a further indication that the Middle River segment is not very geomorphically active under existing conditions, most likely the result of the extensive influences of exogenous factors and inherently low sediment loads (R2 Resource Consultants, Inc. and Tetra Tech 2014).

All of these examples of study integration between Studios 6.5 and 6.6 and many more presented in the 21 Study 6.5 and 6.6 Technical Memorandums, the ISR and the SIR all clearly demonstrate the integration between the two studies as well as significant incorporation of the knowledge gained in the Geomorphology Study (6.5) to support the Fluvial Geomorphology Modeling Study (6.6) on the important topics of the equilibrium state of the system and key geomorphic processes dictating the system behavior as well as the two studies progressing together to develop an accurate and consistent assessment of the potential Project effects on the Geomorphology of the Susitna River.

There is no cost for implementing this modification as it is already part of the FERC-approved Study Plan.

2.3.1.11.2. Response to Modification Request Concerning the Application of the Effective Discharge in the Middle River

NMFS (Modification 11-2; NMFS_pp6.5-4_ph4) and USFWS (Modification 11-2; USFWS_pp6.5-4_ph4) request AEA provide details about how the lateral channel changes along the Middle River will be predicted if the effective discharge calculation is abandoned.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established “good cause” for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

First, the effective discharge calculation is not being abandoned as the Services have characterized. The effective discharge is often calculated by combining a sediment rating curve with a flow duration curve. It can also be calculated by summing the sediment transport rates from a sediment transport model over the duration of the run. As explained in the Study 6.5 ISR Part D, Section 7.2, as a modification to the FERC-approved Study Plan, AEA proposed to not calculate effective discharge in the Middle River because the sediment rating curve will be significantly altered due to sediment trapping in the reservoir, effective discharge is not likely a meaningful predictor of hydraulic geometry. Effective discharge is not the only way to evaluate the potential for lateral change in the Middle River. Relatively frequent annual peak flows are also often used with hydraulic geometry relationships to predict lateral channel changes (such as narrowing). In the low sediment supply with-Project condition in the Middle River, vegetation is expected to be the primary factor in channel "narrowing". As described in the RSP Section 6.6.4.3.2.2, "Vegetation can also contribute to channel narrowing by encroaching onto bars and islands and riverward growth of banks through trapping of sediments."

The discussion in the Services' modification request also refers to the 1-D BED (sic) as focused on answering questions about bed aggradation and degradation in the main channel and contends this will not provide useful information on Project effects related to salmon since the primary area of importance to salmon are the lateral habitats and "not the center of the main channel which might be currently 9' deep in August, aggrades or incises by two feet." We agree with several of the points in the Services' discussion, but disagree with the dismissal of the importance of the main channel response to the Project, since the aggradation or degradation in the main channel impacts the interaction with the lateral habitats. For precisely these reasons and the importance of the lateral habitats as salmon habitat, the modeling approach uses the 1-D BEM to determine the reach scale effects (aggradation, degradation, bed material size change in the main channel) of the Project and then applies the 2-D BEM at a much higher spatial resolution to assess the Project effects on a finer scale, including in the lateral habitats mentioned in the modification request discussion.

For additional detail on the combined application of the 1-D and 2-D BEM, refer to Study 6.6 SIR Attachment 1, 2014 Fluvial Geomorphology Model Development TM Sections 4.1.3 and 4.2.6.

AEA has a developed a rigorous and thorough modeling procedure in Study 6.6 that integrated with Study 6.5 addresses the Project effects on both the main channel and in the lateral habitats. Therefore, the modification request is not necessary to meet the overall objectives of the Geomorphology Studies to quantify the Project effects on the geomorphology of the Susitna River.

The estimated cost of implementing this modification is $100,000 to $200,000.

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2.3.2. Study 6.6 – Fluvial Geomorphology Modeling below Watana Dam Study

As established in the Study Plan (RSP Section 6.6.1), the goal of this study is to model the effects of the proposed Project on the fluvial geomorphology of the Susitna River to assist in predicting the trend and magnitude of geomorphic response. More specifically, the purpose of the modeling study, along with the Geomorphology Study (Study 6.5), is to assess the potential impact of the Project on the behavior of the river downstream of the proposed dam, with particular focus on potential changes in instream and riparian habitat. Whether the existing channel morphology will remain the same or at least be in "dynamic equilibrium" under post-Project conditions is a significant question in any instream flow study (i.e., is the channel morphology in a state of dynamic equilibrium such that the distribution of habitat conditions will be reflected by existing channel morphology, or will changes in morphology occur that will influence the relative distribution or characteristics of aquatic habitat over the term of the license? [Bovee 1982]). This key issue prompts four overall questions that must be addressed by the two geomorphology studies:

- Is the system currently in a state of dynamic equilibrium?
- If the system is not currently in a state of dynamic equilibrium, what is the expected evolution over the term of the license in the absence of the Project?
- Will and in what ways will the Project alter the equilibrium status of the downstream river (i.e., what is the expected morphologic evolution over the term of the license under with-Project conditions)?
- What will be the expected effect of the Project-induced changes on the geomorphic features that form the aquatic habitat and therefore are directly related to the quantity, distribution, and quality of the habitat?

The methods and results from the Geomorphology Study and the Fluvial Geomorphology Modeling below Watana Dam Study address these questions.

Specific objectives of the Fluvial Geomorphology Modeling below Watana Dam Study are as follows:

- Develop calibrated models to predict the magnitude and trend of geomorphic response to the Project.

- Apply the developed models to estimate the potential for channel change for with-Project operations compared to existing conditions.
- Coordinate with the Geomorphology Study to integrate model results with the understanding of geomorphic processes and controls to identify potential Project effects that require interpretation of model results. And support the evaluation of Project effects by other studies in their resource areas providing channel output data and assessment of potential changes in the geomorphic features that help comprise the aquatic and riparian habitats of the Susitna River.

Data collection has been completed and the modeling is ongoing. Several decision points from the RSP have been made, including the selection of the Focus Areas, tributaries, and representative hydrology, as well as the decision to not extend the 1-D BEM below PRM 29.9, as outlined in the *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 TM* (Tetra Tech 2014c).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 23, 2016, AEA plans seven modifications of the methods of this study:

1. use of Ackers White transport function instead of Wilcock Crowe;
2. inclusion of groundwater sources in FA-128 hydraulic models;
3. not considering PDO for selection of hydrology for representative wet, average and dry years;
4. excluding dimensionless critical shear as a parameter for the sensitivity analysis;
5. exclusion of Bank Energy Index (BEI) for channel bank erosion as ice breakup is primary driver;
6. extension of 2-D BEM modeling time period as necessary to evaluate tributary fan development; and
7. future decision to identify specific 2-D modeling scenarios at Focus Areas.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, Rebecca Long, TCCI, SRC et al., ADF&G, NMFS, and USFWS filed comments for Study 6.6. NMFS, USFWS, TCCI and SRC et al. also submitted 14, 14, 1, and 3 study modification proposals for Study 6.6, respectively. Note that NMFS and USFWS each request the same 14 Study Modifications for Study 6.6. AEA received no comments opposing AEA's proposed modifications to Study 6.6 outlined above. Two commenters (NMFS and USFWS) disagreed with the decision not to extend the 1-D BEM model past PRM 29.9, while one (ADF&G) agreed with the decision, as outlined in the *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 Technical Memorandum* (Tetra Tech 2014c), which was filed with FERC in September 2014. In the study modification requests for the Cook Inlet Beluga Whale Study (RSP Study 9.17) the Services also referred to their disagreement with the Study 6.6 decision not to extend the 1-D BEM downstream of PRM 29.9. AEA's responses to the comments can be found in Table 2.3.2-1 and below.

Responses to requests for study modification and comments for Study 6.6 are organized by study component, then by agency, individual, and organization. When applicable, comments that provide background on a study modification are included with the modification. In some cases, a requested study modification affects model development (study component 1) and modeling of operations (study component 2). These requests are included under study component 2. There are also requests for modification and comments that are more general in nature. These are included in Section 2.3.2.4.

Table 2.3.2-1. Study 6.6 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
	Objective 1	
NMFS_pp6.6-2_ph5; USFWS_pp6.6-2_ph5	*Modification 1-1 Compare the results of the 1-D and 2-D models across common cross sections and for various identical pre- and post-Project flow conditions.*	As explained below in Section 2.3.2.1.1, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of this modification is $40,000-$80,000.
NMFS_pp6.6-2_ph6; USFWS_pp6.6-2_ph6	*Modification 1-2 Provide detailed information on the fluvial morphology modeling capabilities of HECRAS (Hydrologic Engineering Center's River Analysis System) 5.0.0 (1-D model) and SRH-2D 3.0 (Sedimentation and River Hydraulics 2-D model) to demonstrate the real capabilities of both models.*	As explained below in Section 2.3.2.1.2, AEA requests FERC not adopt this proposed Study Plan modification. There is no cost for implementing this modification as AEA has already provided this information.
NMFS_pp6.6-3_ph9; USFWS_pp6.6-3_ph10	*1-D models underestimate sediment transport in gravel-bed rivers (Ferguson 2003), which could lead to underestimation of the effects of the proposed Watana Dam.*	AEA disagrees with this comment based upon the results of the initial model runs (Tetra Tech 2015a). These results show very good agreement between model results and the measured loads for sand sizes, which are predominantly suspended load, and gravel sizes, which move as bed load (Figures 3.4-1 through 3.4-10, Appendix A of Attachment 1, Tetra Tech 2015a). AEA will continue to evaluate model performance based on the recent and 1980s USGS bed load and suspended load sampling.
NMFS_pp6.6-3_ph11; USFWS_pp6.6-4_ph1	*The 1-D (HEC-RAS 5.0 Beta) and 2-D (SRH-2D 3.0 Beta) modeling software used for the bed evolution models in the November 2015 ISR Part D report, were Beta versions not widely used, tested or documented. There is no guarantee that the results presented in the ISR using these Beta versions can be replicated later using the final public release of the software. (HEC-RAS 5.0 was released in February 2016.)*	The model selection process was established in RSP Section 6.6.4.1.2.1, initially documented in the FGM Approach TM (Tetra Tech 2013 Sections 3.1.4 and 3.2.4) and finalized in the Updated FGM approach TM (Tetra Tech 2014a Sections 3.1.4 and 3.4.2). Further model development and application will be conducted with official release versions of the models available at the time. AEA will provide documentation of modeling results as the modeling data and software are updated in the USR.
NMFS_pp6.6-2_ph7; USFWS_pp6.6-2_ph7	*Modification 1-3 Limit the use of pass-through nodes to only Devils Canyon within the final version of the 1-D BEM.*	As explained below in Section **Error! Reference source not found.**, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the

Reference Number	Comment or Study Modification Request	AEA's Response
		criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp6.6-4_ph1; USFWS_pp6.6-4_ph2	*Preliminary 1-D geomorphology modeling results of the effects of the Watana Dam in the Middle River have been presented using HEC-RAS 5.0 Beta June 2014. Because of stability problems with the software, the model uses pass-through nodes on every island in the model including the Focus Areas, which is not acceptable.*	See Section 2.3.2.1.3.
NMFS_pp6.6-3_ph10; USFWS_pp6.6-3_ph11	*The 1-D bed evolution model (HEC-RAS 5.0 Beta) has been "calibrated" by comparing USGS measurements of transport rates with values computed by the 1-D model. However, this does not guarantee the 1-D model can provide reliable results of bed degradation, especially considering the excessive use of pass-through ('fixed-bed') nodes in the model.*	See Section 2.3.2.1.4.
NMFS_pp6.6-2_ph8; USFWS_pp6.6-2_ph8	*Modification 1-4 Improve the modeling approach to include a short reach of each tributary as a lateral branch in the 1-D model, such that tributary sediment loads are dynamically computed by the model taking into account the post-Project changes in both water levels and bed levels.*	As explained below in Section 2.3.2.1.5, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $500,000-$800,000.
NMFS_pp6.6-2_ph9; USFWS_pp6.6-2_ph9	*Modification 1-5 Describe tributary modeling in the Susitna Middle Reach that will incorporate dynamic feedback effects between the tributaries and the main stem.*	As explained below in Section 2.3.2.1.6, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $500,000-$800,000.
Long_160620_pp11_ph5	*The stakeholder concern is that of the 2 transects on the Chulitna River, only the results of the 1 transect can be used for various reasons. And the field work is complete. The concerns is how scientifically defensible is only 1 transect data-reading to represent the whole Chulitna River confluence?*	The comment concerns only the winter bed sampling, not overall sediment sampling or surveyed cross sections on the Chulitna and Talkeetna Rivers. RSP Section 6.6.4.1.9.1 introduced the idea for winter bed sampling during clear-water under ice conditions as a supplement to the bar- and island-head surface and subsurface samples. There were five surface and subsurface bed material samples collected on the Chulitna River and five surface and subsurface bed material samples collected on the Talkeetna River. The purpose of the winter bed sampling was to determine whether the channel bed was coarser than the sampled bar and island heads. Therefore, fewer winter bed samples were collected in general, and the primary focus of the winter bed sampling was on the

Reference Number	Comment or Study Modification Request	AEA's Response
		Susitna Middle River segment. The Chulitna and Lower Susitna River winter samples shows similar sizes to the bar-head samples for these locations, unlike the Middle Susitna River data that showed a much coarser bed. Winter bed sampling on the Susitna, Chulitna and Talkeetna Rivers was sufficient to achieve study objectives.
SRC_etal_WATER_pp15_ph3	*AEA is not properly modeling sediment transport.*	The discussion associated with this comment incorrectly indicates that AEA is using total annual runoff as a predictor of annual sediment transport and that total sediment transport will depend much more on peak runoff than on total. This is a mischaracterization of AEA's approach in Studies 6.5 and 6.6. In these studies, annual amounts are reported as this is a meaningful and efficient means of conveying sediment transport information. The analyses and modeling, however, actually use daily hourly values of flow integrated and simulated over 50 years, thereby capturing the complete range of magnitude and duration of river flows. The flows include the Susitna River and its major tributaries (Chulitna, Talkeetna, and Yentna Rivers) and most small, ungaged tributaries.
SRC_etal_WATER_pp17_ph1	*AEA should reevaluate the use of some models if the selected model is not capable of simulating the natural system.*	If AEA determines that some of the selected models are not capable of adequately simulating the required components of the natural system, then AEA would make that reevaluation as a study modification or variance. As suggested in the comment, AEA did not state that it would modify field data to "fit" model results, but that "model outputs will be used to modify, refine, quantify and validate field-based observations and key geomorphic processes". This was meant to indicate that, as part of the Study Plan, AEA plans on coordination between the geomorphology study (Study 6.5) and fluvial geomorphology modeling study (Study 6.6), and between these studies and other resource studies. The two geomorphology studies coordinate because models are imperfect and benefit from field observations and insights on geomorphic processes. Conversely, the interpretation of field conditions may be revised based on compelling model results.
	Objective 2	
NMFS_pp6.6-2_ph10; USFWS_pp6.6-2_ph10	*Modification 2-1 At each Focus Area, present 1-D model results of predicted bed levels for*	As explained below in Section 2.3.2.2.1, AEA does not object to FERC's adoption of this

Reference Number	Comment or Study Modification Request	AEA's Response
	each year over the 50-year simulation period. This data should be presented in terms of location specific curves showing time on the x axis and bed elevation on the y-axis.	proposed Study Plan modification, but only at the applicable geomorphic reach scale rather than at individual cross section areas within Focus Areas as NMFS requested. The estimated cost of implementing this modification as described by AEA at the appropriate geomorphic reach scale is $20,000 to $30,000.
NMFS_pp6.6-2_ph11; USFWS_pp6.6-3_ph11	*Modification 2-2 Replace or overhaul the Sediment Delivery Index (SDI) approach by using a more physically-based approach in order to develop a more robust assessment of pre- and post-Project accretion rates.*	As explained below in Section 2.3.2.2.2, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $50,000-$100,000.
NMFS_pp6.6-3_ph1; USFWS_pp6.6-3_ph2	*Modification 2-3 Account for and explain why sediment gradation along the deep portion of the channel is courser than that on the shallow bar heads, as reported in the WTSM.*	AEA does not object to FERC's adoption of this proposed Study Plan modification. AEA will add discussion as to why this is the case in the USR. The winter sampling of bed material (Tetra Tech 2014b) was performed to determine if the bar-head samples were representative of the channel bed. It was determined that the main channel bed was coarser than the bar head armor. The coarse bed in the channel appears to be a lag deposit of relatively immobile coarser material. If this modification is implemented, it would not add any significant costs to the Study.
NMFS_pp6.6-3_ph2; USFWS_pp6.6-3_ph3	*Modification 2-4 Extend some type of fluvial geomorphologic modeling from mile 29.9 to the Cook Inlet. NMFS agrees that the HEC-RAS based model may be an inappropriate tool for this extremely braided lowest reach which transitions into an estuary.*	As explained below in Section 2.3.2.2.3, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $800,000 to $1,200,000 for the initial model development and the existing conditions scenario. Each Project scenario would cost $250,000 to $400,000 to analyze. If 4 with-Project scenarios were analyzed, then the total cost of this modification request would be $1,800,000 to $2,800,000.
NMFS_pp9.17-11_ph1	*Modification 3c (from Study 9.17): NMFS recommends that the modeling of channel morphology be extended to the mouth of the river and that tidal hydrodynamic modeling be completed under a range of likely reservoir operation scenarios and including an evaluation of changes in ice formation be completed for the lower 29.9 miles of the Susitna River. This is described and justified in Study 6.6, Modification 2-4.*	This is the same modification request as NMFS Study 6.6 Modification 2-4. As explained below in Section 2.3.2.2.3, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $800,000 to $1,200,000 for the initial model development and the existing conditions scenario. Each Project scenario would cost $250,000 to $400,000 to analyze. If 4 with-Project scenarios were analyzed, then the total cost of this modification request would be $1,800,000 to $2,800,000.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp6.6-3_ph3; USFWS_pp6.6-3_ph4	*Modification 2-5 Assess the sedimentation and development of deltas at the mouth of the mainstem (e.g., head of the reservoir) and reservoir tributaries.*	AEA agrees that the tributary deltas in the reservoirs need to be evaluated in terms of delta formation. AEA already included the work requested in this modification as part of the FERC-approved Study Plan for Study 6.5 (not Study 6.6) for selected tributaries in the reservoir (RSP Section 6.5.4.8) with the final selection of tributaries presented in the ISR (Study 6.5 ISR Part C, Section 7.1.1.8 and Table 7.1-1). AEA also already proposed a modification to the FERC-approved Study Plan for Study 6.5 (not Study 6.6) to add 1-D BEM modeling of the mainstem at the head of the reservoir, as described in Study 6.5 SIR Section 7.2.3. As such, there is no need to adopt the proposed modification to Study 6.6. Although the assessment of the sedimentation at the head of the reservoir will involve development of a 1-D BEM, the modification was proposed to Study 6.5 since overall assessment of reservoir geomorphology is performed under Study 6.5. The estimated cost of implementing AEA's proposed modifications to Study 6.5 are $400,000-$500,000.
NMFS_pp6.6-3_ph4; USFWS_pp6.6-3_ph5	*Modification 2-6 Re-evaluate how throughput load and bed load interact to move sand and gravel between Talkeetna and Mile 40.*	As explained below in Section 2.3.2.2.4, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp6.6-4_ph2; USFWS_pp6.6-4_ph3	*The 1-D modeling results in the Lower Susitna River show the largest dam impacts (bed changes) farther downstream in the river, which does not seem physically realistic.*	AEA disagrees with this interpretation of the results. See Section 2.3.2.2.5.
TCCI_pp04_ph2	*Modification: TCCI requests that AEA provide 2D modeling of at least the immediate confluence mouths of the Susitna, Chulitna, and Talkeetna Rivers to adequately assess project related changes which could affect the safety of downstream communities. We are particularly concerned with the effects of the elevated winter flows (potentially 10, 000 cfs) under ice conditions proposed in the load following operations model. TCCI requests the BEI be applied to the confluence area.*	This modification request involves Study 6.6 and Study 7.6. As previously explained in Section 2.3.2.2.6 (Study 6.6) and below in Section 2.4.2.2.4, AEA does not object to FERC's adoption of part of this modification request. The estimated cost of implementing the entire modification as requested is $2.5M to $3.5M. The estimated cost of implementing the portion for which AEA has no objection to is $750,000 to $900,000 with the geomorphic portion (Study 6.6) estimated at $500,000 to $600,000 and the ice portion (Study 7.6) at $250,000 to $300,000.
TCCI_pp04_ph3	*TCCI requests a comprehensive analysis of the Three Rivers Confluence which include the*	See Section 2.3.2.2.6.

Reference Number	Comment or Study Modification Request	AEA's Response
	potential for erosion, winter sediment and ice transport and all other geomorphic project related effects - most of which 1D modeling cannot simulate. .. TCCI hopes to gain more insight upon review of the Initial Study Reports on these critical topics.	
SRC_etal_WATER_pp15_ph5	*AEA has not properly evaluated effective discharge and sediment transport to understand post-project impacts….AEA needs to evaluate post-Project sediment transport in the context of flows above the threshold for sediment motion, rather than average flows, in order to assess project effect on habitat quality in the Susitna River.*	AEA disagrees. SRC et al. incorrectly assert that the full flow range of flows are not being considered. Since Studies 6.5 and 6.6 (as well as habitat, ice processes, water quality, etc.) are already using the range of flows, the SRC et al. assertion that AEA is not properly evaluating effective discharge and sediment transport is unsubstantiated and untenable.
SRC_etal_WATER_pp16_ph1	*AEA lacks data and a defined modeling approach to understand the LWD budget in the Middle River and properly evaluate post-project impacts.*	The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. This comment raises questions with the Study Plan itself, and not AEA's implementation. The Study 6.6 FGM Approach TM describes how LWD can affect sediment transport, but it was not part of the Study Plan to simulate LWD transport. AEA does not lack the data on LWD (See Study 6.5 ISR Part A, Section 5.9) with an inventory of a total of 1,590 individual pieces of LWD over 20 feet in length and 306 log jams within 16 LWD sample areas. These data included repeat surveys before and after the significant flows in August 2013 (Study 6.5 ISR Section 4.9.3), which was an opportunistic variance to the Study Plan implemented by AEA. The LWD inventory in Study 6.5, along with the turnover analysis in Study 6.5 of bankline erosion is sufficient to perform a LWD budget and to evaluate potential Project effects on LWD.
Objective 3		
NMFS_pp6.6-3_ph5; USFWS_pp6.6-3_ph6	*Modification 3-1 Include the effects of climate-change induced alterations to sediment load within geomorphic and geomorphology modeling studies (similar to Modification 3-3 in Study 6.5).*	As explained below in Section 2.3.2.3.1, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is on the order of $800,000 to $1,000,000 for the geomorphology modeling associated with each climate scenario. If three climate scenarios were addressed, the cost would be $2,400,000 to $3,000,000.
NMFS_pp6.6-3_ph6; USFWS_pp6.6-3_ph7	*Modification 3-2 Demonstrate how the outputs from the fluvial geomorphology models will be used in all other models. Every study from 7.5 Groundwater to 9.12 Fish Barriers is dependent on how the channel changes.*	As explained below in Section 2.3.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this

Reference Number	Comment or Study Modification Request	AEA's Response
		request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp16_ph6	*AEA should integrate ice processes into the geomorphology model and assessment.*	AEA is planning on integrating ice processes and geomorphology modeling as part of the FERC-approved Study Plan. The Study 6.6 Study Component 3 is Coordination and Interpretation of Model Results (RSP Section 6.6.4.3 and Study 6.6 ISR Part A, Section 4.3). The Study 6.6 ISR Part A, Section 4.3.2.2 includes discussion on coordination of results with other resource studies, with a subsection on Ice Processes. Modeling integration is already part of the FERC-approved Study Plan for Study 8.5 (RSP Section 8.5.4.8.1). See also Section 2.3.2.3.2 below on model integration and Section 3.4 for AEA's response to request for a new model integration study.
	General	
NMFS_pp6.6-3_ph7; USFWS_pp6.6-3_ph8	*Modification G-1(Global) Select a range of operational scenarios with the intent of bracketing the possible range of future geomorphic change with Project impacts to fish habitat downstream of the Susitna-Watana Dam, which should include, but not be limited to: channel narrowing, bed degradation, coarsening of substrate leading to bed armoring, and decrease in fine sediment.*	As explained below in Section 2.3.2.4.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the proposed modification. AEA has already developed the maximum load following scenario and an intermediate load following scenario; results of existing conditions and one operational scenario will be provided in the USR. In addition, AEA will model baseload and a run-of-the-river scenario, as required by FERC. The modeling of these scenarios will inform the range of the potential impacts on affected resources. It is premature to select additional operational scenarios at this time. AEA may model additional operational scenarios as part of its FERC License Application and anticipates that these would be developed with input from from licensing participants. Importantly, this modification is not necessary because the necessary data to model additional scenarios is already being collected as part of the FERC-approved Study Plan. To the extent that NMFS is seeking additional data collection or modeling as part of this proposed modification, there would be substantial costs associated with this proposed modification.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.17-8_ph6	*Modification 3b: NMFS recommends determining the range of likely flow release quantities and patterns expected for reservoir operations with the Project in place, and redoing analyses of Project effects on sediment supply and transport as needed to reflect the range of likely operations. This modification is described and justified in Study 6.6, Modification G-1.*	As explained below in Section 2.3.2.4.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the proposed modification. AEA has already developed the maximum load following scenario and an intermediate load following scenario; results of existing conditions and one operational scenario will be provided in the USR. In addition, AEA will model baseload and a run-of-the-river scenario, as required by FERC. The modeling of these scenarios will inform the range of the potential impacts on affected resources. It is premature to select additional operational scenarios at this time. AEA may model additional operational scenarios as part of its FERC License Application and anticipates that these would be developed with input from from licensing participants. Importantly, this modification is not necessary because the necessary data to model additional scenarios is already being collected as part of the FERC-approved Study Plan. To the extent that NMFS is seeking additional data collection or modeling as part of this proposed modification, there would be substantial costs associated with this proposed modification.
SRC_etal_WATER_pp14 _ph4	*Modification: FERC should modify the Geomorphology Modeling Study (6.6) to require AEA to use different data to model sediment transport and design a transparent plan to integrate the transport of Large Woody Debris (LWD) and ice processes into the model.*	As explained below in Section 2.3.2.4.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification
SRC_etal_WATER_pp18 _ph4	*AEA should have completed the development of the conceptual models before data collection began. If that had been done AEA and licensing participants would have a better understanding of critical data gaps.*	See Section 2.3.2.4.2.
NMFS_pp6.6-4_ph3; USFWS_pp6.6-4_ph4	*The delay in Study 6.6 negatively affects the progress of other studies that will use the results of geomorphic modeling such as 6.5 (Geomorphology), 8.5 (Fish and Aquatics Instream Flow Study) and 8.6 (Riparian Instream Flow Study).*	AEA disagrees. Delays resulting from access issues and resulting from funding issues have affected each of the studies. Each study has progressed without adverse impacts based on delays in the Fluvial Geomorphology Modeling Study (Study 6.6). In 2014 Study 6.6 produced four Technical Memorandums including the *Proof of Concept 2-D Hydraulic*

Reference Number	Comment or Study Modification Request	AEA's Response
		Modeling (Tetra Tech 2014a), and *1-D Bed Evolution Modeling* used for the decision to not extend fluvial geomorphology modeling below PRM 29.9 (Tetra Tech 2014c). In 2015 Study 6.6 produced the *Fluvial Geomorphology Modeling Model Development Technical Memorandum* (Tetra Tech 2015a) describing 1-D and 2-D bed evolution model development and application.
SRC_etal_WATER_pp17_ph4	*AEA should use a single integrated model rather than piecing together a variety of process models.*	Although in theory one model could account for all processes, in reality, there is no model that integrates reservoir operations, 1- and 2-D sediment transport processes of all size classes, 1- and 2-D ice processes, and water quality.
ADNR_ADFG_pp9_ph2A	*The purpose of the modeling study, in combination with the Geomorphology study, is to assess the potential impact of the project on the behavior of the river downstream of the proposed dam, with particular focus on potential changes to instream and riparian habitat. This study will also provide information for evaluation of project effects for other studies…. We believe significant progress has been made and the study is on-track to meet the FERC-approved study objectives.*	AEA appreciates ADF&G's review and support for AEA's implementation of the FERC-approved Study Plan.
ADNR_ADFG_pp9_ph2B	*We agree with AEA's recommendation to not extend the 1-D Bed Evolution Model below PRM 29.9, based on the analysis provided and that the additional data will not provide meaningful results to further inform the decision process.*	AEA appreciates ADF&G's support for AEA's decision to not extend the 1-D BEM below PRM 29.9, as described in the Decision Point TM (Tetra Tech 2014c) and presented in the ISR.
ADNR_ADFG_pp9_ph2C	*We agree with the study modification to include groundwater flows as point source inputs to the 2-D hydraulic models at lateral features that are identified as having persistent groundwater sources.*	AEA appreciates ADF&G's support for AEA's proposed modification to the FERC-approved Study Plan, as described in ISR Part D Section 7.1.
ADNR_ADFG_pp9_ph2D	*Based on the information presented, we agree with AEA's determination that open water flows do not appear to contribute appreciably to bank erosion at FA-128 (Slough 8A) and that bank erosion is more likely related to ice processes.*	AEA appreciates ADF&G's support for AEA's proposed modification to the FERC-approved Study Plan, as described in ISR Part D Section 7.1.
ADNR_ADFG_pp9_ph2E	*We also concur with AEA's recommendation to not continue the Bank Energy Index analyses for open water conditions at the remaining Focus Areas, if similar results are observed at one other focus area.*	AEA appreciates ADF&G's support for AEA's proposed modification to the FERC-approved Study Plan, as described in ISR Part D Section 7.2.
ADNR_ADFG_pp9_ph3	*We also agree with the study modification to the 2-D bed evolution modeling of existing and*	AEA appreciates ADF&G's support for AEA's proposed modification to the FERC-approved

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	future conditions to select the number of water years used in the model based on tributary fan development.	Study Plan, as described in ISR Part D Section 7.2.
ADNR_ADFG_pp9_ph4	*We believe significant progress has been made and the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's constructive participation in the development of this study plan and review of the study implementation within the context of the FERC ILP. AEA concurs that the study is on track to meet the FERC-approved Study Plan.
Long_160620_pp4_ph2	*Study Modification Request to Classify Confluence Focus Area or Sub-Study: The current10 Focus Areas were selected for 2 D modeling because they are representative of important habitat types, geomorphic reaches channel classification types and relation to other relevant studies. The Confluence is an important habitat/channel type. It represents a unique geomorphic, hydraulic, riparian system not found in the 10 FAs. And it affects human communities significantly.*	As explained below in Section 2.3.2.2.6, AEA agrees to perform 2-D hydraulic modeling of the Three Rivers Confluence area. The proposed model would extend from approximately PRM 98.5 to PRM 104.5 on the Susitna River and extend approximately 3 miles up the Chulitna and Talkeetna Rivers. The hydraulic modeling would include a range of flows representing existing conditions on each of the three rivers and the same flows on the tributaries coupled with operational flows on the Susitna River, and will provide information on potential project effects for open water conditions.

2.3.2.1. Study Component 1: Bed Evolution Model Development, Coordination, and Calibration

2.3.2.1.1. Response to Modification Request to Compare 1-D and 2-D Model Results

NMFS (Modification 1-1; NMFS_pp6.6-2_ph5) and USFWS (Modification 1-1; USFWS_pp6.6-2_ph5) request that results of the 1-D and 2-D models be compared across common cross sections and for various identical pre- and post-Project flow conditions.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved study plan or under anomalous conditions.

The proposed modification should not be adopted because the suggested comparison is not meaningful and is not necessary to meet Study 6.6 objectives. As indicated in the RSP (e.g., RSP Section 6.6 pages 6-98 – 6-100) and subsequent technical memoranda, the 1-D model was intended to evaluate reach-scale issues and should be interpreted at the geomorphic reaches. The 1-D model is well suited to analyze long-term trends (decades) over large river reaches (tens to hundreds of miles) whereas 2-D models are well suited for short durations (short-term hydrographs, annual hydrographs, and in the exceptional case multiple years) and relatively short distances (~1 to 3 miles). The 2-D models are intended to address local-scale processes. Therefore, the results aren't comparable and, as discussed in the RSP, this was never the intent.

If this modification is implemented, it would add on the order of $40k to $80k to the Study costs.

2.3.2.1.2. Response to Modification Request to Provide Detailed Information on 1-D and 2-D Model Capabilities

NMFS (Modification 1-2; NMFS_pp6.6-2_ph6) and USFWS (Modification 1-2; USFWS_pp6.6-2_ph6) request detailed information on the fluvial morphology modeling capabilities of the HEC-RAS 5.0 and SRH-2D 3.0 be provided to demonstrate the real capabilities of the models.

AEA requests that FERC not adopt this proposed study plan modification because AEA is already providing the information requested in this modification under the FERC-approved Study Plan. This request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan.

The model selection process for fluvial geomorphology modeling was initially described in the RSP (e.g., RSP Section 6.6 pages 6-100 – 6-106) and expanded on in the *Fluvial Geomorphology Modeling (FGM) Approach Technical Memoranda* (Tetra Tech 2013, 2014a) and *FGM Development Technical Memorandum* (Tetra Tech 2015a) providing detailed information on these and other models. The selection of these models was made very clear throughout the licensing process and included information on how the models would be developed, calibrated and run. The *FGM Development TM* (Tetra Tech 2015a) provided further information on model calibration and results.

This should not be adopted as a study modification because AEA followed the procedure as described in the RSP with only minor deviations. These are US Army Corps of Engineers (1-D BEM) and US Bureau of Reclamation (2-D BEM) models that (as with all currently available sediment transport models) have limitations but continue to be developed to improve their representations of a wide range of complex physical processes.

There is no cost associated with this modification request because AEA has already provided the information requested in the modification.

2.3.2.1.3. Response to Modification Request to Limit the Use of Pass-through Nodes in the 1-D BEM

NMFS (NMFS_pp6.6-4_ph1) and USFWS (USFWS_pp6.6-4_ph2) commented that because of the stability problems with the preliminary 1-D model results run with HEC-RAS 5.0 Beta (June 2014), the model uses pass-through nodes on every island in the model including the Focus Areas, which is not acceptable. NMFS (Modification 1-3; NMFS_pp6.6-2_ph7) and USFWS (Modification 1-3; USFWS_pp6.6-2_ph7) therefore request AEA to limit the use of pass-through nodes to only Devils Canyon with the final version of the 1-D BEM.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan and the requested modification is unnecessary.

The Study Plan already envisions limiting the use of pass-through nodes to Devils Canyon. As described in Study 6.6 SIR, Attachment 1, Appendix A, Section 3.3.4, this has always been the plan for future 1-D reach-scale model development however the *initial* model used pass-through nodes at split flow reaches and in Devils Canyon. The decision to use pass-through nodes was based on the Beta version of HEC-RAS allowing excessive large material into side channels. The final release version of HEC-RAS will not have this limitation. AEA intends to eliminate the use of pass-through nodes except in the area of Devils Canyon. There is no need for a study modification.

There is no cost associated with this modification request because this is already part of the FERC-approved Study Plan.

2.3.2.1.4. Response to Comment on 1-D Model Calibration Procedure

NMFS (NMFS_pp6.6-3_ph10) and USFWS (USFWS_pp6.6-3_ph11) believe AEA's calibration of the 1-D bed evolution model by comparison of USGS measurements of transport rates with 1-D model results does not guarantee reliable results of bed degradation, in part due to the large amount of pass-through nodes used in the model.

AEA disagrees. The RSP for Study 6.6 (Section 6.6.4.1.2.5) and Section 3.1.1 of the *Updated Fluvial Geomorphology Approach TM* (Tetra Tech, 2014a) describes the approach for development and calibration of the 1-D bed evolution model. As indicated in these documents, the initial 1-D BEM was first calibrated hydraulically to compute hydraulic responses that accurately represent the system. Also as indicated in these documents, the sediment transport component of the model was calibrated using available data, which primarily consisted of observed sediment loads, but also comparative cross sections. These are the available data for existing conditions and will also be used to calibrate the final 1-D BEM. No data exist for calibration/validation of the 1-D BEM for with-Project conditions. This is why the first two study components for Study 6.6 were (1) Model Development, Coordination, and Calibration, and (2) Model Existing and with-Project Conditions. The results of these models have been, and will continue to be, evaluated and interpreted based on the third component of the study plan, Coordination on Model Output.

2.3.2.1.5. Response to Modification Request for Inclusion of Tributaries as Lateral Branches in the 1-D Model

NMFS (Modification 1-4; NMFS_pp6.6-2_ph8) and USFWS (Modification 1-4; USFWS_pp6.6-2_ph8) request a short reach of each tributary be included as a lateral branch in the 1-D models.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved study plan or under anomalous conditions.

The proposed modification is not necessary to meet Study 6.6 objectives. The approach for tributary delta modeling was described in the RSP Section 6.6.5.1.2.6 and was not commented on by the Services as of the RSP. In the 1-D reach scale modeling the sediment supplied by a tributary does not form a delta in the main channel cross section, but is distributed throughout the wetted area. Therefore, the suggested approach would not provide useful information at the small, ungaged tributaries. This approach is being implemented for the Chulitna and Talkeetna Rivers in the final 1-D BEM because these are much more substantial sediment sources where mainstem and tributary interactions are more important. The approach for tributary delta analyses (1-D and 2-D) were demonstrated in the *FGM Development TM* (Tetra Tech 2015a) and were shown to provide consistent results by evaluating long-term conditions on the main channel and tributary inputs. Therefore, this should not be adopted as a study modification.

If this modification is implemented, it would add on the order of $500,000 to $800,000 for data collection and modeling of over 20 tributaries.

2.3.2.1.6. Response to Modification Request to Include Modeling Feedback Between Tributaries and the Mainstem

NMFS (Modification 1-5; NMFS_pp6.6-2_ph9) and USFWS (Modification 1-5; USFWS_pp6.6-2_ph9) request dynamic feedback effects between the tributaries and the Middle Susitna River be described.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved study plan or under anomalous conditions.

The proposed modification is not necessary to meet Study 6.6 objectives. This was demonstrated in the *FGM Development TM* (see Study 6.6 SIR Attachment 1, Sections 5.1.5, 5.2.1, and 5.2.2). The dynamic effects at Skull Creek were demonstrated using the 2-D BEM and compared with fan growth calculations based on 1-D model results. This type of analysis of tributary delta modeling will be conducted for the 15 Middle River Tributaries identified in Table 7.1-1 of the Study 6.6 ISR Part C. This modification request is similar to NMFS Modification 1-4 and USFWS Modification 1-4 and is addressed above. No study modification should be required based on either of these requests.

If this modification is implemented, it would add on the order of $500,000 to $800,000 for data collection and modeling of over 20 additional tributaries.

2.3.2.2. Study Component 2: Model Existing and With-Project Conditions

2.3.2.2.1. Response to Modification Request on Presentation of 1-D Model Results

NMFS (Modification 2-1; NMFS_pp6.6-2_ph10) and USFWS (Modification 2-1; USFWS_pp6.6-2_ph10) request 1-D model results of predicted bed levels for each year over the 50-year simulation period be presented for each Focus Area at specific locations.

AEA supports FERC's adoption of this proposed study plan modification, subject to the modification being implemented at an appropriate geomorphic reach-scale. FERC should not approve this modification request as described because the 1-D BEM is not intended for use at the local scale, only the geomorphic reach scale. As described in the RSP (RSP Section 6.6 pages 6-99 and 6-100, "Development of Modeling Approach") and subsequent TMs (Tetra Tech 2013, 2014a, and 2015a), the 1-D BEM is intended for reach-scale analyses, not specific cross sections (see also response to NMFS Modification 1-1 above). AEA agrees to developing this type of plot (average bed change through time), but only on the appropriate spatial geomorphic reach scale and not at individual cross sections.

If this modification is implemented as described by AEA at the appropriate geomorphic reach scale, it would add on the order of $20,000 to $30,000 to the study costs.

2.3.2.2.2. Response to Modification Request to Replace or Modify the Sediment Delivery Index

NMFS (Modification 2-2; NMFS_pp6.6-2_ph11) and USFWS (Modification 2-2; USFWS_pp6.6-3_ph1) request the Sediment Delivery Index (SDI) approach be replaced or over-hauled with a more physically-based approach.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved study plan or under anomalous conditions.

The proposed modification is not necessary to meet Study 6.6 objectives. As indicated in the SIR, Studies 6.5 and 6.6 will coordinate with the Ice Processes and Riparian IFS studies on sediment accretion (Study 6.6 SIR Section 4.3 and Section 6.2). The SDI is based on suspended sediment concentrations, which is the dominant physical driver of sediment accretion in floodplains. With-Project suspended sediment concentrations will be a very small fraction of the existing conditions, so accretion can only be very small in the with-Project condition. This should not be a study modification because, as demonstrated in the SIR, the SDI will be evaluated based on the amount of time features will be inundated, the associated sediment concentrations, and the information available through coordination with the Ice Processes and Riparian IFS studies, including sediment accretion measurements and observations of inundation during the winter and during breakup.

If this modification is implemented, it would add on the order of $50,000 to $100,000 to the Study costs.

2.3.2.2.3. Response to Modification Request to Extend Fluvial Geomorphology Modeling below PRM 29.9

The FERC-approved Study Plan included a decision point to determine the lower extent of the 1-D Bed Evolution Modeling. AEA completed an analysis based on the data gathered and determined that modeling below PRM 29.9 (below the confluence of the Yentna River) was not warranted because the additional information would not provide meaningful results to further inform the decision process. ADF&G (ADNR_ADFG_pp9_ph2B) agrees with AEA's recommendation to not extend the 1-D Bed Evolution Model below PRM 29.9, based on the analysis AEA provided. However, NMFS (Study 6.6 Modification 2-4 [NMFS_pp6.6-3_ph2] and Study 9.17 Modification 3c [NMFS_pp9.17-11_ph1]) and USFWS (Modification 2-4; USFWS_pp6.6-3_ph3) request that AEA extend some type of fluvial geomorphologic modeling from PRM 29.9 to the Cook Inlet.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan or under anomalous conditions.

The proposed modification is not necessary to meet Study 6.6 objectives. The criteria for extending FGM downstream of PRM 29.9 were established in the RSP (Section 6.6.3.2) that results of the 1-D model of Existing and with-Project conditions would be used to determine the natural variability of the existing system and determine whether the with-Project condition would be beyond the range of the natural variability. FERC adopted this approach without comment in the Study Plan Determination (FERC April 1, 2013). As described in the Study 6.6 ISR Section 7.1.1.1.2, the criteria included hydrology, hydraulics, bed elevation, and sediment transport conditions, which are the pertinent variables that can be evaluated with the 1-D BEM. The very small change in these variables relative to the large natural variability resulted in the recommendation to not extend 1-D bed evolution modeling below PRM 29.9 (Tetra Tech 2014c).

As discussed in the decision point memo (Tetra Tech 2014c), large amounts of historic aggradation (20+ ft) are apparent in profile at and above the Yentna River relative to the channel bed upstream and downstream, which also exhibits an aggradational trend (Tetra Tech 2014c Section 5.3). The NMFS and USFWS assertion that 3 to 4 feet of aggradation at this location in 50 years is counterintuitive. This does not account for the large volume of sediment supplied by the Yentna River immediately above the significant constriction located at Susitna Station. This should not be adopted as a study modification because the decision point TM followed the procedure from the RSP and showed very small changes relative to the natural variability.

In addition, in the NMFS Study 9.17 comments (NMFS_pp9.17-10_ph4), NMFS stated the following reasons for not supporting AEA's decision to only model from the proposed dam site at PRM 187 downstream to PRM 29.9:

- Predicted changes at PRM 29.9 in stream flow, water depth, and channel width are not insignificant and could potentially have substantial effects on channel morphology in the Lower River.
- The analysis did not address increased winter flows and the possible effects of those flows on channel morphology.
- The analysis did not include an evaluation of the effects of changed flows and water depth on ice conditions and subsequent impacts on channel morphology.
- The predicted change in mid-winter flow and channel width does not appear to be within the normal range of variability.
- The predicted decrease in flow during the summer will cause changes in channel morphology.
- The largest predicted changes are expected to occur during the early open water season when CIBW are likely to be present.

It should be noted that NMFS did not, however, comment on the approved approach for making the decision. Specifically, RSP Section 6.6.3.2 indicated that results of the 1-D model of Existing and with-Project conditions would be used to determine the natural variability of the existing system and determine whether the with-Project condition would be beyond the range of the natural variability. Although a small amount of geomorphic change, including changes to flows, sediment loads, and channel width, and hydraulic conditions (velocity, depth), are expected, the decision criteria was based on the amount of change in relation to the natural variability. AEA disagrees with NMFS assertions because when change is small in relation to natural variability in geomorphic and hydraulic variables, the changes will also be small in relation to the natural variability for CIBW and eulachon. With respect to the final bullet, the largest relative changes in flow do occur in the early open water season, yet because of the attenuating effects of the Chulitna, Talkeetna, and Yentna Rivers, flows in May and June are within the existing range of variability approximately 95 percent of the time (Figures 5.1-6 and 5.1-7, Tetra Tech 2014c). The channel system below PRM 29.9 widens rapidly and transitions to a tidally influenced river and braided tidal estuary. Open water and winter conditions are going to have minimal change compared to the large natural variability. Regarding modeling ice processes in the Lower River, initial modeling of the 1984-85 winter (average winter) with the River1D ice model shows little detectable effect below the Three Rivers Confluence (PRM 102). The Yentna and Chulitna Rivers are the primary ice producers that contribute to the Lower River frazil ice production and ice cover. These tributary sources will be unaffected by changes in the Susitna River discharge. Because effects from the Yentna and Chulitna Rivers will not change the Lower River ice cover, there will be no effects to CIBW. Also winter flows below PRM 29.9 will increase from approximately 25,000 to 35,000 cfs on average. These flows will result in minimal sediment transport and not affect channel morphology. Therefore, fluvial geomorphology modeling should not be extended below PRM 29.9.

If this modification is implemented, it is estimated it would cost $800,000 to $1,200,000 for the initial model development and the existing conditions scenario. Each with-Project scenario would cost $250,000 to $400,000 to analyze. If four with-Project scenarios were analyzed, then the total estimated cost of this modification request would be $1,800,000 to $2,800,000.

2.3.2.2.4. Response to Modification Request to Re-evaluate How Throughput and Bed Sediment Loads Interact

NMFS (Modification 2-6; NMFS_pp6.6-3_ph4) and USFWS (Modification 2-6; USFWS_pp6.6-3_ph5) request a re-evaluation of how throughput load and bed load interact to move sand and gravel between Talkeetna and PRM 40.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, AEA is already modeling the physical processes identified in the request under the FERC-approved Study Plan. The proposed modification is not necessary to meet Study 6.6 objectives.

In stating that the model is compartmentalizing movement of sand and gravel, which is not how the natural system works, NMFS and USFWS suggest that it is counterintuitive that the bed surface can be composed of gravel when the transport is sand dominated. This condition is very common in gravel (bed) rivers and is clearly demonstrated in all the USGS sediment transport measurements in the Susitna, Talkeetna, Chulitna, and Yentna Rivers (Tetra Tech 2014d Table 6.0-2 and Figure 5.1-1 through Figure 5.1-7, Appendix B and Appendix C). While sand sizes appear to be throughput in the Middle River, the Lower River bed conditions indicate that there is much greater interaction of sand sizes with the bed material. The 1-D BEM includes sediment from all size ranges (sand through cobble and boulders where they are present) contributed by the Susitna, Talkeetna, Chulitna, and Yentna Rivers and routes the sediment by size fraction in the Middle and Lower Rivers down to PRM 29.9. Therefore, the model does not compartmentalize sand and gravel movement. The model includes five sand classes (very fine through very coarse sand), five gravel sizes (very fine through very coarse gravel), and five cobble and boulder sizes, and transports these materials as bed load, suspended load, or mixed load depending on the relative mobility and availability. In summary, the model approach already includes interaction between the sand load and bed load to move sand and gravel below the Three Rivers Confluence. The fact that the model predicts aggradation in the Lower River is an indication of this interaction. The SIR includes comparisons of total bed material load (sand and coarser) with added evaluation of gravel sizes (Figures 3.4-1 through 3.4-10, Appendix A of Attachment 1, Tetra Tech 2015a). These comparisons are made at Sunshine and Susitna Station and show good agreement between the USGS measurements and 1-D BEM results.

There is no cost associated with this modification request because AEA is already modeling the physical processes identified in the request.

2.3.2.2.5. Response to Comment on Lower River 1-D Model Results

NMFS (NMFS_pp6.6-4_ph2) and USFWS (USFWS_pp6.6-4_ph3) suggest that 1-D model results in the Lower River show the largest dam impacts farther downstream.

AEA disagrees. This assertion is a misrepresentation or misinterpretation of the model results. As illustrated in the comparison of existing conditions with Max LF-OS1b, the Lower River modeling indicates that the entire Lower River is aggradational for both conditions. The *Decision Point TM* (Tetra Tech 2014c), which focuses on the Lower River, includes bed profiles and bed change for these conditions (Figure 2.3.2-1 for existing conditions and Figure 2.3.2-2 for Max LF-OS1b, as shown below). As discussed in the TM (Tetra Tech 2014c Section 5.3) and SIR (SIR 6.6 Section 6.2), the depositional nature of the Lower River is an expected condition because it has a strong bar/island braided planform (Tetra Tech 2015b Section 5.5). While the aggradation is concentrated in the lower area in both cases (above PRM 29.9), the impacts of the dam are actually minimal. The conclusion was that the Lower River is less aggradational under with-Project conditions.

The comment appears to be indicating that aggradation in the downstream extent of the Lower River between PRM 29.9 and PRM 40 is physically unrealistic. AEA disagrees with that statement. The Yentna River contributes the largest amount of sediment to the Lower River immediately above the channel constriction at Susitna Station. The bed profiles shown in Figures 2.3.2-1 and 2.3.2-2 (below) show a 20 ft convexity, indicating significant deposition. The 50-year bed profiles are similar for each condition modeled. Other evidence that this is a depositional area is the extensive channel braiding in this area. Therefore, the model, bed profile, and planform provide consistent, expected, and physically realistic picture of the Lower River geomorphology.

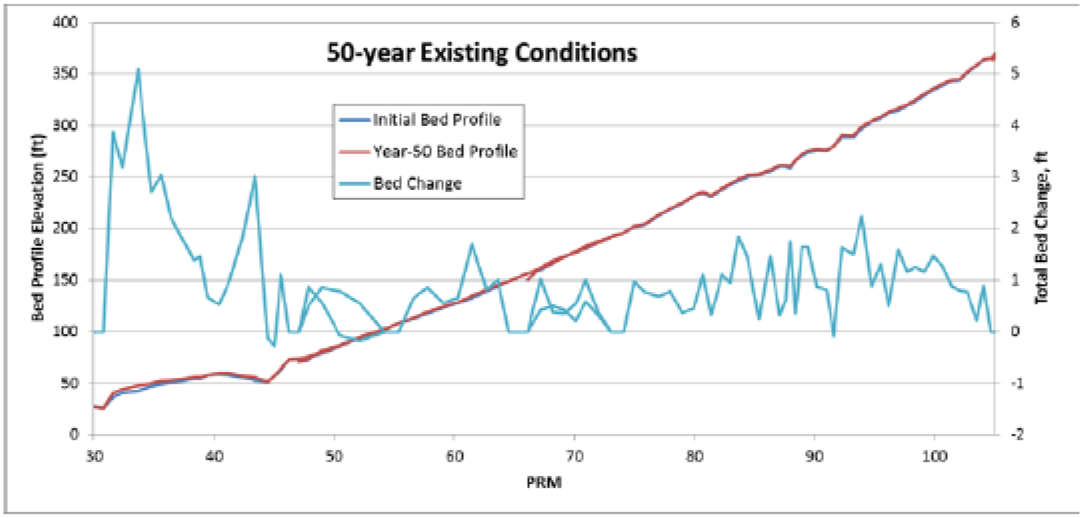

Figure 2.3.2-1. Bed elevation and change in 50 years for existing conditions

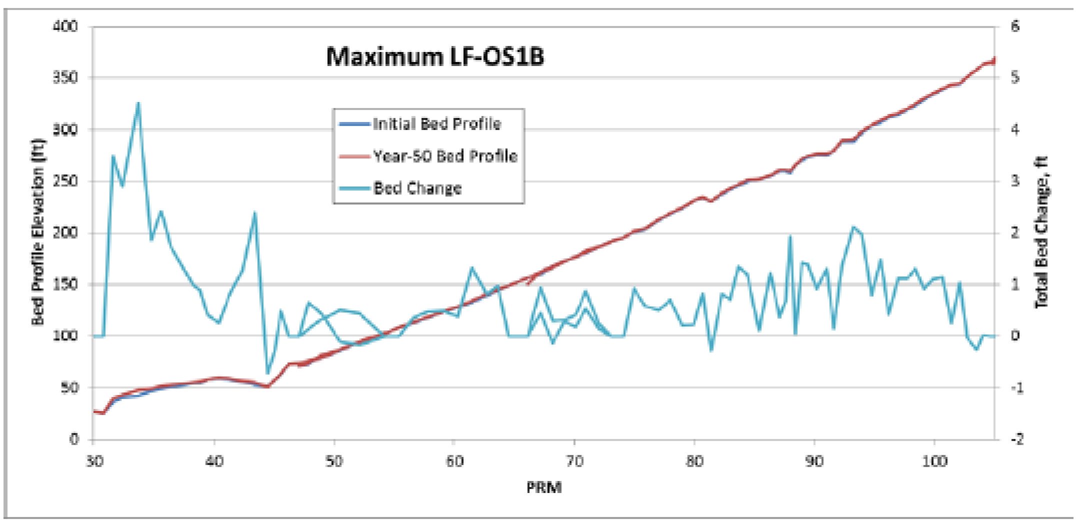

Figure 2.3.2-2. Bed elevation and change in 50 years for Maximum LF-0S1B conditions.

2.3.2.2.6. Response to Modification Request to Perform 2-D Modeling in the Three Rivers Confluence

TCCI (TCCI_pp04_ph2) requests that AEA provide 2D modeling of at least the immediate confluence mouths of the Susitna, Chulitna, and Talkeetna Rivers to adequately assess Project related changes which could affect the safety of downstream communities. TCCI is particularly concerned with the effects of the elevated winter flows (potentially 10,000 cfs) under ice conditions proposed in the load following operations model. TCCI also requests the bed energy index (BEI) be applied to the confluence area. In summary, TCCI (TCCI_pp04_ph3) requests a comprehensive analysis of the Three Rivers Confluence which includes the potential for erosion, winter sediment and ice transport and all other geomorphic Project-related effects.

AEA does not object to FERC's adoption of some elements of TCCI's proposed Study Plan modification. AEA does not object to performing 2-D hydraulic modeling of the Three Rivers Confluence Area as modifications to the Study Plans for Study 6.6 for the open water period and Study 7.6 for the ice-cover period. The modeling for both periods would include a range of flows representing existing conditions on each of the three rivers and the concurrent flows on the tributaries coupled with operational flows on the Susitna River, and will provide information on potential Project-related erosion and flooding effects for open water and ice-cover conditions.

As proposed by AEA, the model for the open water period would extend from approximately PRM 98.5 to PRM 104.5 on the Susitna River and extend approximately 3 miles up the Chulitna and Talkeetna Rivers. The open water period hydraulic modeling would use the SRH-2D model for the 2-dimensional area of the confluence and the 1-D HEC-RAS model to establish downstream boundary conditions. Detailed bathymetric, topographic and hydraulic data would be collected to support the development of the 2-D hydraulic model within the model domain.

For the ice-covered period, AEA proposes to perform hydraulic modeling in Study 7.6 using River2D for the 2-dimensional area of the confluence and would use output from the River1D model to describe downstream boundary and ice conditions. The 2-D ice modeling would extend from approximately PRM 98.5 to PRM 104.5 on the Susitna River and cover only those areas of the Chulitna and Talkeetna Rivers which have been determined to be affected by ice conditions in the Susitna River (3,000 feet up the Chulitna and 5,000 feet up the Talkeetna Rivers). The River2D model would use the bathymetric, topographic and hydraulic data obtained by Study 6.6 plus additional ice thickness and water velocity data collected for model calibration and verification.

AEA requests FERC not adopt TCCI's study modification request to use BEI at the Three Rivers Confluence. However, AEA agrees to compare shear stresses and velocities, both components of BEI, between the two simulations (open water and ice-covered) as a modification to the Study Plan. As discussed in the Study 6.6 ISR Part D Section 7.2, AEA requested a Study Plan modification that BEI not be used at Focus Areas. This request was based on results of 2-D modeling of FA-128 (Slough 8A) and an initial application of the BEI as described in the Study 6.6 SIR Attachment 1, Section 5.2.4. In its comments, ADF&G supported AEA's proposed modification (ADNR_ADFG_pp9_ph2D) and there were no objections to this proposed modification by any reviewers. AEA's proposed modeling of the Three Rivers Confluence area will include with- and without-Project range of flows on the Susitna River combined with the natural range of flows on the Chulitna and Talkeetna Rivers. Differences in shear stress and velocity (components of BEI) between the simulations are recommended as appropriate measures of potential bank erosion at the areas of concern. Bed Evolution modeling (BEM) is not necessary to address the erosion or flooding concerns expressed in the modification request as these concerns can be fully evaluated with the 2-D hydraulic models.

If this modification is implemented as proposed by AEA, the total cost would be $750,000 to $900,000. The portion of this effort conducted under Study 6.6 would include $500,000 to $600,000 for collection of the bathymetric, topographic and hydraulic data; 2-D hydraulic model development and application; and the erosion assessment during open water conditions. The cost of the ice-cover period effort conducted under Study 7.6 would be $250,000 to $300,000 including 2-D hydraulic model development and application, collection of additional ice-cover and velocity data to support model calibration and verification for winter conditions, and the erosion assessment for the ice-cover period. Costs also include integration between the two studies. If the application of a 2-D BEM were implemented, the cost would be $2,500,000 to $3,500,000.

2.3.2.3. Study Component 3: Coordination on Model Output

2.3.2.3.1. Response to Modification Request to Include the Effects of Climate Change

NMFS (Modification 3-1; NMFS_pp6.6-3_ph5) and USFWS (Modification 3-1; USFWS_pp6.6-3_ph6) request AEA include the effects of climate-change induced alterations to sediment load in its analyses.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

Under Study 7.7 (Glacier and Runoff Changes Study), NMFS (NMFS_pp17_ph2) requests development of a new climate change future baseline and the evaluation of with-Project conditions with climate change variability. AEA concludes that such an approach only increases uncertainty due to the large difference in General Circulation Models. The approach described in the FERC-approved Study Plan includes sensitivity analysis as a more direct means of addressing these issues. From the standpoint of fluvial geomorphology modeling, climate-related effects on the Chulitna, Talkeetna, and Yentna Rivers are not related to the Project. Although significant climate change could impact hydrology and sediment delivery, the proposed reservoir would still trap nearly all the sediment and release nearly sediment free water below the dam regardless of the climate condition. Therefore, potential Project impacts are adequately addressed using the approaches already described in the RSP. With regard to the reservoir itself, as described in the TM on glacial surge (Tetra Tech 2014e), the reservoir life is estimated to be at least 850 years. Even if climate change reduces this significantly, many future reevaluations of the Project would occur beyond the initial 50-year license period. See Sections 1.5.2, 2.4.3, and 3.2 for further details regarding incorporation of climate change.

The estimated cost of implementing this modification is on the order of $800,000 to $1,000,000 for the geomorphology modeling associated with each climate scenario. If three climate scenarios were addressed, the cost would be $2,400,000 to $3,000,000.

2.3.2.3.2. Response to Modification Request for Model Demonstration

NMFS (Modification 3-2; NMFS_pp6.6-3_ph6) and USWFS (Modification 3-2; USFWS_pp6.6-3_ph7) request that a demonstration of how the outputs from the fluvial geomorphology models will be used in all the other models.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, this request is already part of the FERC-approved Study Plan which AEA is implementing and AEA has already provided some of the requested information.

Section 2.2 of the updated Modeling Approach TM (Tetra Tech 2014a) and Section 2.2 of the Model Development TM (Tetra Tech 2015a) each discuss how the outputs from the fluvial geomorphology models will be used by other studies. Tables 2-2 and 2.2-1 of these documents, respectively, provide additional information on the data used by each study. The use of model output by other studies was demonstrated as part of the Proof of Concept meeting as described in Attachment A: FA-128 (Slough 8A) Hydraulic Modeling Proof of Concept in Tetra Tech 2014a. Throughout FA-128, depths, velocity, shear stress, substrate, and bed mobility were provided over a range of flows.

Model integration is discussed in Section 3.4.2 in response to the Services' request for a new study on this topic. As with the overall model integration and Decision Support System (DSS) efforts, Study 6.6 will contribute to these activities consistent with the Study Plan to support the analysis of Project effects and the identification of protection, mitigation, and enhancement measures as appropriate. The result of model integration will be reported in the USR without the need for a separate study or modifications to Study 6.6.

This modification request if implemented does not add to the Study costs since this task is already included in the FERC-approved Study Plan which AEA has been implementing.

2.3.2.4. General Modification Requests and Comments

2.3.2.4.1. Response to Modification Request to Select a Range of Operational Scenarios

NMFS (Study 6.6 Modification G-1 [NMFS_pp6.6-3_ph7]; and Study 9.17 Modification 3b [NMFS_pp9.17-8_ph6]) and USFWS (Study 6.6 Modification G-1; USFWS_pp6.6-3_ph8) recommend AEA select a range of operations scenarios with the intent of bracketing the possible range of future geomorphic change with-Project impact to fish habitat downstream of the Susitna-Watana Dam.

AEA requests that FERC not adopt this proposed study plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the proposed modification. AEA has already developed the maximum load following scenario and an intermediate load following scenario; results of existing conditions and one operational scenario will be provided in the USR. In addition, AEA will model baseload and a run-of-the-river scenario, as required by FERC. The modeling of these scenarios will inform the range of the potential impacts on affected resources.

As part of Study 6.6, AEA is evaluating potential geomorphic responses (e.g., channel narrowing, bed degradation, coarsening of substrate and change in sediment loads) as provided for in the FERC-approved Study Plan. AEA has already developed the maximum load following scenario (Max-LF OS1B) and an intermediate load following scenario (ILF-1) and FERC required a run-of-the-river scenario in its Study Plan Determination. As described in the FGM Approach TM (Tetra Tech 2014a), base load will also be modeled in addition to the existing conditions, maximum load following, intermediate load following, and run of river and these operational scenarios will be modeled down to PRM 29.9. Max-LF OS1B is the most extreme condition and was found to produce small changes relative to large natural variability below PRM 29.9. Therefore, developing additional scenarios or extending the model is not warranted.

Results for existing conditions and one operational scenario will be provided in the USR. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests and address issues including the role of ice in channel change. The results of Existing Conditions and a Run-of-River operational scenario will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions.

As such, it is premature to select that range of operational scenarios at this time. Notwithstanding, the data necessary to model those additional scenarios is already being collected as part of the FERC-approved Study Plan. To the extent that NMFS is seeking additional data collection or modeling as part of this proposed modification, there will be substantial costs associated with this proposed modification.

2.3.2.4.2. Response to Modification Request to Model Sediment Transport and Integrate Large Woody Debris and Ice Processes

SRC et al. (SRC_etal_WATER_pp14_ph4) request AEA to use different data to model sediment transport and design a transparent plan to integrate the transport of Large Woody Debris (LWD) and ice processes into the model. In making the modification request SRC et al. also comments (SRC_etal_WATER_pp18_ph4) that AEA should have completed the development of the conceptual models before data collection began and indicates if that had been done AEA and licensing participants would have a better understanding of critical data gaps.

AEA requests that FERC not adopt this proposed study plan modification because the existing Study Plan addresses this concern and this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, this request is already part of the FERC-approved Study Plan which AEA is implementing and AEA has already provided a plan to integrate LWD transport and ice processes into the modeling effort.

It is unclear what different data this comment is referring to related to modeling sediment transport, though from the supporting comments it appears that Abt Associates believe that annual runoff was used by Study 6.6 as a predictor of annual sediment transport. That is incorrect. Study 6.6 actually uses hourly discharges for model input because even daily values do not capture the complete flow range and variability, especially considering natural diurnal fluctuations and load following under the operational scenarios. The hourly results are integrated to report annual values. AEA has sediment transport measurements (bed load and suspended load measurements) collected by the USGS in the 1980s and 2012-2014 (Tetra Tech 2014d Appendix A). These measurements show consistent trends for the range of bed material sizes and in the silt-clay ranges.

With regard to the transport of LWD, AEA recognizes the importance of LWD on habitat and has collected extensive data in the Middle and Lower Rivers (Study 6.5 Study Component 9). The bed evolution models do not incorporate the transport of LWD, but the FGM Approach TM describes how LWD can affect sediment transport and how this will be incorporated into the 1-D and 2-D BEMs (Tetra Tech 2014a Sections 4.3.2. and 4.4.2). Sediment transport under ice cover is known to be very limited and is not a process that is simulated in available 1-D models. The limited transport under ice was a reason for the success of the Winter Bed sampling (Tetra Tech 2014b). The impact of LWD in comparison to ice movement in terms of the effects on ice processes or sediment transport is minimal. Most LWD deposited on main channel islands and bars is moved downstream during ice jamming events. There will be changes in the freeze-up discharge and water elevation for post-Project conditions, generally thicker initial cover/jam formations and higher water elevations in some reaches of the river. Mid-winter and breakup discharges, however, will be more regulated (less large peaks) and thus the mid-winter and breakup jamming will be lower thicknesses and extents than currently exist. Study 6.6 and the Ice Processes (Study 6.6 SIR Section 6 and Tetra Tech 2015a Section 4.1.5) study will be coordinated to evaluate sediment transport potential based on the River1D model results for ice cover conditions and as described that specific simulations will be designed regarding blockage and breakup surges using 2-D BEM modeling (Tetra Tech 2015a Section 2.2). Therefore, this should not be adopted as a modification to the 6.6 Study Plan.

With regard to SRC et al.'s comment on conceptual models, the Study Plan for Study 6.6 was developed based on significant knowledge of the Susitna River and its tributaries based on the extensive data and reports developed in the 1980s. Therefore, a conceptual model existed and was already used to identify data gaps, plan data collection, and guide the modeling process. The model selection process as described in Tetra Tech 2014a was guided by the understanding of the system to select models that can simulate the range of sediment sizes and Susitna River conditions. The selected models are publicly available and developed by U.S. Government Agencies (U.S. Army Corps of Engineers and Bureau of Reclamation) based on currently accepted scientific principles. Additional efforts to develop conceptual fluvial geomorphology models to guide data collection were not warranted.

However, as identified in RSP Section 6.5.4.1.2.3 and further detailed in Study 6.5 ISR Part C Section 7.2.2.1.3 (pp17-18) and Part D, Section 8.2 (p19) the refinement of the geomorphic characterization of the Susitna River will continue as the feedback from the modeling studies helps further develop and refine the understanding of the role of the various physical processes that create and maintain the Susitna River:

> *A comprehensive Technical Memorandum will be prepared presenting the results of the geomorphic characterization of the Susitna River. The technical memorandum will integrate the information compiled in this study as well as relevant information from the Fluvial Geomorphology Modeling Study (Study 6.6), Fish and Aquatics IFS (Study 8.5), Riparian IFS (Study 8.6), Ice Processes Study (Study 7.6) and Groundwater Study (Study 7.5) to provide a thorough characterization of the key geomorphic processes that create and maintain the geomorphic features that form the Susitna River. The identified processes are conceptualized in the geomorphic models that describe the current (pre-Project) behavior of the Susitna River.*

This modification request does not add to the Study costs since the requested work is already included in the FERC-approved Study Plan which AEA has been implementing. Additionally, as indicated above, AEA will continue to refine the geomorphic characterization and understanding of the role of key physical processes in the conceptual model of the Susitna River as part of the FERC-approved Study Plan.

2.3.2.5. References Cited

Tetra Tech. 2013. Fluvial Geomorphology Modeling Approach. Draft Technical Memorandum. Revised June 30, 2013. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech. 2014a. Updated Fluvial Geomorphology Modeling Approach. Technical Memorandum, (includes Attachment A: FA-128 (Slough 8A) 2-Dimensional Hydraulic Modeling for Proof of Concept). May 30, 2014. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech, Inc. 2014b. Winter Sampling of Main Channel Bed Material. Technical Memorandum. Susitna-Watana Hydroelectric Project FERC No. 14241. Prepared for Alaska Energy Authority. September 2014.

Tetra Tech. 2014c. Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9. Technical Memorandum. September 26, 2014. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech. 2014d. Update of Sediment-Transport Relationships and a Revised Sediment Balance for the Middle and Lower Susitna River Segments. Technical Memorandum. September 17, 2014. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech. 2014e. Assessment of the Potential for Changes in Sediment Delivery to Watana Reservoir Due to Glacial Surges. Technical Memorandum, November, 2014. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech. 2015a. 2014 Fluvial Geomorphology Modeling Model Development, Technical Memorandum. Attachment 1 of Study 6.6 SIR. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech. 2015b. Geomorphic Reach Delineation and Characterization, Upper, Middle and Lower Susitna River Segments – 2015 Update. Technical Memorandum. Attachment 1 of Study 6.5 SIR. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

2.4. Water Resources

2.4.1. Study 7.5 – Groundwater Study

As established in the Groundwater Study 7.5 Study Plan[18], the overall goal of the Groundwater Study is to understand the effects of Project operations on groundwater/surface water (GW/SW) interactions at multiple spatial and temporal scales as they relate to aquatic and floodplain species in the Susitna River.

The nine study objectives of the FERC-approved Groundwater Study Plan Section 7.5 are as follows:

- Synthesize historical and contemporary groundwater data available for the Susitna River groundwater and groundwater dependent aquatic and floodplain habitat, including that from the 1980s and other studies including reviews of GW/SW interactions in cold regions.
- Use the available groundwater data to characterize large-scale geohydrologic process-domains/terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow groundwater aquifers, GW/SW interactions).
- Assess the potential effects of Watana Dam/Reservoir on groundwater and groundwater-influenced aquatic habitats in the vicinity of the proposed dam.
- Work with other resource studies to map groundwater-influenced aquatic and floodplain habitat (e.g., upwelling areas, springs, groundwater-dependent wetlands) within the Middle River Segment of the Susitna River including within selected Focus Areas (Fish and Aquatics IFS Study 8.5).
- Determine the GW/SW relationships of floodplain shallow alluvial aquifers within selected Focus Areas as part of the Riparian IFS (Study 8.6).
- Determine GW/SW relationships of upwelling/downwelling in relation to spawning, incubation, and rearing habitat (particularly in the winter) within selected Focus Areas as part of the Fish and Aquatics IFS (Study 8.5).
- Characterize water quality (e.g., temperature, dissolved oxygen, conductivity) of selected upwelling areas that provide biological cues for fish spawning and juvenile rearing, in Focus Areas as part of the Fish and Aquatics IFS (Study 8.5).
- Characterize the winter flow in the Susitna River and how it relates to GW/SW interactions.
- Characterize the relationship between the Susitna River flow regime and shallow groundwater users (e.g., domestic wells).

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[18] The FERC-approved Revised Study Plan (RSP) Section 7.5 for the Groundwater (GW) Study as modified by FERC's Study Plan Determination (Study 7.5 SPD, April 1, 2013), the *Riparian Instream Flow, Groundwater, and Riparian Vegetation Studies FERC Determination Response Technical Memorandum* (Study 7.5, 8.6, and 11.6 TM, July 1, 2013), the *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014 TM* (Study 8.5 TM, March 1, 2013), and the *Adjustments to Middle River Focus Areas TM* (Study 8.5 TM, May 31, 2013) is collectively referred to as Study Plan Section 7.5.

As detailed in Study 7.5 ISR Part D and presented during the ISR meeting for this study held on March 23, 2016, AEA plans no modifications to the methods of this study.

Written comments specific to the Initial Study Report, companion documents, and ISR Meeting for the Groundwater Study 7.5 were filed on June 22, 2016 (USFWS and NMFS) and June 23, 2016 (FERC, ADNR, ADF&G, and Susitna River Coalition *et al*.) in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015.

Each licensing participant's comments pertaining to Study 7.5 ISR and its companion documents are included in Table 2.4.1-1. AEA's responses to comments are provided in the table and responses to proposed Study Plan modifications are further detailed below. These responses are organized by study objective. The general format of responses includes first a restatement of the Groundwater Study objective, followed by a summarization of the modification request and then AEA's response. Comments are identified by the entity, page number, and paragraph number. In cases where multiple paragraphs are included in the table as a single "comment", the comment is identified by the first paragraph.

AEA has also provided a Supplement to the Study 7.5 2014-2015 Study Implementation Report (SIR) (November 9, 2015), the *Upwelling Broad-Scale Mapping of the Middle Susitna River Technical Memorandum* (Attachment 3 to this filing, *Response of the Alaska Energy Authority to Comments on the Initial Study Report*) which describes and presents a GIS-derived map series that depicts groundwater influenced areas identified within the entire Middle River Segment of the Susitna River. This information will be coupled with Focus Area-specific groundwater information, and data from other resource studies (Fluvial Geomorphology Modeling Study 6.6; Ice Processes Study 7.6; Fish and Aquatics Instream Flow [IFS] Study 8.5; and Riparian IFS [RIFS] Study 8.6) to classify the identified groundwater areas based on dependencies on river, upland groundwater, or mixed river/groundwater. The categorization or differentiation of groundwater types will be completed and presented in the Updated Study Report (USR).

Table 2.4.1-1. Study 7.5 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADNR_pp4_ph4	*We believe AEA has made significant progress on the study for understanding site-specific controlling parameters and potential effects on nearby shallow groundwater wells. AEA is on track to meet FERC-approved study objectives.*	AEA appreciates ADNR's reviews and support for AEA's ongoing implementation of the FERC-approved Study Plan.
ADNR_ADFG_pp10_ph01	*This study investigated groundwater (GW)/surface water (SW) interactions at both the watershed and local scales. Information from this study is to be used in evaluating project effects on GW/SW interactions and resulting effects on other aquatic and terrestrial studies. This study has provided valuable information on groundwater relationships in the Susitna River and furthered our understanding of these processes and importance to fish habitat, including information on winter flows and how it relates to GW/SW interactions. When linked to the Ice Processes model, it will enable evaluation of project effects on GW/SW water interactions during the winter ice covered periods. These data, in combination with the habitat suitability curves (HSC)/habitat suitability index (HSI) curves and the 2-D Fish Habitat models, will provide information to calculate habitat quantities by species and life stage under different winter-time flow conditions. Information from the Groundwater model will also inform project operational effects on GW/SW interactions and effects on the riparian community. We believe significant progress has been made and the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's review of the ISR and supportive comments regarding the implementation of this study thus far to achieve the objectives of the FERC-approved Study Plan.
USFWS_pp7.5-04_ph02; NMFS_pp7.5-04_ph03	*Section 5.1 of the Groundwater ISR presents infrared aerial imagery. These data could be potentially useful for investigating changes to the Susitna River during the 1970 – present day period of time. Images from the 1970's for presentation into the record should be annotated more specifically as to date or further explanation of the vague time reference presented.*	AEA agrees with the comment and will provide the dates for the specific imagery as available in the USR. As a component of the FERC-approved Study Plan, AEA will consider using this infrared aerial imagery for various river segments for comparisons with prior studies.
USFWS_pp7.5-05_ph01; NMFS_pp7.5-05_ph03	***Variances*** *This literature review was produced in November of 2015, two years behind schedule. The lack of attention to the 1980's studies may have led to not being able to foresee operational difficulties in the current study plan.*	AEA disagrees. Study leads considered the 1980s studies during the development of the Study Plan. The change in schedule for the literature review was to take advantage of the literature reviews from other studies. The change in schedule was identified in Study 7.5 ISR Part A, Section 4.1.1 where it was likewise noted that such change would not impact meeting the objective of the study. The literature review was completed as specified in the FERC-approved Study Plan.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-05_ph04; NMFS_pp7.5-05_ph06	*The ISR references several documents produced by the American Society for Testing and Materials (ASTM), but does not say which part of the document they plan to follow.*	ASTM standard D5979 "*Standard Guide for Conceptualization and Characterization of Groundwater Systems*" will be used to help define the geohydrologic units (ASTM 2008). ASTM D6106 "*Standard Guide for Establishing Nomenclature of Groundwater Aquifers*" will be used to help establish the aquifer nomenclature and naming of geohydrologic features (ASTM 2010). ASTM standard D6106 will be used to help characterize the groundwater aquifers relevant to proposed Project operations. These standards are general guidelines and will be used as they relate to the specific applications being made and referenced accordingly in the USR.
USFWS_pp7.5-05_ph05; NMFS_pp7.5-05_ph07	*The ISR text states that after characterizing hydro-geologic units present in the study area, the relationship between regional and local groundwater systems would be defined, according to methods described by Anderson [1970] for the Tanana River basin. This study was primarily a basin-scale assessment of physiography, geology, groundwater availability, surface water availability, and water quality. In other words, the study of Anderson [1970] would be a more appropriate guide toward characterizing the Susitna River basin hydrology, not for linking regional and local groundwater systems.*	AEA disagrees. The intent of the ISR citation of the Anderson (1970) report was not to provide methods, but rather to provide a link to an example basin that shows general geohydrologic definitions. This example was cited in the ISR because it facilitated discussions with NMFS staff during Study Plan development.
USFWS_pp7.5-05_ph07; NMFS_pp7.5-05_ph08	*The first two study elements of the Groundwater Study – (1) Existing Data Synthesis and (2) Geo-hydrologic Process Domains – require geologic and soils data for the broader study area and critically, along the Middle River. It should also be recognized that one of the work products from the Geomorphology Study (6.5) has been a surficial geologic map of the entire Middle River [Tetra Tech, 2014]. This data product is available in mapbook form as part of the Geomorphology ISR. This map would provide critical information in completing the first two study elements.*	AEA recognizes the importance of using information from the Geomorphology Study (6.5) in completing the study elements for the Groundwater Study. The surficial geologic map of the Project area compiled in the Geomorphology Study (6.5) was considered when developing the boundaries of the alluvial aquifer in the groundwater flow model in FA-128 (Slough 8A). Other geologic data were also reviewed for model development and included maps from the Geology and Soils Characterization Study (Study 4.5 ISR).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-05_ph08; NMFS_pp7.5-06_ph01	***Results*** *Findings under this study Objective* [Objective 2 Geo-hydrologic Process Domains] *are almost completely unreported. Thus, it is not possible to determine the status of work towards meeting the goals of this Objective.*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed. However, as noted in the Study 7.5 SIR, Section 6.2, a substantial amount of data have been collected and reported from field studies, observations, and information gathered as part of the literature review, as well as from other studies, from which to develop a conceptual understanding of the regional groundwater processes. AEA is working with those data to define the groundwater regional scale relationship to local flow systems in the Middle River and Lower River segments and the relationship with the process-domain river segments. Additional analysis will be needed to determine those processes at the Focus Area scale, which will provide an indication of how those processes are functioning within the entire Middle River Segment. The complete analysis will be presented in the USR.
USFWS_pp7.5-06_ph02; NMFS_pp7.5-06_ph03	***Variances*** *This study element [Geo-hydrologic Process Domains] was originally scheduled for completion in Q4 2013, but has not been completed and is a variance. This variance could potentially affect completion of the study Objectives. Numerical groundwater development relies on conceptual understandings of the groundwater system. This study element is focused on developing conceptual understanding of the groundwater system, and should be a pre-requisite for development of numerical groundwater flow models. It is important to stress that* ***successful completion of this study element is critical to completion of all other Groundwater Study Objectives****.*	Substantial data have been collected and are being analyzed to identify potential empirical relationships that could be used to up-scale Focus Area results to other areas within the Middle River Segment. For example, one relationship being explored pertains to the potential use of open-water leads and geomorphological spatial features to identify valid and invalid extrapolation regions for FA-128 (Slough 8A) groundwater processes. AEA will be exploring these and other approaches for developing an up-scaling process that can be reasonably applied to the Susitna River. The results of these analyses and the up-scaling approach will be presented in the USR.
USFWS_pp7.5-06_ph03; NMFS_pp7.5-06_ph05	***Modification 1: Basin-Scale Groundwater Flow Assessment*** *The Services recommend that Objective 2 be modified to clearly include a basin-scale groundwater flow assessment as described below.* *A basin-scale analyses should include an analysis of the basin water budget and address topics that include recharge rates (and variations due to altitude or other factors throughout the basin), glaciers, permafrost, types, lithology, and transmissivity of aquifers and confining units, expected water table and/or potentiometric surface configurations, and discharge to tributaries. This type of analysis may best be conducted by sub-basin analysis, particularly the sub-basins above and below the proposed dam, or sub-basins contributing to the Focus Areas.*	As explained below in Section 2.4.1.2.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-07_ph04; NMFS_pp7.5-07_ph04	***Modification 3: Hybrid Approach to Up-Scaling*** *The Services recommend that the up-scaling process used to tie information gained in the Focus Areas to the larger river use the hybrid approach described in the Summary Review of Susitna River Hydrogeologic Studies Conducted in the 1980s (Appendix-C, Page 21 of the SIR).* *…* *The SIR (11/2015), as part of its review of prior studies, has suggested a hybrid approach, which we agree with, but which represents a significant modification of the current study. The hybrid approach is succinctly described in Appendix-C, Page 21 of the November 2015 SIR report.*	As explained below in Section 2.4.1.2.2, AEA requests that FERC not adopt this recommendation. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. AEA's referencing to a "hybrid approach to up-scaling" was indicative that it is evaluating that approach and other methods for their applicability to up-scaling. Thus, AEA agrees with the Services' recommendation to use the hybrid approach (if it proves to be applicable) but disagrees that the approach represents a significant modification of the current study. That approach is already being evaluated as part of the FERC-approved Study Plan, and if feasible will be used for up-scaling. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp22_ph06	*[Modification] II. The Groundwater Study should be modified to require AEA to describe how Focus Area models will be extrapolated to the rest of the Susitna River to assess additional data needs and post-project impacts.* *AEA plans to use MODFLOW model results from the Focus Areas to predict groundwater/surface water interactions in other parts of the Susitna River. "Methods for extrapolating from areas where data have been collected to areas without data should be articulated, and this should be part of the considerations for data collection and model development."*[62] *AEA needs to complete this task now so licensing participants and FERC can determine whether more data needs to be collected or whether a regional groundwater model should be developed.*	As explained below in Section 2.4.1.2.2, AEA requests that FERC not adopt this recommendation. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-04_ph03; NMFS_pp7.5-04_ph04	*Prior studies concluded that the groundwater models are not transferable to other sloughs. The dichotomy between these two mutually exclusive methodologies is unaddressed, not reconciled, and may be a fundamental factor in the evaluation of work conducted under the FERC-ordered study. This is one important finding from the prior studies is highly pertinent to this review.* *Specifically, the finding states: "This report (R&M and WCC, 1985) concludes that because of the substantial differences among sloughs in the hydraulic and thermal behavior, detailed projections of slough discharge or temperature variations relative to mainstem conditions could only be made if mathematical models are constructed for each individual slough. Additional field investigations would also be necessary to generate input data for the models, and it is expected that different sloughs will have different discharge responses to project conditions."* *The present study does not incorporate these important 1980's findings about the unique qualities and complexities of each slough and is engaged in a process of modeling, characterizing, and up-scaling (see subsequent sections of this review) that track in a different direction to those previous findings without adequate justification or demonstration of the viability for the approach and reconciliation with prior findings.* *The feasibility of the current approach relies to a great extent on groundwater modeling efforts and a poorly-defined up-scaling process that have thus far not been successfully completed and demonstrated to be viable, even at the best monitored Focus Area.*	AEA disagrees that the current study does not consider the findings from the 1980s. AEA acknowledges the conclusion that simple regression relationships explored in the 1980s for understanding discharge and temperature variations in sloughs were not found to be transferrable to other sloughs. However, the current Study is using empirical data, process understanding gained through 2-D groundwater modeling, and results of 3-D groundwater modeling in FA-128 (Slough 8A) to develop methods to characterize potential operational effects in sloughs related to discharge and temperature to meet stated Study objectives. AEA further notes that the selection of Focus Areas and data collection sites did consider the information from the 1980s studies and contemporary information when developing Study Plan Section 7.5 and for locating key aquatic and riparian transects and areas of intensive groundwater study. The site selection process was described in the ISR (Study 7.5 ISR Part A, Sections 4.5 and 4.6) and presented at various technical presentations and will be further described in the USR. See Section 2.4.1.2.2 below for further discussion on AEA's approach for up-scaling.
SRC_etal_WATER_pp22_ph04	*… AEA needs to address the issue raised by R&M and Woodward Clyde (1980)… that "it would be necessary to construct mathematical models of each individual slough in order to make detailed predictions of the effects on the sloughs of changes in mainstem conditions." (R & M Consultants and Woodward-Clyde, 1985, p. 4-17). Even if AEA had completed a simulation that accurately described baseline conditions throughout side sloughs, plans to move from current conditions to simulation of Project operations would need to be developed and described.* [4]	AEA acknowledges the conclusion that simple regression relationships explored in the 1980s for understanding discharge and temperature variations in sloughs were not found to be transferrable to other sloughs. However, the current Study is using empirical data, process understanding gained through 2-D groundwater modeling, and results of 3-D groundwater modeling in FA-128 (Slough 8A) to develop methods to characterize potential operational effects in sloughs related to discharge and temperature to meet stated Study objectives. See Section 2.4.1.2.2 below for further discussion on AEA's approach for up-scaling.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-05_ph09; NMFS_pp7.5-06_ph02	*Expanding the results of the Focus Areas (up-scaling) appears to be highly dependent upon mapping efforts under this study element. In light of the 1980's findings about the unique characteristics of sloughs, there is a considerable lack of clarity on how or whether this is going to work, especially at the scale needed for habitat evaluations. A draft or pilot-scale work product is needed to understand this better.*	An initial introduction of how groundwater process information will be up-scaled from the Focus Areas was introduced in the *Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling Technical Memorandum* (Study 7.5 TM, September 30, 2014). Groundwater data from each Focus Area, in addition to mapping and analysis products from Groundwater and other studies, will be used to develop an up-scaling approach appropriate for the aquatic and riparian resource evaluations objectives in the Study Plan Section 7.5. AEA is providing the results of the upwelling mapping (Groundwater Objective 4) in the *Upwelling Broad-Scale Mapping of the Middle Susitna River Tech Memo* (Attachment 3 to this filing, *Response of the Alaska Energy Authority to Comments on the Initial Study Report*). In terms of the need for a draft or pilot scale work product, AEA notes that this type of preliminary analysis is already ongoing as part of the Proof of Concept studies being completed on FA-128 (Slough 8A). In addition to detailed 3-D groundwater MODFLOW modeling, relationships between various groundwater metrics (e.g., water temperature) and surface characteristics are being explored as possible ways to expand results to other areas. Further analysis including the results specific to FA-128 (Slough 8A) will be provided in the USR. See Section 2.4.1.2.2 below for further discussion on AEA's approach for up-scaling.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-09_ph04; NMFS_pp7.5-09_ph06	***Methods*** *The methods for this study component* [Potential Effects in the Vicinity of the Watana Dam/Reservoir] *consist primarily of characterizing hydrogeology of the area in the vicinity of the dam site. The ISR indicates that this work will consist primarily of using data collected by other studies, such as the Geology and Soils Characterization study, to develop a conceptual model of groundwater in the vicinity of the dam site. The methods section (ISR 4.3) also states that ground reconnaissance during fall 2013 and LiDAR data will be used to develop information on channel geometry and inundated area of the reservoir. However, the text of the ISR does not explain how these data relate to this study Objectives, specifically, how the effects of the dam and reservoir would affect groundwater-related aquatic habitat. More detailed information is needed to assess whether the methods presented here are adequate to address the study Objectives.*	The information being collected through the engineering studies at the proposed dam site, in combination with Geology and Soils Characterization Study (Study 4.5), Vegetative and Wildlife Habitat Mapping Study (Study 11.5), and Wetland Mapping Study (Study 11.7) provide most of the field scale data for evaluating the study objective. Reservoir operations developed by the Water Quality Modeling Study (Study 5.6) will also be used to provide information on the reservoir stage for various operational scenarios. Project Engineering Feasibility Studies are ongoing and the Geotechnical Investigation Program which is taking the lead in this effort, and the Geology and Soils Characterization Study (Study 4.5) are providing the primary information used to assess groundwater conditions in the proposed dam area under the ISR stage of the ILP process. This information will include results from past and contemporary geotechnical studies of the proposed dam location that include geologic well logs, pump tests, seismic data, permafrost information, water level records and other geotechnical information. The Geotechnical Investigative Program and the Soils and Geology Characterization Study (Study 4.5) will describe the pre-Project groundwater conditions in the vicinity of the proposed dam and will be used to develop conceptual GW/SW models that describe pre- and post-Project conditions. The conceptual models will assist in identifying key potential groundwater flow pathways in the proposed dam area and how the proposed dam construction may affect groundwater flow. The use of vegetation mapping information (Study 11.5, 11.7), LiDAR data (Study 6.6), reservoir stage simulation modeling (Study 5.6), 1-D bed evolution modeling of sedimentation in the upstream varial and deltaic zones (Study 6.6) and results from a field photographic survey conducted in fall 2013 will be used to estimate the variation in inundation areas and associated backwater effects at the upstream end of the reservoir for the potential loss of aquatic and riparian habitat associated with the main channel of the Susitna River. This data will be used to develop cross-sections (channel profile and channel and floodplain cross-sections) and maps describing the potential loss in aquatic and riparian upstream habitat. The information will help describe the timing and duration of inundation of potential habitat.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-09_ph09; NMFS_pp7.5-10_ph03	***Methods*** *The proposed methodology includes multiple techniques to map groundwater features, including open-lead mapping, aerial photography, thermal infrared (TIR) imagery, and ground-based observations. These are sound approaches to identifying the presence of groundwater upwelling over such an extensive area, in part because the first three methods could be used for joint cross-comparison and cross-validation and are also conducted at different times of the year. These approaches are also appropriate for the spatial scale of interest. The last technique described, ground-based observations, would be necessary to provide confirmation of areas of suspected upwelling. This was the essence of Objective 4; however, AEA has not presented methods for this important study element.*	The study has not yet been completed; study implementation is ongoing. Since filing the SIR, AEA has completed upwelling mapping in the Middle River and presented the methods for differentiating groundwater features (i.e., open-lead mapping, aerial imagery, thermal infrared (TIR) imagery and ground-based observations) and the results in the *Upwelling Broad-Scale Mapping of the Middle Susitna River Tech Memo* (Attachment 3 of this filing). The TM includes GIS-based maps displaying potential areas of groundwater influence and a longitudinal plot showing the cumulative distribution of groundwater influenced areas.
USFWS_pp7.5-10_ph05; NMFS_pp7.5-10_ph07	*Recent work (Technical Team Webinar, 12/5/14, slide 53 and other slides) shows the presence of three different regimes: Upland, Transitional, and Riverine in the Susitna River bottomlands. The criteria for differentiating these units are not clearly presented, nor are the boundaries delineated. This may be a useful concept for "upscaling" the results of the groundwater work, however additional work is required to determine whether these units (or some other units) are appropriate for mapping areas adjacent to the river on a larger scale. In reviewing slide 53 for example, these map units may not correlate meaningfully with other resources such as riparian vegetation or aquatic fish habitat.*	AEA is currently in the initial study reporting phase of the licensing process. The study has not yet been completed. Refinement of the regimes and their relationship to the up-scaling of groundwater processes at the river segment scale will be further developed in coordination with the Riparian Instream Flow Study 8.6. Mapping and terrain data from Geomorphology Study 6.5, vegetation mapping, and flow routing modeling (using the OWFRM) of stage levels will be used to develop a GIS approach to defining these areas. Data collected from Focus Areas will be used to validate the methods when applied to the Middle River Segment of the Susitna River. Results of the completed analysis will be provided in the USR.

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USFWS_pp7.5-10_ph06; NMFS_pp7.5-11_ph02	*As stated in the RSP, one of the work products from study Objective 4, Upwelling/Springs Broad Scale Mapping, is an "analysis of the identified upwelling/spring areas to determine if they are (1) main flow/stage dependent, (2) regional/upland groundwater dependent, or (3) of mixed influence. Given the vast number of upwelling areas already mapped in the Middle Susitna River, this will be a tremendously challenging task. Yet, this work product has received virtually no discussion in the ISR or technical meetings with regard to how it will be accomplished. It is therefore recommended that specific, detailed methods be developed regarding this work product.*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed; study implementation is ongoing. Since filing the SIR, AEA has completed upwelling mapping in the Middle River and presented the methods and results in the *Upwelling Broad-Scale Mapping of the Middle Susitna River Tech Memo* (Attachment 3 of this filing), which includes GIS-based maps displaying potential areas of groundwater influence and a longitudinal plot showing the cumulative distribution of groundwater influenced areas. Also since the SIR, additional analysis (correlation and Root Mean Square Error) looking at the response in groundwater elevation during changes in the Susitna River mainstem stage during the winter melt out period (June and July) suggests that it may be possible to develop a categorization for influence on groundwater by the Susitna River mainstem. The categorization or differentiation of groundwater types into three categories – riverine dominated; transitional; and upland dominated will be completed and presented in the Updated Study Report (USR).

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USFWS_pp7.5-11_ph02; NMFS_pp7.5-11_ph03	*The Final Study Plan (7/2013) states: Results will be provided in appropriate sections of the Initial Study Report. Information resulting from this study component was supposed to include the following:* *• GIS map layer of upwelling and groundwater influenced areas.* *• Analysis of the identified upwelling/spring areas to determine if they are (1) main flow/stage dependent, (2) regional/upland groundwater dependent, or (3) of mixed influence.* *No GIS map layer was provided in the ISR, nor were analyses of upwelling/spring areas presented. The 2015 SIR report states that "differentiating upwelling areas into the three categories will not be possible," (page 15, Section 5.4). There is no elaboration on why the differentiation into the categories identified in the study plan is not possible. The study plans for this task are applicable to the locations of areas in the "Middle River Segment and upper portion of the Lower River Segment that are currently influenced by groundwater inflow".*	AEA is currently in the initial study reporting phase of the licensing process. The study has not yet been completed; study implementation is ongoing. Since filing the SIR, AEA has completed upwelling mapping in the Middle River and presented the methods for differentiating groundwater features (i.e., open-lead mapping, aerial imagery, thermal infrared (TIR) imagery and ground-based observations) and the results in the *Upwelling Broad-Scale Mapping of the Middle Susitna River Tech Memo* (Attachment 3 of this filing), which includes GIS-based maps displaying potential areas of groundwater influence and a longitudinal plot showing the cumulative distribution of groundwater influenced areas. This represents the first of two work products (RSP Section 7.5.4.3.1) associated with this study element. The second study element is the analysis of the identified upwelling/spring areas to determine if they are (1) main flow/stage dependent, (2) regional/upland groundwater dependent, or (3) of mixed influence. Although these three categories were differentiated in FA-128 (Slough 8A), it was noted in the SIR (Study 7.5 SIR, Section 5.4), that differentiating upwelling into similar categories would not be possible in all other areas. This was noted, since at the time, the mapping and analysis had not been completed so it was not clear whether the results would allow the differentiation into those exact categories or whether some other categorization may be more applicable. Since the SIR, additional analysis in the Middle River (correlation and Root Mean Square Error) looking at the response in groundwater elevation during changes in the Susitna River mainstem stage during the winter melt out period (June and July) suggests that it may be possible to develop a categorization procedure that can be utilized for other areas in the Middle River Segment. AEA will also evaluate whether LiDAR data could be useful in identifying groundwater areas above river influence. Additional analysis is needed to further develop the categorization process for the Middle River Segment. That process and the results of the categorization will be presented in the USR. As for the Lower River Segment, the RSP did not include a study element to complete the same level of upwelling mapping as is being done for the Middle River. This is because Project effects will be the greatest on the Middle River Segment groundwater sources. The TIR imagery was completed for large portions of the Lower River Segment as a means to identify areas of potential importance to fish in the Lower River (as may be influenced by groundwater), but not to designate areas into specific categories of upwelling.

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USFWS_pp7.5-11_ph08; NMFS_pp7.5-12_ph02	*These three categories are not the same three categories mapped at FA-128 in the 2015 SIR: "Riverine Dominated, Riverine-Upland Transitional, and Upland Dominated". There seems to be a bit of confusion in the terminology and perhaps the methods and results used to identify these different areas. In any event, it seems like it should have been feasible to perform a differentiation of sources. Not performing this activity would be a variance.* *A source of data (in addition to those listed) that should be considered to differentiate between different upwelling areas is detailed LIDAR-based topographic mapping. The elevation of upwelling areas above various seasonal high water or flood stages can be a useful parameter in their differentiation.*	The study has not yet been completed; study implementation is ongoing. Since filing the SIR, AEA has completed upwelling mapping in the Middle River and presented the methods for differentiating groundwater features (i.e., open-lead mapping, aerial imagery, thermal infrared [TIR] imagery and ground-based observations) and the results in the *Upwelling Broad-Scale Mapping of the Middle Susitna River Tech Memo* (Attachment 3 of this filing). The TM includes GIS-based maps displaying potential areas of groundwater influence and a longitudinal plot showing the cumulative distribution of groundwater influenced areas. This represents the first of two work products (RSP Section 7.5.4.3.1) associated with this study element. The second study element is the analysis of the identified upwelling/spring areas to determine if they are (1) main flow/stage dependent, (2) regional/upland groundwater dependent, or (3) of mixed influence. Although these three categories were differentiated in FA-128 (Slough 8A), it was noted in the SIR (Study 7.5 SIR, Section 5.4), that differentiating upwelling into similar categories would not be possible in all other areas. This was noted, since at the time, the mapping and analysis had not been completed so it was not clear whether the results would allow the differentiation into those exact categories or whether some other categorization may be more applicable. Since the SIR, additional analysis in the Middle River (correlation and Root Mean Square Error) looking at the response in groundwater elevation during changes in the Susitna River mainstem stage during the winter melt out period (June and July) suggests that it may be possible to develop a categorization procedure that can be utilized for other areas in the Middle River Segment. AEA will also evaluate whether LiDAR data could be useful in identifying groundwater areas above river influence. Additional analysis is needed to further develop the categorization process for the Middle River Segment. That process and the results of the categorization will be presented in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-12_ph03; NMFS_pp7.5-12_ph06	*Modification 8: Map-based Impact Assessment* [The Services recommend] *including an assessment of proposed project effects based on groundwater-influenced aquatic and floodplain habitat maps of the entire river corridor, where impacts may occur.* *… The "Decision Support System" needed for this project should be much more focused on preparing resource-based maps of the river corridor and the creation of "impact zones" based on hypothetical but realistic scenarios of river and groundwater dynamics based on data collected to date, aerial imagery and field-based detailed mapping at a scale of approximately 1:6000 (1 inch = 500 feet), and models of river dynamics based on project operating scenarios.* *Resource-based maps should include, for example, detailed geological mapping, vegetation mapping such as is found in Figure 5-32 of the Riparian Instream Flow Study (RIFS) (8.6, SIR, November 2015), aquatic habitat mapping such as is found in Figures 5.6.1, 5.6.2, and 5.6.3 of the Fish and Aquatics Instream Flow Study (8.5, SIR, November 2015), groundwater upwelling and groundwater influenced areas. The mapping should consider various stages of the Susitna River such as is found in Figure 5.32 of the RIFS (SIR report).*	As explained below in Section 2.4.1.4.1, AEA requests that FERC not adopt this proposed Study Plan modification. This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. The analysis of Project impacts will appear in the License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impacts assessment in the License Application, please see Section 1.3. Further, the modification request pertains to the DSS, which is not part of Study 7.5; the DSS is already part of the FERC-approved Study 8.5. Moreover, the Services submitted a new study request for model integration and DSS; see Section 3.4 for further discussion on the DSS and AEA's response to the Services' request for a new study. The estimated cost of this modification is contained within the cost estimate presented for the DSS Modification (see Section 3.4.2.3).
USFWS_pp7.5-12_ph07; NMFS_pp7.5-13_ph02	*The project has embarked on a highly quantified process of attempting to determine impacts with a variety of very complex models that require large amounts of data and assumptions, but which may end up producing results that are less useful than planned. Re-evaluation of these complex models in favor of simpler and less precise but more reliable overall assessments may be in order.*	AEA notes that licensing participants have been directly involved in the selection of all of the detailed models that AEA is developing to assess impacts. Moreover, the majority of both oral and written comments proffered to date across all resource areas have been directed toward increasing rather than decreasing the level of study and model complexity. See Section 2.4.1.4.1 below.
USFWS_pp7.5-13_ph05; NMFS_pp7.5-13_ph07	*Monitoring stations established under this study component primarily provide information on groundwater levels and temperatures, and surface water levels and temperatures. There is limited information on soil moisture, soil temperature, and meteorological variables. Time-lapse cameras are deployed at the Focus Areas to assist interpretation of incoming data streams.*	The collection of soil moisture and temperature profile data occurred at two Focus Areas: FA-128 (Slough 8A) and FA-104 (Whiskers Slough). These two Focus Areas were selected because they are equally important to both the Fish and Aquatics IFS and the Riparian IFS and the information obtained from each should be representative of that from other Focus Areas.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-14_ph01; NMFS_pp7.5-14_ph03	*1) Up-Scaling* *The models are described by the RSP as useful tools to scale up the findings of the Focus Areas to unmonitored areas. The applicability of these models to different hydrogeologic environments such as hydrologically distinct types of sloughs or the areas below the three rivers confluence is not addressed. The focus area differ from each other and from areas below the three river confluence so much that applying groundwater information learned at one location to another may not be possible. Findings previously described from the 1980s studies cast doubt on the viability of this approach. It is not clear how the modeling results will be up-scaled to the broader study area. Focus Areas are all contained in Riparian Process Domains (RPDs) 3 and 4, so it is not likely that the findings would be applicable to domains 1, 2, and 5. Also, within RPD 3 and 4, there are numerous individual vegetative communities and the degree of dependence of these vegetative communities on the water table is not clear. The methodologies for incorporating other factors such as soil type, aquifer lithology, or thickness of the unsaturated zone for which data may be lacking or sparse, are not described. (Addressed with Modification 3 under Objective 2.)*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed. Results of the completed analysis will be provided in the USR. The purpose of the groundwater modeling is to develop a better understanding of GW/SW processes to help inform studies on how to make appropriate assumptions in other areas. The differences in Focus Areas and the Riparian Process Domains they represent will be taken into account when applying these results. The effects of Project operations on groundwater hydrology below the confluence of the Chulitna and Talkeetna rivers is expected to be in the range of natural variation. Data collected at Lower River Riparian Transects will be used to verify this, along with stage level analysis from flow-routing models. The Riparian Process Domain (RPD) analysis is to be completed for the final study with the addition of the ice processes data analysis. Regarding the representativeness of the RPDs, RPD 1 extends from the dam site at PRM 187 to Devils Canyon. RPD 2 encompasses Devils Canyon and is not included in the Riparian IFS (8.6) considering there is very limited, if any, floodplain within the Canyon. In RPD's 3 and 4 numerous vegetative communities are being sampled and groundwater relations characterized as described in *the Riparian Instream Flow, Groundwater, and Riparian Vegetation Studies FERC Determination Response Technical Memorandum* (Study 7.5, 8.6, and 11.6 TM, July 1, 2013). RPD 5 currently encompasses the river segment from Three Rivers Confluence to the down river Project area extent at PRM 38. Under the current Riparian IFS design (RSP Section 8.6), there are five Lower River riparian vegetation study sites to evaluate riparian vegetation groundwater and surface water relationships. The results of this sampling effort will be compared with the Focus Area riparian vegetation analyses to evaluate whether Middle River riparian vegetation and GW/SW are similar for use in the scaling efforts of the final analyses. For related information, see Section 2.4.1.2.2 below.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-14_ph02; NMFS_pp7.5-14_ph04	*2) Water Table Maps* *Construction of a 3-D groundwater model is proposed for FA-128. This would normally be based on water table maps constructed for selected time periods for calibration purposes. Construction of water table maps is not an original element of the RSP; However it has subsequently been incorporated as a work element of the Groundwater Study. Omission of the preparation of water table maps for each Focus Area is a significant flaw of the FSP (RSP RVTM) which has been partially corrected by the preparation of water table maps contained in the SIR report. Problems with data coverage and quality associated with the maps are discussed subsequently in this technical memorandum.*	AEA disagrees with the assertion that omission of the preparation of water table maps for each Focus Area is a significant flaw of Study Plan Section 7.5. First off, development of water table maps was not specified in the FERC-approved Study Plan, which had been thoroughly reviewed by the licensing participants. Thus, there would be no flaw had water table maps not been developed. However, water table maps were prepared and presented in the SIR (Study 7.5 SIR, Appendix A: *Preliminary Water Table Contour Maps for Focus Areas FA-104 (Whiskers Slough), FA-115 (Slough 6A), FA-128 (Slough 8A), and FA-138 (Gold Creek)*). AEA commissioned the construction of water table maps under different seasonal conditions and associated river stages for each Focus Area after preliminary maps were presented at the Groundwater Study Technical Team meeting on December 5, 2014. The maps provided useful information on seasonal changes in groundwater elevations, flow directions, and horizontal gradients, at different locations within the Focus Areas. Furthermore, the maps were informative with respect to identification of groundwater fed sloughs and with MODFLOW model calibration efforts in FA-128 (Slough 8A). However, the water table maps were not an essential component for the development of the MODFLOW models. Rather, those models rely on surface water and groundwater data and other topographic and physical information for their development.
USFWS_pp7.5-14_ph03; NMFS_pp7.5-14_ph05	*3) Winter Conditions* *It is also not stated whether the models will be capable of simulating wintertime conditions when aquifers can be locally confined by ground ice, surface ice, or icings. These phenomena are not discussed.*	A more thorough evaluation of winter conditions relative to Project operational effects on groundwater will be presented in the USR. During winter conditions, aquifers will not be confined by local freezing or surface icing. The water table aquifers are permeable enough to not allow small changes in frozen ground to impact groundwater levels. The shallow aquifer is also a heat source, preventing active-layer (annual) ground freezing into the top of the water table. This is also reflected by groundwater upwelling inflow to side channels and slough melting out surface water icing under colder air temperature conditions. Ice in slough and side channels will have an impact on water flow and stage characteristics in the channels during winter due to modifications of the channel cross-sectional areas. Groundwater levels will represent changes in surface water levels, as they do during summer stage increases associated with storm or snowmelt hydrographs.

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USFWS_pp7.5-14_ph05; NMFS_pp7.5-14_ph07	*5) Groundwater/Surface Water Response Functions* *The ISR report states: "Task 5 of the GW plan (Study 7.5) centers on defining groundwater/surface water (GW/SW) relationships associated with riparian habitats within selected Focus Areas. This task is linked with the Riparian Instream Flow Study (R-IFS) (RSP8.6) with one of the Objectives being the development of GW/SW response functions for different locations within a Focus Area that can be used to assess upland-dominated groundwater from riverine dominated GW/SW interactions resulting from different Project operational scenarios."* *It is not clear what a "GW/SW response function" is or how they will be developed and used to assess the effects of different Project operational scenarios. This section is confusing and should be further clarified and defined.*	AEA has provided a detailed description of the methods that will be used to develop GW/SW relationships for the Riparian IFS, as well as presented some preliminary relationships in the *Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling* filed with the Commission September 30, 2014. Further analysis is ongoing and will be presented in the USR. In terms of the GW/SW response function question, a "groundwater/surface water response" refers to the degree to which groundwater elevations respond to changes in surface water elevations. Thus, the development of groundwater response functions seeks to use observable geomorphological features (e.g., relative elevation and distance to the main channel) to predict the degree to which surface water elevation impacts groundwater elevation. AEA is evaluating multiple data sets and completing exploratory analysis looking to define and apply these GW/SW response functions in evaluating riparian habitats.
USFWS_pp7.5-15_ph02; NMFS_pp7.5-15_ph03	*6) 2D vs 3D Groundwater Flow Systems and Models* *As a general guide to 2D transect models, Anderson and Woessner (2002) state that "the main consideration in orienting the profile is to align the model along a flow line"... so that all flow in the model occurs "parallel to and in the plane of the profile". Field situations in which this is not done introduce errors into the modeling process that should be recognized and addressed with respect to the purposes of the modeling simulations. Previous hydrologic studies [e.g. Loeltzand Leake, 1983; Nakanishi and Lilly, 1998; Arihood and others, 2013] confirm this concept.* *For example, Nakanishi and Lilly [1998] (cited in the FoSP as a template methodology for this study) used a 2D transect model along the Chena River, Alaska, and found it necessary to use a "30 percent adjustment for geometry effects" to account for the three-dimensional nature of the flow system caused by the river's large meander. In the Focus Areas, local surface water geometries are far more complex. Examination of multiple Focus Area water table maps shows that inferred directions of groundwater flow are commonly not aligned with the planned profile models, which should cause reevaluation of the adequacy of the planned 2D modeling to simulate conditions in real-world three-dimensional transient groundwater flow systems.*	See Section 2.4.1.5.1 below regarding 2-D versus 3-D groundwater flow systems and models.
USFWS_pp7.5-15_ph04; NMFS_pp7.5-15_ph05	*One of the stated Objectives of the modeling is to simulate the effects of sudden rises or lowering of river stage. These changes may be caused by river ice processes, natural flooding processes, or future dam operations and are an important part of the groundwater analysis. If water levels in the mainstem suddenly rise for example, the groundwater flow directions (in plain view) will likely change in a manner that cannot be simulated with a 2D profile model. Errors introduced by this transient situation should be addressed, especially as it pertains to simulating water-level changes caused by proposed dam operating scenarios.*	The potential error associated with changes in groundwater flow direction will be addressed as part of the modeling effort that will be described and presented in the USR. To clarify, the intent of the 2-D models is not to simulate groundwater flow directions in plan view. The intent is only to simulate the rise and fall of groundwater levels in response to changes in the mainstem flows regardless of cause.

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USFWS_pp7.5-15_ph05; NMFS_pp7.5-15_ph06	*These analyses call into question the validity of the key assumptions underlying the use of 2D transect models for Focus Areas on the Middle Susitna River. Compelling evidence for this approach has not yet been presented and this approach may not be adequate to meet the Objective for this study element.*	See Section 2.4.1.5.1 for AEA's response to USFWS and NMFS comments regarding 2-D vs. 3-D groundwater flow systems and models.
USFWS_pp7.5-15_ph06; NMFS_pp7.5-15_ph07	*In some situations, the most appropriate modeling exercise would be to construct a 2-D plan view model rather than a 2-D transect model. The distribution of water-table data and surface water geometries for use in calibrating the model at many of the Focus Areas appears to be better suited to a 2-D plan view analysis than a 2-D transect analysis. In some cases, there may be advantages to performing both types of analysis in order to achieve project Objectives.*	The intent of the 2-D models is not to simulate groundwater flow directions in plan view. The intent is only to simulate the rise and fall of groundwater levels in response to changes in the mainstem flows regardless of cause. However, AEA will consider application of a plan view type model if analysis so indicates. Also see Section 2.4.1.5.1 for AEA's response to USFWS and NMFS comments regarding 2-D vs. 3-D groundwater flow systems and models.
USFWS_pp7.5-16_ph01; NMFS_pp7.5-16_ph02	*8) Vertical Groundwater Gradients* *Another potential limitation with the design of the groundwater modeling effort in this task is that vertical gradients within the aquifer were not measured. The comparable study cited (Nakanishi and Lilly, 1998) had multiple nested observation wells with which to calibrate the model to deeper parts of the flow system. Since these are lacking in this study, the model will only be able to be calibrated and verified for the surface of the aquifer. Thus, the transect model of Nakanishi and Lilly (1998) is only generally, not entirely, similar. If there is no water-level information at depth to guide model calibration, the modeling work, in effect, becomes more of a 1-D calibration exercise, possibly with a distributed recharge component, a variable thickness aquifer, and boundary conditions.*	AEA acknowledges the need to understand the groundwater system components outside the floodplain for the Susitna River. AEA's plans to use single wells and other groundwater related observations to estimate vertical groundwater flow components was a result of observing shallow groundwater intersecting land surface and the available well installation methods. The application of these other observations can help infer understanding of the larger groundwater system. For example the many seeps, springs, and wetland complexes along the Middle River are indications of shallow groundwater intercepting land surface. This information, when used in conjunction with vegetation mapping, land surface information (LiDAR), and geologic mapping, can help extend the understanding gained from the wells that were installed for the Project. AEA concurs with the Services' conclusion that this study is "not entirely similar" to Nakanishi and Lilly (1998). That model related to a project where the objective required application of a regional 3-D groundwater flow model and primary application of groundwater modeling to provide an understanding of regional groundwater hydrology in support of contaminant transport problems; whereas, AEA's needs are different. For related information, see Section 2.4.1.5.9 below.
USFWS_pp7.5-16_ph03; NMFS_pp7.5-16_ph04	*10) Icings* *There is no discussion of the potential for groundwater levels to rise during the winter as a result of icings (the freezing of discharging groundwater into large masses of ice that partially "dam" groundwater and cause the water table to rise). This is a well-known phenomenon in cold regions and should have been addressed as a potential cause of the some of the observed stage fluctuations. The process of icings and observations about their occurrence and extent (if any), especially in the focus areas, should have been included in the groundwater study,*	AEA acknowledges that icing issues related to freezing soils is a process observed in Northern Alaska that are continuous permafrost regions, and in central Alaska areas that are discontinuous permafrost with the right conditions to produce these effects. However, AEA believes there is little/no potential for large masses of groundwater to freeze in this area because groundwater temperatures are too warm in this part of the basin and the river valley floodplain does not have any reporting of significant permafrost in it. Furthermore, the contribution of warm surface water from the river into the shallow groundwater system would have melted any permafrost that could have existed in the Middle River floodplain. That said, AEA acknowledges localized icing has been observed and reported during the October 24, 2012 TWG meeting.

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USFWS_pp7.5-16_ph04; NMFS_pp7.5-16_ph05	*In summary, the methodology for analysis of the data is not presented in enough detail to determine whether the Objectives will be met, however the identified shortcomings of the methodology casts significant doubt that the 2-D modeling proposed would be technically valid and accomplish the project Objectives.*	AEA notes that the purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. It was not intended to provide final results of analysis or modeling as will be provided in the USR, nor a detailed evaluation of potential Project impacts which will be presented in the License Application (Exhibit E).
USFWS_pp7.5-16_ph06; NMFS_pp7.5-17_ph01	*FA-128 Groundwater Model Results* *The preliminary three-dimensional groundwater model at FA-128 has significant conceptual and technical shortcomings that are discussed in the following section.* *1) Sparse and Limited Areal Coverage of Data and Data Quality* *The feasibility of constructing 2D or 3D models at most Focus Areas in order to provide the inputs planned for the riparian and aquatic habitat analyses and the up-scaling process is significant hampered because of insufficient and questionable data. The water table maps at all of the Focus Areas except FA-128 have very sparse spreads of monitoring stations with which to draw water table maps and construct 3D groundwater models. Groundwater contour lines are short and discontinuous and large areas of the Focus Areas are devoid of data and contours, including at important sloughs. The original plan was to construct profile models along linear orientations perpendicular to the river; however this is likely to not be viable. Since this was previously commented at the October 2014 technical meetings and December 5, 2014, webinar, AEA has not further addressed this concern or clarified how it plans to model these Focus Areas in the future. As a result of these issues, the feasibility of constructing 2D or 3D models in order to provide the inputs planned for the Riparian and aquatic habitat analyses and the up-scaling process is in significant doubt.*	AEA re-affirms that the purpose of the 3-D modeling in FA-128 (Slough 8A) was to test the assumptions in making the 2-D transect models in the aquatic and riparian transects. The data collection in FA-128 (Slough 8A) was designed to support this objective. Modeling in the other Focus Areas was intended to use 2-D transect models and limited to providing insight to the GW/SW interaction processes needed for the aquatic and riparian resource evaluation assessments. Development and calibration of the preliminary FA-128 MODFLOW model was done using available project data. Project LiDAR and bathymetry data and output from other project hydrologic models were used to define river extents, bottoms, and stages. Assigned surface water stages were also compared to surface water monitoring stations. The preliminary calibration of MODFLOW relied on matching simulated groundwater levels to observed groundwater levels using observations from 19 groundwater monitoring stations for steady state and using observations from 15 stations for transient conditions. The FA-128 3-D MODFLOW model refinement is ongoing and incorporates groundwater flux as a model calibration target and measurements of aquifer hydraulic conductivity. Flux targets were estimated from existing Project data: discharge measurements collected in 2014 as documented in the SIR (Study 6.6 SIR, Table 5.1-14) and seepage measurements collected during the early 1980s studies (Harza-Ebasco, April 1984). Additional data are also being collected during the summer of 2016 to assist with the refined model calibration. These new data include well slug tests at site monitoring wells for estimating the aquifer hydraulic conductivity and seepage meters installed at key locations for estimating groundwater fluxes (2 meters in FA-138 [Gold Creek], 4 meters in FA-128 [Slough 8A], and 2 meters in FA-104 [Whiskers Slough]) (Figure 2.4.1-3, Figure 2.4.1-4, Figure 2.4.1-5, and Figure 2.4.1-6 below).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-17_ph02; NMFS_pp7.5-17_ph04	*There are numerous anomalous data reported on the water table maps that are omitted from contouring based on "professional judgment" (SIR Appendix A-Page 3, Section 4, Methods). Item-by-item, these should be further evaluated with descriptions of exclusion criteria and discussion regarding possible hydrodynamic influences on the data, irresolvable data errors, or other causes. Any "lessons learned" should be incorporated into future data collection efforts to ensure that a robust set of groundwater and surface water data are usable for the time periods of interest in the groundwater analyses.*	Omission of water levels was generally because the "anomalous" data were measured from a different time period than the balance of the data. As stated in the SIR (Study 7.5 SIR, Appendix A: *Preliminary Water Table Contour Maps for Focus Areas FA-104, FA-115, FA-128, and FA-138*): *"Manual water-level elevations were included and shown on contour maps when no pressure transducer readings were available. It should be noted that manual measurements were not always collected on the target date, and therefore may not be representative of water-level elevation conditions on the target date. Manual measurements were shown on the maps and some measurements were excluded from contouring based on professional judgement. A quantitative inclusion/exclusion criteria based on hydrographs of the Middle River Segment of the Susitna River may be appropriate but was not developed."*
USFWS_pp7.5-17_ph03; NMFS_pp7.5-17_ph05	*The Groundwater Study has made data available from project monitoring wells, including groundwater levels and temperatures at http://gis.suhydro.org/reports/isr. Two critical pieces of information that have not been provided are the well depth and lithology. It is standard in hydro-geologic investigations to provide records of both when reporting results. Obviously, well drive points do not provide lithology data, however data from other sources such as the 1980's studies and shallow soil investigations conducted under other studies should be used to characterize the subsurface. The interpretation and groundwater modeling proposed as part of this study is limited without these data, and it is difficult for reviewers to interpret data from the groundwater stations without also having knowledge of well depth and lithology. Therefore, it is recommended that these data be made available along with other monitoring station data, and be explicitly included as appendices or figures in future reports.*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed. As part of this filing, AEA has provided the *Upwelling and Broad-Scale Mapping of the Middle Susitna River Tech Memo* (Attachment 3 to this filing). Results of the completed analysis will be provided in the USR. The well depth data is provided in Table 2.4.1-2 below. The USR will include and describe well depth information along with lithology information from the detailed floodplain mapping by Geomorphology Study (6.5). Additional information from slug tests conducted in summer of 2016 will also be incorporated into the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-17_ph04; NMFS_pp7.5-17_ph06	*2) Unsuccessful Transient Calibration* *Table 5.1 presents calibration statistics which make appear like the model matches the field data, however the process for arriving at calibration statistics requires further explanation. The model predictions for groundwater wells that are close to surface water measurements match well, however those that are 200 meters from open water do not match well at all. Was the analysis inadvertently biased by the 12-hour quasi-steady state periods of time prior to and after the river stage pulse compared to the time period of rapidly changing pulse? Were the statistics performed on each time step for each target well for the simulation?* *One of the major purposes of the transient model is to simulate the river pulse dynamic, and a qualitative review of the most dynamic portions of the curves for FA128-4, FA128-5, FA128-6, FA128-7, FA128-11, FA128-13, FA128-21, FA128-26, and FA128-27 on Figures 5-5, B1-3, 5-6, 5-7, 5-8, 5-9, B1-10, B1-14, and B1-15 show that the model fit to the data look rather poor. This is a relatively large number of curves that appear not to be well-simulated by the model's dynamic river pulse. It should be better explained why the apparent fit for FA128-13 appears to be rather good on Figure 5-3 and rather poor on Figure 5-9. A few of the targets have relatively well-fitting curve shapes, but they are offset by a significant amount that may be explainable by approximations in the river stage modeling scheme. While one of the major purposes of the transient simulation was to simulate the river pulse, the relatively poor and anomalous fitting of numerous data sets merits closer evaluation. Re-evaluation of the model calibration statistics for the transient run and a more thorough analysis is needed to verify the findings before concluding that the calibration statistics "were relatively good" (as readers might infer incorrectly that the calibration is relatively good).*	The analysis was not biased by the 12-hour quasi-steady state periods. The calibration statistics were performed on the complete target data set in each model. Each well has one target value contributing to the dataset in the steady-state model. In contrast, each well has 54 target values in the transient model for each stress period contributing to the dataset. The river stage pulse simulated in the transient model occurred over a 5-day period and was represented using ½ day stress periods which were capable of capturing the rising limb, peak, and falling limb of the hydrograph. This is more than adequate for model calibration purposes and does not result in a statistical bias. Future predictive simulations will have the flexibility to simulate shorter stress periods. AEA clarifies that simulated versus observed "groundwater levels" are presented in Figure 5-3; whereas, "differences between groundwater levels and surface water levels" are presented in Figure 5-9. The preliminary model has a good match to the observed "groundwater levels" at station FA128-13 but the match to the observed "differences between groundwater levels and surface water levels" was not as well matched. The preliminary transient MODFLOW model is being refined and calibrated to improve match to all target locations. Flux targets are also being considered to improve the calibration. The updated calibration statistics will be re-evaluated and presented in the USR.
USFWS_pp7.5-18_ph02; NMFS_pp7.5-18_ph02	*During the March 22, 2016 meeting, it was noted that the method for determining calibration statistics for the transient run should be reevaluated. Mr. Swope stated that they did not calculate calibration statistics for the transient calibration. This is an incorrect statement. Table 5.1 of the SIR shows that the Root Mean Square Error (RMSE) for the transient run is listed as 9.6%. The modeling report makes clear that the transient model is not properly calibrated. This is likely because:* *• Model parameters aquifer storativity and regional groundwater recharge were given potentially unrealistic values in an attempt to make simulated water levels match measured water levels;* *• An important process was not incorporated into the model formulation, that of direct groundwater recharge from snowmelt; and* *• Measurements of flow in sloughs attributable to groundwater discharges should be important groundwater model calibration targets, but were not used.*	AEA is currently refining and recalibrating the FA-128 (Slough 8A) MODFLOW model. This effort has improved the calibration significantly compared to results presented in *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)* (Study 7.5 SIR, Appendix B). The recalibration of this model has included incorporation of discharge measurements taken in sloughs (e.g., Study 7.5 TM, September 30, 2014: *Groundwater and Surface-Water Relationships in Support of Riparian Vegetation Modeling*, Table 3.1-2) and resulted in a more realistic aquifer storativity value for unconfined aquifers than was reported in the preliminary model report. The updated calibration statistics will be presented in the USR. For related information see the response to USFWS_pp7.5-17_ph04; NMFS_pp7.5-17_ph06.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-17_ph07; NMFS_pp7.5-18_ph07	*Direct Groundwater Recharge from Snowmelt* *There is a potentially major conceptual flaw in the groundwater model based on the conclusion that "...the hydrologic response is exclusively related to increases in river stage..." Surprisingly, the model fails to simulate or even acknowledge the process of on-site snowmelt recharge to the water table to raise water levels in observation wells completely distinct from any changes in river stage. Springtime increases in groundwater levels from snowmelt are commonly in the range of a few feet, which is of a similar magnitude as increases caused by increases in river stage. With all of the data available at this site, the model should have incorporated direct recharge from snowmelt into the analysis. Without doing so, the comparisons of transient model head values with measured head values presented, as a measure of goodness of calibration of the model, is relatively meaningless. This conceptual shortcoming undermines the validity of the entire modeling process to date.*	AEA notes that the Services' concern about the perceived undermining of the validity of the modeling process will be overcome by incorporation of snow melt. As specified in USFWS_pp7.5-15_ph07; NMFS_pp7.5-16_ph01, regional spring snow survey data from the National Resources Conservation Service will be used to estimate regional snow conditions for the field data collection periods. This information, spring snow surveys and analysis by the Glacier and Runoff Changes Study (7.7) and field observations, will be used to estimate the potential influence of snowmelt on local GW/SW interactions.
USFWS_pp7.5-17_ph08; NMFS_pp7.5-19_ph01	*Annual precipitation in Alaska is commonly divided into three major components: evapotranspiration, surface runoff, and groundwater recharge. For this model to assign a value for groundwater recharge based only on the difference between annual precipitation and pan evaporation without further explanation is a potentially significant conceptual problem in the structure of the model. Also, recharge tends to be highly seasonal in this area, with most recharge occurring during the fall rainy season or spring snowmelt season with additional recharge from significant summer storms. The steady state period simulated, May 20 to June 6, is described as being "...stable with little flooding or precipitation...," (Appendix B-Page 10), which raises questions whether the relatively high groundwater recharge rate simulated is characteristic of the steady-state period simulated. This needs further explanation, evaluation, and revision.*	AEA notes that use of an annual average recharge value in steady-state groundwater flow models is common practice. As stated in the response to USFWS_pp7.5-17_ph07 and NMFS_pp7.5-18_ph07, the FA-128 (Slough 8A) MODFLOW model is currently being refined and recalibrated. Additional analysis will be completed and presented in the USR which will include consideration and refinements of groundwater recharge and its sensitivity to steady-state conditions.
USFWS_pp7.5-19_ph02; NMFS_pp7.5-19_ph03	*Regional Groundwater Flow* *The fluxes of groundwater into the modeled region along the sides of the model (representing regional groundwater flow inputs to the modeled area) were reduced by an order of magnitude in order "to improve the overall calibration". This requires further justification and analysis prior to acceptance of it into the model. This parameter was the result of prior estimation of these fluxes, which have not been demonstrated to be flawed, and is a very large deviation from those estimates. This parameter should not be treated as an adjustment parameter on a black box model that can be adjusted to values that simply seem to make the model work better.*	Comment noted and AEA provides the following additional clarification. The estimated regional groundwater flux derived in the 1980s was based on a simple Darcy calculation using assumed values of hydraulic conductivity, aquifer thickness, and groundwater gradients. No measured data were available on the values of these parameters during the current studies, which can vary by orders of magnitude. AEA considers the adjustment of specified flux boundaries within reasonable ranges during model calibration as common practice.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-19_ph03; NMFS_pp7.5-19_ph04	*Analysis of the "GW regional scale relationship to local flow systems" should include additional evaluation of the early 1980's estimate of fluxes of 2.1 ft2/d from regional groundwater flow towards the Susitna River compared to the models use of 0.21 ft2/d for the flux at FA-128. As part of this evaluation, the model's application of a recharge rate of 10.5 inches/year should be compared to average regional recharge rates that would reflect the different regional flux estimates towards the river.*	AEA considers this a reasonable request and will address as part of further analysis to be presented in the USR**.**
USFWS_pp7.5-19_ph04; NMFS_pp7.5-19_ph05	*The SIR modeling text is dismissive of estimates by 1980's studies of the regional groundwater flux towards the Susitna River (2.1 ft2/day) based on "regional aquifer properties, gradients, and thicknesses, but not empirical data". The authors present no basis for their current 0.21 ft2 /day parameter, which is an order of magnitude lower. The regional information used to determine the prior estimates are "empirical data" and should not be so readily dismissed in favor of the model-derived parameter. The authors do not consider that the unusually low model-derived parameter could be an artifact of some other approximation or problem with the model. This should be reevaluated during any future attempts to calibrate or validate the model.*	Comment noted and AEA provides the following additional clarification as provided in the response to USFWS_pp7.5-19_ph02; NMFS_pp7.5-19_ph03. The estimated regional groundwater flux derived in the 1980s was based on a simple Darcy calculation using assumed values of hydraulic conductivity, aquifer thickness, and groundwater gradients. No measured data were available on the values of these parameters during the current studies, which can vary by orders of magnitude. AEA considers the adjustment of specified flux boundaries within reasonable ranges during model calibration as common practice.
USFWS_pp7.5-19_ph05; NMFS_pp7.5-20_ph01	*Aquifer Storativity* *The model also tweaked values of aquifer storativity as a calibration parameter of the model. The value they ended up with is characteristic of confined or semi-confined aquifers, not a water table aquifer, like the rest of the report describes. This is a very large unexplained technical shortcoming.* *The text states: "The storage coefficient was initially set to 0.2, but was eventually reduced to a value of 0.001 to achieve a better match to the observed GW elevation response. This value is somewhat low for an unconfined aquifer and may suggest the aquifer is semi-confined." This is anomalous in consideration of the fact that the aquifer "is assumed to be a water table aquifer" and abundant data and prior reports show that it is. Freeze and Cherry (1979) describe aquifer storativity as having a "usual range" for unconfined aquifers of 0.01 to 0.3. The modeled value is a full order of magnitude below the lower bound of the usual range.* *This parameter adjustment should be vetted against other data, such as geological information about the nature of the aquifer, well construction information, depth of frost penetration, and backhoe pits and aquifer tests that were performed in the 1980's. This parameter should not be treated as an adjustment parameter on a black box model that can be adjusted to values that seem to make the model work better. Such a deviation from values typical for a water table aquifer suggests that there may be one or more fundamental undiscovered problems with the model.*	Refinement of the FA-128 (Slough 8A) MODFLOW model has resulted in a more realistic aquifer storativity value for unconfined aquifers than was reported in *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)* (Study 7.5 SIR, Appendix B). The process used for revising the storativity value and the resulting MODFLOW results will be presented in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-20_ph02; NMFS_pp7.5-20_ph04	*Groundwater Discharge to Sloughs* *The steady state model is described as simulating a period of time when side channels are predominantly fed by groundwater. These side channels and sloughs have been the subject of considerable study, including discharge measurements of channels that have no headwater connection to the Susitna River. At the same time, these channels represent one of the major applications of the entire modeling exercise, this being the evaluation of changes to aquatic and riparian habitat in these areas.* *Thus, it would seem that flow data (specifically, groundwater upwelling fluxes into the side channels or sloughs) should be a calibration target in addition to head data. The model should explicitly simulate flow to these side channels and other regions of upwelling within the channel network. If it isn't, the grid spacing should be refined enough to do so, with the necessary direct measurements of VHG, exchange flux, and groundwater discharge to validate the models. This would be one of the best ways for the model to fulfill its potential, to be able to simulate changes in water quantity and temperature in side-channels and sloughs in response to potential future project operations. Without using these side-channel discharge data as calibration targets, it may be impossible to determine the reliability of future groundwater flow models and the knowledge gained from the valuable fieldwork measuring side-channel and slough flows will have not have been used to its full potential.*	Comments noted and appreciated. Groundwater flux targets were not used in the preliminary MODFLOW model for FA-128, but are being used in the refined model. AEA offers the following additional information. AEA is in the process of refining the 3-D MODFLOW model and calibration targets for the refined model to include both shallow groundwater elevations and groundwater fluxes to side sloughs. Additional data was collected during the summer of 2016 to assist with refining the model calibration. These new data include well slug tests at site monitoring wells for estimating the aquifer hydraulic conductivity and seepage meters installed at key locations for estimating groundwater fluxes (2 meters in FA-138 [Gold Creek], 4 meters in FA-128 [Slough 8A], and 2 meters in FA-104 [Whiskers Slough]) (Figure 2.4.1-3, Figure 2.4.1-4, Figure 2.4.1-5, and Figure 2.4.1-6 below). Details of the refined model will be provided in the USR.
USFWS_pp7.5-20_ph03; NMFS_pp7.5-20_ph05	*In summary, the studies fail to prove that calibration and verification of a three-dimensional groundwater flow model is possible, even in the best-instrumented Focus Area (FA-128). Considering the poorly understood system response to present and future short-duration hydrologic events and other limitations noted above, the studies to date create significant doubt that project Objectives are achievable with the current methodologies and progress of work.*	AEA also notes that the materials presented in the ISR, including the presentation of the Preliminary MODFLOW model, were not intended to serve as endpoints of any of the studies or in terms of any of the models, to contain final model calibrations. The ISR serves as a check-in point to the FERC ILP process to demonstrate progress made toward achieving study objectives. AEA is confident that a fully functional 3-D MODFLOW model can be successfully calibrated for FA-128, and can be used in evaluating potential project operational effects on groundwater within sloughs and side channels, and that the model results can be applied in addressing resource issues associated with the Riparian IFS and Fish and Aquatics IFS. As noted in response to USFWS_pp7.5-20_ph02; NMFS_pp7.5-20_ph04, the FA-128 (Slough 8A) MODFLOW model is currently being recalibrated to both groundwater elevations and groundwater fluxes in side sloughs and showing substantial improvements compared to results presented in *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)* (Study 7.5 SIR, Appendix B).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-20_ph04	*Variances* *Water table maps have been prepared, which is a variance from the FERC-ordered study plan. This study element was originally scheduled for completion in Q4 2014 and is not yet complete. The deviation from the schedule is a variation.*	AEA disagrees regarding whether the progress AEA has made on water table maps is a variance, since the water table maps are not a component of the FERC-approved Study Plan Section 7.5. To clarify, these maps were prepared at the suggestion of the licensing participants following preparation of preliminary maps for a single time period that were presented and discussed during the December 5, 2014 Groundwater Technical Team meeting (Study 7.5 SIR, Appendix D: *December 5, 2014 Technical Team Meeting Notes and Presentation*). The maps proved useful for spatially depicting groundwater levels over the entire Focus Area and for potentially differentiating riverine versus upland dominated categories of groundwater. AEA expanded that analysis to include development of a total of six maps corresponding to six different time periods for FA-104 (Whiskers Slough) and FA-128 (Slough 8A), three maps corresponding to three time periods for FA-138 (Gold Creek), and two maps corresponding to two periods for FA-115 (Slough 6A). The maps were prepared as part of the overall analysis of groundwater data contained in the FERC-approved Study Plan.
USFWS_pp7.5-20_ph05; NMFS_pp7.5-21_ph01	*Data should have been provided on well depths and open intervals. Variances from the Revised Study Plan Data should have been provided on well depths and open intervals. This is a standard component of groundwater studies as described by the references to the FoSP and is a variance.*	Comment noted, however, this is not a study variance. The well depth data is provided in Table 2.4.1-2 below. The USR will include and describe well depth information along with lithology information from the detailed floodplain mapping by Geomorphology Study (6.5).Additional information from slug tests conducted in 2016 will also be incorporated.
USFWS_pp7.5-20_ph07; NMFS_pp7.5-21_ph03	*Modification 2: Short-Duration Hydrologic Event Data Collection and Modeling* *The Services recommend including the acquisition of field data and improving the current performance of surface water/groundwater models to be able to simulate short-duration fluctuations in surface water/groundwater interactions characteristic of future proposed project operations at each Focus Area.*	As explained below in Section 2.4.1.5.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp25_ph05	*[Modification III]* *c. AEA should use an integrated groundwater/surface water model that can simulate small head differences in groundwater and surface water elevations.* *… Small head differences in groundwater and surface water elevation will drive changes in upwelling and downwelling. Although the primary objective of the model is to understand how Project operations might change these patterns of upwelling and downwelling, at this point, the current model does not appear to have the ability to simulate these small differences effectively. This could become a particular problem when simulating operational conditions since the transient river stages could oscillate by multiple feet over sub-daily timescales (see Figure 2).*	As explained below in Section 2.4.1.5.2, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and as well, the request is already being met as part of the FERC-approved Study Plan. AEA notes that the purpose of the groundwater modeling was to develop a better understanding of the GW/SW interaction processes and how they might be influenced by Project operations. Importantly, the assigned stress periods in the MODFLOW model can be adjusted to simulate short-duration fluctuations (i.e. sub-daily; note: time steps of data collection were at 15 minute intervals) so the models will be able to address operational conditions that may result in short term oscillations in stage. Likewise, the current Open-water Flow Routing Model (OWFRM) is set-up on an hourly basis, but can be adjusted to even shorter time-steps (15 minutes) as needed. The OWFRM is capable of simulating stage changes as small as 0.2 feet. See SIR Study 8.5, Appendix B (*Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*). Because the request is already being met as part of the FERC-approved Study Plan, there is no additional cost for implementing this modification.
USFWS_pp7.5-21_ph01; NMFS_pp7.5-21_ph04	*The current groundwater modeling effort is not capable of simulating fluctuating groundwater/ surface water interactions at short-duration time scales (hourly) that will be characteristic of proposed project operations, nor does it appear likely that it will be capable of modeling such events during the course of the approved study. This is a major limitation of the model and a variance from the approved plan to model groundwater to simulate such pulses. Approved studies were not conducted as provided for in the approved study plan.*	AEA disagrees with the characterization that this is a variance from the FERC-approved Study Plan or that the study was not conducted as provided for in the approved Study Plan. See Section 2.4.1.5.2 below regarding acquisition of additional field data and inclusion of short-duration fluctuations in the groundwater model.
USFWS_pp7.5-21_ph02; NMFS_pp7.5-21_ph05	*"Short duration temporal variations" can occur "in response to the various hydrologic events" (SIR study), such as precipitation, ice dams, river rise, or snowmelt. Analysis of these types of events is extremely challenging, and the averaging procedures used in the SIR study, such as 12-hour time steps, were not sufficiently detailed to capture the responses of the groundwater system to these types of events, likely contributing to some of the anomalies that resulted from the studies. This is important because the Project is also expected to produce significant short-duration temporal variations in flow (hourly and daily) that will not be well understood without additional work identifying the responses of the natural system to these short-duration events.*	See Section 2.4.1.5.2 below regarding acquisition of additional field data and inclusion of short-duration fluctuations in the groundwater model.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-21_ph03; NMFS_pp7.5-21_ph06	*The Project will affect Susitna River flow on a seasonal, daily and hourly basis and will affect downstream resources/processes including ice dynamics, channel form and function, water temperature, and sediment transport. These changes have thus far not all been incorporated into the GW model and associated other models such as OWFRM and the 2D PHABSIM models that are needed to assess project impacts. 'Proof of Concept' is not complete until the models can be demonstrated to adequately simulate and predict the effects of all of these physical phenomena.*	See Section 2.4.1.5.2 below regarding acquisition of additional field data and inclusion of short-duration fluctuations in the groundwater model.
USFWS_pp7.5-21_ph04; NMFS_pp7.5-21_ph07	*The authors of the SIR groundwater modeling report describe the complexities of analyzing short-duration hydrologic events. It is not clear if there are adequate data available to analyze these phenomenon. Frequent and synchronous data on river stage, groundwater levels, precipitation and snowmelt may be required and portions of the datasets appear not to have been collected during critical times to conduct robust analyses. Part of this study modification* [Modification 3] *would be to perform a data needs assessment and take steps to make sure that adequate data are available.*	AEA believes the amount of data are sufficient to meet the study objectives. A significant effort was made on collecting continuous (15-minute interval) groundwater and surface water level data, summer precipitation data at four Focus Areas, and time-lapse camera images which provide information on the timing and conditions of spring snow melt. For related information, see Section 2.4.1.5.2 below regarding acquisition of additional field data and inclusion of short-duration fluctuations in the groundwater model.
USFWS_pp7.5-21_ph05; NMFS_pp7.5-22_ph02	*Modification 4: Model Integration on a Pilot Scale Study Area.* *The Services recommend that in a single Pilot Scale area, AEA should demonstrate that the various models can interact to produce useable data with realistic error bars (Objective 5 and 6).* *This request is refined and justified in the Model Integration New Study Request and will not be discussed here.*	As explained below in Section 2.4.1.5.3, AEA requests that FERC not adopt this recommendation. Proposing a modification to a FERC-approved Study Plan that refers to a concurrent request for new study submittal, as the Services have done here, does not constitute a modification request nor does it meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. Most importantly, the request ignores that AEA is already developing a Proof of Concept for Focus Area FA-128 (Slough 8A), which will ensure that the objectives for this study are met and address integration of the results from interrelated studies. The estimated cost of this modification is contained within the cost estimate presented for the DSS Modification (see Section 3.4.2.3). See Section 3.4 for AEA's response to the Services' request for a new study regarding model integration.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-21_ph07; NMFS_pp7.5-22_ph03	*Modification 5: Evaluating Changes in Groundwater Temperature and Dissolved Oxygen* *The Services recommend evaluating changes in groundwater temperature and dissolved oxygen from proposed project operations.* *The temperature and dissolved oxygen content of upwelling groundwater are important factors influencing aquatic habitat. There appears to be no task or Objective in the groundwater study for evaluating changes in these parameters under proposed operating scenarios, even using non-modeling techniques. MODFLOW, the only groundwater model proposed, does not simulate these parameters. The importance of this topic is indicated by the fact that a two-dimensional heat-flux/groundwater flow model was constructed during the 1980's studies.* *Unless this topic is adequately covered in other studies, this represents a significant gap in the FERC-ordered study plan and a modification of the plan should be made in order to address this important process.*	This request is similar to SRC et al. Modification IIId. As explained below in Section 2.4.1.5.4, AEA requests that FERC not adopt this modification proposal as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. Changes in groundwater and dissolved oxygen are already being evaluated by AEA under the FERC-approved Study Plan. It is difficult to provide a cost estimate for implementing this modification request as the Services do not suggest an alternative model. Assuming the use of a more complex groundwater model and the potential need for additional data collection to calibrate and validate the model, as well as the additional cost for model integration, the estimated cost of implementing this modification could be $1,000,000-$1,500,000.
USFWS_pp7.5-14_ph04; NMFS_pp7.5-14_ph06	*4) Temperature and Dissolved Oxygen of Upwelling Groundwater* *The methodology for understanding future changes in surface and groundwater temperatures and dissolved oxygen is unknown. This is a complex phenomenon under existing conditions and is even more complex under proposed project conditions. The groundwater model as presented does not simulate water temperatures and there is no known bolt-on, post-processor software that would adequately simulate the processes.*	AEA disagrees that there are no known methods for considering water temperature within a MODFLOW model platform. AEA is developing methods for simulation of groundwater heat transport including the use of the mass transport code MT3DMS (Zheng and Wang 1999). The mathematics of heat and mass transport are similar and MT3DMS can be used in conjunction with MODFLOW. MT3DMS has been used by others for simulation of heat transport in groundwater (Hecht-Méndez et al. 2010). See also Section 2.4.1.5.4 below for further discussion on the evaluation of temperature and dissolved oxygen, the latter of which is handled outside of MODFLOW.
USFWS_pp7.5-16_ph05; NMFS_pp7.5-16_ph06	*Results* *Temperatures and Dissolved Oxygen of Upwelling Groundwater* *There is no data or analysis about understanding the temperature or dissolved oxygen of upwelling groundwater under project operating conditions. These are key aquatic habitat parameters that should be addressed in the groundwater study. The suggestion that this can be evaluated with model output is vague and peculiar considering that MODFLOW does not simulate thermal properties of water and aquifers.*	AEA is currently at the ISR stage of the ILP. The RSP as approved by FERC does not require this information to be available at the current ISR stage. AEA is developing methods for simulation of groundwater heat transport including the use of the mass transport code MT3DMS (Zheng and Wang 1999). The mathematics of heat and mass transport are similar and MT3DMS can be used in conjunction with MODFLOW. MT3DMS has been used by others (Hecht-Méndez et al. 2010) for simulation of heat transport in groundwater. Analysis of GW/SW dissolved oxygen relationships will be based on combined surface water - dissolved oxygen modeling coupled with empirical measurements of intergravel dissolved oxygen. See also Section 2.4.1.5.4 below for further discussion on the evaluation of temperature and dissolved oxygen, the latter of which is handled outside of MODFLOW.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp26_ph01	*III d. AEA should use an integrated groundwater/surface water model that can simulate changes in water temperature.* *As previously raised in comments for the Water Quality Study we are particularly concerned with AEA's ability to evaluate and predict temperature changes in off-channel habitats under post-project conditions. Groundwater upwelling is particularly important because it can provide temperature warming effects and benefits that aid salmon egg survival in the winter. Not only does AEA not have sufficient temperature data for the Middle River, but it is also using MODFLOW, a model that is not capable of modeling temperature to predict groundwater/surface water interactions. The model results will be unreliable under AEA's current approach because MODFLOW lacks the ability to model observed conditions.*	This request is similar to the USFWS Modification 5 and NMFS Modification 5. As explained below in Section 2.4.1.5.4, AEA requests that FERC not adopt this recommendation. Changes in groundwater and dissolved oxygen are already being evaluated by AEA under the FERC-approved Study Plan. It is difficult to provide a cost estimate for implementing this modification request as the Services do not suggest an alternative model. Assuming the use of a more complex groundwater model and the potential need for additional data collection to calibrate and validate the model, as well as the additional cost for model integration, the estimated cost of implementing this modification could be $1,000,000 - $1,500,000.
SRC_etal_WATER_pp26_ph03	*We question the use of MODFLOW for groundwater-surface water evaluations. It is well known that MODFLOW only simulates saturated flow conditions, and oversimplifies plant transpiration processes. Better tools exist to model the subsurface variable saturation conditions and associated recharge/evapotranspiration dynamics. We recommend that AEA consider using more sophisticated, physically-based, and fully integrated tools that can much more readily incorporate surface water dynamics into this evaluation. As indicated above, MODFLOW also lacks the ability to simulate 3-D heat flow in groundwater, which is an important factor associated with the upwelling/downwelling associated with the salmon lifecycle. AEA should consider using a more appropriate code such as the Integrated Hydrology Model (InHM), Hydrogeosphere, or a similar code to evaluate the 3-D heat balance in groundwater.*	The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. This comment raises questions with the Study Plan itself, and not AEA's implementation. As such, it is not relevant to FERC's Study Plan Determination. The use of MODFLOW to meet study objectives was identified in the Revised Study Plan and FERC's Study Plan Determination supported this conclusion. For further discussion, see Section 2.4.1.5.4 below.
SRC_etal_WATER_pp26_ph04	*Conclusion* *The groundwater model predicts groundwater/surface water interactions and will serve as the foundation for a variety of other studies. Currently, AEA does not have enough data to properly calibrate the model. It is not appropriate to use short cuts or model manipulations to work around the lack of data. AEA should also strongly consider using an integrated groundwater/surface water model that can simulate groundwater flow and temperature so the results are more reliable. "Many codes can simulate processes relevant to the Susitna Watana modeling efforts, including snowmelt, ice, sediment transport, and fully integrated advective/dispersive fate/transport and water quality."[73] For the foregoing reasons, we request that FERC require AEA to develop a fully integrated groundwater/surface water model to address the problems with the preliminary MODFLOW model for FA-128.*	AEA notes that the presentation of the preliminary MODFLOW model results in the Study 7.5 SIR Appendix B (*Preliminary MODFLOW Three Dimensional Groundwater Model for FA-128 (Slough 8A)*), were not intended to serve as endpoints of any of the studies or in terms of any of the models, to contain final model calibrations. AEA is confident that a fully functional 3-D MODFLOW model can be successfully calibrated for FA-128 (Slough 8A), and can be used in evaluating potential Project operational effects on groundwater within sloughs and side channels, and that the model results can be applied in addressing resource issues associated with the Riparian IFS (8.6) and Fish and Aquatics IFS (8.5). Since the SIR and as noted in response to USFWS_pp7.5-20_ph02 and NMFS_pp7.5-20_ph04, the FA-128 (Slough 8A) MODFLOW model is currently being recalibrated to both groundwater elevations and groundwater fluxes in side sloughs and showing substantial improvements compared to results presented in Study 7.5 SIR Appendix B.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-27_ph05	*3. Water temperature in the Groundwater Model is not currently modeled, nor is it possible to model temperature using MODFLOW* *The documents* [GWS and R2 2014 and AEA 2015b, Study 7.5, Appendix B] *do not describe how this would be accomplished with MODFLOW model output. Although there are models that simulate groundwater flow and water temperature, this is not a capability of MODFLOW. It is unclear how the Groundwater Model will be refined to evaluate impacts to water temperature.*	AEA disagrees that there are no known methods for considering water temperature within a MODFLOW model platform. AEA is developing methods for simulation of groundwater heat transport including the use of the mass transport code MT3DMS (Zheng and Wang 1999). The mathematics of heat and mass transport are similar and MT3DMS can be used in conjunction with MODFLOW. MT3DMS has been used by others for simulation of heat transport in groundwater (Hecht-Méndez et al. 2010). See also Section 2.4.1.5.4 below for further discussion on the evaluation of temperature and dissolved oxygen.
USFWS_pp7.5-22_ph03; USFWS_pp7.5-22_ph07; NMFS_pp7.5-22_ph07	*Modification 6: Assessment of Overbank, Breaching Flow, and Braidplain Side-Channel Flow on Groundwater and Aquatic and Riparian Habitat* *The Services recommend assessing the current and future flows that will be required to breach the head-of-slough barriers to meet Objective 6.* *The effects of overbank flow, breaching flows over head-of-slough sediment barriers, and flow in side channels of the braidplain in the lower river area are significant drivers of groundwater levels, however appear to be unevaluated and are not apparently included in the groundwater and surface water studies to date.* *Also, the overtopping or breaching of surface water should be regarded as an anomalous or changed field condition, and this modification is warranted on the basis that the study was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way.*	As explained below in Section 2.4.1.5.5, AEA requests that FERC not adopt this recommendation. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan (Study 8.5). The analysis of breaching flows under Existing Conditions, was specifically described in Study 8.5 ISR Part D, Section 8. As such, there is no additional cost for implementing this modification. Further, AEA does not agree that the hydrology during the years of study amounted to "anomalous environmental conditions" for the purposes of FERC's ILP regulations, 18 CFR § 5.15(d). Please see Section 1.5.1 for further discussion of the conditions in 2013.
USFWS_pp7.5-22_ph05; NMFS_pp7.5-22_ph09	*In the lower river, a comparison of proposed flows and natural flows show that there would be fewer and lower high-flow events that would inundate side channels and recharge groundwater under project operations. The absence or reduced frequency and peak of these high flows could lead to the condition found in many other dammed river systems that the water table generally becomes lower in response to dams. This persistently lower water table can then result in establishment of different vegetation regimes (like spruce and birch) that are better adapted to persistently lower water tables and reduction of aquatic habitat.*	While AEA agrees with the Services that there would be fewer and lower high-flow events in the Lower River with the Project, these changes in peak and daily flows are not of the magnitude that result in the dramatic changes in vegetation presented by the Services. See Section 2.4.1.5.5 below for further discussion on the assessment of current and future breaching flows of head-of-slough barriers.
USFWS_pp7.5-22_ph06; NMFS_pp7.5-22_ph10	*In the Middle River segment, many sloughs are headed by alluvial berms. When these are overtopped, it is expected that there would be a relatively quick and substantial impact on groundwater levels near the slough. The later recession of river levels would then be followed by much slower returns of groundwater levels to lower levels. Similarly, low bars and islands could be overtopped, also leading to groundwater recharge.*	AEA agrees that the Services' assessment is likely and further notes that the overtopping of alluvial berms is modeled by the SRH-2D model (Study 6.6), which is a boundary condition for the groundwater flow model. Once modeling indicates the berm is overtopped the groundwater flow model will respond accordingly. The response would include both recharge to groundwater and corresponding groundwater level rise. See also Section 2.4.1.5.5 below for further discussion on the assessment of current and future breaching flows of head-of-slough barriers.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-22_ph08; NMFS_pp7.5-23_ph02	*One possible tool for this evaluation that should be considered is inundation mapping using existing LIDAR topographic mapping and flood stage modeling. Such an analysis can characterize the existing frequency and extent of inundation with projected future inundation under project scenarios. These characterizations could then be used to evaluate groundwater responses and impacts to habitats.*	See Section 2.4.1.5.5 below for further discussion on the assessment of current and future breaching flows of head-of-slough barriers. AEA will also evaluate whether LiDAR data could be useful in identifying extent of inundation, as well as identifying groundwater areas above river influence.
USFWS_pp7.5-23_ph01; NMFS_pp7.5-23_ph03	*Modification 7: Snow Survey at Focus Areas.* *The Services recommend the collection of snow survey data at representative Focus Areas.* *The current groundwater modeling efforts are hampered by a lack of key data for simulating direct groundwater recharge during the spring snowmelt period. This is critical because this is the time period that was selected for the transient modeling work. A snow survey should be conducted during late March or early April before significant seasonal snowmelt occurs in order to establish appropriate transient groundwater recharge rates for the model.* *Standard groundwater modeling methodologies as cited in the approved study plan are clear that appropriate data should be used to establish groundwater recharge rates for transient model simulations where recharge is an important process. This justifies approval of this study modification because "approved studies were not conducted as provided for in the approved study plan".*	As explained below in Section 2.4.1.5.6, AEA requests that FERC not adopt this recommendation. AEA intends to apply regional spring snow survey data from the National Resources Conservation Service to estimate regional snow conditions for the field data collection periods. The Riparian IFS team conducted snow depth measurements to specifically characterize snow water equivalents at FA-104 (Whiskers Slough) and FA-128 (Slough 8A) on April 4, 2014. Forty (40) snow depth measurements were made at the FA-104 meteorological station and an additional groundwater well station. Sixty-eight (68) snow depth measurements were made at the FA-128 meteorological station. This information, along with analysis by the Glacier and Runoff Changes Study 7.7, field observations completed during the winter HSC studies (Study 8.5), and Riparian IFS (Study 8.6) spring seedling analysis, will be used to estimate the potential influence of snowmelt on local GW/SW interactions. Additional detail on how rainfall data and the accompanying soil moisture and water table data will be used in the modeling work is provided in Section 2.4.1.5.6. AEA considers the information/data it has already collected along with snow survey data noted above as sufficient for evaluating groundwater recharge during the spring snowmelt period. If additional snow survey data is required to be collected as a modification, the estimated cost of this modification is $350,000-$450,000 per year. This would require extending the data collection periods at numerous Focus Areas, not just the addition of a few sites; cost depends on having comparable data collection sets, collected in the concurrent years.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-15_ph07; NMFS_pp7.5-16_ph01	*7) Local Recharge* *The modeling work describes simulating hydraulic head pulses from changing river levels, but the water table is also influenced by local recharge events at the sites of the monitoring wells and from up-gradient areas. Rain gages were installed, however the study does not discuss how the data and the accompanying soil moisture and water table data will be used in the modeling work to simulate the effects of local rainfall and snowmelt on fluctuating water tables. These rainfall and snowmelt events could affect water levels in these shallow aquifers on the same time scale as rising-river levels (minutes to hours). The absence of snow survey data to inform groundwater recharge estimates during the spring snowmelt is another significant limitation of the methodology.*	AEA agrees with the importance of addressing transient recharge in groundwater simulations within the context of objectives identified in Study Plan Section 7.5. Use of an annual average recharge value in steady-state groundwater flow models is common practice. The sensitivity of the steady state model to a range of recharge values can be evaluated. As noted in Section 2.4.1.5.6 below, AEA intends to apply regional spring snow survey data from the National Resources Conservation Service to estimate regional snow conditions for the field data collection periods. This information, along with analysis by the Glacier and Runoff Changes Study 7.7, field observations completed during the winter HSC studies (Study 8.5), and Riparian IFS (Study 8.6) spring seedling analysis, will be used to estimate the potential influence of snowmelt on local GW/SW interactions. The Riparian IFS team conducted snow depth measurements to specifically characterize snow water equivalents at FA-104 (Whiskers Slough) and FA-128 (Slough 8A) on April 4, 2014. Forty (40) snow depth measurements were made at the FA-104 meteorological station and an additional groundwater well station. Sixty-eight (68) snow depth measurements were made at the FA-128 (Slough 8A) meteorological station. Additional detail on how rainfall data and the accompanying soil moisture and water table data will be used in the modeling work is provided in Section 2.4.1.5.6.
USFWS_pp7.5-23_ph04; NMFS_pp7.5-23_ph06	*Modification 9: Collect Additional Water Table Data in Focus Areas other than FA-128* *The Services recommend that additional water table data must be collected to provide sufficient spatial and temporal distribution of water table data in Focus Areas other than FA-128. In all other Focus Areas too few wells were monitored for too short a time period.* *It is apparent from inspection of the water table maps for all of the Focus Areas except FA-128 that most of the groundwater data collection-stations are aligned along a single transect perpendicular to the river. This clustering of data makes for a poor water table map, which is key for three-dimensional or two-dimensional plan view groundwater flow modeling. As part of this proposed modification, a data needs assessment should be performed to optimize data collection for periods of time that will be simulated by the models.* *As previously described, two-dimensional transect modeling is generally not appropriate for the Focus Areas because of up-valley or down-valley components of groundwater flow that cause significant inaccuracies in the models. Standard groundwater modeling methodologies as cited in the approved study plan provide that transect models should be aligned parallel to groundwater flow directions. This justifies approval of this study modification because "approved studies were not conducted as provided for in the approved study plan".*	As explained below in Section 2.4.1.5.7, AEA requests that FERC not adopt this recommendation. The estimated cost of implementing this modification is from $3,000,000-$6,000,000 depending on number of additional years of monitoring, number and locations of new wells developed, number of Focus Areas measured and extent of additional modeling. See also Section 2.4.1.5.1.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-23_ph07; NMFS_pp7.5-24_ph02	*Modification 10: Assessment of the Impacts of Geomorphic Channel Changes on Groundwater and Habitats.* *The Services recommend including the effects of aggrading or degrading channels or other channel changes on groundwater and associated habitats to meet Objective 6. (If the New Study Request for Model Integration was accepted, it would also cover this modification.)* *The effects of the project on the geomorphology of the river (aggrading, degrading channels or other channel changes) and consequent implications for groundwater and habitats needs further development and inclusion into the groundwater study. Current groundwater modeling uses only current river channel configurations and stage for defining model boundaries. If channel down-grading or aggradation or other changes occur, this will affect groundwater. Evaluation of this effect is currently not part of the groundwater study, but it should be. Such changes in the river would mean that the current modeled conditions would be considered anomalous compared to future conditions, thus justifying this modification.*	As explained below in Section 2.4.1.5.8, AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
USFWS_pp7.5-16_ph02; NMFS_pp7.5-16_ph03	*9) Assessment of Geomorphic River Channel Changes* *The methods described do not address the effects that potential changes in river geomorphology - either aggrading or degrading streambeds, could have on the system. Any thorough groundwater model-based assessment of the project effects on groundwater levels and aquatic or riparian habitat should consider the effects of this phenomenon. For this reason NMFS requested a New Study on Model Integration*	Assessment of geomorphic channel changes resulting from the Project are being evaluated as part of Geomorphology Study 6.5 and are described in the SIR (Study 6.5 SIR, Attachment 1: *Geomorphic Reach Delineation and Characterization, Upper, Middle and Lower Susitna River Segments – 2015 Update*; and Study 6.5 SIR, Attachment 1, Appendix A: *1D Bed Evolution Model*. One of the primary purposes of the geomorphology studies is to assess potential effects of Project operations on the dynamic behavior of the river reaches downstream from the dam. The studies and modeling have been designed to evaluate whether existing channel morphology will remain the same or at least be in dynamic equilibrium under post-Project conditions. Studies to date suggest that because so little sediment transport would occur under with-Project conditions, the primary expression of width change (hence channel morphology change) would be through vegetation growth along channel and island banks (Study 6.5 SIR, Attachment 1). As part of the FERC-approved Study Plan, the existing groundwater data and analysis and modeling results can and will be used to draw some inferences about the projected geomorphic changes and how GW/SW relationships may be affected. For related information, see Section 2.4.1.5.8 below.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-24_ph01; NMFS_pp7.5-24_ph04	*Modification 11: Measurement of Vertical Groundwater Gradients through Nested Observation Well Pairs* *The Services recommend the installation and measurement of vertical groundwater gradients through nested observation well pairs to meet Objective 6.* *The SIR report failed to identify the variance of not having installed nested monitoring wells to measure vertical groundwater gradients. The lack of nested wells and measurement of vertical groundwater gradients hampers understanding of local and regional groundwater flow system relationships. The FSP states that nested wells and shallow wells in surface water habitats will be installed as part of Objective 6, however these were not installed.* *The FSP also states that simulated hydraulic gradients will be compared to observed hydraulic gradients as part of Objective 6. Without collecting data on vertical hydraulic gradients, it will not be possible to complete this analysis. It is recommended that field efforts be undertaken to get the wells in place as soon as possible.* *Approved studies were not conducted as provided for in the FERC-approved study plan.*	As explained below in Section 2.4.1.5.9, AEA requests that FERC not adopt this recommendation. The estimated cost of implementing this modification is $1,500,000-$1,600,000; this would require a major change in well installation methods and field methods. Air rotary drilling methods and drill rig movement by use of Hughes scale helicopters would be required. This cost assumes 6 sites in each of 4 different Focus Areas, 2 wells per site, for a total of 48 new wells.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-27_ph01; NMFS_pp7.5-28_ph01	*These areas do not include water quality sampling locations. In order to address the Objective of this study element, it may be necessary to revisit sampling locations based on field data collected in 2013, to ensure that water quality sampling brackets the full range of groundwater-surface water conditions in the Focus Areas.*	AEA considers the extent of water quality sampling that has been completed across different resource disciplines sufficient to meet the objectives of the Study Plan. As noted in the SIR (Study 7.5 SIR, Section 4.7), as part of IFS Study 8.5 and in response to the FERC Study Plan Determination (Pages B-84 to B-86 of Study 8.5 SPD, April 1, 2013), AEA completed a detailed evaluation of the relationship between fish abundance and specific microhabitat variables that included several water quality parameters (water temperature, dissolved oxygen, pH, alkalinity, macronutrients, dissolved organic carbon, as well as surface-groundwater exchange flux) and reported results in a TM, *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables* (Study 8.5 TM, September 17, 2016). AEA has also, as part of the IFS Study 8.5 HSC analysis (Study 8.5 ISR Part A, Section 4.5), continued the collection and analysis of ancillary water quality data (dissolved oxygen, water temperature and conductivity) from surface water locations some of which are influenced by groundwater upwelling, and from continuous temperature (surface and intergravel) and dissolved oxygen (intergravel) recorders placed in Focus Areas with known spawning activity (FA-104 [Whiskers Slough], FA-128 [Slough 8A], FA-138 [Gold Creek] and FA-144 [Slough 21]). The dissolved oxygen monitors were deployed prior to spawning and have recorded data throughout the egg incubation and fry emergence periods that has included winter under ice conditions. The dissolved oxygen monitors were serviced in September 2015 and redeployed to continue collecting data over the 2015-2016 winter period. Further discussion related to the analyses of water quality data in Focus Areas are presented in the SIR (Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*; SIR 8.5, Appendix D: *Habitat Suitability Criteria Development*; and Study 8.5 SIR, Sections 5.5 and 6.5). In addition, and more broadly, the Baseline Water Quality Study (Study 5.5) has prepared a Study Completion Report (Study 5.5 SCR). That report includes the results of the water quality sampling that was conducted in the Focus Areas in surface water and in selected groundwater wells.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-27_ph02	*The FSP includes a work product under this task:* *• Groundwater modeling archived flow models, model input and calibration data sets and files, groundwater model documentation.* *It is not clear as to why this element includes such a work task. The text of the FoSP in this section does not mention any specific modeling work, and it seems as though this work product belongs elsewhere.* *A limitation of the study methodology is the lack of any information about how the data collected would be used to evaluate the potential groundwater (and related surface-water) quality impacts of the proposed project. There should be clear cross-references to relevant portions of other studies so that the relationship between data collected and the ultimate use of the data can be determined.*	AEA clarifies that the reference to "*archived flow models …*" was simply intended to indicate that AEA would provide all information and supporting data used in the development of groundwater models for the study. AEA has done this throughout the study implementation and has provided links to data sets in the ISR and SIR (http://gis.suhydro.org/reports).
USFWS_pp7.5-27_ph08; NMFS_pp7.5-28_ph04	*Variances* *This study element (Objective 7 Water Quality in Selected Habitats) was originally scheduled for completion in Q4 2014. The ISR lists two variances for this study element. The first is a change in schedule for the completion of groundwater flow models. The second is a change in schedule for water quality comparison of select productive and non-productive habitat types. The first variance is somewhat confusing. Groundwater models are listed as a work product for this study element, in the FoSP. However, the text of the FoSP (section 7.5.4.6) does not describe groundwater modeling and what role, if any, groundwater modeling would have in completion of the study Objective.*	AEA corrected its reference to schedule change as a variance in the ISR and noted in the SIR that it had implemented the methods as described in the Study Plan with no variances. Further, given the description of data collected and analysis completed as referenced in Study 7.5 SIR, Section 4.7, AEA noted that the objective of this particular component of the Groundwater Study has been met.
USFWS_pp7.5-28_ph03; NMFS_pp7.5-29_ph02	*These kinds of measurements, referred to either as "synoptic differential discharge measurements" or more commonly, "seepage runs", represent a sound approach towards characterizing reach-scale groundwater/surface-water interactions. However, successful implementation relies on also measuring tributary inflows along the study reach, and performing the discharge measurements spaced as closely (in time) as possible. These are two critical considerations of successfully performing a seepage run that should be discussed in the methodology but are not.*	As an initial matter, the seepage runs measured by the Groundwater Study 7.5 considered tributary inflow when selecting sites, and as well, completed discharge measurements at close intervals spatially and temporally. The location for the seepage runs (paired discharge measurements) are shown in *Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River* (Study 7.5 TM, September 30, 2014). AEA will provide additional information on the full suite of hydrologic data used in the groundwater analysis in the USR.
USFWS_pp7.5-28_ph05; NMFS_pp7.5-29_ph04	*Only selected data was provided in the ISR and this appears to be a variance from the FSP, which appears to call for a more thorough presentation of data. The ISR does however contain some analysis and interpretation of data, which exceed the expectations set by the FSP.*	Comment noted. More detailed information will be presented in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-28_ph06; NMFS_pp7.5-29_ph05	*Data report in the ISR includes data that are used to identify important wintertime process, such as ice-jam flooding in the mainstem and seasonal temperature variations. In general, these processes are well known and the data serves to demonstrate that they occur in the Susitna River basin. The data also serve to quantify the specific events observed at the sites monitored. What is unclear is how representative these data are of unmeasured sites. There could be challenges in this project to "up-scale" the findings to the broader study area.*	This comment is directed toward Ice Processes Study 7.6; see Section 2.4.2 (Study 7.6 – Ice Processes).
USFWS_pp7.5-29_ph02; NMFS_pp7.5-30_ph01	*One key question, perhaps falling more under the purview of the Ice Processes Study, is the relation between discharge and ice cover in the mainstem to ice processes and GW/SW interactions in the off-channel habitats. This question could be addressed by comparing the evolution of ice cover using time series from multiple cameras. For example, the results shown in ISR section 5.8 use images from stations ESCFA 104-22, looking out through slough 3B into the main channel. These images could be compared to the time-lapse images collected at ESCFA104-19, ESCFA 104-17, and ESCFA 104-18, to show the progression of ice movement into the off-channel habitat. This kind of data interpretation would more clearly relate flow in the river to GW/SW interactions in the off-channel habitats, using data that are already available.*	AEA agrees. The combination of observations from time-lapse images and other data and observations from these and other studies will be used to describe the relationship between ice and snow cover of lateral side channels and sloughs and GW/SW interactions in the final USR. AEA notes that the placement of the cameras, which were intended to collect data useful for both winter and summer studies, was coordinated with the Ice Processes Study 7.6 before placement, so the time-lapse photo data sets could be used in conjunction with the time-lapse camera data sets from Groundwater Study 7.5 in conjunction with the aerial photo surveys that the Ice Processes Study 7.6 was conducting in the winter to cover the spatial variation and nature of ice cover in the mainstem and lateral channels and sloughs. See also Ice Processes Study 7.6 response in Section 2.4.2 (Study 7.6 – Ice Processes).
USFWS_pp7.5-29_ph07; NMFS_pp7.5-30_ph06	*The Alaska DNR and USGS databases are likely deficient in identifying most of the wells close to the Susitna River, unless prior studies have performed detailed inventories. In remote areas such as this, the percentage of wells with entries in either database is typically low. Other means should be employed, including air photo interpretation of likely structures with wells and field inventories of wells.*	AEA does not believe an interpretation of aerial photos or field inventories to identify additional wells is warranted to meet the study objectives. The data from home owner wells and Focus Area studies will both be used. The Middle River Segment has a very low use of private wells. Groundwater wells in the Lower River Segment at Riparian Transects will be used to help evaluate the range of natural variation of shallow groundwater levels near the river associated with Susitna River stage changes.
USFWS_pp7.5-29_ph08; NMFS_pp7.5-30_ph07	*Results* *The ISR reports that data for shallow groundwater users are available on-line, however they could not be found during this review. In any event, there is no analysis of the data.*	The analysis of data related to shallow groundwater users will be presented in the USR. The data for the Groundwater Study 7.5 that passes QC3 will be posted by AEA on the Geographic Information Network of Alaska (GINA) web portal and additionally archived in the collection at the Alaska Resources Library and Information Services (ARLIS) library.
USFWS_pp7.5-30_ph04; NMFS_pp7.5-31_ph04	*SUMMARY OF TECHNICAL REVIEWS* *Overall, the groundwater studies lack clear direction and methodology. Data collections efforts at FA-128 may have enough spatial coverage, but there appear to be issues with anomalous data vales. At all other Focus Areas there simply is not enough groundwater data to construct a water table map or a 3-D groundwater model.*	AEA disagrees. The data collection and analysis designed for the Groundwater Study 7.5 were specifically designed to meet each of the study objectives. AEA maintains that data collection and analysis that includes different levels of groundwater modeling at the Focus Areas is adequate for meeting study objectives for the aquatic and riparian resource key questions identified for the Study Plan Section 7.5.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp7.5-30_ph06; NMFS_pp7.5-31_ph06	*With many study elements incomplete, some with almost no results reported, insufficient data and methodological descriptions are presented to determine whether study Objectives can be met in the future. It is clear that overarching study goal has not been met at this time.*	The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. The study has not yet been completed. AEA disagrees with this assertion that insufficient data and methodological descriptions have been presented to determine whether study objectives can be met. The Study 7.5 SIR provided updates on each of the study objectives and included four separate appendices that contained additional details concerning the literature review, water table mapping, groundwater modeling, and summary information from a December 5, 2014 Technical Team meeting with licensing participants. The first three appendices provided substantially more information than was available during the December 5, 2014 meeting. AEA is continuing to work on the groundwater models and the integration of model output to the Riparian IFS and Fish and Aquatics IFS and is confident the level of analysis is sufficient to address stated objectives. This analysis will be presented in the USR. Even so, AEA remains open to considering additional analysis if so indicated pending completion of the USR.
SRC_etal_WATER_pp20 _ph01	*[Modification] I. The Groundwater Study should be modified to require AEA to develop a detailed conceptual groundwater model, clearly describe linkages/coupling between the groundwater model and other dependent studies and address sources of uncertainty.* *a. AEA should clearly describe linkages or couplings between models.*	AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. As an initial matter, the development of a conceptual model for groundwater/surface water interactions was not explicitly specified in the FERC-approved Study Plan. Rather, FERC acknowledged that AEA proposes to characterize the regional hydrogeologic framework in accordance with ASTM standard D5979 (ASTM 2008) which is consistent with generally accepted practices in the scientific community (section 5.9(b)(6)), and should provide the information necessary to characterize the regional hydrogeologic system. Thus, this suggestion is already incorporated into the series of study elements in the FERC-approved Study Plan. See also Section 2.1.4.2.1 for AEA's response to a related USFWS and NMFS Modification Request to complete a basin-scale groundwater flow assessment. Model uncertainty is part of the FERC-approved Study Plan and will be provided in the USR for one operating scenario. Model integration is ongoing. Model integration was first described in the FERC-approved Study Plan under Study 8.5 (RSP Sections 8.5.4.1 and 8.5.4.8) and then further discussed during a number of extended multiple day TWG meetings, including the November 13-15, 2013 Riverine Modeling Technical Team meeting and April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting. The results of model integration will be reported in the USR. See Section 3.4 for further discussion on model integration and AEA's response to the Services' request for a new study on this topic.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp20_ph07	*Abt Associates Comment: We were unable to find a description of how the Groundwater Model will be linked, spatially and temporally, with these six other models. These linkages will be critical to the success of the modeling studies. It does not appear that the linkages will be bi-directional, in the sense that the output from the hydraulic models will feed into the groundwater model, and the groundwater model will feed back into the hydraulic model. Particularly in the off-channel habitats, the surface water and groundwater will interact in space and time. The surface water and groundwater processes should be coupled in space and time, rather than using the output from one model to feed into another separate model, which is then run separately.*	AEA agrees that model linkages and integration is critical and has expended substantial time and resources in communicating the overall model integration process. This was first described in the FERC-approved Study Plan under Study 8.5 (RSP Sections 8.5.4.1 and 8.5.4.8) and then further discussed during a number of extended multiple day TWG meetings, including the November 13-15, 2013 Riverine Modeling Technical Team meeting and April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting. The Proof of Concept for model integration was further described in *Middle River Fish Habitat and Riverine Modeling Proof of Concept* (Study 8.5 ISR Part C, Appendix N). In each of these cases, the results of the groundwater modeling were included as part of the model integration process. Most recently, in the SIR (Study 7.5 SIR, Appendix B: *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)*), a preliminary 3-D MODFLOW groundwater model for FA-128 (Slough 8A) described the conceptual application of model results in evaluating Project operational changes on flows and groundwater and linkages to the Fish and Aquatics IFS and Riparian IFS studies. AEA is continuing to refine the FA-128 model and will be presenting results and demonstrating linkages with other models in the USR. Regarding the space/time coupling of surface and groundwater processes, AEA notes that the surface and groundwater models are being developed to allow bi-directional analysis. See Section 3.4 for further discussion on model integration and AEA's response to the Services' request for a new study on this topic. As with the overall model integration and Decision Support System (DSS) efforts, Study 7.5 will contribute to these activities consistent with the Study Plan to support the analysis of Project effects and the identification of protection, mitigation, and enhancement measures as appropriate. The results of model integration will be reported in the USR without the need for a separate study or modifications to Study 7.5.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp21_ph03	*[Modification I].* *b. AEA has not adequately developed a conceptual model for groundwater/surface water interactions.* *Abt Associates Comment: A conceptual framework for the models that are under development should be prepared and expressed to ensure that the modeling is consistent with the conceptual site model. In the most general terms, we believe that AEA should improve upon and more clearly articulate their conceptual model for how the relevant hydrologic, geomorphic, and ecological processes in the Susitna River system interact. This conceptual model should be depicted in a clear, concise diagram that illustrates each of the relevant processes and the interactions between them. This figure would replace the series of figures currently depicted as Figures 5-8 in this memorandum, which we believe are too complicated for stakeholders to understand exactly how different physical processes interact in the Susitna system, or how the current models simulate these interactions in space and time. This conceptual model should then be used to guide and develop a fully integrated groundwater and surface water model of the entire system, which can accurately track and simulate the exchanges of water, heat, and other relevant parameters that occur between surface water and groundwater systems. Although the data collected in the focus areas would still provide key data for calibrating this revised model, an integrated modeling framework would more broadly inform AEA's understanding of surface water-groundwater interactions, heat exchange, and sediment transport throughout the Susitna system, rather than just within these focus areas.[59]*	As an initial matter, the development of a conceptual model for groundwater/surface water interactions was not explicitly specified in the FERC-approved Study Plan. Rather, FERC acknowledged that AEA proposes to characterize the regional hydrogeologic framework in accordance with ASTM standard D5979 (ASTM 2008) which is consistent with generally accepted practices in the scientific community (section 5.9(b)(6)), and should provide the information necessary to characterize the regional hydrogeologic system. Thus, this suggestion is already incorporated into the series of study elements in the FERC-approved Study Plan. See also Section 2.1.4.2.1 for AEA's response to a related USFWS and NMFS Modification Request to complete a basin-scale groundwater flow assessment.
SRC_etal_WATER_pp22_ph02	*[Modification I].* *c. AEA should describe sources of data and model uncertainty.* *The ISR does not describe "sources of uncertainty and how they will be addressed. Uncertainties include those resulting from evaluating groundwater/surface water relationships outside of FAs, in conditions that are beyond those used to calibrate the model, and under Project operations."[0]*	AEA notes that the discussion of uncertainty was raised during the initial Riverine Modeling Technical Team meeting (November 13-15, 2013: http://www.susitna-watanahydro.org/wp-content/uploads/2014/02/2013.11.13Modelers_Notes.pdf) concerning the development of a Decision Support System. AEA recognizes the importance of addressing uncertainty, but also recognizes that it will be important for each model to identify those parameters or elements which are most influential in the modeling as those for which uncertainty should be evaluated. AEA provides as part of the responses under IFS Study 8.5 one example of how uncertainty can be addressed (*Decision Support System Uncertainty* Tech Memo, Attachment 6 to this filing). AEA recognizes the comment and will address in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp24_ph01	*III. The Groundwater Study should be modified to require AEA to develop a fully integrated groundwater/surface water model to address the problems with the preliminary MODFLOW model for FA-128.* *The MODFLOW "model's ability to represent observed conditions is a consideration in establishing the credibility and reliability of the model. The preliminary model does a poor job representing water levels in several wells, particularly those located away from the river, side channels, and sloughs [e.g., FA128-4, FA128-5, FA128-21, FA128-25, FA128-26, FA128-27 (see Figure 3-3, Figures B1-1 through B1-15, (AEA, 2015b, Study 7.5, and Appendix B). The ability of the model to simulate observed conditions informs the confidence that can be placed in the predictive capabilities of the model and its ability to represent Project conditions/dam operations."65 For that reason, AEA should make the following changes.*	AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations. In fact, SRC et al.'s proposed modification is not based on AEA's implementation of the study at all, but rather seeks to reconsider FERC's original Study Plan Determination itself, without any reference to the substantial work AEA has already completed pursuant to the FERC-approved Study Plan or meaningful explanation regarding whether the Study Plan objectives will be met with the existing MODFLOW model. AEA notes that the calibration of the FA-128 (Slough 8A) MODFLOW model is being refined and new calibration statistics will be generated with more detailed explanation provided in the USR. The refined calibration has improved significantly compared to results presented in *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)* (Study 7.5 SIR, Appendix B). Model targets for the refined FA-128 (Slough 8A) MODFLOW model include transient changes in shallow groundwater elevations and groundwater fluxes to side sloughs. Groundwater flux targets are estimated from synoptic discharge measurements and seepage surveys conducted both in the 1980s and as part of the current study. In addition, new seepage meters have been installed at key locations in Focus Area sloughs for the 2016 field season. Seepage meter stations are instrumented to measure both groundwater flux and vertical gradients. Slug tests are also being conducted on many of the groundwater wells during the 2016 field season to provide measured values of hydraulic conductivity. These new data will support model calibration efforts.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp24_ph03	*[Modification III]* *a. AEA should not use a storage coefficient value for a confined aquifer to calibrate the model.* *In the ISR, AEA reports that because it lacks studies that provide a storage coefficient value for an alluvial aquifer, the storage coefficient was adjusted from a confined to an unconfined value during calibration. "The storage coefficient was initially set to 0.2, but was eventually reduced to a value of 0.001 to achieve a better match to the observed GW elevation response. This value is somewhat low for an unconfined aquifer and may suggest the aquifer is semi-confined."[66]* *Abt Associates Comment: The storage coefficient value used in the model to improve calibration is a confined aquifer value, which is inconsistent with the representation of the alluvial aquifer as an unconfined (water table) aquifer that interacts with the surface water. For example, the groundwater level maps prepared for the area are labeled "water table" maps, suggesting an unconfined water table aquifer. AEA's choice to change this model parameter is inconsistent with a conceptual model of a water table aquifer. Because many combinations of model parameters can result in a model that matches observed conditions, other parameters could have been adjusted instead during model calibration. Despite adjustment of the storage coefficient, the transient model calibration still was not a good match for many of the wells.[67]*	AEA agrees. As part of the FA-128 (Slough 8A) MODFLOW model refinement efforts, a more realistic aquifer storativity value has been applied for unconfined aquifers than was reported in *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)* (Study 7.5 SIR, Appendix B).

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp25_ph01	*[Modification III]* *b. AEA should conduct aquifer testing at the Focus Areas to estimate hydraulic conductivity.* *"One of the most important parameters in a groundwater model is the hydraulic conductivity assumed for the aquifer. The preliminary MODFLOW model currently contains simplified parameters based on 1980s studies. Most of these aquifer parameters were obtained from locations that are not in the modeled area (FA-128), and values ranged widely. No additional aquifer testing was done during the 2013–2015 timeframe. The simplified parameters include application of a single groundwater recharge value per season, and a single value for hydraulic conductivity, storage coefficient, riverbed conductance, and regional groundwater influx to the alluvial aquifer boundaries."*[68] *As AEA reports in the ISR, "[t]he hydraulic conductivity of the alluvial aquifer in the Susitna River floodplain is estimated to range from about 1 to 100 ft/day. These ranges are based on the following studies: a pumping test conducted on the water supply well at the Talkeetna Fire Hall (HESJV, 1984a); specific capacity data from several Talkeetna Wells (HESJV, 1984b); falling head borehole tests conducted at Slough 9 in the 1980s (R&M Consultants, 1985); and values reported for the lower Susitna River (USGS, 2013). An initial value of 66 ft/day was assigned to the alluvial aquifer and later adjusted during the steady state calibration."*[69] *Abt Associates Comment: The simplified model does not do a good job of simulating water levels within the model domain and will need to be refined. No aquifer testing has been done to estimate the hydraulic conductivity in FA-128 (Slough 8A); this parameter was estimated from testing done in other areas that may or may not represent conditions in Slough 8A.*[70]	AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause". SRC et al.'s proposed modification is not based on AEA's implementation of the study at all, but rather seeks to reconsider FERC's original Study Plan Determination itself, without any reference to the substantial work AEA has already completed pursuant to the FERC-approved Study Plan. Contrary to the SRC et al.'s comment, AEA expects to be able to meet the Study Plan objective through reliance upon the results of the MODFLOW model. AEA also notes that in response to comments received during the March ISR meeting, slug tests were performed on 47 wells consisting of 12 wells in FA-104 (Whiskers Slough), 9 wells in FA-115 (Slough 6A), 20 wells in FA-128 (Slough 8A), and 6 wells in FA-138 (Gold Creek) during the 2016 field season to provide measured values of hydraulic conductivity. These efforts will support model refinement and calibration work.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-28_ph02	*5. The methods that will be used to extrapolate from the FAs to the rest of the Susitna River are not described or defined* *…The consultants working on the groundwater/surface water studies in the 1980s concluded, "Detailed projections cannot be made of the slough discharge or temperature variations which might result from changes in mainstem conditions as a result of project operation. Because of the substantial differences among the sloughs in their hydraulic and thermal behavior, it would be necessary to construct mathematical models of each individual slough in order to make detailed predictions of the effects on the sloughs of changes in mainstem conditions." (R & M Consultants and Woodward-Clyde, 1985, p. 4-17).* *Since that time, extensive surface water and groundwater data have been collected in detail in one FA, FA-128, and some data have been collected in a few other FAs. It is difficult to evaluate whether these data are sufficient to develop an assessment of the impacts on FA-128, to say nothing of all individual off-channel habitats, many of which have no data.* *The documents do not describe how extrapolation of data and models from FAs to the rest of the river system will be accomplished. MODFLOW models will be developed for four FAs. No regional groundwater model is planned. The study plans should describe how data and model results from these four FAs will be used to assess Project impacts for the groundwater/surface water interactions within the Susitna River. In addition, the methods that will be used to determine the representativeness of results from these four FAs for application to the rest of the river should be detailed.*	See Section 2.4.1.2.2 below for further discussion on the hybrid approach to upscaling.
SRC_etal_WATER_ppAtt-29_ph01	*7. Conceptual model for groundwater/surface water interactions has not been adequately presented* *…Although the development of conceptual models was planned, we have been unable to find detailed conceptual models incorporating the data that have been collected to date. A conceptual framework for the models that are under development should be prepared and expressed to ensure that the modeling is consistent with the conceptual site model.*	Comment noted. See response to SRC_etal_WATER_pp20_ph07 above.

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA3_ph1	*In keeping with the ASTM standard, please explain why a more rigorous evaluation of the conceptual model, including more information on unconsolidated thickness, stratigraphy, regional inflow, and anticipated inflow rates (upland recharge), specific to FA-128 is not needed to achieve the study objectives. For example, if processes, boundary conditions, or stresses are insignificant to the scale of the model for evaluating project effects, then please provide a clear and defensible justification as to how you reached that conclusion.*	AEA agrees to apply ASTM guidelines for this conceptual model. Regional geologic information and mapping information and interpretation from Geomorphology Study (Study 6.5) will be used to describe the assumptions made for aquifer thickness and other geologic characteristics. Aerial observations and other mapping data from this study and Riparian Instream Flow Study (Study 8.6) will be used to understand the potential occurrence of recharge from upland areas, such as occurrences of active springs in late winter before snowmelt indicating constant upland recharge sources at end of winter. Riparian vegetative mapping will be used to help define areas of shallow groundwater in upland areas, which would also be reflective of upland recharge characteristics. This information will be evaluated using the ASTM guidelines that are related to the type of geologic and hydrogeologic settings and analysis being conducted. Additional data on aquifer hydraulic conductivity of groundwater seepage rates into side channels are being collected during the summer 2016 field season to assist with model calibration. The sensitivity of the groundwater model to recharge and regional groundwater inflow rates can be evaluated by varying these hydrologic parameters in the groundwater model and developing an understanding for the sensitivity of the groundwater model in terms of stage variations to changes in these parameters. This will help guide future evaluation and use of the groundwater model as well as any future data collection requirements.
FERC_ppA3_ph2	*Please evaluate and report on the sensitivity of the assumption of 100 ft thickness in the USR.*	AEA will address this in the USR. AEA notes that the aquifer thickness controls the transmissivity of the aquifer which is a function of the hydraulic conductivity and thickness of the aquifer. This parameter was adjusted to achieve calibration and can be assessed in a sensitivity analysis.
FERC_ppA3_ph3	*Please explain why you believe it is appropriate to classify the aquifer as confined and yet use a storage coefficient and/or recharge rate that would be more indicative of an unconfined aquifer.*	AEA has revised the storage coefficient to reflect unconfined aquifer conditions as part of the refinement of the FA-128 (Slough 8A) MODFLOW model. This will be reported in the USR.
FERC_ppA4_ph1	*Please describe how you intend to separate and evaluate the potential for regional flow effects from project effects.*	The difference between Project effects and existing effects, both regional and local, will be evaluated by comparing operational scenarios to the baseline of current conditions scenario. AEA notes that while the regional system has not been explicitly simulated in the model, the model nonetheless reflects any effects of the regional flow system on Project data since it is calibrated to Project data. This will be reported in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA4_ph2	*Please explain why it would not be better to calibrate the model with measured boundary condition data interpolated from the results of the open water flow model.*	AEA notes that interpolation of surface water stations into sloughs with no stations or over large distances would not take into account the influence of geomorphological characteristics on river stages. However, the existing calibrated hydrologic models (OWFRM and SRH-2D), which incorporate morphologic characteristics of the river, provide a more realistic map of surface water stages throughout the sloughs and side channels. The effectiveness of the methodology to represent river stages in the model similar to those observed at the monitoring stations will be evaluated and reported in the USR.
FERC_ppA4_ph3	*Usually, expected regional groundwater flux is computed based on factors such as valley recharge and contributory groundwater drainage area. You have the data to do this calculation; therefore, please include it and its basis in the USR.*	AEA will discuss this in the USR.
FERC_ppA4_ph4	*Please clarify whether the model has been calibrated, and if not, when and how you intend to do so.*	Since filing the SIR, AEA has calibrated the FA-128 (Slough 8A) MODFLOW model and will present the results as part of the USR.
FERC_ppA5_ph1	*Please clarify whether well movement or survey errors are responsible for the low levels observed at station 128-2.*	AEA notes that neither well movement nor survey errors resulted in "the low levels observed at 128-2." The low water level elevations observed at station 128-2 appear to be correct. However, the high water levels at station 128-3 are due to an unusually high manual measurement reading on 9/22/2013 11:34:00 AM. Removing this manual measurement results in 128-3 elevations that very closely match 128-2 elevations. Additionally, the final manual measurement for 128-3 on 10/2/2015 12:05:00 PM is now only used to adjust transducer heights after that date, since it appears that the transducer moved sometime during or shortly before that manual measurement. These corrections have been made to the Project database.

2.4.1.1. Objective 1

Objective 1: Synthesize historical and contemporary groundwater data available for the Susitna River groundwater and groundwater dependent aquatic and floodplain habitat, including that from the 1980s and other studies including reviews of GW/SW interactions in cold regions.

There were no Modification Requests submitted that pertain to Objective 1. Comments pertaining to Objective 1 are addressed in Table 2.4.1-1.

2.4.1.2. Objective 2

Objective 2: Use the available groundwater data to characterize large-scale geohydrologic process domains/terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow groundwater aquifers, GW/SW Interactions).

2.4.1.2.1. Response to Modification Request to Complete a Basin-Scale Groundwater Flow Assessment

USFWS (Modification 1; USFWS_pp7.5-06_ph03) and NMFS (Modification 1; NMFS_pp7.5-06_ph05) recommend that the FERC-approved Study Plan be modified to include a basin-scale groundwater flow assessment to understand groundwater processes important to riverine and immediately adjacent environments of the Susitna River bottomlands. The Services recommend that the modification include an analysis of the basin water budget and address topics that include recharge rates (and variations due to altitude or other factors throughout the basin), glaciers, permafrost, types, lithology, and transmissivity of aquifers and confining units, expected water table and/or potentiometric surface configurations, and discharge to tributaries. They also stated this type of analysis may best be conducted by sub-basin analysis, particularly the sub-basins above and below the proposed dam, or sub-basins contributing to the Focus Areas.

The Services (USFWS_pp7.5-06_ph03; NMFS_pp7.5-06_ph05) commented that there is a lack of clarity on specific methods to be applied rendering it impossible to determine whether this study objective will be met, and emphasize the important linkage with the context of upwelling in river bottoms lands and tributaries.

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was not implemented as provided by the approved Study Plan.

Importantly, the suggestion of a basin-wide groundwater flow assessment is already incorporated into the series of study elements in the FERC-approved Study Plan for Study 7.5 (RSP Section 7.5.4.1.2). As the Services comment about the limitations of available data, water budget estimates are limited to those areas with adequate data. The same level of analysis and understanding is not needed in all areas of the basin to meet the needs of evaluating potential Project effects.

Importantly, AEA has already incorporated linkages with several related resources, as requested by the Services, during development and implementation of the Study Plan. For example, it uses data from Geology and Soils Characterization Study (Study 4.5) to describe the regional geology and lithology based on published information, air photo interpretation and reconnaissance mapping, as well as new LiDAR survey data. The information resulting from Study 4.5 provides updated geologic information about the proposed dam site and surrounding area, including surficial and bedrock geology, geologic structure, seismicity and tectonics, mass wasting, and mineral resources. The recently acquired LiDAR imagery was further used to compile geologic information for a large area of the Susitna Basin.

Information from the Baseline Water Quality Study (Study 5.5) will be used to characterize both historical and current water quality conditions within the Susitna River Basin. Water quality samples and data were also collected from a series of wells located in three Focus Areas (FA-104 [Whiskers Slough]; FA-128 [Slough 8A]; and FA-138 [Gold Creek]) in conjunction with surface water quality sampling proximal to the wells. The surface water and groundwater samples were measured for the same chemical parameters as a means to detect possible groundwater chemical signatures.

The Geomorphology Study (Study 6.6) provides basin scale information for the Susitna River watershed as needed for predicting the trend and magnitude of geomorphic response due to Project operations. This will inform the analysis of potential Project-induced impacts to aquatic and riparian habitats, and as well how such effects may influence groundwater resources. The results of this study, along with results of the Fluvial Geomorphology Modeling below Watana Dam Study (Study 6.6), will be used in combination with geomorphic principles and criteria/thresholds defining probable channel forms to predict the potential for alteration of channel morphology from Project operation, which will again be informative in evaluating potential changes to the groundwater resources.

Information from the Glacier and Runoff Study (Study 7.7) is also contributive to understanding groundwater resources. Study 7.7 is specifically focused on analyzing potential impacts of glacier wastage and retreat and changes in upper basin hydrology on the Susitna-Watana Hydroelectric Project (Project). The study includes: 1) development of a hydrological modeling framework that includes the effects of glacier wastage and retreat on runoff in the Susitna basin, and estimates of potential glacier mass changes until the year 2100; 2) simulations of the inflow of water to the proposed Watana Reservoir and projections of runoff from the Upper Susitna basin to the year 2100 using downscaled climate projections; 3) analysis of the response of the Susitna River above the proposed Watana Dam site to changes in climate with respect to annual runoff, seasonality, and peak flows; and 4) analysis of potential changes to sediment load resulting from glacial surges.

The Fish and Aquatics Instream Flow Study (Study 8.5) has included the development of an Open-water Flow Routing Model (OWFRM) for the Susitna River extending from PRM 187.1 downstream to PRM 29.9. The OWFRM accounts for both tributary inflow and groundwater accretion and is sensitive to diurnal changes in flow due to glacial meltwater. Study 8.5 has also included a hydrologic assessment of 26 tributaries to the Susitna River to gain an understanding of seasonal flow contributions and patterns of discharge which likewise may influence groundwater recharge. In addition, Study 8.5 has included an extensive field sampling program designed in part to detect the presence of groundwater upwelling or downwelling via measurement of vertical hydraulic gradients (VHG) within aquatic habitats. These data, coupled with an extensive array of intergravel temperature data have been provided to the groundwater study both to assist in the calibration of MODFLOW models, as well to further the overall understanding of groundwater /surface water relationships in the basin. The Riparian IFS Study (Study 8.6) has also been closely coordinated with the Groundwater Study in determining the dependencies of the existing riparian vegetative communities on surface/groundwater resources. All of these studies will provide basin-scale information that will contribute to the understanding of groundwater-surface water interactions in the Susitna River watershed.

Specific to Study 7.5 and the issue of transmissivity, since the SIR, slug tests have been conducted on 47 wells consisting of 12 wells in FA-104 (Whiskers Slough), 9 wells in FA-115 (Slough 6A), 20 wells in FA-128 (Slough 8A), and 6 wells in FA-138 (Gold Creek). The information obtained from the slug tests will be useful for estimating aquifer transmissivity and will be applied in the calibration of MODFLOW groundwater models. The combination of data collected explicitly for the GW Study, along with complimentary information provided from other resource studies (described above), will be used for providing a basin scale groundwater assessment. As noted in the FERC-approved Study Plan, the groundwater analysis will rely upon ASTM standard D5979 "*Standard Guide for Conceptualization and Characterization of Groundwater Systems*" to help define the geohydrologic units (ASTM 2008); ASTM D6106 "*Standard Guide for Establishing Nomenclature of Groundwater Aquifers*" to help establish the aquifer nomenclature and naming of geohydrologic features (ASTM 2010); and ASTM standard D6106 to help characterize the groundwater aquifers relevant to proposed Project operations.

2.4.1.2.2. Response to Modification Request for Hybrid Approach to Up-Scaling

USFWS (Modification 3; USFWS_pp7.5-07_ph04) and NMFS (Modification 3; NMFS_pp7.5-07_ph04) request AEA use the hybrid approach described in the review of hydrogeologic studies conducted in the 1980s (Page 21 of Study 7.5 SIR, Appendix C: *Summary Review of Susitna River Hydrogeologic Studies Conducted in the 1980s and other Non-Project Related Studies with Relevance to Proposed Susitna-Watana Dam Project*) to expand (up-scale) the use of groundwater models developed for Focus Areas. This request is based on their conclusion that the current approach relies to a great extent on groundwater modeling that has yet to be successfully completed and validated. They state that a draft or pilot-scale work product is needed to understand whether this is going to work, especially at the scale needed for habitat evaluations.

The Services further noted (USFWS_pp7.5-05_ph09; NMFS_pp7.5-06_ph02) that the expansion of results from the Focus Areas appears to be highly dependent on mapping efforts completed under this study objective and at the same time, cite the results of the 1980s studies as reported in the literature review completed by AEA (Study 7.5 SIR, Appendix C) that described the unique characteristics of the sloughs, calling into question whether up-scaling will even work for the Susitna River.

The SRC *et al.* (SRC_etal_WATER_pp22_ph04; SRC_etal_WATER_ppAtt-28_ph02) expressed similar concerns regarding the up-scaling, also citing the R & M Consultants and Woodward-Clyde (1985) conclusion that detailed projections of slough discharge and temperature variations from Project operations could not be made because of the substantial differences of hydraulic and thermal behavior among the sloughs. The SRC *et al.* requested the Study Plan be modified to require AEA to describe how Focus Area models will be extrapolated to the rest of the Susitna River to assess additional data needs and post-Project impacts SRC_etal_WATER_pp22_ph06.

AEA appreciates and agrees with the suggested use of a hybrid approach for upscaling as was described during the March 2016 ISR meeting and presented in Appendix C of Study 7.5 SIR *(Summary Review of Susitna River Hydrogeologic Studies Conducted in the 1980s with Relevance to Proposed Susitna-Watana Dam Project and other Non-Project Related Studies*). That approach would include reviewing differentiating characteristics of sloughs (such as the presence of tributaries, upland soil/geology type, apparent influence from mainstem flows, influence from overtopped-berm flows, etc.) and their hydrologic responses to see if sloughs with similar characteristics show similar responses. If this is the case, representative sloughs could then be focused on and potentially modeled, with simulated results extrapolated to other sloughs that are expected to have similar responses. Of note is that much of the water level and temperature data necessary for initial comparisons have already been collected at multiple sloughs which will facilitate application of this approach.

AEA notes however, that the application of a hybrid type approach to upscaling does not constitute a Modification to the study. AEA has now collected sufficient data and information from which to proceed with development of an approach for upscaling, which already includes consideration of the hybrid approach described above.

Accordingly, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the type of analysis AEA described in the hybrid approach is already included within the FERC-approved Study Plan.

As a further point, the Services (USFWS_pp7.5-04_ph03; NMFS_pp7.5-04_ph04) seem to misunderstand AEA's planned approach for applying groundwater information at Focus Areas to other river segments. AEA has indicated both in the ISR and SIR that no substantive activity had been completed on this study component since the June 2014 ISR and has never suggested that up-scaling will be entirely dependent on the expansion of relationships determined as part of groundwater modeling to other areas. AEA is fully aware of the unique hydrogeologic characteristics and functioning of the slough and side channels in the different Focus Areas referenced by the Services and studies conducted in the 1980s. However, as noted in the SIR, substantial data have been collected from field studies, observations, and information gathered as part of the literature review as well as from other studies to develop a conceptual understanding of the regional groundwater processes. AEA does not intend to simply transfer groundwater-surface water exchanges that occur in Focus Areas to other river segments, but rather to apply the concepts along with available data to define the groundwater regional scale relationship to local flow systems in the Middle River and Lower River segments and the relationship with the process-domain river segments. Additional analysis will be necessary to determine those processes at the Focus Area scale, which will provide an indication of how those processes are functioning within the entire Middle River Segment.

AEA has already been exploring potential relationships of various spatially discrete groundwater characteristics that might serve to differentiate groundwater into several broad categories that could be applied across the process-domain river segments. The hybrid approach mentioned in the SIR is one example. Another example exists within different spatial scales in upland areas, where changes in surface water elevation are assumed to exert minimal impact on groundwater elevations and relative to fish habitat, the direction of groundwater-surface water interactions. This was observed in wells 115-2-W1 and 115-1-W1 in FA-115 (Slough 6A). By contrast, groundwater elevations in sloughs proximal to riverine vegetative islands manifest a proportional and correlated response to changes in main channel surface water stage as was observed in the majority of wells in FA-128 (Slough 8A). A "groundwater/surface water response" function refers to the degree to which groundwater elevations respond to changes in surface water elevations. Thus, the development of groundwater response functions seeks to use observable geomorphological features (e.g., relative elevation and distance to the main channel) to predict the degree to which surface water elevation impacts groundwater elevation. These types of changes represent a possible proxy for defining the direction of GW/SW impacts since changes in vertical hydraulic gradient (VHG) and seepage have not been measured directly. Such a response function may take the form of a step-function, such that no impact is anticipated until surface water stage exceeds a critical threshold value. If adequately calibrated and validated, such a groundwater response function could be applied to less well-studied regions with a similar process domain to predict spatially, where the direction of groundwater and surface water interaction are insensitive to changes in main river flow.

To date, AEA has looked at the response in groundwater elevation during changes in Susitna main stage during the winter melt out period (June and July). Both (i) correlation and (ii) RMSE (root mean square error) (a proxy for the absolute difference in elevation profiles) have been considered. Most groundwater elevations in wells in FA-128 (Slough 8A) (situated in a side slough and on a vegetated island) are highly correlated and most have low RMSE. By contrast, in FA-115 (Slough 6A) correlations are weaker and RMSE greater. The correspondence in stage and groundwater elevation changes completely breaks down in those wells furthest upland and away from the main channel. AEA's analysis to date suggests that it may be possible to develop a categorization of groundwater-surface water response functions for a particular process domain that could be applied to other less studied areas.

2.4.1.3. Objective 3

Objective 3: Assess the potential effects of Watana Dam/Reservoir on groundwater and groundwater influenced aquatic habitats in the vicinity of the proposed dam.

There were no Modification Requests submitted that pertain to Objective 3. Comments pertaining to Objective 3 are addressed in Table 2.4.1-1.

2.4.1.4. Objective 4

Objective 4: Work with other resource studies to map groundwater-influenced aquatic and floodplain habitat (e.g., upwelling areas, springs, groundwater-dependent wetlands) within the Middle River Segment of the Susitna River including within selected Focus Areas (RSP Section 8.5.4.2.1.2).

2.4.1.4.1. Response to Modification Request to Add Aquatic and Floodplain Habitat Map-based Impact Assessment

USFWS (Modification 9; USFWS_pp7.5-12_ph03) and NMFS (Modification 9; NMFS_pp7.5-12_ph06) recommended a modification to the FERC-approved Study Plan to include an assessment of the potential Project effects based on groundwater-influenced aquatic and floodplain habitat maps of the entire river corridor where impacts may occur.

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The Services' requested modification under Study Objective 4 transcends the purpose of the primary study element which was to provide broad-scale maps of groundwater influenced areas within the Middle River Segment. Instead, the Services' requested modification relates to impact assessment and the Decision Support System (DSS) which is not part of the FERC-approved Study Plan for Study 7.5.

The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of potential Project impacts across several different study disciplines. This study was designed to collect current information to provide an overall understanding of groundwater/surface water (GW/SW) interactions at both the watershed- and local-scales. The analysis of Project impacts will appear in the License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impacts assessment in the Draft License Application, please see Section 1.3.

The DSS is part of the Fish and Aquatic Instream Flow Study 8.5. As AEA has noted in Section 2.5.1.8, the development of the DSS is ongoing and will be coordinated with the licensing participants. Development of a DSS-type process, and supporting software to efficiently process data analyses, will be initiated in collaboration with the TWG after the initial results of the various habitat modeling efforts are available. The intent is to prepare the DSS tool to assist in the evaluation of Existing Conditions and develop an operational scenario that addresses Stakeholder interests in support of the License Application (RSP Section 8.5.4.1).

The Service suggests that the DSS should be much more focused on preparing resource-based maps of the river corridor and the creation of "impact zones" based on potential Project operational scenarios. This type of analysis may be considered as part of the DSS, at the appropriate time, once all of the resource models have been developed and integrated and results have been provided from the different scenarios.

In their supporting rationale for this modification request, the Services state (USFWS_pp7.5-12_ph07; NMFS_pp7.5-13_ph02):

> *The project has embarked on a highly quantified process of attempting to determine impacts with a variety of very complex models that require large amounts of data and assumptions, but which may end up producing results that are less useful than planned. Re-evaluation of these complex models in favor of simpler and less precise but more reliable overall assessments may be in order.*

In response, AEA notes that licensing participants have been directly involved in the selection of all of the detailed models that AEA is developing to assess impacts. Moreover, the majority of both oral and written comments proffered to date across all resource areas have been directed toward increasing rather than decreasing the level of study and model complexity. The discussion related to 2-D vs. 3-D groundwater modeling is a good example of this, where the Services state (USFWS_pp7.5-15_ph05; NMFS_pp7.5-15_ph06):

> *These analyses call into question the validity of the key assumptions underlying the use of 2D transect models for Focus Areas on the Middle Susitna River. Compelling evidence for this approach has not yet been presented and this approach may not be adequate to meet the Objective for this study element.*

This is clearly suggestive that more sophisticated models such as 3-D MODFLOW may be needed in some locations. Importantly, AEA selected groundwater analysis to match specific resource questions rather than simply applying the same level of model sophistication across all Focus Areas.

Specific to the DSS, the licensing participants have also suggested at least one option that would make the analysis even more complex (see Section 3.4). For example, the DSS modeling process presented by the USGS at the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting and referenced by TNC (TNC_pp20_ph02, June 20, 2016) is a highly complex model that was developed over more than ten years, not because of the lag in technology, but in large part due to the complex task of defining values across licensing participants quantifying those values in space and over time and calculating representative metrics to approximate whether those values will be met under various scenarios, and lastly, testing the sensitivity of those approximations and optimization functions.

As detailed in AEA's response to the Services' request for a new model integration and DSS study in Section 3.4, model integration and the DSS will be developed consistent with the FERC-approved Study Plan (RSP Section 8.5.4.8) to support the analysis of Project effects and the identification of protection, mitigation and enhancement measures as appropriate. AEA considers this modification request mis-aligned with the objectives of Study 7.5 and as well, premature.

2.4.1.5. Objective 5 and Objective 6

Objective 5: Determine the Groundwater/Surface Water Relationships of Floodplain Shallow Aquifers Within Selected Focus Areas as Part of Study 8.6 (Riparian Instream Flow).

Objective 6: Determine Groundwater/Surface Water Relationships of Upwelling/Downwelling in Relation to Spawning Incubation, and Rearing Habitat (Particularly in Winter) with Selected Focus Areas as Part of Study 8.5 (Fish and Aquatics Instream Flow).

Objective 5 and Objective 6 were reviewed by the Services together and comments and modifications that relate to both were submitted to FERC. AEA's responses follow a similar approach and proceed first with specific comments warranting detailed responses, followed by AEA's responses regarding requests for modifications (Modifications 2, 4, 5, 6, 7, and 9). Responses to comments pertaining to basic components of each of the studies (e.g., up-scaling, water table maps, winter conditions, etc.) are found above in Table 2.4.1-1.

2.4.1.5.1. Response to Comments Regarding 2-D vs. 3-D Groundwater Flow Systems and Models

The Services (USFWS_pp7.5-15_ph02; NMFS_pp7.5-15_ph03) state that a general guide to 2-D transect models is to align them along a flow line so that all flow in the model occurs parallel to and in the plane of the profile and not doing so introduces errors into the modeling process that should be recognized and addressed with respect to the purposes of the modeling simulations. The Services note that examination of water table maps for multiple Focus Areas showed that inferred directions of groundwater flow were commonly not aligned with the planned profile models, and that this should cause reevaluation of whether the planned 2-D modeling is adequate to simulate conditions in real-world three-dimensional transient groundwater flow systems. The Services state (USFWS_pp7.5-15_ph05; NMFS_pp7.5-15_ph06) that the analyses call into question the validity of the key assumptions underlying the use of 2D transect models for Focus Areas on the Middle Susitna River. They also state (USFWS_pp7.5-15_ph06; NMFS_pp7.5-15_ph07) that in some situations, the most appropriate modeling exercise would be to construct a 2-D plan view model rather than a 2-D transect model.

In response, AEA notes that the primary purpose of groundwater modeling for the Riparian IFS 8.6 and Fish and Aquatics IFS 8.5 studies was not to simulate the groundwater system for all aspects of groundwater hydrology, but to develop an understanding of the interactions between potential stage (or flow) changes in the Susitna River due to Project operations and adjacent groundwater. The location of wells and the resulting profile was geared to specific ecologically relevant locations (i.e., riparian areas, and known fish spawning locations) to enable a better understanding of how Project operations may influence these interactions and correspondingly, the riparian and fish and aquatic habitats. The main driving mechanism for the GW/SW interactions is a pressure response (stage or water level change) between surface water features (i.e., main channel, side channel, sloughs, streams) and adjacent groundwater. Adjacent groundwater could be lateral (away from the slough or channel) or below the streambed in a vertical direction. In lateral habitat, stage changes can occur due to flow increases (i.e., floods, over-topping flows, increased groundwater discharge), ice jams, development of beaver dams, or erosion/depositional changes. Key Project potential effects involved changes in summer and winter flows, thus changes in summer and winter surface water levels. As surface water levels change, for example due to a flood event in a side channel, the initial groundwater response is a pressure wave, or kinematic pressure wave response. The response does not propagate into the shallow groundwater system along flow lines. The propagation is dependent on the nature of the stream and groundwater interface. The propagation is most similar to a 2-D plain (or transect) near straight stream sections or on the outside center of meander bends. This conceptual relationship was one of the factors used in the selection of aquatic and riparian cross-sections. The further one moves away from the stream/groundwater (bank) interface into the groundwater system, the assumption of 2-D GW/SW pressure effects likely becomes reduced. This is why groundwater wells were positioned along the transects and near the bank to characterize the greatest levels of interactions (relative water level changes) between groundwater and surface water. For related information regarding water table data in Focus Areas other than FA-128 (Slough 8A), see Section 2.4.1.5.7 below.

Furthermore, and specific to the inference that 2-D models may not be adequate for simulating conditions and therefore 3-D models are needed at all Focus Areas, the design of the Groundwater

Study (Study 7.5) was closely coordinated with the Riparian IFS (Study 8.6) and Fish and Aquatics IFS (Study 8.5) to meet the objectives of those studies. AEA made no a-priori selection of 2-D or 3-D models for use in all Focus Areas, but rather model selection was based on resource needs within each Focus Area as well as Focus Area complexity. This resulted in the installation of wells that were largely transect oriented in FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek), with additional wells installed in FA-128 (Slough 8A) due to its complexity. Correspondingly, since the SIR, AEA has been in the process of developing a 3-D MODFLOW model for FA-128; and 2-D transect based MODFLOW models for the other Focus Areas.

The use of the modeling described in Nakanishi and Lilly (1998), as referenced by the Services, is similar to how the objectives of the Groundwater Study are being addressed. That is, analysis of the 2-D and 3-D modeling completed in FA-128 (Slough 8A) will be used to evaluate the understanding gained from the 2-D modeling and guide its application to the evaluation of potential Project impacts. Since the modeling objectives are focused on estimating water level responses to river stage changes, the focus on modeling groundwater fluxes is not a primary objective of the Study Plan Section 7.5.

2.4.1.5.2. Response to Modification Request Regarding Acquisition of Field Data and Inclusion of Short-duration Fluctuations in Groundwater Models

USFWS (Modification 2; USFWS_pp7.5-20_ph07) and NMFS (Modification 2; NMFS_pp7.5-21_ph03) request the Study Plan be modified to include the acquisition of field data to improve the current performance of surface water/groundwater models to enable simulation of short-duration fluctuations in surface water/groundwater interactions characteristic of future proposed Project operations at each Focus Area. The Services commented that the current groundwater modeling effort is not capable of simulating fluctuating groundwater/surface water interactions at short time scales (hourly) that will be characteristic of Project operations (USFWS_pp7.5-21_ph01; NMFS_pp7.5-21_ph04) or that can occur in response to various hydrologic events. They suggested that frequent and synchronous data collection on river stage, groundwater levels, precipitation and snowmelt may be required and that portions of data sets appear to not have been collected during important times (USFWS_pp7.5-21_ph02; USFWS_pp7.5-21_ph03; NMFS_pp7.5-21_ph05; NMFS_pp7.5-21_ph06). They further noted that the "Proof of Concept" is not complete until the models can be demonstrated to adequately simulate and predict the effects of seasonal, daily and hourly changes in flows (USFWS_pp7.5-21_ph03; NMFS_pp7.5-21_ph06). SRC et al. (SRC_etal_WATER_pp25_ph05) also submitted a modification proposal to FERC for AEA to use an integrated groundwater/surface water model that can simulate small head differences in groundwater and surface water elevations.

In response, AEA requests that FERC not adopt these proposed modifications because the requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services and SRC et al. have not established "good cause" as required by the ILP regulations, nor have the Services or SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

More fundamentally, the modification requests, like several others, makes the presumption that just because a particular type of analysis has not been demonstrated to date, then it is a deficiency in the study that must be corrected. In this case, the assertion is that since AEA has not demonstrated the ability in its models to simulate short duration fluctuations, it must mean AEA is not planning on doing so. This is incorrect. As an initial matter, the FERC-approved Study Plan for Study 8.5 specifically describes the methods proposed for evaluating short duration flow fluctuations on fish and aquatic invertebrate habitats. The FERC-approved Study Plan for Fish and Aquatics IFS Study 8.5 (RSP Section 8.5.4.6.1.6: Varial Zone Modeling) notes that:

> *The proposed load-following operations of the Project will affect hourly flow fluctuations downstream of the Watana Dam site.*

The section then describes the methods and modeling that will be used for evaluating short duration fluctuations over three different time scales: 12 hours, 7 days, and 30 days. A 12-hour time series will provide an indication of the effects of water level changes on aquatic biota that rapidly colonize a previously dewatered area. A 7-day time series will be used as an indicator of the risk of dewatering due to hourly and daily changes in load-following operations, such as weekday versus weekend generation. A 30-day time series will be used as an indicator of the risk of dewatering associated with weekly to monthly changes in flow patterns, such as changes in minimum flow requirements or seasonal runoff. AEA also notes that it has demonstrated the ability to simulate daily and hourly fluctuations in flow as part of the Open Water Flow Routing Model (OWFRM) (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*; Study 8.5 ISR Part C, Appendix K: *Hydrology and Version 2 Open-water Flow Routing Model*) which will be used in the Varial Zone analysis and will also route such flows to other models.

In terms of the groundwater models, a significant effort has been made in collecting continuous (15-minute interval) groundwater and surface water level data and summer precipitation data at four Focus Areas (FA-104 [Whiskers Slough], FA-115 [Slough 6A], FA-128 [Slough 8A], and FA-138 [Gold Creek]), and time-lapse camera images which provide information on the timing and conditions of spring snow melt. The amount of data is sufficient to meet Groundwater Study objectives 5 and 6. Importantly, since the field data have been collected on relatively short (15 minute) time scales, the assigned stress periods in the MODFLOW model can be adjusted to simulate effects on groundwater of short-duration fluctuations in surface flows as provided by the OWFRM. Again, these types of analyses are already embedded within the FERC-approved Study Plan Section 7.5 and do not represent a study modification.

The comments related to Proof of Concept are similar to others proffered under different resource studies and as referenced in the Services' Modification 4 (Demonstration of Models within Pilot Scale Area) regarding the integration of modeling results and the need for demonstrating the validity of the models for providing realistic results that FERC can use to evaluate potential Project effects. This was likewise noted by FERC in its June 23, 2016 comments (FERC_ppA-1_ph01, June 23, 2016). Since the initial November 13-15, 2013 Riverine Modeling Technical Team meeting that was designed to discuss modeling and study integration efforts, the follow-up Proof of Concept meeting held April 15-17, 2014 that demonstrated the application of resource specific models (i.e., Water Quality Study 5.6, Fluvial Geomorphology Modeling Study 6.6, Groundwater Study 7.5, Ice Processes Study 7.6, and fish habitat modeling as part of IFS Study 8.5) in calculating two biological metrics that was followed by preparation of *Middle River Fish Habitat and Riverine Modeling Proof of Concept* (Study 8.5 ISR Part C, Appendix N) that described the overall Proof of Concept completed at that time. AEA has continued working on model refinements and integration including incorporation of the groundwater models. This work will continue and as specified in the FERC comments on the ISR, preliminary results for all models (including the 3 Dimensional MODFLOW model for FA-128 [Slough 8A]) will be presented in the USR for at least two operational scenarios; existing conditions and maximum load following (FERC_ppA-1_ph01, June 23, 2016).

2.4.1.5.3. Response to Modification Request Regarding a Demonstration Within a Single Pilot Scale Area

USFWS (Modification 4; USFWS_pp7.5-21_ph05) and NMFS (Modification 4; NMFS_pp7.5-22_ph02) have requested a study modification characterized as a demonstration of model integration at a single Pilot Scale Area. The Services made a similar request (USFWS_pp8.5-58_ph01 [Study 8.5 Recommendation]; NMFS_pp8.5-55_ph04 [Study 8.5 Modification 7-2]) under Study 8.5 (Fish and Aquatics IFS) that included both model integration and Decision Support System and provided as a separate attachment a detailed description of the New Study Request (USFWS New Study Request for Susitna-Watana Integrated Modeling and Decision-Support System and NMFS New Study Request: Integrated Modeling and Decision Support System). The request proffered under Groundwater Study 7.5 referred to that study request.

AEA requests that FERC not adopt this proposed modification. Proposing a modification to a FERC-approved Study Plan that refers to a concurrent request for new study submittal, as the Services have done here, does not constitute a modification request nor does it meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan.

Moreover, as part of the FERC-approved Study Plan, AEA is already proceeding with this effort as has been repeatedly demonstrated to the Services and other licensing participants during several Technical Team meetings including an initial November 13-15, 2013 Riverine Modeling Technical Team meeting that was designed to discuss modeling and study integration efforts, and the follow-up Proof of Concept meeting held April 15-17, 2014 that demonstrated the application of resource specific models (i.e., Water Quality Study 5.6, Fluvial Geomorphology Modeling Study 6.6, Groundwater Study 7.5, Ice Processes Study 7.6, and fish habitat modeling as part of IFS Study 8.5) in calculating two biological metrics within FA-128 (Slough 8A). Focus Area FA-128 (Slough 8A) was selected because it represented one of the more complex areas and contained areas known to be important for fish spawning and incubation. The analysis presented in the Proof of Concept meetings was further described in the ISR (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*) and Study 8.5 SIR. Since then AEA has continued working on model refinements and integration including development and incorporation of a preliminary 3-D MODFLOW groundwater model. This work will continue and as clarified by AEA during the ISR meetings and in the FERC comments on the ISR (FERC_ppA-1_ph01), preliminary results for all models will be presented in the USR for Existing Conditions and one operational scenario. Included in the USR will be a complete description of how each model was configured, parameterized, calibrated, and validated, as well as a description of sensitivity analyses and uncertainties in key model parameters. AEA is fully aware of the importance of demonstrating not only the reliability of the outputs of individual models, but also demonstrating how the respective model outputs will be integrated/combined for evaluating specific effects on riparian (Study 8.6) and fish and aquatic habitats (Study 8.5). AEA considers the requested modification as duplicative of ongoing efforts and unwarranted.

2.4.1.5.4. Response to Modification Requests Regarding Evaluation of Changes in Groundwater Temperature and Dissolved Oxygen

USFWS (Modification 5; USFWS_pp7.5-21_ph07) and NMFS (Modification 5; NMFS_pp7.5-22_ph03) recommend a modification to the study to evaluate changes in groundwater temperature and dissolved oxygen from Project operations. The SRC et al. requested a study modification (Modification IIIa; SRC_etal_WATER_pp26_ph01) for AEA to use an integrated groundwater/surface water model that can simulate changes in water temperature. The Services (USFWS_pp7.5-14_ph04; NMFS_pp7.5-14_ph06 and USFWS_pp7.5-16_ph05; NMFS_pp7.5-16_ph06) stated that the methodology for understanding future changes in surface and groundwater temperatures and dissolved oxygen is unknown, and there is no data or analysis about understanding the temperature or dissolved oxygen of upwelling groundwater under Project operating conditions. All three commenters assert that MODFLOW is not capable of modeling temperature to predict groundwater/surface water interactions (USFWS_pp7.5-14_ph04; NMFS_pp7.5-14_ph06; SRC_etal_WATER_pp26_ph03). SRC et al. suggests the use of a more sophisticated, physically-based model instead of MODFLOW to simulate groundwater flow and temperature and further adds that AEA does not have sufficient temperature data in the Middle River to model temperature or calibrate the model (SRC_etal_WATER_pp26_ph03; SRC_etal_WATER_ppAtt-27_ph05).

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan.

The SRC et al. assertion that there is insufficient temperature data is unsubstantiated. Specifically, AEA notes that both water temperature and dissolved oxygen have been extensively measured throughout the Susitna River as part of the Baseline Water Quality Study (Study 5.5) with results presented in the Study Completion Report (Study 5.5 SCR, November 24, 2015). The report includes temperature and dissolved oxygen data collected in 2013 and 2014 from within seven Focus Areas as well as from monitoring stations within the mainstem river. These data are serving as input to the Environmental Fluid Dynamics Code (EFDC) model that will be used to model a variety of water quality parameters (including water temperature and dissolved oxygen) throughout the river and, to the (2-D) River Water Quality Model with Enhanced Resolution for modeling within Focus Areas (Study 5.6 ISR Part A, Section 4.3). In addition, water temperatures (surface and intergravel) have been extensively monitored over a wide range of habitats within and outside of Focus Areas as part of the development of site specific habitat suitability curves (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Dissolved oxygen has likewise been measured extensively within surface waters associated with the Focus Areas; as well, intergravel dissolved oxygen has been continuously monitored at several Focus Areas as part of Winter Studies investigations (Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*). AEA fully understands the importance of these two parameters on salmonid ecology and river productivity and as part of the IFS habitat modeling (Study 8.5) will be explicitly considering how Project induced changes in water temperature may influence salmonid egg incubation and emergence timing, and rearing habitats, especially during winter-time periods.

In terms of the groundwater models, in RSP Section 7.5.4.4 of the FERC-approved Study Plan, AEA explicitly noted that "*Where appropriate, MODFLOW (Feinstein et al. 2012; Maddock et al. 2012; USGS 2005, 2012) GW/SW interaction models of floodplain shallow alluvial aquifer and surface water relationships will be developed and that the selection of the MODFLOW modeling package will utilize ASTM D6170 "Standard Guide for Selecting a Groundwater Modeling Code" as the guideline for documenting the code selection process (ASTM 2010b)"*. Further, AEA noted that MODFLOW GW/SW interaction models would be used to model GW/SW relationships using empirical monitoring data collected at the Focus Areas. AEA does not reference any other groundwater models for application in this study.

AEA disagrees that there are no known methods for considering water temperature within a MODFLOW model platform as the commenters assert. AEA is developing methods for the simulation of groundwater heat transport including the use of the mass transport code MT3DMS (Zheng and Wang 1999). The mathematics of heat and mass transport are similar and MT3DMS can be used in conjunction with MODFLOW. MT3DMS has been used by others including Hecht-Méndez et al. (2010) and Zheng and Wang (1999) for simulation of heat transport in groundwater. The MT3DMS coding will be applied to MODFLOW where applicable. Temperature will be calibrated using the temperature data collected at all groundwater elevation stations as well as shallow streambed temperature profile data. Intergravel data has been collected from six locations in FA-128 (Slough 8A). The intent is to simulate transient changes in short-term streambed temperature effects in spawning habitat areas that result from localized stage changes.

Other GW/SW temperature analysis will be based on a combination of the surface water temperature modeling coupled with empirical data collected at specific locations. Likewise, analysis of GW/SW dissolved oxygen relationships will be based on combined surface water-dissolved oxygen modeling coupled with empirical measurements of intergravel dissolved oxygen. AEA is confident that the combined modeling and data analysis as planned and described in the ISR and SIR will be able to address potential Project operational effects on water temperature and dissolved oxygen, and the resulting effects on fish and aquatic biota.

2.4.1.5.5. Response to Modification Request Regarding Assessment of Current and Future Flows That Will Be Required to Breach the Head-of-Slough Barriers

The USFWS (Modification 6; USFWS_pp7.5-22_ph03) and NMFS (Modification 6; NMFS_pp7.5-22_ph07) request a modification to the Study to assess the current and future flows that will be required to breach the head-of-slough barriers to meet Objective 6. The Services (USFWS_pp7.5-22_ph05; USFWS_pp7.5-22_ph06; USFWS_pp7.5-22_ph07; USFWS_pp7.5-22_ph08; NMFS_pp7.5-22_ph09; NMFS_pp7.5-22_ph10; NMFS_pp7.5-23_ph02) expressed concern about the ability of the groundwater modeling to address changes in breaching flows that may result from channel aggradation and/or degradation due to Project operations. Specifically, they asserted that effects of overbank flow and breaching flows (in the Middle River Segment) and flow in side channels in the braid plain of the Lower River Segment appear to be unevaluated and are not apparently included in the groundwater and surface water studies, to date.

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. AEA disagrees that the FERC-approved Study Plan was not implemented. This particular analysis is already planned for in the FERC-approved Study Plan and in terms of defining the breaching flows under Existing Conditions, was specifically described in Study 8.5 ISR Part D, Section 8.

Although the Services claim that anomalous weather conditions occurred in 2013, as explained in Section 1.5.1, 2013 did not involve "anomalous environmental conditions" for the purposes of 18 CFR § 5.15(d)(2). See section 1.5.1, above. While it is true that 2013 experienced unusually prolonged winter conditions and a delayed spring break-up, the Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and the Services make no showing that the meteorological conditions in 2013 impaired the value of the collected data for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of conducting additional years of data collection would be excessive.

Even with the unusual weather conditions in spring 2013, AEA's study team gathered useful data that met the Study Plan objectives. Despite the Services' claim, the groundwater and hydrology data collected in the spring of 2013 has proven valuable in helping to define the range of surface and groundwater conditions that occur naturally within the Susitna River system. Moreover, having a monitoring period that captures a wide range of hydrologic and geohydrologic conditions provides for a much more robust data set from which to develop and employ models than monitoring stable, average conditions.

As noted in Study 8.5 ISR Part D, Section 8, and described further in Section 2.5.1.5.2 (Breaching Flow Analyses) of AEA's response to comments on IFS Study 8.5, one of the steps to complete Study 8.5 includes measuring inlet elevations at major Middle River side channels and sloughs (both within and outside of Focus Areas) to calculate breaching flows that affect habitat connectivity. That analysis will be complementary to the Fish Passage Barriers Study 9.12 that is designed to evaluate existing and future potential barriers to fish movement. Once defined, the current bed elevations associated with breaching will be compared with the bathymetric changes predicted for different Project operational scenarios by the 1-D bed evolution model (BEM) (Study 6.6 SIR, Attachment 1, Appendix A: *1-D Bed Evolution Model of the Middle and Lower Susitna River: Model Development and Calibration*) at different locations throughout the Middle River Segment. The 1-D BEM will be coupled with the more detailed SRH-2D sediment transport models (Study 6.6 SIR, Attachment 1, Appendix B: *FA-128 2-Dimensional Sediment-transport Model Development and Calibration*) developed for specific Focus Areas to enable more precise predictions of bed elevation changes affecting breaching flows within specific sloughs and side channels. Both the 1-D and 2-D BEMs utilized inputs from the LiDAR topographic mapping that was available for 2011, 2013, and 2014 (Study 6.6 SIR). These changes in breaching flows can then be linked with the respective groundwater models to determine potential effects on groundwater flux, and ultimately how such changes may influence fish habitat via the 2-D Fish Habitat modeling. The bed elevation changes will be assessed at various intervals over the duration of the Project and provide a means to evaluate potential changes in breaching flow conditions within the Focus Areas and as well although more generally at other locations throughout the Middle River Segment.

With respect to the Lower River, while AEA agrees with the Services that there would be fewer and lower high-flow events in the Lower River with the Project, these changes in peak and daily flows are not of the magnitude that result in the dramatic changes in vegetation presented by the Services (USFWS_pp7.5-22_ph05; NMFS_pp7.5-22_ph09). In support of the decision on whether to extend the Fluvial Geomorphology Modeling (Study 6.6) downstream of PRM 29.9 (Susitna Station), AEA determined the change in annual flood frequency between existing and Project conditions (Max Load Following OS-1b). The results (Table 5.1-1 in *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 Technical Memorandum* [Study 6.6 TM, September 26, 2014]) indicate, due to the substantial flow contribution from the Chulitna and Talkeetna rivers, that between the Three Rivers Confluence and the Yentna River confluence, there will be a 15 to 19 percent reduction in annual peak flows for the 1.5- to 100-year return period under with-Project conditions. Below the Yentna River confluence, the additional flow contribution attenuates Project effects on hydrology to the point that the reduction in peak flows ranges between 5 to 11 percent for the 1.5- to 100-year return periods. Daily flow duration curves generated for the months of the open water period show similar shifts with an average reduction of approximately 5 percent and a range of a 2 percent increase in October to a maximum decrease of 12 percent in June for with-Project conditions. These changes in peak and daily flows are not of the magnitude that result in the dramatic changes in vegetation presented by the Services in the comment. In fact, AEA has shown that the variability in 2-year peaks determined on a decadal basis, varied by plus or minus approximately 10 percent compared to the 61-year based value, indicating Project induced changes are on the order of natural variability (Table 5.1-2 in *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 Technical Memorandum*). In addition, it is often the case in dammed systems that the reduction in flow is accompanied by channel degradation which further isolates the floodplain from the channel, however, in the case of the Lower Susitna River, the system is generally aggradational and will continue to be aggradational under Project conditions (Tables 5.3-1 and 5.3-2 in *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 Technical Memorandum*), thus maintaining floodplain connectivity.

AEA notes that the modeling analyses concerning Lower River riparian vegetation and groundwater/surface water relationships will be completed, as described in the FERC-approved Study Plan (Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 1-6, 8-10), in the final study year and modeling results of Project operations will be included in the USR. Individual plant species and riparian plant community type groundwater depth relationships will be developed based on rooting depth characterizations collected to date.

AEA concludes that this modification is duplicative of ongoing efforts and is not warranted as a separate item in the Groundwater Study 7.5. Data (collected from 2013 through current conditions in 2016) that are relevant to overtopping provide a range of conditions to help understand GW/SW interactions that are important for the aquatic and riparian resource evaluations. AEA notes that the collection of this groundwater and surface water elevation data along with the modeling and analysis that are being performed through the Fish and Aquatics Instream Flow Study 8.5, Geomorphology studies 6.5 and 6.6, and Ice Processes Study 7.6 all take into account overtopping flow processes.

2.4.1.5.6. Response to Modification Request Regarding Collecting Snow Survey Data at Representative Focus Areas

The USFWS (Modification 7; USFWS_pp7.5-23_ph01) and NMFS (Modification 7; NMFS_pp7.5-23_ph03) requested a modification to the Study Plan to collect snow survey data at representative Focus Areas in late March or early April, based on their suggestion that groundwater modeling efforts are being hampered by a lack of key data for simulating groundwater recharge during the spring snowmelt period. The Services also stated that the study does not discuss how the rainfall data and the accompanying soil moisture and water table data will be used in the modeling work to simulate the effects of local rainfall and snowmelt on fluctuating water tables (USFWS_pp7.5-15_ph07; NMFS_pp7.5-16_ph01).

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Moreover, this particular analysis is already planned for in the FERC-approved Study Plan and collection of additional snow data is not necessary to meet the objectives.

Specifically, AEA intends to apply regional spring snow survey data from the National Resources Conservation Service (NRCS) to estimate regional snow conditions for the field data collection periods. This information along with analysis by the AEA-commissioned Glacier and Runoff Changes (Study 7.7), and field observations made during the IFS and Fish winter studies, and Riparian IFS spring studies, will be used to estimate the potential influence of snowmelt on local GW/SW interactions. Additionally, the Riparian IFS team conducted snow depth measurements to specifically characterize snow water equivalents at FA-104 (Whiskers Slough) and FA-128 (Slough 8A) on April 4, 2014. Forty (40) snow depth measurements were made at the FA-104 meteorological station and an additional groundwater well station. Sixty-eight (68) snow depth measurements were made at the FA-128 meteorological station. In addition, for the Riparian IFS Study 8.6, soil pits were dug in the spring to assess infiltration patterns from snowmelt and rainfall. These observations will help in determining whether snowmelt infiltration to the groundwater table can alter groundwater levels. These empirical data collected in the Focus Areas will be used to evaluate the need to incorporate recharge from the ground surface to the water table.

Importantly and as referenced to FA-128 (Slough 8A), local recharge from rain and snowmelt events has not been quantified or incorporated in the current MODFLOW model for FA-128 (Slough 8A). Rather, the groundwater simulations have focused on simulating groundwater responses to changes in surface water stages since potential impacts from Project operations will be primarily on surface water flows and associated stages. Even so and as noted above, AEA will use a combination of site data and the regional snow data from NRCS to evaluate the relative importance of local recharge from rain and snowmelt compared to recharge from surface water flooding in Focus Areas.

2.4.1.5.7. Response to Modification Request to Collect Additional Water Table Data in Focus Areas

The USFWS (Modification 9; USFWS_pp7.5-23_ph04) and NMFS (Modification 9; NMFS_pp7.5-23_ph06) recommended installation and monitoring of additional wells in all Focus Areas other than FA-128 (Slough 8A) to address their assessment that the alignment of wells in other Focus Areas was generally along a single transect perpendicular to the river, and that this clustering of data makes for a poor water table map. They also recommend a "*data needs assessment*" to optimize data collection for periods that will be simulated by the models and suggest that two-dimensional modeling *"…is generally not appropriate for Focus Areas because of up-valley or down-valley components of groundwater flow that cause significant inaccuracies*". This, they reason, justifies approval of their study modification.

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan.

As an initial matter, the FERC-approved Study Plan did not specify the number of individual wells that would be installed at each of the Focus Areas. Rather, the Study Plan stated that to support the Riparian IFS Study (RSP Section 7.5.4.4):

> *Wells will be placed to help describe the hydrologic conditions at internal boundaries (such as sloughs, side channels) and at varying distances from these boundaries to help measure the time lag in groundwater level response to changes in surface water stage. Well locations will take into account the riparian vegetation mapping units. Some wells will be placed at boundaries of the groundwater model simulation domains to provide model boundary input data, or validation data sets.*

Similarly, for the Fish and Aquatics IFS Study it was noted that (RSP Section 7.5.4.5):

> *The groundwater study will be measuring both horizontal and vertical head gradients through combinations of nested wells installed at different depths and shallow wells installed in surface water habitat areas to measure the gradients between surface water sources and underlying groundwater conditions.*

Example schematic layouts of well installations were provided (and reproduced here for illustration) for both the riparian and Fish and Aquatics IFS studies (Figure 2.4.1-1 and Figure 2.4.1-2) that clearly illustrate the plans for installing some of the wells along transects oriented perpendicular to the river. Comparison of those figures with the maps of the actual well locations (Study 7.5 ISR Part A, Figures 4.5-2, 4.5-3, 4.5-4, and 4.5-6) confirms these types of transect-based orientations for wells. AEA notes that the primary purpose of groundwater modeling for the Riparian IFS 8.6 and Fish and Aquatics IFS 8.5 studies was not to simulate the groundwater system for all aspects of groundwater hydrology, but to develop an understanding of the interactions between potential stage (or flow) changes in the Susitna River due to Project operations and adjacent groundwater. The location of wells was geared to specific ecologically relevant locations (i.e., riparian areas, and known fish spawning locations) to enable a better understanding of how Project operations may influence these interactions and correspondingly, the riparian and fish and aquatic habitats. The main driving mechanism for the GW/SW interactions is a pressure response (stage or water level change) between surface water features (i.e., main channel, side channel, sloughs, streams) and adjacent groundwater. Adjacent groundwater could be lateral (away from the slough or channel) or below the streambed in a vertical direction. In lateral habitat, stage changes can occur due to flow increases (i.e., floods, over-topping flows, increased groundwater discharge), ice jams, development of beaver dams, or erosion/depositional changes. Key Project potential effects involved changes in summer and winter flows, thus changes in summer and winter surface water levels. As surface water levels change, for example due to a flood event in a side channel, the initial groundwater response is a pressure wave, or kinematic pressure wave response. The response does not propagate into the shallow groundwater system along flow lines. The propagation is dependent on the nature of the stream and groundwater interface. The propagation is most similar to a 2-D plain (or transect) near straight stream sections or on the outside center of meander bends. This conceptual relationship was one of the factors used in the selection of aquatic and riparian cross-sections. The further one moves away from the stream/groundwater (bank) interface into the groundwater system, the assumption of 2-D GW/SW pressure effects likely becomes reduced. This is why groundwater wells were positioned along the transects and near the bank to characterize the greatest levels of interactions (relative water-level changes) between groundwater and surface water.

Because of its complexity, additional wells were installed in FA-128 (Slough 8A) to allow development of a 3-D MODFLOW model. Importantly, and as referenced above, the location and number of wells installed within each Focus Area was based on addressing groundwater questions related to the Riparian IFS (groundwater influence on riparian community health and vigor) and Fish and Aquatic IFS (groundwater influence on salmonid spawning habitats [upwelling] and egg incubation [upwelling and temperature]) and not on an a priori selection of 3-D or 2-D model application.

Analysis of groundwater data collected from the respective locations is ongoing including the development of a 3-D MODFLOW model in FA-128 (Slough 8A) that will incorporate a temperature module to allow simulation of groundwater temperatures. Overall, AEA maintains that the number of wells that have been installed and monitored will be sufficient for addressing the groundwater related questions associated with the Riparian IFS and Fish and Aquatics IFS studies. However, AEA will consider installation and monitoring of additional wells in selected Focus Areas if the results of data analysis and modeling reveal information gaps.

2.4.1.5.8. Response to Modification Request to Assess Effects of Main Channel Aggradation or Incision on Focus Area Groundwater

The USFWS (Modification 10; USFWS_pp7.5-23_ph07) and NMFS (Modification 10; NMFS_pp7.5-24_ph02) recommended a modification to the Study Plan to assess impacts of geomorphic channel changes on groundwater and habitats based on the use of current river channel configurations and stage for defining model boundaries, and not incorporating changes in channel form (aggradation and degradation) under Project operations.

In response, AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Moreover, the assessment of geomorphic channel changes resulting from the Project are already being evaluated as part of Geomorphology Study 6.5 and are described in the RSP, ISR, and SIR (RSP Section 6.5.4.11.2; Study 6.5 ISR Part C, Section 7.2.1.11; Study 6.5 SIR, Attachment 1: *Geomorphic Reach Delineation and Characterization, Upper, Middle and Lower Susitna River Segments – 2015 Update*).

One of the primary purposes of the geomorphology studies is to assess potential effects of Project operations on the dynamic behavior of the river reaches downstream from the proposed dam. The studies and modeling have been designed to evaluate whether existing channel morphology will remain the same or at least be in dynamic equilibrium under post-Project conditions. Studies to date suggest that because so little sediment transport would occur under with-Project conditions, the primary expression of width change (hence channel morphology change) would be through vegetation growth along channel and island banks (Study 6.5 SIR, Attachment 1). As part of the FERC-approved Study Plan, the existing groundwater data and analysis and modeling results can and will be used to draw some inferences about the projected geomorphic changes and how GW/SW relationships may be affected. The analysis and results specific to this will be provided in the USR.

2.4.1.5.9. Response to Modification Request Regarding Measurement of Vertical Groundwater Gradients Through Nested Observation Well Pairs

The USFWS (Modification 11; USFWS_pp7.5-24_ph01) and NMFS (Modification 11; NMFS_pp7.5-24_ph04) recommended the installation and measurement of vertical groundwater gradients through nested observation well pairs to meet Objective 6. They commented that the SIR report failed to identify the variance of not having installed nested monitoring wells to measure vertical groundwater gradients. The Study Plan (RSP Section 7.5.4.5) states that:

> *The groundwater study will be measuring both horizontal and vertical head gradients through combinations of nested wells installed at different depths and shallow wells installed in surface water habitat areas to measure the gradients between surface water sources and underlying groundwater conditions.*

Although nested monitoring wells have not been installed, this will not affect the ability to determine GW/SW relationships of upwelling/downwelling in relation to spawning, incubation, and rearing habitats (particularly in the winter) within selected Focus Areas as part of the Fish and Aquatics IFS (Study 8.5), which is Objective 6 of the FERC-approved Study Plan.

In general, the methods used for installation of shallow wells followed the same techniques developed in the 1980s. Many of the areas requiring well installation involved gravel and cobble rich deposits and surface conditions which would not allow the use of portable drilling rigs. Moreover, the locations of the wells were remote and removed from transportation portals that could be used to bring in large drill rigs that employ hollow stem drilling techniques that are needed for drilling deeper wells. However, a small portable (380 pound) Mobile Drill Minuteman auger drill was used for testing of potential well locations and pre-drilling. Installation of wells was achieved by drive point methods whereby galvanized pipe (2, 3, and 4 foot sections) in combination with sand points (screened drive point) were installed to desired depths at each location. Because the drive point methods did not allow installation of deep wells, the goal was to have the drive point installed several feet below seasonally low water table conditions, which were estimated based on site conditions in the field. The drill was used to pre-drill a hole, and then drive the well down through the pre-drilled hole and further to the desired depth of installation. Frequently, the drill was used to test drill several borings, stopping when large cobble or boulder material was encountered and shifting over to a new location in the target area until a reasonable depth could be found to start installation of the well casing with the drive point.

The portable drill was transported to sites near shore by boat on a custom skid, and a combination of field staff, a 12-volt wench, and rollers were used to move the drill to the desired location. For some of the more remote locations, the portable drill was placed on the skid and sling-loaded into the site by an R-44 helicopter. Drilling supplies were sling loaded in Knaak boxes. This approach minimized the surface disturbance of the sites, which was a requirement in areas located on State Parks lands as well as private lands.

A combination of sledge hammers or fence-post drive hammers were used to drive the well point into the coarse sediments. Difficult sites where wells could still be successfully installed could take up to 500 blows per foot during installation. It was commonly possible to only drill down 5 to 10 feet with the drill, but then cobbles prevented further drilling with the 3-inch diameter solid stem auger and the wells would be driven in the rest of the way. Only 1 well was not installed due to sediments being too coarse to drive a well to a target depth; there were more than 4 holes attempted at this location. If a well was damaged during the installation process, it was pulled out using a handyman jack and chain and new well material was reinstalled. Once the desired installation depth was achieved, or a depth of refusal was met, then the well surface area was back filled around the well pipe by natural material and slightly mounded around the well. A top assembly was then placed on top of the well pipe to hold the upper portion of pressure transducer cabling, or of self-logging pressure transducer assemblies. A location was then marked to survey the top of casing and use for level-loop surveying for establishing elevation datum for the well, and to make manual measurement of water depths from this measurement point.

In reference to the Services' comments (USFWS_pp7.5-24_ph01; NMFS_pp7.5-24_ph04), to just measure vertical gradients with wells, two wells side by side or close to each other drilled to different depths would be needed. The current wells were installed to just below the seasonal low water table conditions and for reasons just noted, it was not possible to install companion location but deeper wells, say in the range of 45-50 feet below land surface.

However, AEA has been using and will continue to use a combination of data sets for estimating vertical gradients. First off, what was not understood at the time of writing the Study Plan, were the common occurrences of springs, wetlands, and small streams in upland areas, which provided a good idea of groundwater presence near the land surface. These observations, coupled with the extensive temperature profile data and other empirical data, have proven useful in helping to understand the vertical components of the flow system. This was illustrated in the Technical Memorandum, *Preliminary Groundwater and Surface-Water Relationships in Lateral Aquatic*

Habitats within Focus Areas FA-128 (Slough 8A) and FA-138 (Gold Creek) in the Middle Susitna River (Study 7.5 TM, September 30, 2014).

In addition, there has been an extensive LiDAR coverage developed of the areas that can be used to differentiate topographic differences suggestive of groundwater influence. In general springs flow year round, some locations create wetlands where snow does not accumulate over winter, etc., so the groundwater contribution from upland valley sides is critical to riparian vegetation processes (vegetation types and location also support shallow groundwater interpretations in uplands). The development of the LiDAR data, when matched with the mapping and images of these features provides a way to estimate the water table surface in more areas than just groundwater well locations.

Most recently, AEA has installed and is collecting seepage flow data at 8 locations: two in FA-104 (Whiskers Slough), four in FA-128 (Slough 8A), and two in FA-138 (Gold Creek) (Figure 2.4.1-3, Figure 2.4.1-4, Figure 2.4.1-5, and Figure 2.4.1-6). Three types of data are collected from the seepage meter installations: streambed permeability, direction of flow (upwelling or down welling), and seepage flux. Streambed permeability is directly comparable to the MODFLOW stream conductance variable. Stream conductance controls the flow of water between the aquifer and overlying stream. A total of 47 slug tests were also conducted during 2016, consisting of 12 tests on wells within FA-104 (Whiskers Slough); 9 tests in FA-115 (Slough 6A), 20 tests in FA-128 (Slough 8A), and 6 tests in FA-138 (Gold Creek). These tests will provide measured values of hydraulic conductivity that can be used in the MODFLOW modeling. Figures 2.4.1-3 through 2.4.1-5.

The direction of flow data can be combined with the existing extensive set of VHG data (developed as part of the IFS Study 8.5 HSC/HSI) to evaluate locations of upwelling and downwelling. Initial indications suggest that seepage directions are consistent for specific locations and can be generalized based on stream geomorphology. For example, seepage meters located in pools generally indicate upwelling, whereas station ESGFA128-3, which is located just above a riffle, has consistently indicated downwelling. This is consistent with the current understanding of streambed hydrology and can possibly be extrapolated outside the study area. Seepage flux can also be used in combination with recent streamflow measurements of FA-128 (Slough 8A) to calibrate the MODFLOW model seepage into the Slough 8A, and adjust spatial variability.

AEA is confident that the combined data sets just mentioned, along with other hydrology measurements that have been collected designed to assess groundwater contributions, can be applied in understanding the VHGs without needing to install additional wells.

For these reasons, AEA requests that FERC not adopt this proposed Study Plan modification. While AEA implemented a variance to the FERC-approved Study Plan, a combination of alternative methods will allow the study objectives to be met.

2.4.1.6. Objective 7

Objective 7: Characterize water quality (e.g., temperature, dissolved oxygen [DO], conductivity) of selected upwelling areas that provide biological cues for fish spawning and juvenile rearing, in Focus Areas as part of the Fish and Aquatics Instream Flow Study (RSP Section 8.5).

There were no Modification Requests submitted that pertain to Objective 7. Comments pertaining to Objective 7 are addressed in Table 2.4.1-1.

2.4.1.7. Objective 8

Objective 8: Characterize the winter flow in the Susitna River and how it relates to GW/SW interactions.

There were no Modification Requests submitted that pertain to Objective 8; Comments pertaining to Objective 8 are addressed in Table 2.4.1-1.

2.4.1.8. Objective 9

Objective 9: Characterize the relationship between the Susitna River flow regime and shallow groundwater users (e.g., domestic wells).

There were no Modification Requests submitted that pertain to Objective 9; Comments pertaining to Objective 9 are addressed in Table 2.4.1-1.

2.4.1.9. References Cited

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2.4.1.10. Tables

Table 2.4.1-2. Groundwater Study 7.5 well depths.

Focus Area Station/Well Name	Date Complete	Well Material	Drive Point Type	Drilling Method	Hole Depth[1] (ft)	Well Depth (ft)	Instrumentation Type
FA-138 (Gold Creek)							
ESGFA138-1-W1	9/12/2013	Gal	Sand Screen	MD	7.5	10.0	CS451 PT
ESGFA138-1-W2	9/13/2013	Gal	Sand Screen	MD	8.5	10.8	CS451 PT
ESGFA138-2-W1	9/14/2013	Gal	Sand Screen	MD	~12	~12	CS451 PT
ESGFA138-2-W2	9/14/2013	Gal	Sand Screen	MD	10	9.7	CS451 PT
ESGFA138-3-W1	10/16/2013	SS	SS-slotted	GHA	5	6.22	INW PT2X
ESGFA138-4-W1	9/14/2013	SS	SS-slotted	GHA	5	5.42	INW PT2X
ESGFA138-5-W1	10/18/2013	Gal	Sand Screen	GHA	4	6.4	INW PT2X
FA-128 (Slough 8A)							
ESGFA128-2-W1	9/18/13	Gal	Sand Screen	MD	11.0	~11	CS451 PT
ESGFA128-3-W1	9/23/13	Gal	Sand Screen	MD	7.0	~7	CS451 PT
ESGFA128-4-W1	9/23/13	Gal	Sand Screen	MD	3.0	10.3	CS451 PT
ESGFA128-5-W1	9/23/13	Gal	Sand Screen	MD	10.8	15.22	CS451 PT
ESGFA128-6-W1	9/23/2013	Gal	Sand Screen	GHA	5	9.8	CS451 PT
ESGFA128-7-W1	8/2/2013	Gal	Sand Screen	MD	5	10.7	CS451 PT
ESGFA128-7-W2	9/30/2013	Gal	Sand Screen	MD	5.2	12.74	CS451 PT
ESGFA128-9-W1	7/31/2013	Gal	Sand Screen	GHA	5	9.2	CS451 PT
ESGFA128-9-W2	9/24/2013	Gal	Sand Screen	GHA	5	9.2	CS451 PT
ESGFA128-10-W1	9/24/2013	Gal	Sand Screen	HD	0	~10	CS451 PT
ESGFA128-11-W1	9/24/2013	Gal	Sand Screen	HD	0	10.79	CS451 PT
ESGFA128-12-W1	9/30/2013	Gal	Sand Screen	MD	0	9.37	CS451 PT
ESGFA128-13-W1	8/4/2013	SS	SS-slotted	GHA	5	12	CS451 PT
ESGFA128-13-W2	9/28/2013	Gal	Sand Screen	MD	6	15.97	CS451 PT
ESGFA128-18-W1	8/2/2013	SS	SS-slotted	GHA	4	9.9	INW PT2X
ESGFA128-19-W1	9/29/2013	Gal	Sand Screen	GHA	4	8.63	INW PT2X
ESGFA128-20-W1	7/31/2013	Gal	Sand Screen	GHA	5	8.4	INW PT2X
ESGFA128-21-W1	9/24/2013	Gal	Sand Screen	HD	0	8.81	CS451 PT
ESGFA128-23-W1	9/27/2013	Gal	Sand Screen	MD	12.8	12.78	INW PT2X
ESGFA128-24-W1	9/27/2013	Gal	Sand Screen	MD	5	8.85	INW PT2X
ESGFA128-25-W1	9/27/2013	Gal	Sand Screen	HD	0	8.78	INW PT2X
ESGFA128-26-W1	9/27/2013	Gal	Sand Screen	MD	13.75	10.75	INW PT2X
ESGFA128-27-W1	9/27/2013	Gal	Sand Screen	MD	4	9.65	INW PT2X
FA-115 (Slough 6A)							
ESMFA115-1-W1	7/5/2013	Gal	Gal-slotted	HD	0.0	4.9	CS451 PT
ESMFA115-1-W2	9/12/2013	Gal	Sand Screen	GHA	5.0	7.3	CS451 PT
ESGFA115-2-W1	9/12/2013	Gal	Sand Screen	HD	0.0	8.3	CS451 PT

Focus Area Station/Well Name	Date Complete	Well Material	Drive Point Type	Drilling Method	Hole Depth[1] (ft)	Well Depth (ft)	Instrumentation Type
ESGFA115-3-W1	9/13/2013	Gal	Sand Screen	GHA	5	8.19	CS451 PT
ESGFA115-4-W1	9/13/2013	Gal	Sand Screen	HD	0	7	CS451 PT
ESGFA115-5-W1	9/8/2013	Gal	Sand Screen	MD	5.9	8.1	CS451 PT
ESGFA115-6-W1	9/9/2013	Gal	Sand Screen	MD	4.75	9	CS451 PT
ESGFA115-7-W1	9/10/2013	Gal	Sand Screen	HD	0	9.5	CS451 PT
ESGFA115-8-W1	9/12/2013	Gal	Sand Screen	HD	0	8.22	INW PT2X
FA-113 (Oxbow 1)							
ESGFA113-1-W1	8/13/2013	SS	SS-slotted	GHA	5.0	11.5	CS451 PT
ESGFA113-1-W2	9/7/2013	Gal	Sand Screen	MD	9.5	10.9	CS451 PT
FA-104 (Whiskers Slough)							
ESMFA104-2-W1	8/23/2013	Gal	Sand Screen	MD	9.0	8.0	CS451 PT
ESGFA104-3-W1	8/24/13	Gal	Sand Screen	MD	8.3	8.0	CS451 PT
ESGFA104-4-W1	8/25/2013	Gal	Sand Screen	MD	5.0	12.1	CS451 PT
ESGFA104-5-W1	8/27/13	Gal	Sand Screen	MD	10.0	13.4	CS451 PT
ESGFA104-6-W1	8/27/13	Gal	Sand Screen	MD	8.0	11.3	CS451 PT
ESGFA104-6-W2	8/28/2013	Gal	Sand Screen	MD	8.0	14.9	CS451 PT
ESGFA104-7-W1	8/28/13	Gal	Sand Screen	MD	8.0	12.5	CS451 PT
ESGFA104-8-W1		Gal	Sand Screen	MD	FAILED		
ESGFA104-8-W2	8/28/13	Gal	Sand Screen	MD	8.0	11.0	CS451 PT
ESGFA104-9-W1	8/14/2013	SS	SS-slotted	GHA	4.0	9.0	CS451 PT
ESGFA104-9-W2	10/7/13	Gal	Sand Screen	MD	8.3	11.0	CS451 PT
ESGFA104-10-W1	9/6/2013	SS	SS-slotted	MD	13.0	14.6	CS451 PT
ESGFA104-10-W2	9/6/2013	Gal	Sand Screen	MD	14.0	14.6	CS451 PT
ESGFA104-11-W1	10/9/2013	Gal	Sand Screen	MD	6.8	6.5	INW PT2X
ESGFA104-12-W1	10/9/2013	Gal	Sand Screen	MD	10.8	10.5	INW PT2X
ESGFA104-13-W1	8/25/2013	Gal	Sand Screen	MD	8.8	8.3	INW PT2X
Lower River GW Riparian Transects							
ESGLR1-1-W1	9/16/2013	Gal	Sand Screen	GHA	5.0	6.9	CS451 PT
ESGLR1-1-W2	9/16/2013	Gal	Sand Screen	GHA	5.0	10.5	CS451 PT
ESGLR2-1-W1	9/17/2013	Gal	Sand Screen	GHA	5.0	11.2	CS451 PT
ESGLR2-1-W2	9/17/2013	Gal	Sand Screen	GHA	5.0	15.29	CS451 PT
ESGLR3-1-W1	9/18/2013	Gal	Sand Screen	GHA	5.0	10.0	CS451 PT
ESGLR3-1-W2	9/18/2013	Gal	Sand Screen	GHA	5.0	10	CS451 PT
ESGLR4-1-W1	9/19/2013	Gal	Sand Screen	GHA	5.0	11.3	CS451 PT
ESGLR4-1-W2	9/19/2013	Gal	Sand Screen	GHA	5.0	12.52	CS451 PT
ESGLR4-2-W1	10/7/2013	Gal	Sand Screen	GHA	5.0	14.45	CS451 PT
ESGLR4-2-W2	10/7/2013	Gal	Sand Screen	GHA	5.0	10.45	CS451 PT

2.4.1.11. Figures

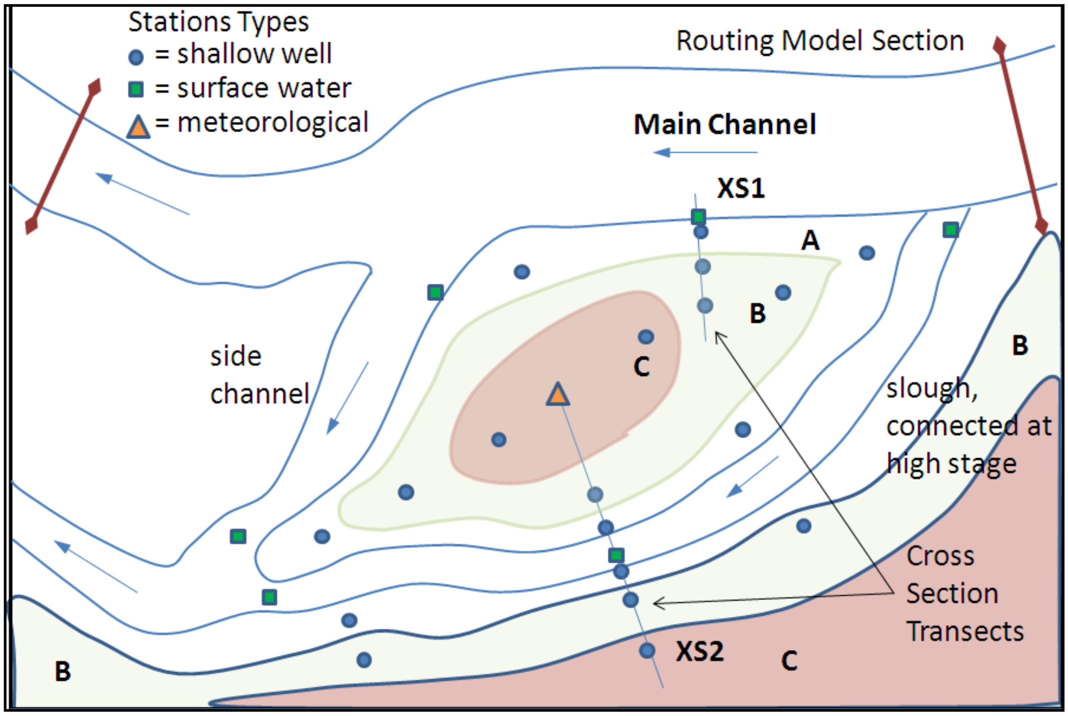

Figure 2.4.1-1. Example schematic of groundwater well and surface water station network in a hypothetical Focus Area targeting riparian analysis (Source: RSP 7.5, Figure 7.5-8.)

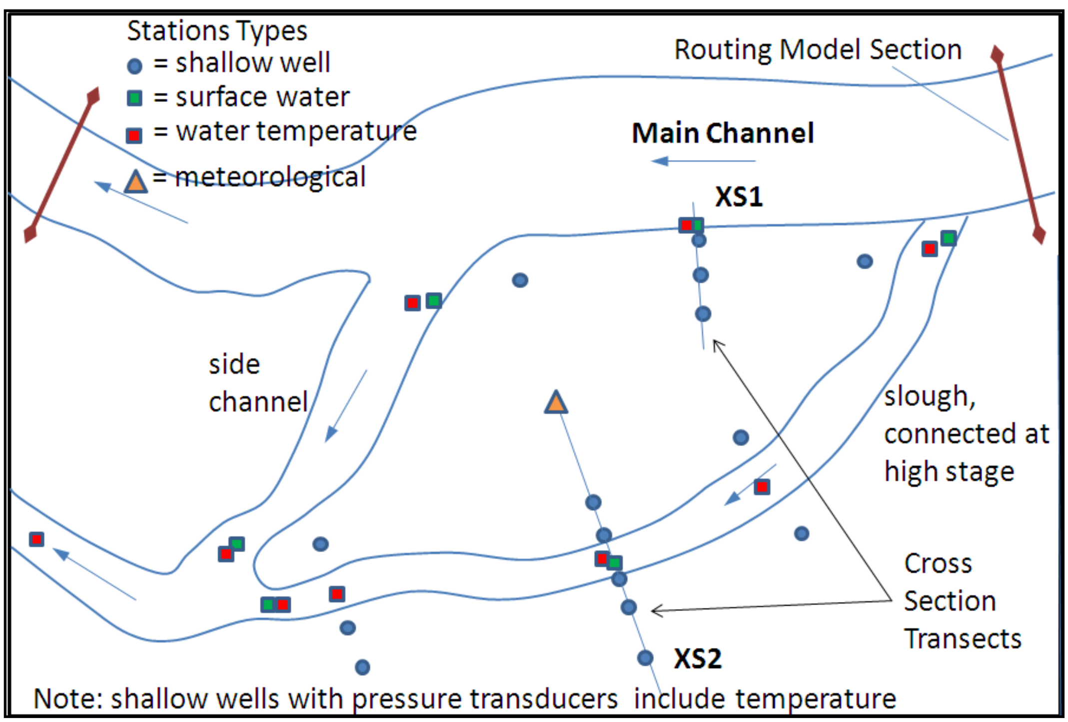

Figure 2.4.1-2. Example schematic of groundwater well and surface water station network in a hypothetical Focus Area targeting fish and aquatic habitat analysis. (Source: RSP 7.5, Figure 7.5-9.)

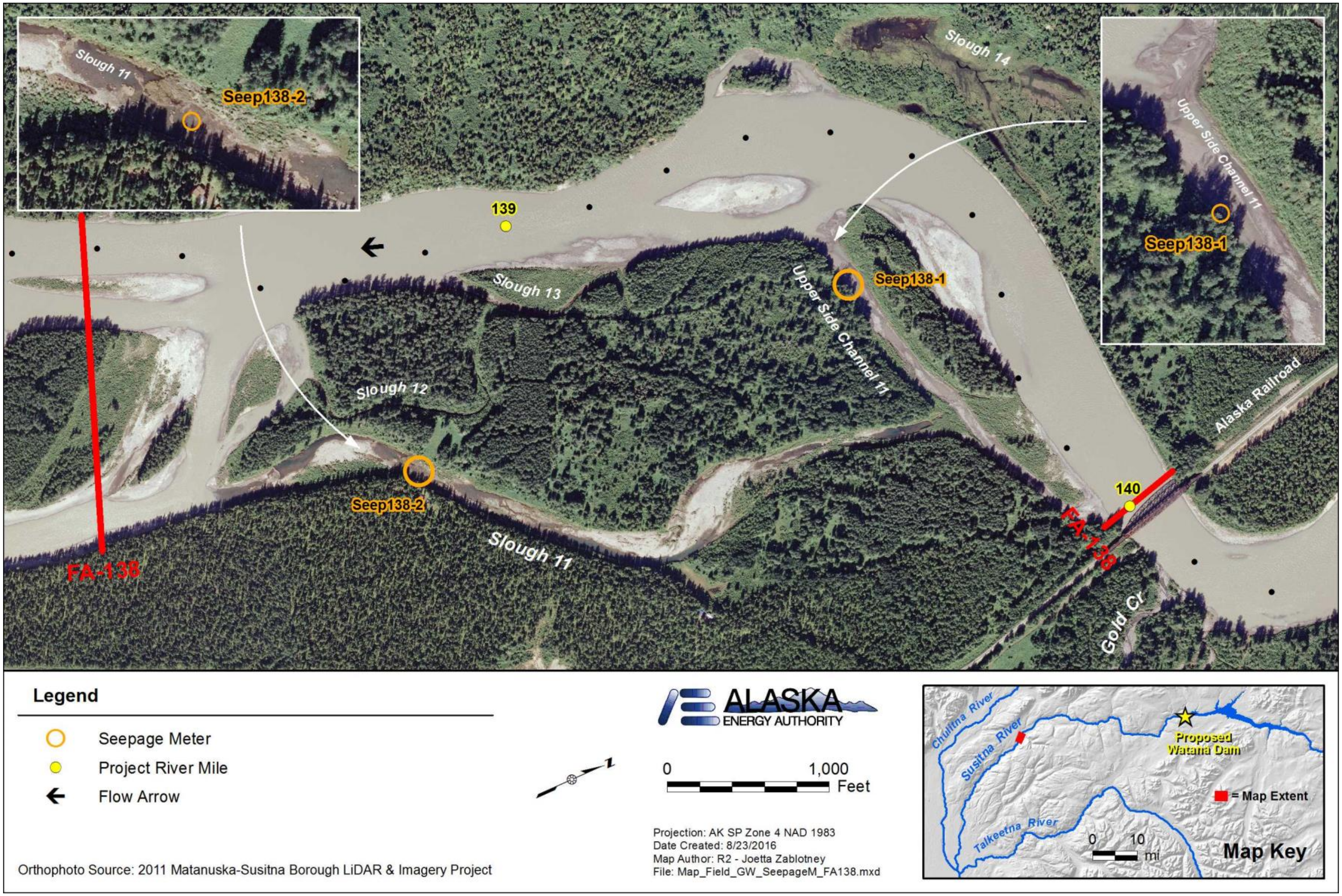

Figure 2.4.1-3. Location of seepage meters installed during summer 2016 in FA-138 (Gold Creek).

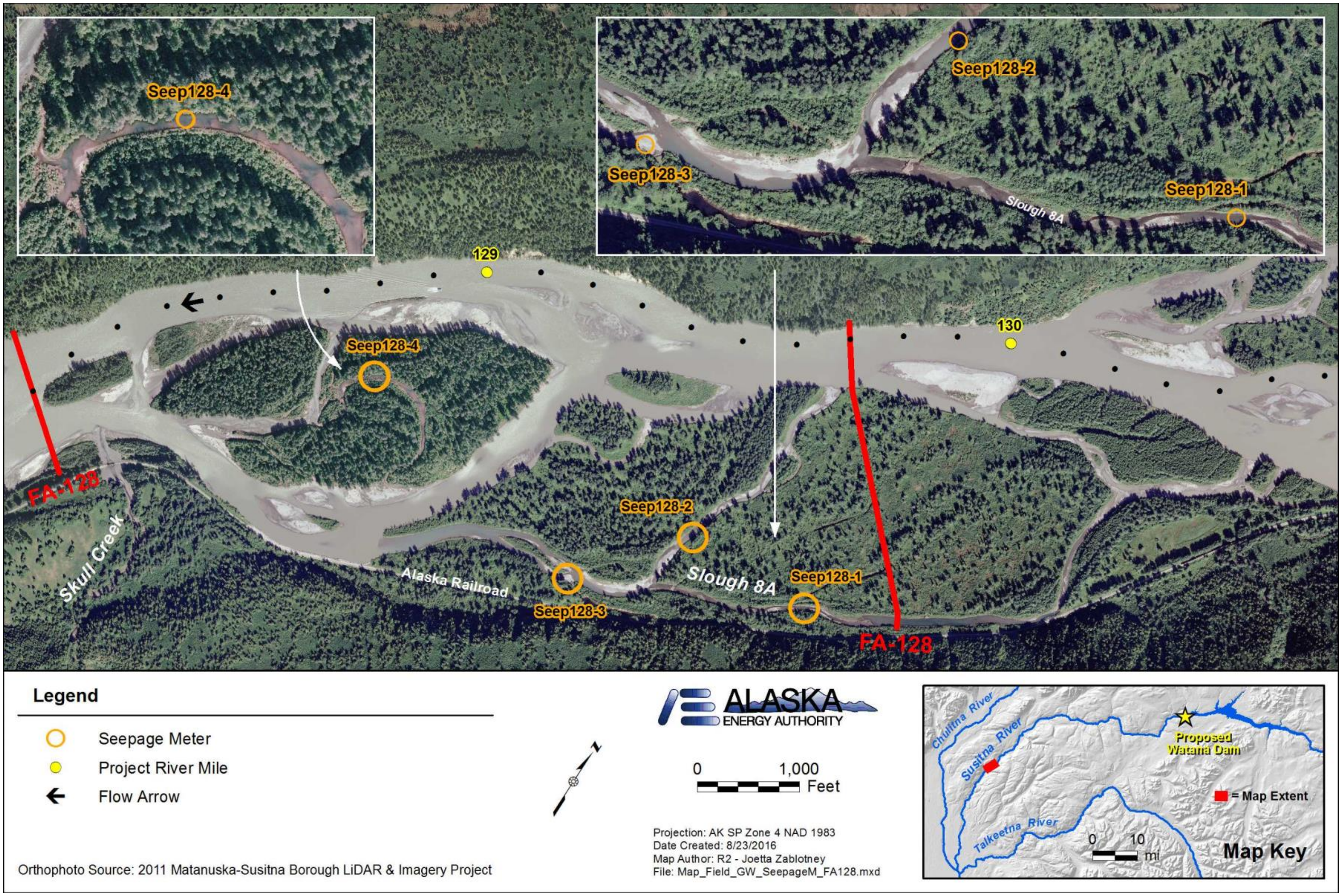

Figure 2.4.1-4. Location of seepage meters installed during summer 2016 in FA-128 (Slough 8A).

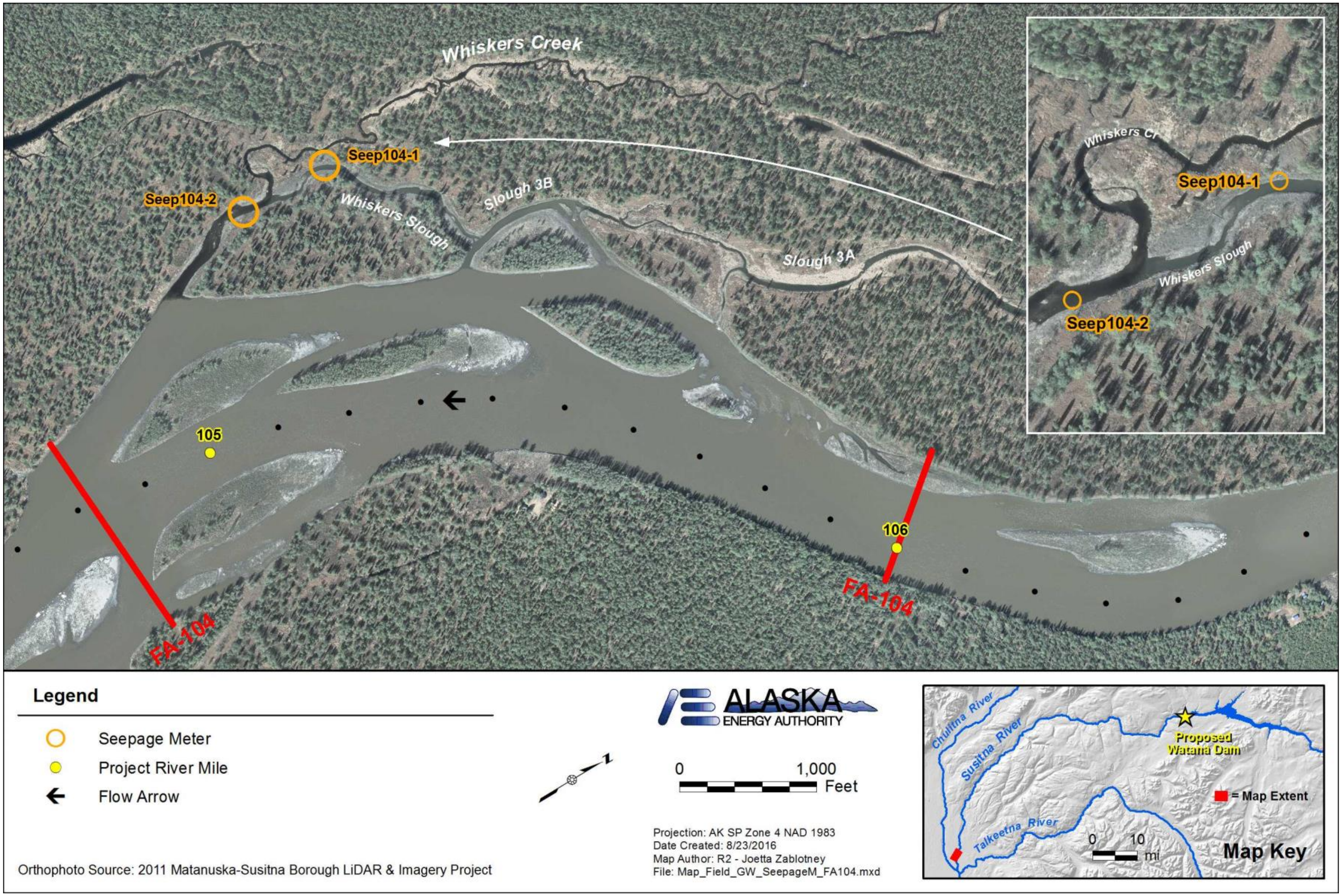

Figure 2.4.1-5. Location of seepage meters installed during summer 2016 in FA-104 (Whiskers Slough).

Figure 2.4.1-6. Representative photographs of seepage meter installations during summer 2016.

2.4.2. Study 7.6 – Ice Processes in the Susitna River Study

As established in the Study Plan (RSP Section 7.6.1), the overall goals of the ice processes study are to further the understanding of natural ice processes in the Susitna River and provide a method to model/predict pre-Project and post-Project ice processes in the Susitna River. The study will provide a basis for impact assessment, which will inform the development of any necessary protection, mitigation, and enhancement measures. The study also will provide ice processes input data for other resource studies with winter components (e.g., Fluvial Geomorphology Modeling below Watana Dam Study [Study 6.6], Instream Flow Studies [Studies 8.5-8.6], Instream Flow Riparian [ISR Study 8.6], and Groundwater Study [Study 7.5]).

The study objectives are established in RSP Section 7.6.1:

- Document the timing, progression, and physical processes of freeze-up and break-up during 2012–2014 between tidewater and the Oshetna River confluence (PRM 235.2 [RM 233.4]), using historical data, aerial reconnaissance, stationary time-lapse cameras, and physical evidence.
- Determine the potential effect of various Project operational scenarios on ice processes downstream of Watana Dam using modeling and analytical methods.
- Develop a modeling approach for quantitatively assessing ice processes in the Susitna River.
- Calibrate the model based on existing conditions. Use the model to determine the extent of the open water reach downstream of Watana Dam during Project operations.
- Use the model to determine the changes in timing and ice-cover progression and ice thickness and extent during Project operations.
- Develop detailed models and characterizations of ice processes at instream flow Focus Areas in order to provide physical data on winter habitat for the Fish and Aquatics Instream Flow Study (Study 8.5).
- Provide observational data of existing ice processes and modeling results of post-Project ice processes to the Fluvial Geomorphology Modeling below Watana Dam Study (Study 6.6), Groundwater Study (7.5), Instream Flow Studies (Studies 8.5-8.6), Fish and Aquatics Study (Studies 9.12), Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6), Recreation and Aesthetics Studies (12.5-12.7), and Socioeconomic and Transportation Study (Study 15.7).
- Research and summarize large river ice processes relevant to the Susitna River, analytical methods that have been used to assess impacts of projects on ice-covered rivers, and the known effects of existing hydropower operations in cold climates.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 24, 2016, AEA planned one modification to Study Plan Section 7.6:

1. Take additional field measurements of ice thickness, snow depth, and water surface elevation at FA-104 (Whiskers Slough), FA-113 (Oxbow I), FA-115 (Slough 6A), and FA-128 (Slough 8A) to assist in calibration of the River 1D and 2D models. No other field measurements will be required for calibration of the River1D model of the Middle River or the River2D models of these Focus Areas.

In March 2016, AEA collected additional field measurements of ice thickness, snow depth, and water surface elevation at FA-104 (Whiskers Slough), FA-113 (Oxbow I), FA-115 (Slough 6A), and FA-128 (Slough 8A) to assist in calibration of the River 1D and 2D models. No other field measurements will be required for calibration of the River1D model of the Middle River or the River2D models of these Focus Areas.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS, USFWS, ADF&G, NPS, SRC et al. (SRC, Talkeetna Community Council [TCCI], Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, Wild

Salmon Center), TCCI and Cathy Teich submitted comments to Study 7.6. USFWS and NMFS each submitted nine study modification proposals that were identical between the two Services. NPS, SRC et al., and TCCI each submitted one study modification proposal, plus additional comments.

NMFS and USFWS organized their study modification requests by study "objectives." However, the objectives noted in their comments are not the objectives of the FERC-approved Study Plan. Accordingly, AEA organized the responses by study objective as stated in the FERC-approved Study Plan rather than the paraphrased objectives provided in NMFS and USFWS comments. Because NMFS and USFWS modification requests were identical, AEA combined them below. AEA's responses to the comments can be found in Table 2.4.2-1 and further detailed below.

Table 2.4.2-1. Study 7.6 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp10_ph2	*We believe significant progress has been made and the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's reviews and support for AEA's implementation thus far of the FERC-approved Study Plan.
ADNR_ADFG_pp10_ph2	*We appreciate AEA's decision to provide updated visualizations of freeze-up progression and open lead survey information. The new format greatly improves the ability to comprehend the large amount of technical information in a visual manner.*	Comment noted.
ADNR_ADFG_pp12_ph2 (from 8.6)	*The study (study 8.6) will model potential impacts to downstream floodplain vegetation from project operational flow modification of the existing flow, sediment, and ice regimes. Observations of ice effects and tree ice scar mapping have provided insight on these processes and relationships.*	AEA concurs. Coordination between studies 7.6 and 8.6 will result in identification of flooded riparian areas during ice jamming events and how those areas may change with post-Project operations.
ADNR_ADFG_pp9_ph3 (from 6.6)	*Based on the information presented, we agree with AEA's determination that open water flows do not appear to contribute appreciably to bank erosion at FA-128 (Slough 8A) and that bank erosion is more likely related to ice processes.*	Ice processes do play an important part in bank erosion and channel configuration, especially during ice jamming and flooding events. Study 7.6 is determining the areas of flooding in side sloughs and back channels of FA-128 based on the River1D modeled water levels and ice conditions in the main channel of the Susitna River.
NMFS_pp7.6-04_ph4; USFWS_pp7.6-04_ph2	*NMFS (Modification 2-1), USFWS (Modification 1): [The Services] recommend the objective include describing how ice currently interacts with the channel bed and banks and then, either using modeling or other methods, assess how that will change with the winter flows projected under the various operating scenarios.*	As explained below in Section 2.4.2.2.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp7.6-04_ph9; USFWS_pp7.6-04_ph7	*NMFS (Modification 2-2), USFWS (Modification 2): [The Services] recommend the objective describe how open leads form and how the project will change this process.*	As explained below in Section 2.4.2.2.2, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $5,000,000.
NMFS_pp7.6-05_ph4; USFWS_pp7.6-05_ph3	*NMFS (Modification 3-1), USFWS (Modification 3): [The Services] recommend that the processes that cause ice jam initiation during three time periods (freeze-up, mid-winter, and breakup) be described and then, either using modeling or other methods, describe*	As explained below in Section 2.4.2.2.3, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the

Reference Number	Comment or Study Modification Request	AEA's Response
	how that will change with the winter flows projected in the various operating scenarios.	FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
TCCI_pp04_ph2	*Modification:* *TCCI requests that AEA provide 2D modeling of at least the immediate confluence mouths of the Susitna, Chulitna, and Talkeetna Rivers to adequately assess project related changes which could affect the safety of downstream communities. We are particularly concerned with the effects of the elevated winter flows (potentially 10, 000 cfs) under ice conditions proposed in the load following operations model. TCCI requests the BEI be applied to the confluence area.* *TCCI requests a comprehensive analysis of the Three Rivers Confluence which include the potential for erosion, winter sediment and ice transport and all other geomorphic project related effects - most of which 1D modeling cannot simulate.*	This modification request involves Study 6.6 and Study 7.6. As previously explained in Section 2.3.2.2.6 (Study 6.6) and below in Section 2.4.2.2.4, AEA does not object to FERC's adoption of part of this modification request. The estimated cost of implementing the entire modification as requested is $2.5M to $3.5M. The estimated cost of implementing the portion for which AEA has no objection to is $750,000 to $900,000 with the geomorphic portion (Study 6.6) estimated at $500,000 to $600,000 and the ice portion (Study 7.6) at $250,000 to $300,000.
NMFS_pp7.6-05_ph8; USFWS_pp7.6-05_ph7	*NMFS (Modification 3-2), USFWS (Modification 4):* *[The Services] recommend expanding the geographic extent of the current ice study to include the lowest ten miles of the Chulitna, Talkeetna, and Yentna Rivers.*	As explained below in Section 2.4.2.2.5, AEA does not object to FERC's adoption of part of this modification request. The estimated cost of implementing the entire modification as requested is beyond $5,000,000. This cost does not include the additional $10,000,000 to develop and extend an ice processes model to the Lower River. The estimated cost of implementing the portion for which AEA has no objection, as described in Section 2.4.2.2.4 is $10,000.
NMFS_pp7.6-06_ph3; USFWS_pp7.6-06_ph3	*NMFS (Modification 3-3), USFWS (Modification 5):* *[The Services] recommend modeling ice processes from the bottom of the varial zone (approximately Project River Mile 222) and up to the Oshetna confluence. NMFS and USFWS is not recommending a particular model or a particular approach.*	As explained below in Section 2.4.2.2.6, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of modeling the area above the reservoir varial zone is $1,500,000.
Teich_pp1_ph7	*Studies of how ice cracks and ridges on a frozen lake would affect caribou have not been done. (the water level would fall under the ice when water level on the lake would drop).*	See Section 2.4.2.2.6. AEA recognizes the concern about the potential effects of ice shelving and other ice conditions in the proposed reservoir on the movements of caribou and other mammals during winter and spring, which was first discussed for the original Su Hydro studies in the 1980s, as cited in the Wildlife Data-gap Analysis for the Project (ABR 2011) and in Section 4.6.2 of the Pre-Application Document for the Project (AEA 2012b).

Reference Number	Comment or Study Modification Request	AEA's Response
		The existing ice cover upstream of the dam site is characterized by extensive freeze-up jams, sections of accumulated frazil deposits, open leads and large stage changes over the winter. This results in difficult access from the riparian areas onto and across the ice cover. Under post-Project conditions, the reservoir level would gradually recede over the winter and the ice cover would drop with the water level. Areas within 5 feet of the shoreline may see small pieces of ice (less than 10 feet in size) sitting on rocks or shoreline discontinuities. Crossings may become easier, especially travel along the reservoir cover. Within the caribou study (Study 10.6), the deployment of GPS and VHF radio-collars was intended to provide the seasonal movement and range-use data that will be needed to evaluate this impact. The wildlife study plans, the ice processes study (Study 7.6), and the water-quality modeling study (Study 5.6) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. The impact analysis will consider Project-induced changes to ice processes and how those changes would impact caribou as well as other mammals. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit).
NPS_pp3_ph9	*The project reservoir should be added to the scope of this study. Ice formation and stability will be an important factor for many species of wildlife, especially caribou, because the 42-mile long reservoir may interrupt migration. The stability and safety of the reservoir ice sheet will also be important to humans, for transportation, subsistence and recreation. It will be impossible to develop wildlife, access and recreation management PME without knowing more about ice processes.*	See response to Teich_pp1_ph7 above and Section 2.4.2.2.6 for further details on how ice effects will be addressed in the reservoir. The wildlife, recreation, subsistence and transportation study plans, as well as the ice processes study (Study 7.6), and the water-quality modeling study (Study 5.6) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. The impact analysis will consider Project-induced changes to ice processes and how those changes would impact mammals, subsistence, recreation, and transportation. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit).
NMFS_pp7.6-06_ph8; USFWS_pp7.6-07_ph1	*NMFS (Modification 4-1), USFWS (Modification 6): [The Services] recommend assessing project effects on ice in the side channels and sloughs. Specifically ice characteristics and ice thickness. Either a new model or a completely new approach needs to be used to make the assessment valuable.*	As explained below in Section 2.4.2.3.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as AEA is already modeling this as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp7.6-08_ph2; USFWS_pp7.6-08_ph3	*NMFS (Modification 6-1), USFWS (Modification 7): [The Services] recommend implementing Objective 6 [sic] to expand the geographic extent of the current study to include the Lower River.*	As explained below in Section 2.4.2.2.7, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $10,000,000.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp7.6-08_ph3; USFWS_pp7.6-08_ph4	*Under the load following scenario the dam would release up to 12,000 cfs of 4 °C water at the dam. Eighty miles below that, water would mix with less than 2000 cfs from the Talkeetna and the Chulitna. The amount and thickness of ice in the lower reach will change. Based on information from 8.5 Instream Flow Study, the stage in the lower river could vary daily by 2 feet mid-winter. This action will cause the hinge points on the edge of the suspended ice sheet to bend twice a day. Contrary to AEA's statement, the dam operator cannot set up a 300 m wide "bridged" ice sheet in December that will stay stationary for three months while the water flows underneath following the electric load. Such a bridge defies the laws of physics.*	AEA disagrees. See Section 2.4.2.2.7.
SRC_etal_WATER_pp28_ph1	*Modification I.* *The Ice Processes Study (7.6) should be modified to require AEA to collect additional stage-discharge data to understand winter flows, ice breakup and the flooding of off-channel habitats, to properly calibrate the model and address uncertainty.*	As explained below in Section 2.4.2.3.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp28_ph3	*I a. AEA should collect stage-discharge data in the Middle River to understand breaching flows in off-channel habitats, under ice flows and main channel flows.*	See Section 2.4.2.3.2.
SRC_etal_WATER_pp29_ph2	*I b. Missing aerial photography and stage-discharge data prevents AEA from understanding and modeling interactions of ice with main-channel and side channel habitats and potential impacts to salmon habitat under post-project conditions.*	See Section 2.4.2.3.2. Collection of additional aerial photography was also requested by SRC et al. as a study modification to Study 6.5 (see Section 2.3.1.5.1).
SRC_etal_WATER_pp29_ph6	*I c. AEA needs to demonstrate that the ice processes model can simulate the inundation of off-channel habitats during break up.*	See Section 2.4.2.3.2.
SRC_etal_WATER_pp30_ph1	*I d. AEA needs to address uncertainty introduced by modeling oscillating flows in the winter under post-project conditions.*	See Section 2.4.2.3.2.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp7.6-08_ph6;USFWS_pp7.6-08_ph7	*NMFS (Modification 7-1), USFWS (Modification 8): [The Services] recommend the literature search be completed to cover the wider range of ice processes that occur in the Susitna.*	As explained below in Section 2.4.2.5.1, AEA requests FERC not adopt this proposed Study Plan modification. There is no cost for implementing this modification as AEA has already provided this information.
NMFS_pp7.6-09_ph3; USFWS_pp7.6-09_ph4	*NMFS (Modification G-1), USFWS (Modification 9): [The Services] recommend that AEA demonstrate how the River1D and River2D model will interact with three other physical models (8.5 Open Water Flow Model, 7.5 Groundwater model, and 6.6 Geomorphology Model) considering that at this point, all four function on different time steps.*	AEA requests FERC not adopt this proposed Study Plan modification as model integration is already part of the FERC-approved Study Plan. The modeling charts were presented and described in the FERC-approved Study Plan. In addition, a Riverine Modeling Technical Team meeting was held with licensing participants on November 13-15, 2013 to provide a forum to review and discuss modeling and study integration efforts. A follow-up Proof of Concept meeting was held April 15-17, 2014 to advance the understanding of riverine process and fish habitat modeling by demonstrating the application of the models specific to two key biological metrics (i.e., effective salmon spawning-incubation habitat and juvenile salmonid rearing habitat) at Middle River Focus Area 128 (Slough 8A) (Study 8.5 ISR Part C, Appendix N: Middle River Fish Habitat and Riverine Modeling Proof of Concept). These meetings were held early in the study implementation process to allow potential data gaps or format inconsistencies to be identified and resolved. A description of the integration process and an updated modeling flow chart are provided in Middle River Fish Habitat and Riverine Modeling Proof of Concept (Study 8.5 ISR Part C, Appendix N); however, the integration of riverine process models and development of fish habitat metrics is an ongoing process. AEA has continued coordination efforts by holding monthly conference calls with representatives from each riverine modeling study to ensure modeling results are correctly integrated, consider uncertainty, and fully meet the stated objectives of the various Study Plans. Each of the four models are using the same bathymetry to develop their grids, though the GW model (SIR 7.5, Appendix B: Preliminary MODFLOW Three Dimensional Groundwater Model for FA-128 (Slough 8A)) also includes multiple strata beneath the ground surface to describe GW flow. The model grids do differ slightly from one model to the next based on what the focus of the study is. Time steps for input (the discharge for geomorph, ice, and open water) are the hourly discharge from the dam (or upstream discharge in the river for existing conditions) plus some defined downstream water level as a boundary condition. The various models have to have different calculation time steps due to the processes they are modeling (sediment movement, ice movement, open water wave movement) plus the necessity to have manageable computation times. The GW model uses water elevations as an input and has a longer input time step (6 - 12 hours). Because groundwater movement and storage occurs through a porous media, hydraulic responses to stresses in the groundwater system are slower and more dampened than occur in surface water systems. Use of 6-hour time steps are sufficient

Reference Number	Comment or Study Modification Request	AEA's Response
		for simulation of most groundwater processes. Model input stresses are calculated from datasets with hourly time steps (or less), including site monitoring data and output from other models (i.e. the OWFRM model (SIR Study 8.5, Appendix B: Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8) and the SRH2D model (SIR 6.6, Attachment 1: 2014 *Fluvial Geomorphology Model Development Technical Memorandum*). But overall, the models are using input that is either the hourly flow data (plus other hourly values) or it is based on that hourly data. Overall, the models are using input that is either the hourly flow data (plus other hourly values) or it is based on that hourly data. Model outputs are coordinated to evaluate Project-related flow effects on an hourly basis, including groundwater results which can be interpolated from the 6-hour results. Preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). The Services also requested model integration as a new study. See Section 3.4 for a detailed response.
NPS_pp3_ph8	*There are gaps between work to date and study goals. We will not know if more or less ice will be generated at various points downstream of the dam under various flow and temperature scenarios until a valid model is run. Mid-season breakups and re-freezing have not been studied. The effect of snow on ice dynamics has not been included in the model. Anchor ice formation has not been modeled, or the effects of large wood.*	The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. The study was not intended to be completed by the ISR stage of the process. Since filing the SIR, the River1D model has been calibrated for ice covered conditions and is being used to model the average (1984-85), cold (1975-76), and warm (1984-85) winters for pre- and post-Project conditions. The model does include ice accumulation and thermal ice growth as well as melting during warm periods. Anchor ice and shore ice are accomodated through empirical relationships based on field observations in 2012-14. Breakup jamming will be addressed using either the River1D or HEC-RAS models. The effect of snowfall on the model would be minimal except during the freeze-up process and this would be accounted for in the temperature and precipitation inputs. Large wood is a minimal effect in both freeze-up and breakup conditions, with breakup likely responsible for much large wood transport within the ice.

2.4.2.1. Objective 1

Objective 1: Document the timing, progression, and physical processes of freeze-up and break-up during 2012–2014 between the Oshetna River confluence and tidewater, using historical data, aerial reconnaissance, stationary time-lapse cameras, and physical evidence (RSP Section 7.6.1).

There were no comments or study modification proposals submitted to FERC that related to study Objective 1 as described in the FERC-approved Study Plan.

2.4.2.2. Objective 2

Objective 2: Determine the potential effect of various Project operational scenarios on ice processes downstream of Watana Dam using modeling and analytical methods (RSP Section 7.6.1).

- Develop a modeling approach for quantitatively assessing ice processes in the Susitna River.
- Calibrate the model based on existing conditions. Use the model to determine the extent of the open water reach downstream of Watana Dam during Project operations.
- Use the model to determine the changes in timing and ice-cover progression and ice thickness and extent during Project operations.

2.4.2.2.1. Response to Modification Request Pertaining to Ice Interaction with the Channel Bed and Banks

NMFS (Modification 2-1; NMFS_pp7.6-04_ph4) and USFWS (Modification 1; USFWS_pp7.6-04_ph2) recommend the objective include describing how ice currently interacts with the channel bed and banks and then, either using modeling or other methods, assess how that will change with the winter flows projected under the various operating scenarios. SRC et al. made a similar modification request under Study 6.6, for AEA to provide a plan to integrate the transport of LWD and ice processes into a geomorphology model (SRC_etal_WATER_pp14_ph4), to which AEA responded in Section 2.3.2.4.2 above.

In response, AEA requests that FERC not adopt the Services' proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan or under anomalous conditions. Model integration is already part of the FERC-approved Study Plan which AEA is implementing and AEA has already provided a plan to integrate LWD transport and ice processes into the modeling effort.

The Services indicate that large slabs of ice are pushed and floated into the side sloughs and channels which can push gravels and vegetation similar to a bulldozer blade. AEA agrees that these processes do rearrange gravels berms, erode and reform banks, and remove or prevent vegetation from establishing on bars and berms at the head of side channels or sloughs. While the Services indicate that this process happens primarily during breakup but does occur all winter long, it only occurs during periods of ice movement; during initial freeze-up and consolidation of the freeze-up ice cover, during mid-winter thaws and jamming events, and during breakup. The River1D model does not include the action of moving ice pieces nor LWD on the bed and banks of the main channel or side sloughs as it is a one-dimensional model and does not include sediment transport capabilities. River1D and HEC-RAS with an ice cover, however, do provide estimates of ice jam thickness and water elevations which can be used with the bathymetry to indicate where ice action against banks and beds is likely.

During ice jamming events, as the water elevation increases and ice is pushed into the banks, a shear line is formed along the shoreline with ice in the channel moving and ice along the shore stopped (where depths are shallower than the ice jam thickness). Upon ice jam failure, these shear walls remain on the shore and provide an indication of the jam thickness. Zufelt (2005) describes the development of shear walls during ice jamming and failure. There will be changes in the freeze-up discharge and water elevation for post-Project conditions, generally thicker initial cover/jam formations and higher water elevations in some reaches of the river. Mid-winter and breakup discharges, however, will be more regulated (less large peaks) and thus the mid-winter and breakup jamming will be lower thicknesses and extents than currently exist.

The impact of LWD in comparison to ice movement in terms of the effects on ice processes or sediment transport is minimal. Most LWD deposited on main channel islands and bars is moved downstream during ice jamming events. With regard to the transport of LWD, AEA recognizes the importance of LWD on habitat and has collected extensive data in the Middle and Lower Rivers (Study 6.5 Study Component 9). The bed evolution models (BEMs) do not incorporate the transport of LWD, but the *Fluvial Geomorphology Model Approach TM* describes how LWD can affect sediment transport and how this will be incorporated into the 1-D and 2-D BEMs (Tetra Tech 2014a Sections 4.3.2. and 4.4.2). Sediment transport under ice cover is known to be very limited and is not a process that is simulated in available 1-D models. The limited transport under ice was a reason for the success of the winter bed sampling (Tetra Tech 2014b). Study 6.6 will coordinate with the Ice Processes (Study 6.6 SIR Section 6 and Tetra Tech 2015 Section 4.1.5) study to evaluate sediment transport potential based on the River1D model results for ice cover conditions and has described that specific simulations will be designed regarding blockage and breakup surges using 2-D BEM modeling (Tetra Tech 2015 Section 2.2).

AEA maintains that the selected models and methods have and will continue to meet the objectives of the FERC-approved Study Plan. When completed, the analyses will be reported in the USR for Study 6.6 and Study 7.6, as appropriate. The River1D model is being used to simulate time-variable flow routing, heat-flux processes, seasonal water temperature variation, frazil ice development, ice transport processes, and ice-cover growth and decay. Both River1D and HEC-RAS with an ice cover can be used to estimate the areas where ice movement along the shoreline can be determined. River2D models within the Focus Areas will allow determination of potential for increased water levels and ice shoving potential during jamming events. The models will be run for existing and post-Project conditions to compare the effects. The results for baseline conditions and one operating scenario will be presented in the USR.

2.4.2.2.2. Response to Modification Request Pertaining to Open Leads

NMFS (Modification 2-2; NMFS_pp7.6-04_ph9) and USFWS (Modification 2; USFWS_pp7.6-04_ph7) recommend the objective describe how open leads form and how the Project will change this process.

In response, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the development of modeling to describe the formation and persistence of open leads is beyond the state-of-the-art. Development of the techniques to model velocity and thermal open leads would take many years and multiple millions of dollars. AEA maintains that these descriptions, if they could be developed, would show limited effect of any changes to the open leads on the winter ice conditions since the open leads represent such a small fraction of the surface area of the Middle River.

The evolution and persistence of open leads (thermal and velocity) is a function of water velocity, air and water temperature, bathymetry, groundwater or seep flow, and turbulence. Due to complex three dimensional flow and heat transfer characteristics, open lead development or persistence is highly site specific and has not been modeled successfully to date. Successful modeling of the formation and persistence of open leads would require extensive adaptations to complex three dimensional computational fluid dynamics (CFD) models to include thermal and ice accumulation processes. These site-specific models would require extensive field data acquisition for detailed bathymetry and velocity measurements in open water and ice conditions for calibration and verification. Field data measurements (if even possible under ice conditions) and the adaptations to existing three dimensional CFD models would cost several million dollars and take many years to accomplish. The Services have noted that open leads are a prevalent feature of the Susitna River as they are for most large, turbulent rivers. The Services indicate a tenfold increase in winter discharge will increase mid channel flow velocities and dilute warmer groundwater inflows. While the flows prescribed in ILF-1 will result in a fivefold to sevenfold increase in the winter discharge over a cross section, there will also be an increase in the flow area of that cross section. Velocity open leads are often maintained at locations in the cross section where local conditions result in much higher velocity or turbulent flow conditions than the bulk (average) cross section velocity, often due to local bathymetry such as large boulders or bars. These particular conditions may change under higher discharge conditions, possibly increasing local velocities and maintaining open leads but also potentially resulting in the loss of the open lead if turbulent flow conditions change sufficiently (higher water elevations drowning out shallow, high velocity reaches). Thermal open leads are due to warm water upwelling or seeps and are a function of groundwater discharge levels and water elevations in the main channel. It is possible that with higher winter discharge and water levels, some thermal leads may be inundated with colder water from the main channel. Conversely, thermal leads that are on the channel edges or in side sloughs may be unaffected if separated sufficiently from the main channel. The River2D Focus Area models are intended to determine water levels throughout the back and side channel areas to determine the effects of higher main channel discharges and water levels on these open leads.

The comparison of the observations of open leads from the studies of the 1980s and from 2013-14 have confirmed that the general number and locations of the open leads in the Susitna River have not changed, indicating that they are stable over a wide discharge range and over a long time period. The surface area of the open leads is also a small fraction of the total surface area of the Middle River which could contribute to the generation of frazil ice. The effect of the open leads on ice generation is minimal and determining any changes in ice cover response for post-Project conditions would be within the margin error of the ice formation models.

2.4.2.2.3. Response to Modification Request Regarding Ice Jam Initiation

NMFS (Modification 3-1; NMFS_pp7.6-05_ph4) and USFWS (Modification 3; USFWS_pp7.6-05_ph3) recommend that the processes that cause ice jam initiation during three time periods (freeze-up, mid-winter, and breakup) be described and then, either using modeling or other methods, describe how that will change with the winter flows projected in the various operating scenarios.

In response, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan or under anomalous conditions.

The River1D model of the Middle River is currently being used to simulate the conditions on the Susitna River from September 1 through breakup for the 1984-85 (average), 1975-76 (cold), and 1980-81 (warm) periods. The model has shown its capability of providing water temperature cool down, frazil ice production and transport, and the development of the freeze-up ice cover. The model has been modified to calculate the existence and growth of border ice and the development of anchor ice through empirical relationships developed from observational data collected and reported in the ISR and SIR reports for Study 7.6. The model has been shown to reproduce the progression of the ice cover through the Middle River during freeze-up and to thermally grow or thin the intact ice cover over the mid-winter period and into the breakup period. The River1D progression of the ice cover during the freeze-up period accounts for freeze-up ice jamming that may be occurring with the assumption that the cover progresses from downstream to upstream as a single cover. Observations have shown that this assumption is generally true aside from two or three short ice covers that form but are overtaken by the advancing cover from downstream. For the ILF-1 release scenario, the model predicts daily water level and discharge fluctuations. The model will guide efforts to characterize the changes arising from the post-Project operations, including the effects of higher winter discharges and daily fluctuations of discharge on ice thickness, thermal growth of the cover and potential melting from mid-winter thaws, and the likelihood of ice instability and movement/jamming during the mid-winter and breakup period. The River1D model also provides the volume of ice that exists in the channel which can contribute to an ice jam. HEC-RAS will be used to develop water surface profiles of ice jamming locations based on these volume outputs of the River1D model. The River1D and HEC_RAS models will be used to develop input conditions for the River2D models of various Focus Areas in order to determine the effects of main channel conditions on the side and back channel habitats.

AEA agrees with the Services that ice jams can greatly alter the ice and water flow conditions in the side slough and back channel habitats of juvenile salmon. These changes are to be addressed under Objectives 3 and 4 of the FERC-approved Study Plan through coupled one-dimensional main channel and two-dimensional Focus Area modeling. The objectives of the Study Plan will be met and the completed analysis will be reported in the USR as model runs of River1D and River2D are finalized for pre- and one post-Project operational scenario.

2.4.2.2.4. Response to Modification Request for 2-D Modeling at Three Rivers Confluence and Addition of Area as a Sub-study/Component of Studies 6.6 and 7.6

TCCI (TCCI_pp04_ph2) requests that AEA provide 2-D modeling of at least the immediate confluence mouths of the Susitna, Chulitna, and Talkeetna Rivers to adequately assess Project related changes which could affect the safety of downstream communities. TCCI is particularly concerned with the effects of the elevated winter flows (potentially 10,000 cfs) under ice conditions proposed in the load following operations model. TCCI also requests the BEI be applied to the confluence area. In summary, TCCI (TCCI_pp04_ph3) requests a comprehensive analysis of the Three Rivers Confluence which includes the potential for erosion, winter sediment and ice transport and all other geomorphic Project related effects.

AEA does not object to FERC's adoption of some elements of TCCI's proposed Study Plan modification. AEA does not object to performing 2-D hydraulic modeling of the Three Rivers Confluence Area as a modification to the Study Plans for Study 6.6 for the open water period and Study 7.6 for the ice-cover period. The modeling for both periods would include a range of flows representing existing conditions on each of the three rivers and the concurrent flows on the tributaries coupled with operational flows on the Susitna River, and will provide information on potential Project-related erosion and flooding effects for open water and ice-cover conditions.

As proposed by AEA, the model for the open water period would extend from approximately PRM 98.5 to PRM 104.5 on the Susitna River and extend approximately 3 miles up the Chulitna and Talkeetna Rivers. The open water period hydraulic modeling would use the SRH-2D model for the 2-dimensional area of the confluence and the 1-D HEC-RAS model to establish downstream boundary conditions. Detailed bathymetric, topographic and hydraulic data would be collected to support the development of the 2-D hydraulic model within the model domain.

For the ice-covered period, AEA proposes to perform hydraulic modeling in Study 7.6 using River2D for the 2-dimensional area of the confluence and would use output from the River1D model to describe downstream boundary and ice conditions. The 2-D ice modeling would extend from approximately PRM 98.5 to PRM 104.5 on the Susitna River and cover only those areas of the Chulitna and Talkeetna Rivers which have been determined to be affected by ice conditions in the Susitna River (3,000 feet up the Chulitna and 5,000 feet up the Talkeetna Rivers). The River2D model would use the bathymetric, topographic and hydraulic data obtained by Study 6.6 plus additional ice thickness and water velocity data collected for model calibration and verification.

AEA requests FERC not adopt TCCI's study modification request to use BEI at the Three Rivers Confluence. However, AEA agrees to compare shear stresses and velocities, both components of BEI, between the two simulations (open water and ice-covered) as a modification to the Study Plan. As discussed in the Study 6.6 ISR Part D Section 7.2, AEA requested a Study Plan modification that BEI not be used at Focus Areas. This request was based on results of 2-D modeling of FA-128 (Slough 8A) and an initial application of the BEI as described in the Study 6.6 SIR Attachment 1, Section 5.2.4. In its comments to Study 6.6, ADF&G supported AEA's proposed modification (ADNR_ADFG_pp9_ph2D) and there were no objections to this proposed modification by any reviewers. AEA's proposed modeling of the Three Rivers Confluence area will include with- and without-Project range of flows on the Susitna River combined with the natural range of flows on the Chulitna and Talkeetna Rivers. Differences in shear stress and velocity (components of BEI) between the simulations are recommended as appropriate measures of potential bank erosion at the areas of concern. Bed Evolution modeling (BEM) is not necessary to address the erosion or flooding concerns expressed in the modification request as these concerns can be fully evaluated with the 2-D hydraulic models.

If this modification is implemented as proposed by AEA, the total cost would be $750,000 to $900,000. The portion of this effort conducted under Study 6.6 would include $500,000 to $600,000 for collection of the bathymetric, topographic and hydraulic data; 2-D hydraulic model development and application; and the erosion assessment during open water conditions. The cost of the ice-cover period effort conducted under Study 7.6 would be $250,000 to $300,000 including 2-D hydraulic model development and application, collection of additional ice-cover and velocity data to support model calibration and verification for winter conditions, and the erosion assessment for the ice-cover period. Costs also include integration between the two studies. In constrast, the estimated cost of implementing TCCI's requested modification for 2-D BEM would be an additional $2,500,000 to $3,500,000 beyond AEA's proposal.

In their supporting rationale for this request, TCCI commented on the March 2016 ISR Meeting, which AEA would like to clarify. In their comments, TCCI stated that the ice processes Study Lead contributed to the discussion at the March 2016 ISR Meeting regarding "potential ice processes at the confluence and the challenges of modeling anything other than ice thickening - ie. models will not show potential collapse and transport scenarios in connection to variable winter flows at the confluence. Unfortunately, the confluence has not been included in the Ice Model to date, so he could only speculate as to what effects the confluence might experience under winter project operations. For this reason, TCCI is requesting the 2D Ice Process Model be extended to the confluence utilizing 1D data already available." To clarify, at the March 2016 ISR Meeting Jon Zufelt noted that the River1D model includes the confluence reach of the Susitna River (the inflows from the Chulitna and Talkeetna Rivers) and would model the ice thickening in the Susitna River. At that time, the model had not yet been calibrated so the effects of Project operations on the conditions at the confluence could not be provided. As stated in below in Section 2.4.2.2.5, the post-Project discharge and ice volumes from the Chulitna and Talkeetna Rivers would not change from present conditions. The River1D model results of the 1984-85 winter indicate that the ice thickness, discharge, and stage levels would be greater for the post-Project conditions but still well below the levels where erosion of the banks of the Susitna River would occur. During the winter, ice is grounded along the banks and thus provides protection from erosion. Greater ice thicknesses for post-Project conditions will result in slightly wider grounded ice extending out from the bank, providing increased protection from erosion during the ice-covered period. Post-Project breakup flows will be lower and more controlled than present breakup flows, with reduced potential for bank erosion from large breakup jams.

2.4.2.2.5. Response to Modification Request Regarding the Geographic Extent of the Ice Study

NMFS (Modification 3-2; NMFS_pp7.6-05_ph8) and USFWS (Modification 4; USFWS_pp7.6-05_ph7) recommend expanding the geographic extent of the ice study to include the lowest ten miles of the Chulitna, Talkeetna, and Yentna Rivers.

While not specifically stated, it is assumed that the Services are interested in 1D ice modeling extending 10 miles up these tributaries.

AEA does not object to FERC's adoption of some elements of the NMFS and USFWS proposed Study Plan modification. As described above in Section 2.4.2.2.4 in response to TCCI's request for 2-D modeling of the Three Rivers Confluence area, AEA does not object to performing 2-D ice modeling from approximately PRM 98.5 to PRM 104.5 on the Susitna River and those areas of the Chulitna and Talkeetna Rivers which have been determined to be affected by ice conditions in the Susitna River (3,000 feet up the Chulitna and 5,000 feet up the Talkeetna Rivers). Building upon that, in response to the Services' requested modification, AEA does not object to performing additional HEC-RAS modeling of the Three Rivers Confluence area to include the lowest 3 miles of the Chulitna and Talkeetna Rivers to demonstrate the limited effects of the Susitna River ice conditions on the water levels in the Chulitna and Talkeetna Rivers, as a modification to the FERC-approved Study Plan. This modeling would build off existing model runs of River1D to describe conditions to be assessed on the Chulitna and Talkeetna Rivers using the existing HEC-RAS models. No additional field data would need to be gathered under this effort. AEA's proposed study modification would cost approximately $10,000.

However, AEA requests FERC to not adopt the Services' modification to the Study Plan as submitted, specifically modeling of the Chulitna and Talkeetna rivers between 3 and 10 miles upstream from the confluences with the Susitna and the lower 10 miles of the Yentna River, because their request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Any modeling further upstream than AEA proposed in the Chulitna and Talkeetna rivers, up to 10 miles as the Services requested, is not warranted as this area lies well beyond the influence of Project impacts and the Services have not demonstrated "good cause" to model that far upstream. The Services' requested distance up each of the tributaries is arbitrary and not founded on potential Project impacts to these different river systems. Further, AEA requests FERC not adopt any River1D modeling of ice processes within the Chulitna and Talkeetna Rivers upstream of their mouth since these ice processes will not change from existing to post-Project conditions and HEC-RAS will be able to demonstrate the limited effects of the Susitna River ice conditions on the water levels in the Chulitna and Talkeetna Rivers at a reasonable cost.

AEA also requests FERC not adopt modeling the lower 10 miles of the Yentna River because the ice processes of the Yentna River will not appreciably change from existing to post-Project conditions and the Services have not demonstrated otherwise. Currently, there is no River1D model for the Lower River and development of modeling techniques to describe ice processes in the multiple braided and interconnected channels of the Lower River is beyond the state-of-the-art. Development of the techniques to model ice processes in these types of systems would take many years and multiple millions of dollars. Modeling the Yentna River with no existing model on the Lower River would serve no useful purpose. See Section 2.4.2.2.7 below for further discussion on ice processes in the Lower River and AEA's response to the Services' request to extend the ice modeling into the Lower River.

The Services point out that the Chulitna and Talkeetna confluences are circles of networked channels 2-5 miles in diameter. Rather, the Talkeetna confluence is a multi-channel system upstream of the ARRC bridge (located just upstream of the confluence) and the Chulitna is a wide braided river as it enters the Susitna with some cross floodplain connections to the Susitna up to ½ mile upstream of the confluence during very high flow events (such as breakup events). The Chulitna is quite steep and HEC-RAS modeling has shown that the influence (backwater effects) of the Susitna water elevations at the mouth extend no more than 3,000 feet upstream as the freeze-up ice cover progresses through the confluence. The backwater effects of the Susitna on the Talkeetna River extend approximately 5,000 feet upstream during freeze-up conditions. The Services do correctly point out that the freeze-up of the Chulitna and Talkeetna Rivers increase the water elevation in the rivers and maintain back channel spawning areas even while the discharge decreases over the winter. At higher winter flow rates on the Susitna River for post-Project conditions, the increased water elevations will extend further up these tributaries. The additional HEC-RAS modeling as proposed by AEA will demonstrate these impacts.

The River1D model has shown the following conditions of discharge and stage for the average winter (1984-85) on the Susitna River at the mouth of the Chulitna River. These values are calculated by the River1D model runs for the cross section location immediately downstream of the Chulitna confluence and pertain to modeled water levels and discharges at that cross section. For the pre-dam scenario, discharge was 8,250 cfs at the onset of freezing with a stage of 343.5 ft and continued to drop during freeze-up. When the ice cover had progressed to this location, the discharge had dropped to 5,550 cfs but with the arrival of the ice cover, the stage jumped to 346.4 ft and generally stayed at this level for the remainder of the winter (even while the discharge continued to recede). For the post-dam scenario prescribed in ILF-1, the Susitna River discharge at the mouth of the Chulitna oscillated from 9,676 to 11,130 cfs at the onset of freezing with a stage of 343.7 to 344.2 ft (a daily variation of approximately 0.5 ft). When the ice cover had progressed to this location (and arriving at the same date as the pre-dam scenario), the discharge was slightly lower at 8,720 to 10,650 cfs while the stage rose to 348.7 to 349.2 ft (continuing a daily variation of approximately 0.5 ft). Later in the middle of the winter, both the discharge and stage increased slightly at the mouth of the Chulitna during cold periods to 10,000 to 11,800 cfs and stages of 349.6 to 350.1 ft. This is in response to larger releases from the dam of 6,000 to 10,000 cfs under ILF-1. The 1984-85 winter was an average winter with the onset of freezing on October 24 and the River1D model shows the ice cover progressing to the Chulitna confluence on November 18, slightly later than estimates based on Accumulated Freezing Degree Days (November 15). Historic records show that the onset of freezing can occur as early as October 5 and as late as November 21. The ice cover reaches the Chulitna confluence as early as October 29 and as late as January 2. Historic records also show that discharge in the Susitna River at the confluence at the time that the cover progresses through ranges from 3,000 to 9,000 cfs.

The River1D modeling has also shown that post-Project releases of 0.5°C will not affect water temperatures in the Susitna River below approximately PRM 120 during the beginning of freeze-up and not below PRM 140 during mid-winter. This is based on the comparison of water temperatures calculated for both the pre- and post-Project conditions. The volume of frazil ice discharging from the Chulitna and Talkeetna Rivers will not change for post-Project conditions. The volume of frazil discharge in the Susitna River will be less from the dam to approximately PRM 140 but the ice cover would reach the confluence of the Chulitna at approximately the same time both pre-dam and post-dam.

In summary, AEA does not object to performing additional HEC-RAS and River1D modeling of the Three Rivers Confluence area to include HEC-RAS modeling of the lowest 3 miles of the Chulitna and Talkeetna Rivers. In order to determine the effects of the changes in discharge and water elevation at the confluence area, AEA proposes to use the River1D model for the Middle River and simple HEC-RAS with ice cover models of the lowest reaches of the Talkeetna and Chulitna Rivers to determine pre- and post-Project conditions for the average, cold, and warm winters. These conditions would include arrival date of the ice cover at the confluence, discharge in the Susitna River, and ice thickness and water elevation in the Susitna River and the lower 3 miles of the Talkeetna and Chulitna Rivers. This analysis will be provided in the USR for baseline conditions and one operational scenario.

2.4.2.2.6. Response to Modification Request Pertaining to Evaluating Ice Processes in the Project Reservoir

NMFS (Modification 3-3; NMFS_pp7.6-06_ph3) and USFWS (Modification 5; USFWS_pp7.6-06_ph3) recommend modeling ice processes from the bottom of the varial zone (approximately PRM 222) and up to the Oshetna River confluence (PRM 235.1). Neither of the Services recommend a particular model or a particular approach. The NPS (NPS_pp3_ph9) also requested the reservoir be added to the scope of the Ice Processes Study, noting the importance of ice formation and stability for many species of wildlife, especially caribou, as well as humans for transportation, subsistence and recreation. Ms. Teich (Teich_pp1_ph7) also expressed concern regarding the impact of ice cracks and ridges on the frozen reservoir to caribou.

AEA requests that FERC not adopt the proposed study plan modification to add modeling of ice processes between the bottom of the varial zone and the Oshetna River because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification or demonstrated the study was not implemented as provided by the approved Study Plan. Moreover, ice processes *within* the reservoir are already being evaluated under the FERC-approved Study Plans.

As described in RSP Section 7.6.1, the first objective of the ice processes study is to: "*Document the timing, progression, and physical processes of freeze-up and break-up during 2012–2014 between the Oshetna River confluence and tidewater, using historical data, aerial reconnaissance, stationary time-lapse cameras, and physical evidence.*" This has been completed and was reported in the *Susitna River Ice Process Study Report* (HDR 2013, filed with the Commission March 7, 2013); the June 2014 ISR; the *Detailed Ice Observations October 2013 – May 2014 Technical Memorandum* (HDR 2014, filed with the Commission September 17, 2014) and the November 2015 SIR.

Secondly, thermal modeling for the reservoir will be accomplished under the Water Quality Modeling Study (RSP Section 5.6). The reservoir ice cover will be predicted using EFDC modeled surface water temperature and observed air temperature. The initiation of the reservoir ice cover is a function of the number of accumulated freezing degree days (air temperature) following the decrease of the surface water temperature to 0C. A post-processing tool will be developed to extract the number of days at a water temperature of zero degrees for the EFDC model surface cells from EFDC reservoir results based on past observations from several lakes in southcentral Alaska. Finally empirical equations will be used to estimate the ice cover thickness with time using this information and the accumulated freezing degree days.

As shown in the Study 7.6 ISR and SIR reports, the ice covered conditions in the Upper River in the varial zone in 2012-13 and 2013-14 are characterized by freeze-up jams and sections of ice cover with extensive anchor ice deposits. The reach nearest the Oshetna typically experiences freeze-up jamming and breakup jamming resulting in large ice deposits along the banks or stranded on bars mid-channel. It is not expected that any changes would occur in the reach above the varial zone (the uppermost extent of the reservoir backwater at freeze-up). At the “top” of the varial zone, the ice cover will form as a freeze-up accumulation of frazil and pans moving into the backwater of the reservoir which will already be forming a smooth sheet ice cover. As the reservoir level drops, the ice will also drop (floating on the water surface) but will become stranded along the shore. There will be no large slabs of ice within the reservoir as the Services contend and as the reaches of the varial zone that drop to levels corresponding to the existing natural channel, the smooth reservoir ice cover will simply set down on the main channel bed, similar to what happens under mid-winter conditions when the rougher ice cover sets down on the bed and depresses into the thalweg. Upstream of the top of the varial zone, there will be no detectable change in the river as the reservoir continues to drop.

Since the changes in the ice conditions within and above the varial zone with dropping reservoir levels will simply revert to those that are currently experienced without the project, AEA sees no discovery of new information since FERC approved the RSP and thus does not recommend this modification.

AEA recognizes the concern regarding ice conditions that would be experienced during the winter with a falling reservoir level and the potential associated impacts to wildlife, transportation, subsistence and recreation.

In the License Application, the conditions upstream of the proposed dam including in the varial zone during the freeze-up, mid-winter, and breakup periods will be described using a combination of observations of existing conditions, theory, and reservoir modeling (Study 5.6) and experience from other hydropower facilities with reservoirs in cold regions. These descriptions will allow delineations of the areas within which no detectable change will occur, those areas that will be characterized by an ice-covered reservoir whose level is falling over the winter, and the varial zone which will begin the winter as a reservoir and end the winter as a river channel.

Within the caribou study (Study 10.6), the deployment of GPS and VHF radio-collars was intended to provide the seasonal movement and range-use data that will be needed to evaluate this impact. The data gathered from the wildlife study plans, including seasonal movements of large game and range-use, the ice processes study (Study 7.6), the water-quality modeling study (Study 5.6), the subsistence study (Study 14.5), and the recreation study (Study 12.5) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the

Project. The impact analysis will consider Project-induced changes to ice processes and how those changes would impact these resources. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit).

2.4.2.2.7. Response to Modification Request to Expand the Study into the Lower River

NMFS (Modification 6-1; NMFS_pp7.6-08_ph2) and USFWS (Modification 7; USFWS_pp7.6-08_ph3) recommend implementing "Objective 6" to expand the geographic extent of the study to include the Lower River. In their comments, the Services assert that a calibrated and validated Open Water Flow Routing Model is a prerequisite for developing the River1D model and further that the "version 2.6" of the Open Water Flow Routing Model was not extended into the Lower River.

In response, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan or under anomalous conditions. It is unclear what the Services are asking for and the supporting information is erroneous.

As an initial matter, while the Open Water Flow Routing Model (OWFRM) and River1D utilize the same bathymetrc data in their development, there is no requirement to have a calibrated and validated OWFRM in order to develop River1D. To clarify, AEA has never released a Version 2.6 of the model. Further, Version 2.8 of the OWFRM extends into the Lower River down to PRM 29.9, as presented in Study 8.5 SIR Appendix B: Version 2.8 of the OWFRM

FERC has already considered the Services' concern on how to assess the Project effects on ice processes in the Lower River in their Study Plan Determination of April 1, 2013 and stated:

> *AEA proposes to assess project effects on ice processes in the Lower River based on the magnitude of change seen at the downstream boundary of the River1D model and the estimated contributions of frazil ice to the Lower River from the Middle River from observations and modeling. These effects would be evaluated using simpler steady flow models (HEC-RAS with ice cover) for short sections of interest in the Lower River. The details of the final assessment would have to be established once the magnitude of effects at the upstream boundary of the Lower River is computed. While the concerns raised by the agencies are valid, they cannot be fully addressed until after the Middle River model is developed and operating scenario effects are developed at the lower boundary. For these reasons, we conclude that AEA's proposed approach is consistent with accepted methods (section 5.9(b)(6)), and there would be additional opportunities for evaluating the appropriateness of the downstream extent of the model after reviewing the initial modeling results in the initial and updated study reports.*
>
> *No modifications to the study plan are recommended.*

As reported in Study 7.6 ISR Part A, Appendix A, simple steady flow models (HEC-RAS with ice cover) were developed for two reaches of the Lower River (at Susitna Station – PRM 30 and near

Sunshine – PRM 80-86) to determine the effects of larger winter discharges on ice thickness and water elevation. At the time of the development of these models, the River1D model was not complete nor was the intermediate load following (ILF-1) dam release scenario developed so that the magnitude of changes at the downstream boundary of the River1D model could not be determined. The HEC-RAS modeling used the conditions recorded at ESS 20 (Susitna Station) as reported in Study 7.6 ISR Part A, Appendix A Figure 4.3-4 for the winter of 2012-13 to demonstrate the natural variability in stage and discharge at Susitna Station. At the time of the establishment of the ice cover, the discharge was 33,000 cfs and dropped to 9,000 cfs by mid-December. The stage rose (from an open water condition to that of an ice covered condition) 4.8 ft in a few hours and then gradually decreased approximately 5 ft over the next 1-1/2 months to its mid-winter level. Conditions were modeled corresponding to ice covered discharges of 25,000, 30,000, and 35,000 cfs to simulate the increased levels associated with higher flows and this 10,000 cfs range corresponded to a stage range of approximately 2 ft. Similar modeling was conducted at Sunshine for a natural range of freeze-up discharge of 3,000 to 8,000 cfs and increases to 10,000 and 12,000 cfs with a stage range of approximately 5 ft.

The Services suggest that up to 12,000 cfs of 4°C water will be released from the dam and mixed with 2,000 cfs of water from the Talkeetna and Chulitna on its passage downstream will result in changes in the Lower River ice thickness and volume. ILF-1 indicates a range of dam releases of approximately 6,000 to 10,000 cfs during the winter period and current thinking is that the water release temperature would be closer to 0.5 to 1.0°C. These ranges of discharge fluctuation at the dam would experience some attenuation as they travel downstream, especially in ice covered conditions but would also experience a general increase due to the addition of discharge from tributaries. Initial modeling of the 1984-85 winter (average winter) with the River1D ice model shows that ice cover progression at these release temperatures would show limited ice above PRM 160, slightly delayed (5-10 days) progression between PRM 120-160, and no detectable effect below the Three Rivers Confluence (PRM 102). The Yentna and Chulitna Rivers are the primary ice producers that contribute to the Lower River ice cover and these will be unaffected by changes in the Susitna River discharge.

The Services also comment that the dam operators will attempt to set up an ice cover that will span a 300 m width of river that will stay stationary for the entire winter and assert that defies the laws of physics. On the contrary, ice covers float on the surface of the water, whether that water is moving or stationary. At widths greater than approximately 30 ft, the ice cover will form cracks along the shore where the ice cover is grounded on the banks and the floating cover will move up and down in response to changes in discharge and water elevation. The effects of changes in water elevation can be seen in mid-winter on the Susitna River where the cover becomes grounded in many places and floats on the thalweg at reduced elevations. As the discharge increases in the spring, the cover floats back up to fill the thalweg channel. As reported in Study 7.6 ISR Part C, Appendix C, hydropower operators often manipulate the discharge to establish an ice cover under stable conditions and then increase the discharge once a stable ice cover is formed.

AEA requests FERC not adopt modeling the Lower River, as no River1D model currently exists for the Lower River and development of modeling techniques to describe ice processes in the multiple braided and interconnected channels of the Lower River is beyond the state-of-the-art. Development of the techniques to model ice processes in these types of systems would take many years and multiple millions of dollars. AEA maintains that the implementation of the FERC-approved Study Plan thus far has met the study objectives. The completed analysis of River1D model runs for the Middle River will be provided for baseline conditions and one operational scenario in the USR.

2.4.2.3. Objective 3

Objective 3: Develop detailed models and characterizations of ice processes at instream flow Focus Areas in order to provide physical data on winter habitat for the instream flow study.

2.4.2.3.1. Response to Modification Request Pertaining to Project Effects on Side Channels and Sloughs

NMFS (Modification 4-1; NMFS_pp7.6-06_ph8) and USFWS (Modification 6; USFWS_pp7.6-07_ph1) recommend assessing Project effects on ice in the side channels and sloughs, specifically ice characteristics and ice thickness, with either a new model or a completely new approach to make the assessment valuable.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan.

As stated above, Objective 3 is to develop detailed models and characterizations of ice processes at instream flow Focus Areas in order to provide physical data on winter habitat for the instream flow study (Study 8.5). Metrics to assess Project effects on salmonids will include an Effective Spawning/Incubation Analysis that will track potential salmon redd sites from the start of spawning in the fall through the emergence of salmon fry from the gravel the following spring (see RSP 8.5, Section 8.5.4.6.1.5). The adopted process to accomplish this task was to use River1D to model the ice processes in the main channel area and River2D to describe the conditions in the Focus Area lateral habitats. The River1D model of the Middle Susitna River provides information on stage, discharge, water temperature, and ice thickness at each modeled cross section. Since River1D is a one-dimensional model, these variables are described as a single value across each cross section. These output from River1D are also used in conjunction with the aerial observations to determine the ice roughness, areas of smooth ice cover versus rough cover, flooding due to backwater effects of the developing main channel ice cover, open leads, and apparent velocities in the side channels and sloughs of the Focus Areas. AEA agrees with the Services that River2D is not an ice formation or ice processes model per se but that it is a model that incorporates discharge, detailed bathymetry, bed and ice roughness, plus user-defined ice thickness to calculate the two-dimensional depth (under ice) and velocity fields in the area of interest. The River2D model uses the output of the River1D model and how these variables change along the river, to compute these depth and velocity fields. Ice thickness and roughness in the side channel and slough areas are developed based on the output of the River1D model (water temperature, ice thickness, stage, velocity), how these variables change with time and discharge level, and velocities in the side channels from the River2D model for a variety of conditions (open water, moving frazil, static cover, jammed cover). The static ice cover in River2D responds to changes in discharge and water levels and has the ability to rest on the bed where water depths are not sufficient to float the cover (or in dry bed conditions). The approach also uses observations from pre-Project freeze-up to ascertain ice conditions in the side channels and sloughs at a variety of discharge and stage levels. In this manner, the unsteady processes of ice cover initiation, growth, and jamming/decay over the entire winter in both the main channel and the side channels and sloughs can be simulated in a step-wise manner for the existing and post-Project conditions.

The Services incorrectly assert that the River1D model is not being used in the Focus Areas. As explained above, the River1D model is used to describe conditions in the main channel of the Middle Susitna River, and the River2D model describes conditions in the Focus Area lateral habitats. The Services also incorrectly assert that River2D will only be applied to a single Focus Area. At this point in the study implementation, FA-128 (Slough 8A) has been the primary focus as this Focus Area was chosen as a proof-of-concept for model integration. As provided in the FERC-approved Study Plan, AEA will collect the necessary data to validate and calibrate the models. During March 2016, ice thickness and water velocities were measured at FA-104 (Whiskers Slough), FA-113 (Oxbow I), FA-115 (Slough 6A), and FA-128 (Slough 8A). The March 2016 measurements will be used to support River2D modeling in those Focus Areas. Measurements will occur in other Focus Areas during the next year of study. Coupled with measurements of ice thickness and water velocities, the River2D models will be able to predict not only baseline conditions in the side channels and sloughs but also those expected during post-Project operations. AEA maintains that the objectives of the FERC-approved Study Plan are being met and the completed analysis will be reported in the USR for baseline conditions and one operating scenario.

2.4.2.3.2. Response to Modification Request to Collect Additional Stage-Discharge Data

SRC et al. (SRC_etal_WATER_pp28_ph1) request that the Ice Processes Study (7.6) be modified to require AEA to collect one full year of stage-discharge data in Focus Areas and collect complete aerial photography to understand winter flows, ice breakup and the flooding of off-channel habitats, to properly calibrate the model and address uncertainty.

SRC et al. indicate that the Ice Study is lacking appropriate aerial photographs and stage discharge data that will inform the River1D and River2D models (as well as the geomorphology study) of important relationships between main channel and off channel water exchange. SRC et al. indicates that relying on hydrodynamic models to provide this answer may be misguided, since without these field data the hydrodynamic models will be untestable.

In response, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, SRC et al. have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan.

Detailed bathymetric data that AEA has collected and the 2D Focus Area models being developed allows AEA to develop stage discharge curves for the connecting side channels and sloughs based on the laws of physics. Taking a year's worth of measurements will only corroborate these relationships and not provide any new information. The bathymetry and stage discharge relationships also change with large floods, LWD accumulations, and ice jamming events. The important aspect is knowing how these things (floods, LWD, and ice) affect the physics of each connection such that future changes in flow (for which no data can be measured prior to dam operation) can be analyzed and thus properly modeled.

SRC et al. also indicates that the amount of flow in the side sloughs will depend on whether the discharge created by the dam is sufficient to flood the side sloughs, and by how much, maintaining the importance to have documentation of habitat areas from aerial photographs under the actual range of flows that will occur during the winter, and to collect field data on stage-discharge relationships at each side slough where salmon habitat is important.

On the contrary, it is not possible to collect aerial photography or stage discharge measurements for conditions of post-Project discharges in the winter because they have never occurred. It is also necessary to rely on numerical models to "see" what is occurring beneath the ice cover during the winter in terms of depth and velocity due to the cover itself blocking the view or access for measurements. The output of the models (River1D and River2D in the Focus Areas) combined with aerial observations of the appearance of the ice cover in the main and side channels provides valuable information concerning the conditions beneath the ice.

Under Study 7.6, extensive data has been collected including time lapse and aerial photography as well as videos of most observation flights during breakup 2012, freeze-up 2012, breakup 2013, freeze-up 2013, and breakup 2014 (http://gis.suhydro.org/SIR/07-Hydrology/7.6-Ice/) which, coupled with data on discharge, provides a very good record of side channel and slough connections at various water elevations and discharge levels. These data include some open water periods at lower flows as well as periods when the discharge is decreasing and frazil ice is floating downstream in the main channel (but not frozen over). There are significant changes in water elevation with the passage of the ice front as the ice cover progresses upstream. Side channels which were dry at 5,000 cfs under open water conditions may become flooded at 2,000 cfs after ice cover progression through a reach. The aerial photo and video compilation provides a very good record of when there is connection between the main channel and off channel areas, including the presence or absence of ice cover and the relative roughness, which indicates the underlying water velocity. Aerial observations have been used to determine where the side channels and back sloughs tend to form smooth covers and how these covers are changed upon passage of the main channel ice cover. Aerial photo and video coverage of breakup events also provide information as to the connections and areas where ice pieces from the main channel are pushed into side channels.

As provided in the FERC-approved Study Plan, AEA will collect the necessary data to validate and calibrate the models. During March 2016, ice thickness and water velocities were measured at FA-104 (Whiskers Slough), FA-113 (Oxbow I), FA-115 (Slough 6A), and FA-128 (Slough 8A). Measurements will occur in other Focus Areas during the next year of study as needed depending on the level of modeling necessary with consideration of all resources. Coupled with measurements of ice thickness and water velocities, the River2D models will be able to predict not only present conditions in the side channels and sloughs but also those expected during post-Project operations.

The extensive observations will guide the modeling of both freeze-up and breakup using the River1D model, specific Focus Areas (e.g., FA-104, FA-113, FA-115, FA-128, and FA-138) using the River2D model, and general water elevation and ice jam thickness in the main channel during breakup using HEC-RAS with an ice cover. For the other Focus Areas (FA-141, FA-144, FA-151, FA-173, and FA-184), the level of modeling will be evaluated with consideration of all resources in the next year of study. As provided in the FERC-approved Study Plan, AEA will collect the necessary data to validate and calibrate the models. Uncertainty of the various models and detailed results of the ice-covered modeling efforts will be provided in the USR.

2.4.2.4. Objective 4

Objective 4: Provide observational data of existing ice processes and modeling results of post-Project ice processes to the Fluvial Geomorphology Modeling below Watana Dam Study (Study 6.6), Groundwater Study (7.5), Instream Flow Studies (Studies 8.5-8.6), Fish and Aquatics Study (Studies 9.12), Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (Study 11.6), Recreation and Aesthetics Studies (12.5-12.7), and Socioeconomic and Transportation Study (Study 15.7) (RSP Section 7.6.1).

There were no comments or Study Plan modification proposals submitted to FERC that specifically pertained to Objective 4.

2.4.2.5. Objective 5

Objective 5: Research and summarize large river ice processes relevant to the Susitna River, analytical methods that have been used to assess impacts of projects on ice-covered rivers, and the known effects of existing hydropower operations in cold climates (RSP Section 7.6.1).

2.4.2.5.1. Response to Modification Request Pertaining to the Literature Review

NMFS (Modification 7-1; NMFS_pp7.6-08_ph6) and USFWS (Modification 8; USFWS_pp7.6-08_ph7) recommend the literature search be completed to cover the wider range of ice processes that occur in the Susitna.

In response, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS and USFWS have not established “good cause” for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan.

The Services request the inclusion of a discussion on ice processes that can impact fish habitat; effects of hydropower projects on the river ice regime; impacts of other hydropower projects and non-hydropower projects on river ice regime; and a review of ice process modeling efforts on several hydropower projects. These topics and several others were presented in Study 7.6 ISR Part C, Appendix C. The Services indicate a lack of information on the evolution of open leads and various ice types in the back channels and interaction between ice action in the main channel and side channels. The evolution and persistence of open leads (thermal and velocity) is a function of water velocity, air and water temperature, bathymetry, groundwater or seep flow, and turbulence. Due to complex three dimensional flow and heat transfer characteristics, open lead development or persistence is highly site specific and has not been modeled successfully to date. The fact that the open leads form today at the same locations where they formed in the 1980s indicates that they are formed due to specific physical features and will only change in intensity or length based on changes in the discharge. Thermal leads will most likely be reduced at locations downstream of the dam where the water temperature has decreased to freezing. The velocity leads may disappear if the physical feature is drowned out or may remain but the overall effect on ice processses will not be noticeable. If an open lead in one location is larger, there will be more area for heat loss or gain from/to the atmosphere. More heat loss will produce more ice which may fill in the downstream leads. Overall, the locations and extent of open leads, while important for specific local conditions, will not change enough to affect the overall ice processes of the Middle River.

AEA maintains that this objective of the FERC-approved Study Plan has been met and was provided to licensing participants in the ISR. Particular ice types and conditions in the side and back channels and interaction between the main channel and side channels are a function of the water velocity, depth, frazil ice absence or presence, surface ice conditions, and water temperature. Modeling of the Focus Areas requires the determination of side and back channel ice conditions based on the information provided in this document.

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2.4.3. Study 7.7 – Glacier and Runoff Changes Study

The Glacier and Runoff Changes Study, RSP Section 7.7 (Study 7.7), focuses on understanding how changes to the Upper Susitna basin hydrology due to glacial retreat and climate change can affect Project operations and environmental resources. In its February 1, 2013 study plan determination (February 1 SPD), FERC approved Study 7.7 with recommendations, recognizing the following:

AEA proposes to analyze the potential effects of climate change on glacier wastage and retreat and the corresponding effects on streamflow entering the proposed reservoir, and evaluate the effects of glacial surges on sediment delivery to the reservoir. Specifically, AEA proposes to:

- review existing literature relevant to glacier retreat in southcentral Alaska and the upper Susitna watershed and summarize the current understanding of potential future changes in runoff associated with glacier wastage and retreat;
- develop a hydrologic modeling framework that utilizes a glacier melt and runoff model (Hock 1999) and a Water Balance Simulation Model (WaSiM) to predict changes in glacier wastage and retreat on runoff in the Susitna basin;

- simulate the inflow of water to the proposed reservoir and predict changes to available inflow using downscaled climate projections up to the year 2100; and
- analyze the potential changes to sediment delivery from the upper Susitna watershed into the reservoir from glacial surges.

FERC staff recommended the following in the February 1, 2013 SPD:

- We find that the analysis of the potential changes to sediment delivery from the upper Susitna watershed into the reservoir from glacial surges as proposed by AEA is necessary, and therefore, are recommending approval of this portion of AEA's proposed study (item 4 as described above in the applicant's proposed study).
- We are not recommending approval of the remainder of AEA's proposed study (items 1-3 as described above in the applicant's proposed study). We have no objection to AEA conducting this portion of the study.
- We do not recommend extending the geographic range of the climate change assessment or adding an analysis of the natural resource impacts, as recommended by the NMFS and others.

On February 21, 2013, NMFS filed a notice of study dispute pursuant to section 5.14(a) of the Commission's regulations regarding FERC's decision not to require AEA to implement the three study components related to glacier runoff and climate change that AEA proposed in the RSP. A Dispute Resolution Panel Meeting and Technical Conference was held on April 3, 2013 to discuss NMFS's modification requests. On April 26, 2013 FERC provided its Study Dispute Determination, requiring the following modification:

> *We recommend that AEA review existing literature relevant to glacial retreat and summarize the understanding of potential future changes in runoff associated with glacier wastage and retreat, as described in RSP section 7.7.4.1.*

On May 28, 2013, NMFS and the Center for Water Advocacy (CWA) filed requests for rehearing of the formal study dispute determination issued on April 26, 2013. NMFS and the Center sought rehearing of the Director's finding that studies proposed by the potential applicant, AEA, and NMFS related to global climate change are unnecessary to conduct the Commission's environmental analysis and therefore will not be required to be conducted by AEA. On July 18, 2013, FERC rejected CWA's request for rehearing and denied NMFS's request for rehearing.

AEA implemented the Study Plan as approved by FERC and outlined above. The results of the literature review were presented in the June 2014 ISR Part A. AEA analyzed potential changes to sediment delivery from the Upper Susitna River in its *Assessment of the Potential for Changes in Sediment Delivery to Watana Reservoir Due to Glacial Surges Technical Memorandum,* filed with the Commission on November 14, 2014 and held a Technical Team meeting December 4, 2014 to discuss the results (http://www.susitna-watanahydro.org/wp-content/uploads/2015/03/2014-12-04_Geomorph_Tech_Team_Mtg_Notes.pdf). As detailed in Study 7.7 ISR Part D, Section 7, and presented during the ISR meeting for this study held on March 23, 2016, AEA does not propose any modifications to Study Plan Section 7.7. AEA has met the study objectives and the FERC-approved Study is considered complete.

While not part of the final Study Plan approved by FERC, AEA carried out the other components of the Glacier and Runoff Changes Study as proposed by AEA in the RSP. Specifically, AEA commissioned the ADNR Division of Geological and Geophysical Services (DGGS) and the University of Alaska, Fairbanks (UAF) (hereinafter the "AEA-commissioned study") to:

- develop a hydrologic modeling framework that utilizes a glacier melt and runoff model (Hock 1999) and a Water Balance Simulation Model (WaSiM) to predict changes in glacier wastage and retreat on runoff in the Susitna basin; and
- simulate the inflow of water to the proposed reservoir and predict changes to available inflow using downscaled climate projections up to the year 2100.

The methods and results of the AEA-commissioned study were made publicly available via AEA's Susitna-Watana Hydro Project website (http://www.susitna-watanahydro.org/wp-content/uploads/2015/10/GlacierRunoffChangesStudy_FSR_FINAL_20151028.pdf).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS submitted several study modification proposals for Study 7.7. In addition, NRDC filed a new study request regarding climate change, which overlaps with the NMFS modification requests to Study 7.7 (see Section 3.2). The NPS, TNC, SRC and Rebecca Long also provided comments on climate change. In essence, the commenters requested that AEA expand the AEA-commissioned study to include the entire Susitna River basin, add a water temperature component, include multiple climate change futures, and compare those futures to a new "future" climate change baseline.

Section 2.4.3.1 below provides an overview of the AEA-commissioned study. Section 2.4.3.2 provides a general response to the basin climate change study and AEA's proposed approach for addressing climate change. NMFS divided its study request into 6 discrete components, characterizing each as a modification. Sections 2.4.3.3 through 2.4.3.8 address each of NMFS's proposed modifications. AEA's responses to comments can be found in Table 2.4.3-1.

Table 2.4.3-1. Study 7.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Long_160620_pp04_ph2	*A Susitna River Basin and Ecosystem-wide study of climate change impacts on the environmental and socioeconomic resources and on the project construction and operations should be implemented. This would include the cumulative data for climate change and post project impacts combined. This is necessary in order for FERC to fulfill its section 4(c) statutory duty of the Federal Power Act. The baseline of the River system is changing due to changing climate. The current ISR study attempt to document climate change is only a narrow geographic scope from the glaciers to the dam site. Below the dam site will be left unstudied. A basin wide climate model will be an updated environmental baseline to analyze project impacts and on the project itself.*	As explained below in Sections 2.4.3.2 through 2.4.3.9 and Section 3.2, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $5 million.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp005_ph2	*We reiterate the need for a study that uses best available information to estimate the potential impacts of a changing climate on hydrology in the Susitna River basin. This should be a comprehensive study of climate change in the Susitna River Basin that evaluates the cumulative impacts of climate change and the dam on the whole watershed ecosystem, including analysis of ecological impacts of predicted changes to water temperature and flow.*	As explained below in Section 2.4.3.2, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $5 million.
NMFS_pp7.7-10_ph4	*The overall goal of this study modification request is to assess the effects of the proposed project combined with a range of plausible risks of climate change on the Susitna watershed in order to condition the project license in anticipation of these changes. The proposed project is designed for long-term utility and is located in an area vulnerable to the effects of continued climate change. Therefore, understanding the cumulative impacts from the project and climate change is necessary to develop license conditions that protect anadromous fish, marine mammals, prey species and their habitats. Without this understanding, project operations would be considered in context of static future climate and hydrologic conditions, when it is clear that "baseline" conditions are not likely to be stationary (Wobus et al 2015).*	AEA anticipates that the Commission will address cumulative impacts in its NEPA document, and that climate change to the extent it is reasonable and foreseeable will be considered in the analysis. The AEA-commissioned study and AEA's modeling and sensitivity analysis should facilitate the Commission's analysis.
NMFS_pp7.7-31_ph1	*This proposed study is estimated to require a one-year study involving ~1.3-2 person years of effort including a primary investigator with preferably post-doctoral experience the field of applied climate projections to design and direct the study, along with assistant researchers capable of conducting portions of the study's different topics. A lower level of effort (~1.3 person-years) is feasible if there are existing datasets available and deemed appropriate as input for all the elements described above; if not, a higher level of effort as reflected in the following estimates may be required. This year of study is estimated to cost between $250,000 to $350,000. This is a very cost-effective expense.*	See Section 2.4.3.2. AEA disagrees with NMFS's estimate of the cost to address its proposed modifications. Modeling of the low and high change future climates for the Susitna Basin upstream of Watana dam perhaps could be conducted within the one-year time frame suggested by NMFS. However, to add the areas downstream of Watana dam would be an enormous and time consuming effort costing on the order of $5 million.
NMFS_pp7.7-12_ph2	*Study Modification 1: Update and expand the GRC literature review (previously ordered by FERC) to include new published studies and information available and a more comprehensive scope of studies in the literature to include the following:* *a. New literature published since 2012.* *b. A review of existing literature on climate change impacts on ecosystems in this region, and in*	As explained below in Section 2.4.3.3, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $25,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	particular any literature relating to the effects of climate change on species identified below in reference to 18 CFR § 5.9 (a). A wider scope including possible effects of changing climate on water temperature and forest/vegetation change and other aspects *c. A concise summary of the findings in the literature review of likely impacts of changing climate and plausible ranges on the Susitna Basin based on the literature.*	
NMFS_pp7.7-12_ph3	*Study Modification 2: Acquire and evaluate at least three downscaled climate projections for the Susitna Basin that sample a range of projected climate change for use in further glacial and hydrologic impacts modeling. This effort will include:* *a. Obtain downscaled climate model projections sufficient for the follow-on hydrologic modeling in Elements 3 and 4 below from at least three models, including the Zhang et al (2015) downscaled projection that was used in the AEA modeling study (Wolken et al 2015). The projections should include a range of warming and precipitation change, including futures with high and low precipitation changes, as well as smaller and greater warming. An example of the range of temperature and precipitation changes from CMIP5 climate models for the Susitna region is shown if Figures 3 and 4. Work currently in progress at the University of Alaska Fairbanks and the Alaska Climate Science Center to apply the Zhang et al (2015) Weather Research and Forecast (WRF) model dynamical downscaling to additional GCMs (U. Bhatt, personal communication, 24 May 2016) would likely meet this requirement. Other possible sources include model output from the following international coordinated downscaling projects CORDEX-North America; NARCCAP (Mearns et. al 2003); CORDEX-Arctic. Although the NARCCAP and CORDEX products do not all cover all of the state of Alaska, some of the downscaled GCMs sufficiently cover the region around the Susitna to be reasonable to use for analysis. These downscaled data would need to be subjected to the same bias correction procedure as noted in Wolken et al (2015).* *b. Evaluate these projections and the GCMs they were derived from in terms of their positions in the array of possible futures indicated by CMIP5 climate models.* *c. Electronically publish model output for the Susitna Basin and make available to NMFS*	As explained below in Section 2.4.3.4, AEA requests FERC not adopt this proposed Study Plan modification. NMFS divided its request for expansion of the AEA-commissioned study to the entire basin into six interrelated components; the estimated cost of implementing NMFS Study 7.7 Modification 1 through Modification 6 is $5,000,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	researchers and others for further studies; Leppi et al (2014) used a similar strategy of multiple strategically-chosen GCMs to drive hydrologic and Coho Salmon models to assess changes in fish production in the Chuitna River and Wobus et al (2015) used a similar process to assess the combined risks of climate change and mining on Pacific salmon and habitats in the Bristol Bay watershed of southwestern Alaska.	
NMFS_pp7.7-13_ph2	*Study Modification 3: Acquire and evaluate existing downscaled glacier and runoff projections for the Susitna basin that adequately sample a range of future conditions and that allow the evaluation of the Project under a range of future climate-driven risks. This includes the AEA Glacier and Runoff Study based on the Zhang et al (2015) downscaling. Wolken et al (2015) implement and calibrate a hydrologic model for the Upper Susitna Basin that includes a model of glacial change. We believe that this model is adequate for the current study.* *a. Include the results from the full Wolken et al (2015) Glacier and Runoff Changes study, including the modeling component and future projections.* *b. Use the Wolken et al (2015) modeling framework to investigate at a minimum two additional climate projections (described in Element 2). Alternatively, another glacier and hydrologic modeling framework may be used provided it is run for an adequate sample of future climate inputs.* *c. Electronically publish model output and make available to NMFS researchers and others for further studies.*	As explained below in Section 2.4.3.5, AEA requests FERC not adopt this proposed Study Plan modification. NMFS divided its request for expansion of the AEA-commissioned study to the entire basin into six interrelated components; the estimated cost of implementing NMFS Study 7.7 Modification 1 through Modification 6 is $5,000,000.
NMFS_pp7.7-14_ph1	*Study Modification 4: Acquire or develop projections for streamflow, water temperature and quality below the proposed dam for use in assessing impacts of the Project on species affected by the project and climate change, and their habitats, under future climates.* *a. Provide simulation of water temperature, streamflow amount and timing below the proposed dam downstream to the downstream extent of project effects for the scenarios described above for future periods extending from the near future to 2100.* *b. This data is needed by NMFS in order to establish the altered environmental baseline trends against which the effects of the Project on anadromous fish and associated habitat will be*	As explained below in Section 2.4.3.6, AEA requests FERC not adopt this proposed Study Plan modification. NMFS divided its request for expansion of the AEA-commissioned study to the entire basin into six interrelated components; the estimated cost of implementing NMFS Study 7.7 Modification 1 through Modification 6 is $5,000,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	assessed for the license term and the reasonable life of the project.	
NMFS_pp7.7-14_ph2	*Study Modification 5: Summarize potential climate change effects under a range of climate projections in a Climate Change Technical Report.* *This technical report should include a description of the assumptions made, models used, and other background information. The report will provide interpretation and guidance on the science knowledge developed, in order to translate them into useable knowledge, through syntheses and translational products developed to address the hydropower, water, and fisheries needs. Additionally this report will include an analysis of the impacts of projections on the project nexus, and hydropower facilities. The report will include an electronic supplement that makes the data used in this study available for the use of other studies.*	As explained below in Section 2.4.3.7, AEA requests FERC not adopt this proposed Study Plan modification. NMFS divided its request for expansion of the AEA-commissioned study to the entire basin into six interrelated components; the estimated cost of implementing NMFS Study 7.7 Modification 1 through Modification 6 is $5,000,000.
NMFS_pp7.7-14_ph3	*Study Modification 6: Coordinate study data and results with other studies and technical working groups.*	As explained below in Section 2.4.3.8, AEA requests FERC not adopt this proposed Study Plan modification. NMFS divided its request for expansion of the AEA-commissioned study to the entire basin into six interrelated components; the estimated cost of implementing NMFS Study 7.7 Modification 1 through Modification 6 is $5,000,000.
NMFS_pp7.7-10_ph1	*However, the concept of a stationary environmental baseline with fluctuations (high and low water years) around a relatively stationary mean (as previously used by FERC and other regulators) is an outdated concept given the current level of scientific certainty of climate change (Milly et al 2008; Viers 2011).*	AEA plans to model a baseline with various hydrologic and meteorology combinations to cover Project variability. The geomorphic model will extend out 50 years to model changes with and without the Project. AEA will then consider the potential for additional change attributed to climate change through sensitivity analyses. AEA's proposal does not constitute a stationary environmental baseline. There are many conditions that could be developed to provide a suite of climate change baselines, but that effort would be extremely costly and have great uncertainty. AEA's proposed approach will provide the Commission with information for decision-making.
NMFS_pp7.7-10_ph3	*Projects constructed according to designs that do not anticipate future climate conditions may fail to meet ESA objectives under different conditions, causing adverse effects to listed species.*	Once AEA has filed the License Application and the Commission conducts its formal consultation on ESA, if such consultation is necessary, FERC and the resource agencies can determine if the AEA-commissioned Glacier and Runoff study coupled with sensitivity analyses are sufficient to address climate change.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp7.7-17_ph2	*Climate and hydrologic data are part of long-term natural resource assessments collected in the watershed since the late 1970s (and some habitat assessments dating to the 1940s). These assessments document trends toward earlier snow melt, warming air temperatures, shifts in precipitation, increases in stream temperatures, declines in fish populations, increases in the length of the growing season as temperatures increase. Other changes noted in the region include a decrease in boreal forest growth. Increases in temperature and changes in precipitation have had profound effects on regional hydrology, including shrinking wetlands, glacial recession (and in some less frequent instances, glacial surging), permafrost melting, and an increase in fire frequency and intensity across the landscape as a result of increased drought and thunderstorms (SNAP 2011). Given the trends (as shown in Figures 1 and 2 above), there is need to document the environmental baseline of the project, and develop a realistic projection of the range of potential trends in the future, in order to evaluate the potential project effects and to fashion license conditions.*	AEA maintains that developing a "future baseline" and comparing future resource effects to that "baseline" would result in a great deal of uncertainty. Given the differences in General Circulation Models (GCMs), what "future baseline" would be most appropriate in a constantly changing climate? Should a 50 or 100-year horizon be chosen, or even a longer period? Rather than consider one or many "future baselines", AEA proposes to use a common sense approach using existing baseline conditions that examines future trends based on the AEA-commissioned study and the sensitivity analysis that it intends to conduct for each model. FERC can then use an adaptive management approach to protect the downstream environmental resources as discussed in their July 18, 2013 Order Rejecting and Denying Rehearing.
NMFS_pp7.7-17_ph3	*The range of these "SNAP-preferred" models would be adequate to represent a high, medium, and low change future climates.*	The AEA-commissioned study assumes a medium change future climate. See Section 2.4.3.5 for AEA's rationale on modeling additional future climate change projections.
NMFS_pp7.7-2_ph1	*Understanding the cumulative impacts from the project and climate change is necessary to develop license conditions that protect anadromous fish, marine mammals and prey species and their temperature dependent habitats.*	AEA agrees that the Commission NEPA document will need to consider cumulative effects. Cumulative effects are those that are reasonably foreseeable actions. AEA believes that the uncertainty of climate change effects, coupled with modeling error bands, makes quantification of climate change effects unreliable and unnecessary.
NMFS_pp7.7-24_ph1	*These direct project effects, when combined with the warming associated with climate change, have likely detrimental effects to fish productivity for incubating, rearing and spawning anadromous and resident fish species (see Wobus et al 2015, Shanley and Albert 2014 and Leppi et al 2014).*	AEA believes that it is premature to conclude whether the project will likely have detrimental effects to fish productivity for incubating, rearing and spawning anadromous and resident fish species because AEA will have the ability to manage both downstream flows and water temperatures.
NMFS_pp7.7-8_ph1	*Sedimentation could impact project longevity and thus cost-benefit calculations. Sedimentation gradually reduces the capacity of reservoirs, as well as causing abrasion on the turbines and other dam components. The rate of sedimentation is strongly tied to climate and erosion processes.*	It is possible that sedimentation could be increased due to melting permafrost and higher flow events from increased precipitation and associated runoff. However, it is speculative on how high these flows might be or what the additional

Reference Number	Comment or Study Modification Request	AEA's Response
		sediment input might be from melting permafrost. The useful life of the reservoir is hundreds of years. This is well beyond the economic life of the Project. Regarding abrasion of turbines, AEA has experience with a glacially fed reservoir, Bradley Lake Hydro, and has factored this into the Project design.
NMFS_pp7.7-8_ph2	*Sedimentation rate changes below glaciers above the reservoir and in downstream tributaries will affect project longevity and fish habitat.*	Sedimentation rates in downstream tributaries and their effect on fish habitat will be assessed through the modeling studies and sensitivity analyses. Increased sedimentation rates can also occur without climate change if there are mud slides that occur in tributaries.
NMFS_pp7.7-8_ph3	*Changes in vegetation type and amount driven by climate change could lead to changes in the hydrologic regime and in riverine habitat quality.*	AEA has assessed climate change effects on the hydrologic regime for the area upstream of Watana reservoir. Vegetation changes could similarly occur downstream of Watana dam. The Commission plans to use adaptive management measures to address future vegetation changes, as appropriate.

2.4.3.1. Summary of AEA-commissioned Glacier and Runoff Changes Study

As noted above, AEA implemented the components of the Glacier and Runoff Changes Study as AEA proposed in the RSP, but not required by FERC and published the results of the larger effort along with documentation of the methodology (Wolken et al. 2015). AEA understands that climate is in the process of changing; glaciers in Alaska are shrinking, snowmelt is occurring earlier, and precipitation appears to be shifting.[19] Because of the importance of glaciers to the Susitna River hydrology and the potential effects of climate change, AEA commissioned DGGS and UAF (Wolken at al. 2015) to conduct a study to determine how flow and the timing of flow in the Susitna River could be affected over the next hundred years. The purpose of the study was to estimate potential future changes in streamflow into the Project as these changes could affect Project economics and to identify trends in climate change in the Susitna River that could affect future operations of the Project.

Wolken et al. (2015) conducted a physically based hydrological modeling study using a Water Flow and Balance Simulation Model (WaSiM). The model accounts for changes in the mean annual temperature and precipitation, glacial flow contributions, evapotranspiration, and permafrost reduction. Page 28 of Wolken et al. (2015) describes the challenges with permafrost modeling for both surface and groundwater flow. Interior Alaska permafrost has experienced

[19] AEA's study of over 60 years of flow data at the Susitna River at Gold Creek shows that snow melt has been occurring two weeks earlier in the latter part of the record than in the early years of gauging.

degradation from the top and bottom. Continued thawing of permafrost will significantly alter the soil moisture, and the biogeochemical and hydrological cycles in Interior and southcentral Alaska (Wolken et al. 2011). For permafrost modeling, knowledge is required about the geothermal heat flux, soil, surface properties, snow depth and density. Although the amount of data available to develop these datasets has increased dramatically due to the use of remote sensing techniques, developing a comprehensive data set for the Susitna basin is not feasible. Secondly, current theory on the behavior of thermo-hydrological coupled models is advancing, but insufficient computational capability still represents a major challenge to creating simulations of large regions at a fine enough resolution to fully couple the two processes. Therefore, a coarser approach was taken to develop an understanding of the water balance in the active layer. Accordingly, there is significant uncertainty associated with the changes in runoff attributed to melting of the discontinuous permafrost in the Susitna basin. The General Circulation Model (GCM) uses downscaling completed by Zhang et al. 2007, as recommended by NMFS. AEA's assessment uses a mid-range Representative Concentration Pathway (RCP) 6.0 and extends out to about year 2100. (Should climate change be more akin to RCP 8.5, the climate change effects would be accelerated.) WaSiM provided the spatial and temporal variability of hydrological processes in complex models using a daily time step. The model was calibrated using temperature and precipitation data from 1981 through 1983.

The study results indicate that by the end of the 21st century, annual streamflow in the Susitna River will decrease by about 7 percent, snowmelt is likely to occur earlier in the spring, and more precipitation will fall as rain. The study did not attempt to model water temperatures in the Susitna River associated with a changed climate.

Based on climate studies conducted to date, future climate trends for Alaska and the Susitna River basin indicate that the basin will experience higher annual temperatures, glacial retreat, permafrost changes, increased evapotranspiration, earlier snow melt, and likely lower late summer flows.[20] Susitna-Watana operations could not protect environmental resources upstream of the reservoir in a changed climate environment. However, Project operations options may exist for water temperature and flow control to protect downstream resources.[21] Under such conditions, the Project may be able to provide benefits to the fishery that would not be possible without the Project.

2.4.3.2. Response to Modification Request to Conduct a Basin-wide Climate Change Study and AEA's Approach

NMFS, NRDC, TNC, SRC and Rebecca Long requested a modification to the FERC-approved Study Plan to evaluate climate change of the entire Susitna River basin, with NMFS requesting the

[20] Glacial and Runoff Changes, Final Study Report, Susitna-Watana Hydroelectric Report (FERC No. 14241), Division of Geological & Geophysical Surveys, Alaska Department of Natural Resources. Referred to as Wolken et al. 2015 or AEA-commissioned study.

[21] For the past several years, California has been experiencing drought conditions, earlier snowmelt runoff and lower flows and warmer water temperatures during late summer and fall in rivers like the Sacramento and Feather. To protect salmon and steelhead in these rivers, flow and water temperature management measures are being taken at large reservoirs like Shasta and Oroville in 2016. See http://www.westcoast.fisheries.noaa.gov/stories/2014/18_02182014_protecting_fish_from_california_s_extreme_drought.html.

use of multiple downscaled climate projections, building upon the AEA-commissioned study. They requested projections for streamflow, water temperature and water quality in Watana reservoir and downstream of the Project. They request the climate change modeling results to then be compared to a "future baseline" to develop PM&E measures.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the study was not implemented as provided by the approved Study Plan.

Essentially, the request for a climate change study of the Susitna River basin is a restatement of the NMFS climate change study request that the Commission rejected in its July 18, 2013 Order Rejecting and Denying Rehearing. Specifically, the Commission stated:

> *The Commission agrees with NMFS that the effects of climate change on streamflow conditions and any corresponding adverse effects on environmental resources are important issues, and any substantial information regarding these matters will be given due consideration in the Commission's environmental analysis and in any subsequent license order. However, the Commission does not agree that the climate change studies proposed by AEA and requested by NMFS are likely to yield reliable data that can be used in the development of license requirements, particularly when balanced against the cost of such assessments.*
>
> *The panel found that AEA's proposed study would be "useful" to Commission staff as it conducts its environmental analysis and would assist NMFS in the exercise of its FPA section 18 authority. In addition, the panel stated that the study, as modified by the panel's additional recommendations, would provide "valuable" information that would inform potential project operations, resulting from the changes in the timing, magnitude and duration of inflows to the project across a range of potential future conditions. However, the panel did not directly address the accuracy of the proposed study components, nor did it consider the cost of such components, other than to note that the fact that AEA plans on conducting its proposed study suggests that the information to be gained is worth the cost. We are not convinced that the proposed study would yield specific information that would be of use in crafting a license.*

AEA concurs with commenters on the appropriateness of a climate change study for a new project the size of Susitna-Watana and its long-term implications on meeting Railbelt energy and natural resources needs and, in fact, that was the basis for conducting the AEA-commissioned study as proposed in the RSP, independent of the FERC-approved Study Plan Determination. Nonetheless, predicting specific stream flows, water temperature and water quality changes, comparing these changes in future baselines to operational scenarios, modeling effects to environmental resources, and then developing PM&E measures would yield speculative results with enormous uncertainty. Therefore, the Commission's prior determination that the study results relating to climate change projections of streamflow, water temperature, and water quality would be too uncertain for the Commission to craft license conditions remain valid, and there is no basis to adopt the proposed study modifications.

Moreover, the commenters have significantly underestimated the cost of modeling the entire basin. To add the areas downstream of Watana Dam into the AEA-commissioned study (i.e., climate change model) would be an enormous and time consuming effort, considering that the Susitna river basin upstream of Watana is only about one quarter of the Susitna River basin drainage area (e.g., drainage area at Watana dam site is 5,180 square miles versus a Susitna River basin area of 19,400 square miles). AEA assumes that only one point in time would be needed for each GCM, such as around the year 2100. It would then be necessary to model post-Project conditions for all models. In addition, the models would need to be rerun for various PM&E measures, thereby yielding numerous suites of additional runs. For the run-of-river scenario that the Commission has required AEA to conduct, AEA had estimated the cost for that analysis to be on the order of $500,000. Therefore, the modeling of climate change for three GCMs would be on the order of $1.5 million just to run the models, and that is irrespective of developing the basin model for climate change. After adding temperature and expanding the study to include the entire basin, the cost would be approximately $5 million.

Further discussion on specifics aspects of NMFS's requested climate change study is presented in Sections 2.4.3.4 through 2.4.3.8 below.

The AEA-commissioned Glacier and Climate Changes Study, coupled with the sensitivity analysis that AEA intends to conduct as part of the currently FERC-approved Study Plan, will provide information that the Commission can use in its environmental analysis to assess impacts on environmental resources downstream of Watana Dam and trends associated with climate change. AEA's approach is cost-effective and will permit the Commission and other federal agencies to effectively address climate change in the Environmental Impact Statement, as the Commission deems appropriate. AEA's proposed approach is consistent with the Commission's conventional hydrological approach as referenced in the Commission's July 18, 2013 Order Rejecting and Denying Rehearing.

As presented in the final FERC-approved Study Plan, AEA proposes to conduct hydrological and meteorological studies to assess Project effects based on the existing environment. Based upon the results of those comprehensive studies, AEA will develop proposed PM&E measures for reservoir and downstream resources. To better understand Project effects on a future climate, AEA will consider the results of the sensitivity tests to determine climate change trends.

In fact, NMFS provides the answer in its June 22 comment letter as to why additional studies on climate change are unnecessary. NMFS states "NMFS does not need to know with precision the magnitude of change over the relevant time period if the best available information allows NMFS to reasonably project the directionality of climate change and overall effects to species and their habitats." As noted above and referenced numerous times in NMFS comments, AEA's climate change study found that by the end of the 21st century, glacial recession is likely to continue with an overall reduction in reservoir inflows on the order of 7 percent. The basin will receive more precipitation, more of which will be rainfall, and temperatures are expected to be warmer. Hence, the directionality of climate change is known and can be considered in the context of the results of the Commission required studies.

Licensing decision-making should be based upon the Commission's approved Study Plan Determination, which requires an assessment of the effects of various combinations of meteorology and hydrology on aquatic and terrestrial species and their habitats. Specifically, AEA will consider combinations of warm, average, and cool years, coupled with wet, average and dry hydrology. AEA has selected water years 1976, 1981 and 1985 for the modeling studies. These years represent dry/cold, wet/warm, and average conditions. (See Section 1.5.1 for additional detail on the flows for the modeled years.) The flow variability vastly exceeds the 7 percent flow change expected over this century based on the median GCM. AEA's sensitivity analysis on the reservoir water quality model (EFDC) will consider those variables that affect reservoir water temperatures including increased inflow temperatures and increased solar radiation (e.g., effects that are likely during a changed climate based on RCP 6).

AEA, the Commission, or NMFS for that matter, can look at the results of AEA's analysis and then look at the directionality of climate change and assess the influence of climate change on species and their habitat. Since AEA's commissioned study looked at the most likely climate change scenario, it would be easy to consider trends for even warmer temperatures and/or greater precipitation. The range of meteorology (warm year) and hydrology (low flow) that AEA is evaluating should be useful to develop Project PM&E measures, as well as to illustrate Project effects against potential trends in climate change. Common sense can be applied to see what effects would occur if even greater temperatures and/or lower flows were to occur.

As NMFS noted in its comments, having a project like Susitna-Watana would allow AEA to operate the Project to manage for the effects of climate change. This is being borne out today in California as the U.S. Bureau of Reclamation, the U.S. Army Corps of Engineers, and the California Department of Water resources are managing their large reservoirs (e.g., Shasta, Folsom, and Oroville) to provide cold water and flows for salmon and steelhead protection. AEA has included water temperature control as a construction feature. The downstream studies will enable the Commission to develop measures to protect or mitigate environmental resources, as appropriate. It is speculative to develop PM&E measures beyond those that would protect the environment under existing conditions.

2.4.3.3. Response to Modification Request to Update and Expand the Literature Review

NMFS (Modification 1; NMFS_pp7.7-12_ph2) requests that AEA update and expand the Glacial and Runoff Changes literature review to include new published studies and new information that has become available since 2012, and to include a more comprehensive scope of studies in the literature regarding climate change, and to provide a summary of likely impacts of changing climate and plausible ranges on the Susitna Basin based on the literature.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the study was not implemented as provided by the approved Study Plan.

AEA does not see a useful purpose in updating or expanding the Glacial and Runoff Changes literature review in meeting the objectives of the FERC-approved Study Plan. AEA implemented the Plan as approved by FERC. The completed literature review was comprehensive at the time AEA filed it with the Commission. The AEA-commissioned report (Wolken et al. 2015) further supplements the literature review presented in the ISR and includes references to climate change impacts on ecosystems in central Alaska. As with any developing science, literature will continue to be published on glacial and runoff conditions and ecosystem effects related to climate change. AEA will include appropriate literature citations in reports associated with the license application when filed with the Commission. The NMFS request fails to show how an expanded literature review would be used in any Commission decision-making.

2.4.3.4. Response to Modification Request to Acquire and Evaluate Downscaled Climate Projections for the Susitna Basin

NMFS (Modification 2; NMFS_pp7.7-12_ph3) requests FERC to modify Study 7.7 to acquire and evaluate at least three downscaled climate projections for the Susitna Basin that sample a range of projected climate change for use in further glacial and hydrologic impacts modeling, including Zhang et al. (2015) downscaling which was used in the AEA-commissioned modeling study (Wolken et al. 2015).

For the reasons explained above in Section 2.4.3.2, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. Comments related to evaluating downscaled climate projections for the Susitna Basin address the scope and objectives of the Study Plan itself, and not AEA's implementation. The FERC-approved Glacial and Runoff Changes Study Plan did not include an objective to model climate change, and NMFS fails to show "good cause" (per 18 CFR 5.15(d)) as to why the Study Plan should be modified to model climate change.

In the AEA-commissioned modeling study conducted for the Upper Susitna Basin, Wolken et al. 2015 did acquire and evaluate downscaled climate projections for the Susitna basin including Zhang et al. 2015. AEA considered climate change for only one scientifically accepted climate change future derived from state of the art GCMs using generally accepted downscaling methods. Since other models generally show greater or less effects, AEA believes that is unnecessary to expend additional funds to model at least two additional GCM. Thus, no further glacial and hydrologic impacts modeling caused by climate change is warranted in the Upper Basin. Use of the RCP 8.5 emissions scenario would certainly accelerate the climate change effects modeled in the AEA-commissioned study. However, a sensitivity assessment should be sufficient to consider trends.

The Wolken et al. (2015) study indicated that the glacier component of the Susitna basin accounts for about 13 percent of the total runoff (page 27) and glaciers cover only about 4 percent of the basin (page 29). Mean specific runoff at the dam site is expected to decrease by 7 percent at the end of the 21st century. While there would be decreased basin runoff from increased evapotranspiration and permafrost reduction, this would be partially offset by the increased precipitation that is forecast for this area.

As described above in Section 2.4.3.2, AEA maintains that further detailed modeling is unnecessary. Efforts beyond those already conducted by AEA to consider climate change particularly on permafrost and associated runoff into the Susitna-Watana reservoir would provide little additional value in future decision-making or in developing licensing conditions, given the considerable added uncertainty of the modeling.

2.4.3.5. Response to Modification Request for Evaluation of the Project Under a Range of Future Climate-driven Risks

NMFS (Modification 3; NMFS_pp7.7-13_ph2) requests a study modification for FERC to require AEA to acquire and evaluate existing downscaled glacier and runoff climate projections for the Susitna basin that sample a range of future conditions and that allow the evaluation of the Project under a range of future climate-driven risks. NMFS specifically cites the AEA-commissioned study (Wolken et al 2015) and Zhang et al (2015) and notes that the AEA-commissioned study model is adequate for the current study request. NMFS suggests that the overall goal of its proposed climate change study modification request is "for assessment of the effects of the proposed project combined with a range of reasonable plausible risks of continued climate change on the Susitna watershed in order to condition the project license…" NMFS requests that AEA investigate, at a minimum, two additional climate projections and electronically publish model output and make that information available for further studies.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. Comments related to evaluating downscaled climate projections for the Susitna Basin address the scope and objectives of the Study Plan itself, and not AEA's implementation. The FERC-approved Glacial and Runoff Changes Study Plan did not include an objective to model climate change, and therefore NMFS's proposed modification does not meet the criteria under 5.15(d).

AEA's FERC-approved Study program includes hydrology, meteorology, and habitat studies designed to evaluate Project effects over a range of reasonable plausible conditions (e.g., varying temperature conditions). Considering more conservative climate change futures such as RCP 8.5, as NMFS suggests, could be used to model both baseline and Project effects from climate change. However, the results would be speculative and provide little value in developing license conditions. If conservative emissions scenarios were to occur, AEA agrees with NMFS that the changes in baseline or Project effects could be greater than effects modeled under either the median General Circulation Model or the conventional hydrology approach approved by the Commission. The primary differences in the RCPs appears to be in the timing of climate change. It would be difficult at best to compare a future Project operating condition to a "future baseline" condition that has much uncertainty. AEA's current assessment approach will provide information to inform the Commission on trends in future meteorology and associated runoff conditions, and that information can be used in conjunction with the modeling results in a common sense approach to consider adaptive management strategies. AEA has consistently and will continue to provide data and model output of all the Susitna-Watana Hydro licensing studies, subject to confidentiality, federal and state restrictions, as available.

2.4.3.6. *Response to Modification Request to Acquire or Develop Projections for Streamflow, Water Temperature and Quality Below the Proposed Dam for use in Assessing Impacts of the Project on Species of Interest under Future Climates.*

NMFS (Modification 4; NMFS_pp7.7-14_ph1) requests projections for streamflow, water temperature and water quality below the proposed dam to assess impacts of the Project on species affected by the project and climate change, and their habitats, under future climates. NMFS requests simulations for future periods extending to 2100. Further, NMFS states that the data is needed to establish the altered environmental baseline against which the effects of the Project on anadromous fish and associated habitat will be assessed for the license term and reasonable life of the project. While not included in the modification request description, NMFS also requested this information for the reservoir area in other locations within their submittal.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS has not established "good cause" for this modification.

As described in the AEA-commissioned Glacier and Runoff Changes Study (Wolken et al. 2015), AEA has developed projections for streamflow into the Susitna-Watana reservoir based on a median General Circulation Model. The results show a decline in average water flow on the order of 7 percent by the turn of the century. Over the 50-year license period, the decline is expected to be less because of how the glaciers are expected to recede. The water years selected for modeling have a much greater variation in annual flow and can be used to facilitate the trend analysis. For example, there is a 50 percent variation in flows at Gold Creek during the open water flow period (i.e., May through October) between 1976 and 1981 – two of the years being modeled.

AEA will use the EFDC model to simulate varying meteorology and hydrology conditions to assess Project effects relative to existing conditions and allow PM&E measures to be developed to protect resources. For example, the dam design incorporates intake shutters to enable management of downstream water temperatures. The Commission can use this information to consider an appropriate level of flow and temperature control that is available to protect downstream resources from future climate changes. Accordingly, there is no need to predict "future baseline" conditions and associated Project impacts. NMFS recommends that AEA model altered environmental "baseline" conditions to 2100 and then use that "baseline" to measure impacts. As explained above, such an exercise would be unlikely to provide useful results.

AEA has not modeled water temperature or water quality effects of climate change. These results would be speculative because there are many factors that can affect water temperature and water quality in a climate-changing environment, including vegetation changes and permafrost changes. Considerable effort would be required to model runoff temperatures for flows entering Watana reservoir, with little value given the amount of uncertainty.

AEA has collected water temperature data for inflows into Watana reservoir under existing conditions under the Baseline Water Quality Study (Study 5.5). However, for predicting future water temperatures under a changed climate, key factors affecting water temperature include permafrost, vegetation, solar radiation, precipitation etc. Each of these has some level of uncertainty, making the predicted outcome results speculative. The reservoir inflow temperatures may be less of a factor than the meteorology and operations effects on the reservoir itself. The reservoir water quality modeling in the Commission-approved Water Quality Modeling Study (Study 5.6) will allow key drivers of reservoir water temperature to be identified to verify the importance of inflow water temperature on reservoir water temperature.

The overall effort to model water temperature changes under changed climate conditions would be greater than estimated by NMFS and this would be only one component of a much greater evaluation. Rather, AEA intends to use the conventional hydrology modeling approach to assess how changed inflows and inflow temperatures affect reservoir water quality and outflows. This would be done through sensitivity runs using decreased reservoir inflows (from downscaled climate data from Wolken et al. 2015) and warmer temperature inflows.

Project outflow information (flow and water temperature) can then be established for the modeled period (e.g., a one-year period) and the results compared to modeled output for AEA's proposed operations. If there are significant differences, adaptive management provisions could be considered further to protect downstream resources. Similarly, since climate change would also affect the areas downstream of Watana dam, AEA can also apply common sense to how those effects might change in the future and determine if additional PM&E measures may be needed (e.g., tributary inflow may be warmer from the increased climate temperatures, but likewise increased precipitation could also be a factor affecting flow and groundwater.)

AEA plans to assess Project effects on anadromous fish and their habitats and habitat components using conventional hydrology and sensitivity analyses as appropriate. Because of the variations in GCMs, the time continuum of climate change, and the additional uncertainty in input variables, making decisions on such results seems risky. However, the analysis should provide trend information to enable a successful adaptive management approach.

AEA does not dispute that the future trend from climate change will be to increase and cause more variable winter flow and possibly reduce spring flows into the reservoir. However, the proposed operation will be to provide adequate flows for downstream resource protection. Should melt or higher flows occur sooner in the spring, the reservoir will be drawn down and AEA will be able to accommodate those flows and possibly retime the flows when needed by the downstream resources. AEA disagrees with NMFS that the effects of climate-induced changes and Project-caused changes in flow are additive and there is no supporting evidence. AEA's proposed approach will permit an assessment of Project effects under various conditions including those caused by climate change through a sensitivity analysis. AEA's analyses will consider streamflow magnitude and timing, as well as water temperature and quality below the proposed dam.

AEA's proposed study approach uses a substantial number of scenarios to address the complexity of the proposed Project. AEA is considering both the current baseline and the modeled geomorphology of the Susitna River 50 years into the future. AEA will consider the potential effect of climate change on reservoir and downstream resources through sensitivity analyses and common sense. The scenarios will include potential measures that will then need to be modeled in the full suite of models to assess the effects of such measures.

As an example of a common sense approach, the GCMs predict that winters will be milder with a decrease in snowfall (e.g., Wolken et al. predicted a 13 percent decrease in snowfall for RCP 6.0). This suggests that the Susitna basin will continue to experience winter conditions and cold or cool water inflow to the reservoir would still occur in the winter and early spring. This further suggests that Watana reservoir will have a cold water pool and could be managed for downstream water temperatures in the summer during hot, dry periods. As the Commission notes in its July 2013 rejection of NMFS rehearing request, adaptive management may be a more appropriate approach to protect downstream resources.

2.4.3.7. Response to Modification Request to Summarize Potential Project Effects under a Range of Climate Projections in a Climate Change Technical Report

NMFS (Modification 5; NMFS_pp7.7-14_ph2) requests that the potential effects of the project under a range of climate projections be summarized in a Climate Change Technical Report. NMFS requests that the Technical Report include information on assumptions made, models used and other background information as well as interpretation and guidance on the science knowledge developed to translate them into useable knowledge to address hydropower, water, and fisheries needs. Additionally, NMFS requests the report include “an analysis of the impacts of projections on the project nexus, and hydropower facilities.” And to provide the data electronically.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, NMFS has not established “good cause” for the modification.

The detailed modeling of various climate change scenarios recommended by NMFS would be time consuming and expensive. AEA does not disagree with NMFS on the time or cost to expand AEA’s glacier and runoff study to include additional emissions scenarios. However, this is a small part of what would be needed to examine Project effects under a changed climate. For each scenario modeled, AEA would need to model reservoir and downstream effects. Overall, the analysis requested by NMFS and the associated technical report including any electronic supplement would cost about $5 million.

As the Commission has noted in its denial of NMFS’s rehearing request, the results would be speculative. AEA believes that since the climate trends are already modeled, sensitivity analyses and common sense should prevail in assessing Project effects and trends. Further there is no need for a Technical Report. AEA’s modeling effort will be documented in the Updated Study Report and License Application. This will include Study 5.6, water quality modeling; Study 6.6 fluvial geomorphology modeling; Study 7.5, groundwater modeling; Study 7.6, ice modeling; Study 8.5 instream flow modeling, and Study 8.6 riparian instream flow modeling. The License Application will include assessment of operational scenarios on the affected environment and proposed PM&E measures. There is no need for an additional Technical Report as suggested by NMFS. Electronic information will be made available as provided for in the Communications Protocol.

2.4.3.8. Response for Modification Request to Coordinate Climate Change Modeling with Other Studies

NMFS (Modification 6; NMFS_pp7.7-14_ph3) proposes a study modification for AEA to coordinate its requested climate change study data and results with other technical work groups conducting FERC-ordered pre-licensing studies that the Project may exert additive and synergistic effects upon, e.g., of anadromous fishes, marine mammals, their prey and their habitats, including hydrology upstream and downstream of the Susitna Dam and in important lateral side-channel habitats of the river, as well as the Model Integration and Decision Support Study NMFS is also requesting.

AEA does not consider the coordination with other technical working groups as a study modification request. AEA certainly plans to coordinate study results among the technical working groups, as has been done continually throughout the licensing efforts. As to the inclusion of climate change, as appropriate, the working groups can consider climate change trends and sensitivity analyses, once the FERC-approved Study results are available from the conventional hydrologic studies and predictive models.

2.4.3.9. References Cited

Zhang, J., U.S. Bhatt, W.V. Tangborn, and C.S. Lingle. 2007. Climate downscaling for estimating glacier mass balances in northwestern North America: Validation with a USGS benchmark glacier. Geophysical Research Letters. 34(21), doi 10.1029/2007GL031139.

2.5. Instream Flow

2.5.1. Study 8.5 – Fish and Aquatics Instream Flow Study

As established in the Fish and Aquatics Instream Flow (IFS) Study 8.5 Study Plan[22] (RSP Section 8.5.1), the purpose of the IFS Study is to characterize and evaluate the effects of the proposed Project on downstream aquatic resources. Study Plan Section 8.5 is specifically directed toward establishing an understanding of important biological communities and associated habitats, and the hydrologic, physical, and chemical processes in the Susitna River that directly influence those resources. The focus of much of this work will be on establishing a set of analytical tools/models based on the best available information and data that can be used for defining Existing Conditions, i.e., without Project, and quantifying how these resources and processes will respond to alternative Project operational scenarios. Achievement of this goal will require close coordination with a number of interrelated studies (e.g., Fish Distribution and Abundance in the Middle and Lower Susitna River [Study 9.6], Characterization and Mapping of Aquatic Habitats [Study 9.9], Geomorphology [Studies 6.5 and 6.6], Water Quality [Studies 5.5 and 5.6], Ice Processes [Study

[22] The FERC-approved Revised Study Plan (RSP) Section 8.5 for the Fish and Aquatics Instream Flow Study (IFS) as modified by FERC's Study Plan Determination (Study 8.5 SPD, April 1, 2013), the *Open Water HEC-RAS Flow Routing Model Technical Memorandum* (TM) (Study 8.5 TM, January 31, 2013), the *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014 TM* (Study 8.5 TM, March 1, 2013), and the *Adjustments to Middle River Focus Areas TM* (Study 8.5 TM, May 31, 2013) is collectively referred to as Study Plan Section 8.5.

7.6], Groundwater [Study 7.5], and others) that will provide important inputs into an overall Project effects analysis. Specific objectives of this and associated companion studies include the following (RSP Section 8.5.1.2):

- Map the current aquatic habitat in main channel and lateral habitats of the Susitna River affected by Project operations (Study 9.9).
- Select study areas and sampling procedures to collect data and information that can be used to characterize, quantify, and model mainstem and lateral Susitna River habitat types at different scales.
- Develop a Mainstem Open-water Flow Routing Model that estimates water surface elevations and average water velocity along modeled transects on an hourly basis under alternative operational scenarios.
- Develop site-specific Habitat Suitability Criteria (HSC) and Habitat Suitability Indices (HSI) for various species and life stages of fish for biologically relevant time periods selected in consultation with the TWG.
- Develop integrated aquatic habitat models that produce a time series of data for a variety of biological metrics under Existing Conditions and alternative operational scenarios.
- Evaluate Existing Conditions and alternative operational scenarios using a hydrologic database that includes specific years or portions of annual hydrographs for wet, average, and dry hydrologic conditions and warm and cold Pacific Decadal Oscillation (PDO) phases.
- Coordinate instream flow modeling and evaluation procedures with complementary study efforts. If channel conditions are expected to change over the license period, instream flow habitat modeling efforts will incorporate changes identified and quantified by riverine process studies.
- Develop a Decision Support System-type framework to conduct a variety of post-processing comparative analyses derived from the output metrics estimated under aquatic habitat models.

During the March 24, 2016 ISR meeting, AEA proposed five modifications to Study Plan Section 8.5 in the ISR (Study 8.5 ISR Part C, Section 7; Study 8.5 ISR Part D, Section 7). These modifications are generally summarized as follows:

1. Three instead of five representative years were selected to represent wet/warm (1981), average (1985), and dry/cool (1976) conditions (RSP Section 8.5.4.4). Two additional years were considered to represent warm and cold Pacific Decadal Oscillations, but were not included since analysis did not support the distinction (Study 8.5 ISR Part C, Appendix J: *Representative Years*).
2. Final IHA and EFC metrics will be developed with input from the TWG and other resource disciplines after the Open-water Flow Routing Model is finalized (RSP Section 8.5.4.4).

3. Instead of HEC ResSim, the reservoir operations model (MWH-ROM) is being used to forecast reservoir outflows (RSP Section 8.5.4.3).
4. As described in Study 8.5 ISR Part A, Section 4.6.2, AEA deferred LR-2 field studies (near PRM 67) from 2013 to the next study period. All other methods for Lower River fish habitat modeling will remain unchanged from the methods described in RSP Sections 8.5.4.2 through 8.5.4.7.
5. Temporal analyses include extrapolating the results of 2-D modeling of Focus Area fish habitats from Existing Conditions (i.e., License Year 0) to future conditions (i.e., Years 25 and 50). Spatial analyses include applying 1-D and 2-D fish habitat model results from modeled to non-modeled areas. General approaches for temporal and spatial analysis were discussed during the November 13-15, 2013 Riverine Modeling Technical Team meeting, and were more specifically described during the Riverine Modeling Technical Team Proof of Concept meeting on April 15-17, 2014. The final approaches for both the temporal and spatial analysis were to be provided in the ISR (RSP Section 8.5.4.7.1.3); and while discussion occurred during implementation of the Study Plan in 2013 and early 2014, decisions on the final approaches are deferred to the next study period.

Variances from the Study Plan were reported and discussed within the ISR (Study 8.5 ISR Part D, Sections 6.1 and 6.2.)

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, comments were submitted to FERC on June 20, 2016 (Becky Long and The Nature Conservancy), June 22, 2016 (U.S. Fish and Wildlife Service and National Marine Fisheries Service), and June 23, 2016 (Alaska Department of Natural Resources et al., National Park Service, and SRC et al.). Comments included proposed study modifications and recommendations, and comments regarding study details, some of which are the same or similar between multiple licensing participants.

AEA's responses to proposed modifications, recommendations, and comments with detailed responses are provided below. These responses are organized by IFS Study Objective. The general format of responses includes first a restatement of the IFS Study Objective, followed by a summarization of the modification request, recommendation, or comment, and then AEA's response.

AEA's responses to other comments are provided in Table 2.5.1-1. Each licensing participant's comments pertaining to Study 8.5 ISR and its companion documents are included in Table 2.5.1-1. Comments are identified by the entity, page number, and paragraph number. In cases where multiple paragraphs are included in the table as a single "comment", the comment is identified by the first paragraph. Because some of NMFS and USFWS comments and or study modification requests were nearly identical, with differences in the numbering of the proposed modifications and phrasing, they were combined. When material differences occurred between the two sets of comments, both versions of text are supplied.

AEA provides additional information in the following supplements to Study 8.5 *2014-2015 Study Implementation Report* (November 9, 2015) that are filed with FERC as attachments to this filing:

- Attachment 4: Alternative HSC/HSI Development Methods Technical Memorandum
- Attachment 5: Discussion of Habitat Suitability Criteria Model Validation Technical Memorandum
- Attachment 6: Decision Support System Uncertainty Technical Memorandum

Table 2.5.1-1. Study 8.5 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp11_ph02	*The formulation of a Focus Area approach to the study design is seen as a highly effective and practicable approach to such a large and diverse drainage basin. Preliminary results confirm 1980 findings that the highest amount of biologic productivity along the Susitna River, including salmon spawning and rearing, tends to occur in the side channel, side sloughs and other off-channel habitats. Salmon spawning locations from the 1980's studies were observed to occur in nearly identical locations. This is not surprising given that information from the geomorphology study shows that the middle reach has been very stable over past several decades. This also corresponds with observations from other large glacial systems in Alaska where salmon seek out clear water refuges for spawning and rearing. We believe this study, combined with field data collection, modeling efforts, and linkage to other resource studies, will provide the information needed to inform and characterize the resources and ecological processes needed for evaluation of project impacts.*	AEA appreciates ADF&G's review of the ISR and supportive comments regarding the progress made on this study.
ADNR_ADFG_pp11_ph03	*We acknowledge the field effort and data collection by AEA's contractors. In particular, the winter field studies to identify fish distribution and habitat preferences were well designed and executed. These are very difficult studies to perform under challenging winter conditions.*	AEA appreciates ADF&G's review of the ISR and supportive comments regarding the progress made on this study.
ADNR_ADFG_pp11_ph04	*ADF&G staff have spent considerable time and resources on the development of study plans and we believe that the HSC/HSI sampling design is robust and will provide scientifically sound results. We support the approach to use accepted instream flow methods and field protocols to guide the data collection and modeling processes. ADF&G biometricians have reviewed proposed HSC/HSI methods and analysis and concur with the chosen approach and use of a generalized linear mixed model. Information collected has been informative and meets study objectives for the primary target species. Secondary target species were acknowledged to be of lower density and would be more difficult to meet HSC goals. Accordingly, the study plan anticipated this potential outcome and identified alternative methods to complete this information, if necessary.*	AEA appreciates ADF&G's review of the ISR and supportive comments regarding the progress made on this study.
ADNR_ADFG_pp12_ph01	*We believe AEA has made significant progress and is on track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's review of the ISR and supportive comments regarding the progress made on this study.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-02_ph03; NMFS_pp8.5-06_ph03	*Thus far, questions regarding the HSC developed and proposed for this project have prevented discussions with stakeholder to advance beyond this stage. Unless valid criteria can be identified, HSC curves cannot be developed or evaluated. Without realistic HSC curves, habitat cannot be modeled, as a function of flow. If habitat cannot be modeled as a function of flow, flow-habitat relationships cannot be predicted in space and time, model integration is impossible, and no environmental assessment can be made. Because this is how AEA proposed to evaluate the impacts associated with this project, the environmental assessment is stalled at this stage of development.* *Within this particular area of study, significant issues remain in the context of AEA's study design and analyses of HSC data. AEA's study design and data analyses procedures prevented an ecologically valid process for identifying relevant habitat criteria and model development. These procedures and the lack of information needed to assess the proposed models, or the criteria they rest upon, also prevented the assessment of HSC on a statistical basis. As it currently stands,* [the Services are] *in a position of describing how the HSC study was inadequate, given the objectives and determinations, and how necessary information has not been provided to allow a full assessment.*	AEA disagrees with the characterization of the status of the study implementation as well as the suggestion that there has been a lack of documentation of implementation and consultation with the TWG. Applying the study design and analysis described in the FERC-approved Study Plan and through consultation with the resource agencies, multivariate HSC models have been developed for Chinook Salmon fry and juvenile, Chum Salmon spawning, Coho Salmon fry and juvenile, Sockeye Salmon spawning, Arctic Grayling fry and juvenile, Whitefish fry and juvenile, and Longnose Sucker juvenile and adult (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Over the past four years, a large collection of technical reports and presentations have been provided to the licensing participants to document the HSC model development process and to solicit peer review. A list of those documents and presentations that have been produced in support of the HSC model development process are provided in Table 2.5.1-2 below. The Services and other licensing participants would gain a better understanding of the rationale, methods, and statistical approach utilized in development of the draft final HSC models upon a comprehensive and technical review of the material that has been provided.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-03_ph03; NMFS_pp8.5-35_ph04	Modification 1 (USFWS); Modification 4-1 (NMFS): *Habitat criteria must be surveyed with regard to the Project's hierarchical habitat model, according to the approved study plan. The statistical distributions of microhabitat among the various macrohabitats differ drastically. Surface water dominated habitats are typically turbid (in summer), turbulent, and have finergrained substrates. Groundwater dominated habitats are generally clear, tranquil, and are characterized by coarser substrates. Fish use of these criteria in these different macrohabitats varies. Unless habitat criteria are examined according to the Project's hierarchical habitat model, differences in utilization cannot be considered, habitat-specific criteria cannot be evaluated, and habitat-specific responses cannot be identified. The study was not conducted as provided for in the approved study plan.*	As explained below in Section 2.5.1.4.1, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan and it mischaracterizes the methods presented in the FERC-approved Study Plan. The Study Plan states (RSP Section 8.5.4.5.1.1.3) that the distribution and number of HSC study areas for the 2013 and 2014 data collection will be based on a stratified random sampling approach that is not only based on the hierarchical classification system, but several other attributes that include levels based on river segment, geomorphic reach, mainstem habitat composition, relative fish use, number of instream flow Focus Areas, mesohabitat composition, and site-specific attributes including the presence of groundwater upwelling, water clarity (turbid vs. clear water areas), and safety concerns. The Study Plan also indicates that a stratified random sampling scheme will be used to select study areas to cover the range of habitat types. The comments neglect these other considerations and are strictly focused on adherence to the hierarchical classification system. HSC sample site selection was conducted in accordance with the FERC-approved Study Plan, and data collection included measurements within habitat types as defined by the hierarchical classification system. Figures 5.2-1 through 5.2-10 in Study 8.5 SIR, Appendix D (*Habitat Suitability Curve Development*), depict locations of randomly selected study sites for HSC sampling in 2014. These figures clearly show sampling within a diversity of macrohabitat types as defined in the classification system. Importantly, these same sites include different mesohabitat types as defined in the classification system and HSC sampling included both measurements of turbidity and groundwater upwelling (via VHG measurements). The above appendix (Appendix D), along with the ISR and SIR (Study 8.5 ISR Part A, Section 4.5.1; Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*, Section 4.2) provide additional details regarding the rationale used in HSC sample site selection. From a cost perspective, if HSC sampling were to be done strictly based on rigid adherence to the hierarchical habitat classification system, attaining enough data to build stable models in multiple macrohabitat and mesohabitat types for all target species would require multiple years of effort, and cost from $1,000,000-$2,000,000.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-03_ph04; NMFS_pp8.5-34_ph07	Modification 2 (USFWS); Modification 4-2 (NMFS): *HSC must be analyzed according to the Projects hierarchical habitat model and HSC must be developed for individual macrohabitats. During the 1980s studies separate HSC models were developed for main and off-channel habitats, due to the gross differences in habitat and fish utilization represented within these surface and groundwater dominated environments. The study made no attempt to develop separate HSC models for these different macrohabitats. Only when the criteria are surveyed and analyzed in the context of the approved hierarchical habitat model will the study be able to address the approved study plan and consider the ecological relevance of the habitat criteria determined by FERC as necessary for investigation. The study was not conducted as provided for in the approved study plan.*	As explained below in Section 2.5.1.4.1, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan and it mischaracterizes the methods presented in the FERC-approved Study Plan. The Study Plan (RSP Section 8.5.4.5.1.1.3) states that the distribution and number of HSC study areas for the 2013 and 2014 data collection will be based on a stratified random sampling approach that is not only based on the hierarchical classification system, but several other attributes that include levels based on river segment, geomorphic reach, mainstem habitat composition, relative fish use, number of instream flow Focus Areas, mesohabitat composition, and site-specific attributes including the presence of groundwater upwelling, water clarity (turbid vs. clear water areas), and safety concerns. HSC sampling was conducted in accordance with the approved Study Plan, and data collection included measurements within habitat types as defined by the hierarchical classification system. Figures 5.2-1 through 5.2-10 in Study 8.5 SIR, Appendix D (*Habitat Suitability Criteria Development*), depict locations of randomly selected study sites for HSC sampling in 2014. These figures clearly show sampling within a diversity of macrohabitat types as defined in the classification system. However, the Services incorrectly assert that separate HSC models are to be developed for different macrohabitat types, which was never specified in the approved Study Plan. What was stated (RSP Section 8.5.4.5.1.1.7) was that HSC curves for each species and life stage would first be developed using pooled data from all sampling areas and time periods, and then, if appropriate, separate curves would be developed based on stream-specific data (i.e., geomorphic reach, mainstem habitat type, clear vs. turbid water, and upwelling areas) and winter vs. summertime sampling efforts. The Services also incorrectly assert that in the 1980s studies, separate HSC curves were developed for main and off-channel habitats. AEA completed a detailed summary of the HSC developed as part of the 1980s studies and found no mention of separate HSC for main and off-channel areas (Study 8.5 TM, March 25, 2013: *A Summary review of Susitna River aquatic and instream flow studies conducted in the 1980s with relevance to proposed Susitna – Watana Dam Project – 2012: A Compendium of Technical Memoranda*).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-03_ph05; NMFS_pp8.5-36_ph02	Modification 3 (USFWS); Modification 4-3 (NMFS): *Habitat criteria must be surveyed with respect to the distribution and periodicity of fish species and life stages present in the river.* *Habitat utilization and availability were universally surveyed within the distributions of fish that the study called clusters of known utilization. To identify which microhabitat criteria were ecologically relevant, the statistical distributions of utilized criteria must be compared to the statistical distribution of these criteria outside the local distributions of fish species and life stages. In other words, microhabitats must be surveyed in locations occupied by fish and in locations unoccupied by fish. Surveys of microhabitat outside the localized distributions of fish will provide AEA the ability to make valid comparisons with occupied microhabitat and analyze ecological relevance in a sound statistical and ecological manner.*	As explained below in Section 2.5.1.4.2, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. HSC sampling was conducted as described in the FERC-approved Study Plan Section 8.5 and in consultation with the resource agencies. Species' life stage periodicity developed during the 1980s studies were used extensively to determine sampling timing and ensure that the target species were present within the river system during HSC sampling. For the 2013-2014 HSC/HSI sampling, a stratified random sampling approach based on macrohabitat composition within each Focus Area, relative fish use, and life stage periodicity (Study 8.5 ISR Part A, Section 4.2) was used for selecting sampling locations and timing, with some adjustments made to final locations and sampling timing based on access and safety considerations. This approach enabled representative sampling of the range of macrohabitat types available to fishes during the time of year when a particular species and life stage was expected to be found within a Focus Area. Draft periodicity tables were developed to describe the temporal periods for which each priority species and life stage are expected to occur in the study area (Study 8.5 ISR Part A, Appendix H: *Periodicity Tables*). These tables were based largely on information from the 1980s studies as presented in a TM submitted to the FERC March 25, 2013 titled *Summary Review of Susitna River Aquatic and Instream Flow Studies Conducted in the 1980s with Relevance to Proposed Susitna – Watana Dam Project – 2012: A Compendium of Technical Memoranda*. This information was used to help determine the timing of HSC surveys. The estimated cost for expanding HSC sampling to areas unoccupied by fish outside of sites identified consistent with the FERC-approved Study (RSP Section 8.5.4.5.1.1.3) would be $650,000-$750,000.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-03_ph06; NMFS_pp8.5-36_ph04	Modification 4 (USFWS); Modification 4-4 (NMFS): *Surveys of available unoccupied habitat should be conducted in habitats similar to those occupied in order for ecologically and statistically valid comparisons to be made.* *As executed, AEA surveyed availability in the wrong dimension (lateral instead of longitudinal) and in different habitat types, from those utilized. This was ecologically and statistically invalid. Availability could only have been assessed in unoccupied habitats within the same habitat stratum (e.g. unoccupied side slough riffles as compared to those occupied), in order to be valid. This failure was a product of the disregard for the approved hierarchical habitat model that was to be used to structure data collection and analyses.*	As explained below in Section 2.5.1.4.2, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Surveys of available habitat were performed in habitats immediately adjacent to occupied habitats, both laterally and longitudinally, within the same habitat units that were utilized. This modification request is based on faulty information and apparent confusion regarding sampling scale. Identifying and sampling unoccupied habitats as requested by the Services would first require that the site be sampled to determine if fish were present. If fish were present, then another site would need to be selected until an unoccupied site in an identical macrohabitat could be located. This type of sampling was not part of the FERC-approved Study Plan and the Services have not established "good cause" to modify the Plan. This modification is similar to NMFS Modification 4-3 and USFWS Modification 3; the estimated cost for expanding HSC sampling to areas unoccupied by fish beyond sites identified consistent with the FERC-approved Study Plan (RSP Section 8.5.4.5.1.1.3) would be $650,000-$750,000.
USFWS_pp8.5-04_ph02; NMFS_pp8.5-36_ph06	Modification 5 (USFWS) Modification 4-5 (NMFS): *The HSC study experimental design compare the dependence of fish habitat selection on VHG. This can only be accomplished by surveying habitats with a different VHG.* *The study demonstrated a misunderstanding of ground and surface water interactions on alluvial floodplains. Both utilized and available habitats were located within the same longitudinal positions and would have been characterized by the same regional VHG. Furthermore, the study did not assess VHG locally, in association with spawning or rearing, and did not assess VHG hierarchically, according to the Project's hierarchical habitat model. Ground and surface water exchanges occur locally, in association with channel bedforms, at intermediate scales between main and side channels (and sloughs), and regionally at the floodplain scale. Exchanges operating at each of these scales are known to influence the distribution of spawning.*	As explained below in Section 2.5.1.4.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification to expand the VHG sampling to areas beyond the FERC-approved study sites (RSP Section 8.5.4.5.1.1.3) is $350,000-$450,000 for one study year.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-04_ph03; NMFS_pp8.5-36_ph08	Modification 6 (USFWS); Modification 4-6 (NMFS): *AEA must analyze their data in accordance with their proposed and approved hierarchical habitat model.* *AEA pooled all data from all habitats throughout the river to analyze habitat criteria and develop HSC. Pooling forfeits examination of habitat relationships within different habitat types where different life-history tactics are known to exist. Pooling effectively led AEA to abandon the hierarchical habitat model they developed for this project. The pooling of the data was invalid from a statistical, ecological, and evolutionary perspective.*	As explained below in Section 2.5.1.4.1, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. AEA disagrees with the assertion that HSC data were not analyzed in accordance with the FERC-approved Study Plan. HSC data collected from within different macrohabitat types and different reaches were not "pooled". The random effect for sampling event in the statistical model provides for different levels of fish use, while assuming the relationship between individual covariates and habitat preference is consistent (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development*). This does not amount to "pooling". The Services' request for data to be analyzed within the hierarchical habitat model is redundant to other modification requests from the Services, including USFWS Modifications 1 and 2 (USFWS_pp8.5-03_ph03; USFWS_pp8.5-03_ph04) and NMFS corresponding Modifications 4-1 and 4-2 (NMFS_pp8.5-35_ph04; NMFS_pp8.5-34_ph07).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-04_ph04; NMFS_pp8.5-37_ph01	Modification 7 (USFWS); Modification 4-7 (NMFS): *AEA must evaluate microhabitat criteria by comparison and examination of relationships between abundance and microhabitat criteria. AEA must evaluate the statistical and ecological relevance of these relationships using statistical methods.* [USFWS]: *As discussed below, AEA's 2014 Technical Memorandum did not accomplish this. As noted by AEA, there was a mismatched agenda and scales in which abundance and microhabitat data were surveyed. There were no adult salmon abundance data, microhabitat data were not integral to the collection of the abundance data, and groundwater data were incomparable. As such, AEA was emphatic about their deference to the HSC study to identify which microhabitat criteria were important to fish habitat selection. Unfortunately, AEA did not use statistical methods to identify relevant criteria in the HSC study.* [USFWS and NMFS] *Through the use of statistical methods, AEA should identify which criteria are ecologically relevant to fish habitat selection and use this subset of relevant criteria to develop HSC models (with logistic regression or otherwise). AEA used a univariate utilization curve generation process to select habitat criteria for use in multivariate modeling. This is an invalid way to select criteria.* *Utilization does not equate to ecological relevance. Utilization will associate with any number of existing microhabitat criteria and often can simply reflect the distribution of a given criterion, irrespective of the relevance to habitat selection. Identification of relevance requires examination of microhabitat availability outside the local distributions of species and life stages. Relevance can be found only when utilized criteria differ from what is truly available, in a statistically significant way. There are a number of basic exploratory statistical methods that can be used to evaluate the significance of differences between the statistical distributions of occupied and unoccupied microhabitat. The nature of the data will determine which basic method to use, through reference of any basic statistics text.*	As explained below in Section 2.5.1.4.4, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. As recommended in the FERC Study Plan Determination (page B-86 of Study 8.5 SPD, April 1, 2013) and as described in *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables Technical Memorandum* (Study 8.5 TM, September 17, 2014), AEA completed a detailed statistical and ecological evaluation of potential relationships between fish abundance and habitat use. This report describes the findings of the analysis and recommendations for which variables to include in the HSC model. The analysis to date shows which habitat variables show predictive value and should be included in the HSC model as continuous predictors. Ecologically relevant habitat variables such as water depth, velocity, temperature, dissolved oxygen, pH, and distance to water's edge will be included as HSI variables, meaning that habitats that fall outside of an ecologically relevant threshold (minimum or maximum) will be assumed to be completely unusable, regardless of whether they are also included as a variable that determines the relative value within the HSC models.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-05_ph02; NMFS_pp8.5-37_ph04	*AEA's selection of criteria for HSC model development prevented a statistically valid examination of criteria and examination of interactions between criteria. AEA selected criteria for multivariate modeling that were necessary for implementation of a hydraulic habitat evaluation, regardless of whether or not these criteria were ecologically relevant to habitat selection.*	AEA disagrees with this statement. A detailed description of the statistical examination of each microhabitat variable considered for inclusion in the HSC model(s) is presented in ISR and SIR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Criteria Development*; Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). The habitat suitability modeling provides information on which habitat variables (of those collected synoptic with HSC) are most predictive of fish presence. The FERC-approved Study Plan listed the habitat variables for potential inclusion in the HSC models, including: depth, velocity, substrate, cover, turbidity, upwelling-downwelling, surface water temperature, dissolved oxygen, and specific conductance. In response to a FERC recommendation (page B-85 of Study 8.5 SPD, April 1, 2013), additional analysis was completed to determine if "strong" relationships between fish abundance and eight microhabitat variables (surface flow and groundwater exchange fluxes, dissolved oxygen [intergravel and surface water], macronutrients [i.e., nitrogen and phosphorus], temperature [intergravel and surface water], pH, dissolved organic carbon, alkalinity, and Chlorophyll-a) were present. Multiple regression approach modeling was then used to combine all significant predictors (variables identified during univariate modeling) into a combined index of preference or suitability. The statistical methods used by AEA are sound, and are used quite commonly in the resource selection literature (Boyce et al. 2002; Gillies et al. 2006; Johnson et al. 2006; McRae et al. 2012). The methods and results were reviewed by ADF&G biometricians who stated (ADNR_ADFG_pp11_ph04): *"ADF&G biometricians have reviewed proposed HSC-HSI methods and analysis and concur with the chosen approach and use of a generalized linear mixed model. Information collected has been informative and meets study objectives for the primary target species. Secondary target species were acknowledged to be of lower density and would be more difficult to meet HSC goals. Accordingly, the study plan anticipated this potential outcome and identified alternative methods to complete this information, if necessary."* The methods that AEA has applied in developing HSC have also been presented at the International Statistical Ecology Conference (June 2016).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-05_ph05; NMFS_pp8.5-07_ph03	*While hydraulic habitat evaluation can, in certain settings, serve as a useful tool for evaluating alternative flow scenarios, it cannot be applied without adequate consideration of its appropriateness. According to USGS[1], a simple hydraulic habitat analysis such as conducted in PHABSIM is only appropriate (realistic) when habitat is limited by surface water hydraulics used to represent habitat. Users must demonstrate that habitat is primarily a function of depth and velocity. If users cannot perform this demonstration, project stakeholders must be willing to make this assumption.* [The Services do] *not agree that this is a valid assumption and instead requested a scientific process through which habitat criteria can be weighed according to their ecological relevance.*	AEA disagrees. The 2-D PHABSIM based analysis being conducted as part of the Susitna-Watana Hydroelectric Project is perhaps the most sophisticated, complex, and geographically expansive of any application to date. As noted by FERC in the Study Plan Determination for Study 8.5 (April 1, 2013, Appendix B: *Staff Recommendations on Proposed and Requested Studies*, page B-94): *"PHABSIM, including its use of HSC-HSI is a proven and accepted approach to revaluating changes to fish habitat relationships at the microhabitat scale (see 5.9(b)(6))."* This comment seems to inferentially suggest that water depth and water velocity are not determinants of fish habitat in the Susitna River. AEA's acknowledgement that these two parameters are not the only determinants led to the evaluation of a variety of resource parameters that influence fish habitat. Nevertheless, depth and velocity are two of the most important in terms of flow-related parameters that may be influenced by Project operations. Other parameters being evaluated as part of and in addition to the PHABSIM analysis in the Fish and Aquatic IFS Study 8.5 or as part of other resource studies include, but are not limited to, the influence of groundwater upwelling-downwelling, water temperature, dissolved oxygen and other water quality characteristics. Further, AEA does not consider the PHABSIM habitat-hydraulic modeling being conducted as a "simple hydraulic analysis."
USFWS_pp8.5-06_ph02; NMFS_pp8.5-07_ph04	*AEA described HSC-HSI as curves that translate hydraulics into habitat suitability, based on assumptions made about functional relationships. These assumptions were made in the place of scientific assessments of biological-ecological relevance, necessary to discriminate between which HSC-HSI should be used to estimate habitat, as a function of flow. For a project of this scale, with the resources involved, these assumptions of ecological relevance leave stakeholders with great uncertainty about the AEA's ability to develop realistic flow-habitat relationships needed to characterize existing conditions for the proposed project.* [The Services do] *not support making untested assumptions about habitat criteria and HSC upon which AEA has proposed to base their entire assessment of the Project. Modifications to the HSC study must be implemented prior to a successful demonstration of the appropriateness of PHABSIM-2D Habitat Modeling for assessing flow habitat relationships for this Project.*	AEA disagrees with these statements. HSC models are a generally accepted and commonly used method for instream flow studies. The methods used by AEA are an advanced form of HSC modeling, using site-specific multivariate preference curves. The point of the HSC univariate analyses was to determine whether fish preference for habitats can be predicted using microhabitat variables. The analysis to date shows which habitat variables show predictive value and should be included in the HSC model as continuous predictors. Ecologically relevant habitat variables such as temperature and dissolved oxygen will be included in all models as an HSI variable, meaning that habitats with water temperatures or dissolved oxygen outside an ecologically relevant threshold will be assumed to be completely unusable, regardless of whether they are also included as a variable that determines the relative value of habitats between unusable and the highest quality. The ISR and SIR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Criteria Development*, Section 2; Study 8.5 SIR, Section 4.5; Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*) provide detailed descriptions of the statistical methods used to determine the variables that were the best predictors of habitat selection.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-07_ph02; NMFS_pp8.5-08_ph03	*At this point, the feasible, but incomplete approach, is directed at estimates of output variables (such as habitat suitability for a particular species and life stage) under a set of specified "cases" defined by study site, hydrology, and channel geometry; such as, study sites (10 Focus Areas (FAs)) under 3 different discharge year-types (wet, average, dry) under 3 different possible channel geometries (present, 25 year and 50 year). From a practical perspective that is 90 different cases-simulations for each proposed operational alternative. It is not clear from the ISR how all of this information will be integrated into a final analysis of Project effects and if the analysis will provide an appropriate representation of important spatial and temporal variation in geometry, river network position, groundwater, temperature, ice formation, mechanical ice breakup, intra-annual timing of discharge and stage, and the long-term signature of extreme events. In addition, the limited scenarios and the integration of current model capabilities do not address the uncertainty surrounding concerns for fish species and life stages, invertebrates, and plants that must been a critical element of responses to dam construction and operation throughout the world. The estimates from each "case" are not really random samples of all possible outcomes, but at least can be plotted on the same graph with different colored symbols to be able to compare the variation that the proposed operational scenarios might have on instream flow habitat.*	AEA acknowledges the overall complexity of the analysis and has continued to make progress since the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting in the integration of the different resource model outputs as outlined in the analytical framework described in Study Plan Section 8.5 (RSP Section 8.5.4.1). Specific to the temporal and spatial habitat analysis, AEA described the general approaches that will be used in completing the temporal habitat analysis in the Study Plan (RSP Section 8.5.4.7.1.1), with further details provided in the ISR (Study 8.5 ISR Part C, Section 7.7.1.1.1), and during the Proof of Concept meeting on April 15-17, 2014. These include varial zone analysis, effective spawning-incubation habitat analysis, analysis of rearing habitats, breaching flow analysis, and analysis of other riverine processes (e.g., water quality, sediment deposition, ice) that may directly influence fish habitats. As noted in the SIR (Study 8.5 SIR, Section 4.6.4), modifications have been made to the 2-D Fish Habitat Model to allow for a cell by cell analysis of spawning and incubation habitats over time, which is needed to complete the effective spawning-incubation habitat analysis. Relative to spatial analysis and the expansion or extrapolation of habitat-flow relationships from modeled to un-modeled locations, AEA presented and discussed four options (linear distance, microhabitat linear distance, macrohabitat area, and macrohabitat area weighted by fish use) for completing the spatial analysis during the Proof of Concept meeting on April 15-17, 2014 and described these further in the ISR (Study 8.5 ISR Part C, Section 7.7.1.1.2). One of the options involved weightings based on fish use and it was deemed inappropriate for further consideration. An additional option raised during the meetings was to simply rely on the models developed in the Focus Areas for evaluating Project operational effects without expansion to un-measured areas. As indicated in the SIR (Study 8.5 SIR, Section 5.7.2), further discussions will occur with the licensing participants regarding these and potentially other options before selecting a specific approach for conducting the spatial analysis.

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USFWS_pp8.5-07_ph03; NMFS_pp8.5-08_ph04	*Project operational alternatives need to be compared realistically and appropriately. The Services are most interested in the rank order of alternatives and their general absolute magnitudes.* [The Services] *don't want to end up with the relatively best habitat amongst a set of habitat values all producing extirpation. They also don't want an alternative which is clearly the best under representative wet, dry, and normal years, but that produces a terrible result if we are wrong about the role of ice in channel change or ignore the trajectory of channel change that might be triggered by an unusual sequence of years.* [The Services recommend] *focusing the "cases" examined and portrayed to a mixture of (1) those that are most likely or "representative", and (2) those that might result in the biggest differences in the absolute magnitude and rank order among the alternatives.*	The evaluation of alternate operational scenarios will occur as part of the USR and while developing the License Application using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests and address issues including the role of ice in channel change. The results of Existing Conditions and a Run-of-River operational scenario will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-11_ph05; NMFS_pp8.5-11_ph05	*Incomplete and inconsistent sampling of FAs is a variance to the approved Study Plan. Groundwater studies are focused mainly in FA-128 (Slough 8A in MR-6) and FA-104 (Whiskers Slough in MR-8) only, and conclusions regarding groundwater in FAs rely more on 'expert' opinion than from results of rigid sampling design of field measurements from the FAs. The RSP identified that meso- and microhabitat data would be collected-identified on-the-ground in conjunction with the HSC and fish distribution and abundance study to assist in ground-truthing the mesohabitat classifications identified by the 2012-2013 aerial mapping. However, the ISR states that this did not occur due to time constraints and that the microhabitat data would simply be linked to mesohabitat classifications obtained by the aerial mapping. If this is true, then there is no validation data available for the mesohabitat classifications. Similar concerns in the level of data collection efforts are noted for water quality (5.5, 5.6), ice processes (7.6), and fish and aquatics studies (9.5, 9.6, 9.7, 9.8. 9.9).* *Restriction of land access during 2013 resulted in unequal sampling efforts across FAs in general. While land access was not available for the three upper Focus Areas adjacent to CIRWG lands in 2013, this restriction was resolved in 2014 and AEA was able to complete detailed surveys in one of the three Focus Areas (FA-151-Portage Creek) in September 2014. However, work on FA-173 (Stephan Lake Complex) and FA-184 (Watana Dam) was deferred. AEA suggested that not initiating studies in these FAs on a consistent timeline will not have a substantive effect on the completion of this study because all field work, data analysis and modeling will ultimately be completed prior to submittal of the license application. ISR 8.5 Part D and the SIR reports provide summary information for data collection efforts that occurred in 2014 at all 10 FAs.*	AEA agrees that not all of the Focus Areas have been surveyed to date; FA-173 (Stephan Lake Complex) and FA-184 (Watana Dam) for reasons related to access (as noted in second paragraph of comment) and the State's financial situation, still remaining to be surveyed. However, AEA does not agree that the Focus Areas have been inconsistently sampled. As noted in the FERC-approved Study Plan (RSP Section 8.5.4.2.1.2), the ten Focus Areas are sites located in various geographic areas of the Middle River that will be the subject of intensive investigation by multiple resource disciplines including instream flow, groundwater, water quality, ice, etc. However, the Services have asserted that this means ALL of the resource disciplines need to study ALL of the Focus Areas. This was never the case and was clarified in the ISR (Study 8.5 ISR Part A, Section 4.2.1.2.1) and repeatedly during several TWG meetings. Moreover, it hardly makes sense to study all resource disciplines at every Focus Area since specific resource issues can differ by reach. That is why, for example, Fish and Aquatics IFS 8.5 spent limited time investigating spawning habitats in FA-115 (Slough 6A), since it does not contain spawning habitat. Groundwater studies concentrated on those Focus Area where the influence of groundwater would be the most profound on specific resource issues, in particular fish ecology (spawning, egg incubation, fry emergence, overwintering habitats) and ecology of the riparian community. As a result, detailed groundwater studies are being conducted in FA-104 (Whiskers Slough), FA-115 (Slough 6A), FA-128 (Slough 8A), and FA-138 (Gold Creek) (not just FA-128 and FA-104) with groundwater related data (e.g., TIR imagery, temperature) being collected in other Focus Areas and locations outside of the Focus Areas. Groundwater models suitable for addressing resource questions are being developed for FA-104, FA-115, FA-128, and FA-138, with the level of model sophistication varying depending on specific questions to be addressed and data availability. To date, the greatest effort has been expended in development of a 3-D MODFLOW model for FA-128. This Focus Area has both fish and aquatic, and riparian resource issues and was the central focus in the Proof of Concept analysis described in *Middle River Fish Habitat and Riverine Modeling Proof of Concept* (Study 8.5 ISR Part C, Appendix N), that served to conceptually demonstrate model integration across resource disciplines. This model is undergoing further refinement as part of continued model integration work designed to demonstrate actual model outputs and linkages to the flow-habitat models. See Section 2.6.5 (Study 9.9 – Characterization and Mapping of Aquatic Habitats Study) for response to comment regarding mesohabitat and microhabitat.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-12_ph02; NMFS_pp8.5-11_ph07	*The ISR (Part C, 1 of 2), states that there will be two years of study for the three FAs located on CIRWG land. This is problematic because the 2013 data which constitutes year-one of study for the Susitna Watana Project had not yet been reviewed by stakeholders prior to 2014 field efforts.* *In addition the Services are concerned with the potential for erroneous conclusions of data from comparative relationships among inconsistent hydrologic years and conditions across FAs (i.e., 2013 and 2014). AEA has created a temporal mis-match of data collection efforts. FAs were to provide detailed understanding of river processes by geomorphic reach. Two years of data does not allow for model validation with independent data, or model condition and variation under multiple hydrologic or biologic years.*	AEA does not agree that the proposed two years of study of the three Focus Areas (FA-151 [Portage Creek]; FA-173 [Stephan Lake Complex], and FA-184 [Watana Dam]) are problematic relative to study completion. Detailed surveys to collect bathymetric data and other physical and hydraulic data required from 2-D hydraulic model development were initiated on the lower seven of the ten Focus Areas in 2013 and study results presented in the June 2014 ISR. However, limited surveys were completed on the upper three Focus Areas (FA-151 [Portage Creek]; FA-173 [Stephan Lake Complex]; FA-184 [Watana Dam]) due to access restrictions associated with CIRWG lands. These restrictions were resolved and since the June 2014 ISR, AEA has completed detailed bathymetric and 2-D model calibration surveys at FA-151. Data collection in FA-151 was closely coordinated between and among the different resource leads. The bathymetric surveys were completed on June 22, 2014 following the same general procedures described in Study 8.5 ISR Part A, Section 4.6.1.2.2. Detailed methods used for collecting the field data for the calibration transects are provided in Study 8.5 SIR, Appendix C: *2014 Moving Boat Acoustic Doppler Current Profiler (ADCP) Measurements*. AEA conducted HSC/HSI sampling in those three Focus Areas in 2014 with results reported and available for licensing participants' review most recently as part of the SIR (Study 8.5 SIR, Appendix D: Habitat Suitability Criteria Development; HSC dataset at http:--gis.suhydro.org-reports). AEA also completed bathymetric surveying of FA-151 in 2014 so that all data necessary for developing 2-D hydraulic models have been collected at that Focus Area. The remaining work includes the bathymetric surveying of the upper two Focus Areas (FA-173 and FA-184), and 2-D model development and habitat modeling for all three Focus Areas, all of which can be completed in a single year. AEA does not consider the collection and use of data from two separate years for developing hydraulic and habitat models as creating a temporal mismatch. While each of the Focus Area specific 2-D hydraulic models are developed independently of each other and hence are subject to the prevailing topographic conditions during the time of data collection, the flows routed through these modeled sections are all based on the same Open-water Flow Routing Model. Moreover, comparative analysis of channel cross-sections between the 1980s and current cross-sections overall showed minimal change (Study 6.5 TM, September 17, 2014: *Susitna River Historical Cross Section Comparison (1980s to Current)*) which is reflective of a relatively stable channel within the Middle River Segment of the Susitna River. Thus, inter-annual topographic variation within the complex of channels contained in a given Focus Area is likely to be relatively small, as would the differences be in 2-D models developed from data collected in two different years.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-12_ph06; NMFS_pp8.5-12_ph04	*Adult salmon spawning distribution in the lower Middle River is unknown because of limited tagging effort and no tagging of Pink Salmon. Yet, Pink Salmon have been observed in Whiskers and Slough 6A and are an integral part of the ecology of the FAs.*	Characterization of AEA's 3-year adult salmon tagging program as a limited tagging effort with no tagging of Pink Salmon is inaccurate. AEA's tagging program was extensive and based on the number of tags allocated, one of the largest ever conducted in Alaska. A total of 9,661 salmon were radio-tagged from 2012-2014 including 1,431 Pink Salmon along with 4,352 Chinook Salmon; 2,291 Coho Salmon; 1,080 Chum Salmon and 507 Sockeye Salmon. Pink Salmon tag implantations included 800 and 631 in the Lower River and Middle River, respectively. Very large numbers of radio-tagged adult salmon in the Salmon Escapement Study 9.7 provided robust statistical power for evaluating size selectivity and estimating abundance and distribution of spawning salmon. AEA agrees that Pink Salmon have been observed in Whiskers and Slough 6A and they are an integral part of the ecology of the Susitna River.
USFWS_pp8.5-12_ph07; NMFS_pp8.5-12_ph05	*A Project demonstration of hydraulic flow routing and 2D modeling has been limited to within FA-8A.*	The demonstration of hydraulic flow routing and 2-D modeling has been primarily centered around FA-128 (Slough 8A), but preliminary results of 2-D modeling and linkages with the OWFRM have also been described for FA-104 (Whiskers Slough) as part of the November 13-15, 2013 Riverine Modeling meeting. http://www.susitna-watanahydro.org/wp-content/uploads/2013/11/SuWA-FGM-MR-Riverine-Modeling-11-13-13_DRAFT.pdf. In addition, the development of Version 2.8 of the Open-water Flow Routing Model (described in Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*), includes calibration results for Middle River and Lower River locations. The April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*) provided a demonstration of the status of modeling integration using FA-128 (Slough 8A). This demonstration was prepared early in the study implementation process to allow potential data gaps or format inconsistencies to be identified and resolved. Preliminary modeling results for Existing Conditions and at least one operating scenario will be presented in the USR (FERC_ppA-1_ph01, June 23, 2016).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-12_ph08; NMFS_pp8.5-12_ph07	*Groundwater studies are not adequate in scope and scale to provide comprehensive understanding at a scale relevant to fish.* *Data collection is occurring in one FA to develop a 3D model capable of predicting Project operational surface-groundwater exchange at a scale relevant to fish habitat.*	AEA disagrees with this broad statement and refers to Section 2.4.1 (Study 7.5 – Groundwater Study) for details. As an initial matter, the FERC-approved Groundwater Study Plan was designed to address the technical issues raised by licensing participants specifically related to potential effects of Project operations on groundwater and its influence on fish habitat (Study 8.5) and riparian vegetation (Study 8.6). AEA acknowledges the development of a preliminary 3-D MODFLOW at FA-128 (Slough 8A) (Study 7.5 SIR, Appendix B: *Preliminary MODFLOW Three Dimensional Groundwater Model for Focus Area FA-128 (Slough 8A)*). AEA has been making further refinements and calibration adjustments to this model and is specifically working on the integration of model outputs into the IFS Fish Habitat Modeling. AEA also notes that further detailed analysis of groundwater data has occurred at three other Focus Areas: FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek). The analysis in those Focus Areas is employing various modeling and data integration approaches directed toward evaluating Project effects on fish and riparian habitats and is consistent with the FERC-approved Study Plan.
USFWS_pp8.5-12_ph10; NMFS_pp8.5-12_ph08	*Water quality studies do not provide data for lateral off-channel habitats, and do not consider the influence of surface-groundwater exchange.*	AEA disagrees with the Services' description of water quality studies; water quality studies do consider the influence of SW/GW exchange. Water quality studies include steps to refine Focus Area modeling techniques to represent mechanisms responsible for lateral variability in Focus Areas and transfer Focus Area water quality model results to habitat modeling studies, as described in the ISR (Study 5.6 ISR Part D, Section 8: Steps to Complete the Study). Preliminary results for Existing Conditions and at least one operating scenario will be presented in the USR (FERC_ppA-1_ph01, June 23, 2016) for all models required by the Study Plan, including the integration of groundwater and water quality modeling.
USFWS_pp8.5-12_ph11; NMFS_pp8.5-12_ph09	*Macro-invertebrate and productivity studies are only being conducted at a subset of FAs and only two FAs that overlap with salmon distribution in the Middle River.*	This comment pertains to the River Productivity Study RSP Section 9.8. See Section 2.6.4 (Study 9.8 – River Productivity Study) response to USFWS_pp9.8-12_ph1 and NMFS_pp9.8-23_ph1, and for further discussion, see River Productivity Study 9.8 AEA response to Recommendation 5.1-b.
USFWS_pp8.5-13_ph01; NMFS_pp8.5-12_ph10	*Fish passage studies have not been completed and rely on 2D modeling, which may not be robust enough to evaluate passage.*	This comment pertains to the Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries RSP Section 9.12. See Section 2.6.8 (Study 9.12 – Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-13_ph02; NMFS_pp8.5-12_ph11	[The Services] *request multiple, consecutive and concurrent years of data for relevant disciplines be collected across FAs to be used as model inputs.*	While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this suggestion because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations. See response above to USFWS_pp8.5-12_ph02; NMFS_pp8.5-11_ph07. Additionally, AEA is conducting its studies in accordance with the FERC-approved Study Plan that was developed to enable an adequate level of study to address study objectives for numerous disciplines, assess Project impacts, and develop appropriate PM&Es. AEA's actions have included data collection exceeding the two years specified in the Study Plan (Table 8.5-14 in RSP Section 8.5); AEA collected data that for some resource components has spanned four years (e.g., HSC-related data collection efforts commenced in the winter of 2012 and extended into 2015, and in terms of data monitoring [water temperature, dissolved oxygen] into 2016). The structure of the respective models was based on the same physical and hydraulic data collected during 2013 and to a lesser extent in 2014. This is important so that each of the models was foundationally developed around common data sets. There is no indication that wide-spread changes to channel morphology, water chemistry, or biological conditions have or will occur in the short time span between sampling efforts. Even if some minor fluctuation in conditions do occur, the expanded sampling timing may be helpful in defining or quantifying the natural variability in resource conditions.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-13_ph05	*Recommendation* *Two years of groundwater and water quality data and modeling (in addition to the hydraulic modeling) to develop site specific habitat models for each FA. This will require integration of 3D groundwater models and the water quality models to provide analysis at micro- and mesohabitat scales within each FA.*	AEA disagrees. The intensive sampling and modeling requested for each Focus Area exceeds the level of effort described in the FERC-approved Study Plans for the Groundwater (Study 7.5) and Water Quality (Study 5.6) studies, and exceeds the level of effort necessary to meet Study Plan objectives. While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause." The Groundwater Study Plan did not specify application of 3-D models at all Focus Areas, but rather that groundwater modeling would be applied as needed to address specific resource questions. For example, under Objective 5 of the Groundwater Study Plan (RSP Section 7.5.4.4) it states that: *"Where appropriate, MODFLOW (Feinstein et al. 2012; Maddock et al. 2012; USGS 2005, 2012) GW/SW interaction models of floodplain shallow alluvial aquifer and surface water relationships will be developed."* As described in the FERC-approved Study Plan (RSP Section 7.5.4.1.1), the approach for addressing Project effects on groundwater resources recognizes that there are historical and contemporary groundwater data available for the Susitna River including that from the 1980s and other studies. In addition, model outputs from FA-128 (Slough 8A) that are being developed using 3-D MODFLOW model, can be compared with outputs derived with 1-D and 2-D models at FA-128 (Slough 8A) as one means to test the applicability of the 1-D and 2-D models being applied to other Focus Areas. The estimated cost for intensive water quality and groundwater sampling and modeling as described in the USFWS recommendation is $1,300,000-$1,600,000 per Focus Area.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-13_ph06	*Recommendation* *FA study sites and number of sites in the Middle River and Lower River should represent the range of biological use of habitats. FA study site locations and site numbers are not adequate to determine fish distribution and identify the habitat variables within relevant macrohabitats to assess fish-habitat associations.*	While not proposed as a modification to the Study Plan, as explained below in Section 2.5.1.2.1, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was not implemented as provided by the approved Study Plan. Consistent with the FERC-approved Study Plan, since the effects of Project operations attenuate in a downstream direction, and due to the increased size and complexity of the Lower Susitna River, AEA did not use the same Focus Area approach as applied in the Middle River segments (Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies 2013-2014*). Rather, 1-D study sites were selected within LR-1 and LR-2 that were considered representative of main channel, off-channel, and tributary mouth habitat types within those reaches. AEA measured main channel, off-channel, and tributary mouth habitats in the Lower River and initiated 1-D model development (Study 8.5 ISR Part A, Appendix I: *Lower River Hydraulic Model Calibration*; Study 8.5 ISR Part C, Appendix O: *Fish Habitat Modeling in Lower River)*. Assuming AEA would have to collect additional bathymetry, Focus Area hydrology, HSC, and Focus Area substrate data, the estimated cost of this recommendation would be $900,000-$1,000,000 per additional Middle River Focus Area and $300,000-$450,000 per Lower River study site without consideration of additional sampling associated with the other integrated physical process resource areas.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-13_ph07	*Recommendation* *Data protocols and sampling designs of 2013 should be rectified before additional years of Project data collection occur. Due to concerns with the 2013 data, the USFWS recommends that 2014 data not be considered as year-two Project data until FERC determines that information collected in 2013 meets the approved SPD requirements. The recommendation is based on concerns related to the 2013 sampling design and data collection efforts, and the fact that the 2014 data was collected in a similar manner.*	While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this recommendation as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was not implemented as provided by the approved Study Plan. Although no specific issues with data protocols or sampling design are specified by the Services, AEA has adhered to strict QA/QC procedures (Study 9.5/9.6 Implementation Plan, Appendix 12, March 1, 2013: *Susitna Data Standards*) throughout study implementation and data collection activities and has provided periodic updates via TWG meetings, the ISR, SIR, and accompanying appendices, as well as regular postings of data on the Geographic Information Network of Alaska (GINA) website (http://gis.suhydro.org/). AEA stands behind the integrity and reliability of the data collected in 2013 and 2014 as all data were collected in accordance with the FERC-approved Study Plan and all QA/QC procedures were followed (Study 8.5 ISR Part A, Section 4.2). As described in the Study 8.5 ISR Part D, Section 8: Steps to Complete the Study, an additional year of HSC/HSI measurements will be completed in Middle River Focus Areas FA-151 (Portage Creek), FA-173 (Stephan Lake Complex), and FA-184 (Watana Dam), and in the Lower River during the next study year. While HSC/HSI data collection are proposed for the next study year, repeating the 2014 data collection efforts as described in this recommendation would cost more than $300,000.
USFWS_pp8.5-14_ph02	*Modifications:* *Representative site selection of adult salmon spawning and juvenile salmon rearing locations in the Lower River. Locations that were considered to be migration barriers in the 1980s were used as sampling sites. Results from the current adult escapement study should be used to identify representative spawning locations, and results from the 1980s or the current FDA study should be used to identify important juvenile rearing and overwintering locations. This modification is requested to ensure that Project effects on Lower River salmon spawning and rearing are evaluated at known salmon spawning and rearing locations. The overall development of Lower River studies falls behind that of studies in the Middle River.*	As explained below in Section 2.5.1.2.2, AEA requests FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan (Technical Memorandum, *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014* (March 1, 2013). As such, there is no additional cost for implementing this modification. Fish habitat and fish sampling surveys conducted by AEA in the Lower River were completed in accordance with the FERC-approved Study Plan. The findings of those studies regarding the utilization of tributary, tributary mouth, and mainstem habitats sampled in the Lower River Segment of the Susitna River by adult holding and spawning salmon were generally confirmed by results of the Salmon Escapement Study (Study 9.7). See Section 2.5.1.2.2 for more information.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.5-13_ph02	*Modification 2-1: NMFS recommends using results from the escapement study combined with new surveys to locate salmon spawning and rearing habitat to select representative FAs in the Lower River. FA study sites in the Lower River should represent the range of biological use of habitats. Results from the current adult escapement study should be used to identify representative spawning locations, and results from the 1980s or the current FDA study should be used to identify important juvenile rearing and overwintering locations.* *In order to focus study efforts to quantify project effects on salmon you need to identify where in the lower reach those salmon are spawning and rearing. This modification is requested to ensure that Project effects on Lower River salmon spawning and rearing habitats are evaluated at known salmon spawning and rearing locations.* *The selected Lower River study sites are locations that, in the 1980s, investigators believed may present fish migration barriers. These sites are not representative of the geomorphic reach, were not randomly selected, and are not areas of known spawning and rearing. Data analysis results from these locations were presented at the Proof-of-Concept (POC) meeting as an assessment of Project effects for rearing habitat. Instream flow analyses within the Lower River should occur at locations of known spawning and rearing habitat or critical sites. Selection of critical sites would be the most cost-effective method of evaluating Project effects on the Lower River. AEA stated that specific study site locations and transects within LR-2 of the Lower River will be selected and surveyed in 2016. Prior to conducting this work, AEA and their contractors should coordinate with the TWG and make sure that the locations and associated data being collected will be able to answer the study needs in the Lower River. Lower River study site selection is currently being based on the 1980s data that identified locations that were repeatedly used by fish. Rather than selecting sites from historical 1980s data, the NMFS would like the Project to use data from the fish distribution and abundance studies that occurred in 2012 - 2015 to identify current use within the Lower River. While some interdisciplinary data has been collected in the lower river, the collection to date does not seem to follow a plan. The lower river studies were not conducted as provided for in the approved study plan because, to date, they are not following a scientific plan.*	As explained in Section 2.5.1.2.2, AEA requests FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Consistent with the FERC-approved Study Plan, AEA measured main channel, off-channel, and tributary mouth habitats in the Lower River and initiated 1-D model development (Study 8.5 ISR Part A, Appendix I: Lower River Hydraulic Model Calibration; Study 8.5 ISR Part C, Appendix O: Fish Habitat Modeling in Lower River). Since the effects of Project operations attenuate in a downstream direction, and in view of the increased size and complexity of the Lower Susitna River, AEA did not use the same Focus Area approach as applied in the Middle River segments (Study 8.5 TM, March 1, 2013: Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies 2013-2014). Rather, 1-D study sites were selected within LR-1 and LR-2 that were considered representative of main channel, off-channel, and tributary mouth habitat types within those reaches. Tributary mouth habitats were selected in areas known to be important for salmon spawning based on the 1980s data. The proposed approach for addressing IFS related effects in the Lower River Segment was agreed to by the agencies and AEA as noted in Appendix 1 to Study 8.5 TM, 2013). Fish habitat and fish sampling surveys conducted by AEA in the Lower River were likewise completed in accordance with the FERC-approved Study Plan. The findings of those studies regarding the utilization of tributary, tributary mouth, and mainstem habitats sampled in the Lower River Segment of the Susitna River by adult holding and spawning salmon were generally confirmed by results of the Salmon Escapement (Study 9.7). The cost for implementing a Focus Area approach in the Lower River, similar to what is being done in the Middle River, would range from $15M to $20M. This cost assumes one Focus Area would be established in each of five geomorphic reaches above PRM 23, with costs associated with the multidisciplinary studies per Focus Area ranging from $3M to $4M. It should be noted that due to the size (width) and complexity of channels, within the Lower River Segment, 2D modeling (hydraulic, sediment, ice processes, water quality, habitat) would not be feasible nor practical.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-14_ph03	*Modification:* *We recommend that AEA work with the TWG to identify specific habitats that are "critical" for adult and juvenile fish throughout the entire Susitna River system (and not just the Middle or Lower River).*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was not implemented as provided by the approved Study Plan. AEA extensively worked with licensing participants, including the USFWS, through the Technical Workgroups in developing the Services' Study Requests, the PSP, the interim RSP and the RSP for FERC's approval for nearly a year; the USFWS had ample opportunity through the ILP to provide specific comments to the Study Plan to be considered for FERC's approval. This USFWS proposed modification is not based on AEA's implementation of the study at all, but rather seeks to reconsider FERC's original Study Plan Determination itself, without any reference to the substantial work AEA has already completed pursuant to the FERC-approved Study Plan. The USFWS does not provide any information indicating that the sites selected for sampling are inadequate nor do they identify "critical" areas that have been missed. As described in the FERC-approved Study Plan (RSP Section 8.5.3), the study area for the IFS Study 8.5 was designed to evaluate potential effects of the Project on downstream habitats in the Middle and Lower Susitna River where there is a nexus to Project effects. Middle River Focus Areas were selected to be representative of the major features within each geomorphic reach and included mainstem habitat types of known biological significance (i.e., "critical" habitats defined as where fish concentrations have been observed based on previous and/or contemporary studies), as well as some locations (e.g., Slough 17) where previous sampling revealed few or no fish. Selection of Focus Areas and subsequent site modifications were made in consultation with the USFWS and other TWG members in 2013 (*Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014*, Study 8.5 TM, March 1, 2013). AEA has also conducted extensive fish sampling in the Upper River under the Fish Distribution and Abundance in the Upper River Study (Study 9.5) and characterized the habitat present (Study 9.9) as well. USFWS does not identify or provide any information on the number of additional sites that might be deemed "critical" throughout the entire Susitna River system. Assuming AEA would have to collect additional bathymetry, Focus Area hydrology, HSC, and Focus Area substrate data, the estimated cost of this modification would be $900,000-$1,000,000 per additional Middle River Focus Area and $300,000-$450,000 per Lower River study site. It is unclear what is being requested in the Upper River.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-14_ph04; NMFS_pp8.5-13_ph07	USFWS Modification; NMFS Modification 2-2: *Measurement of ice thickness, water depth, water temperature and water velocity at multiple points along 10 or more transects in each FA to accurately model ice thickness and calibrate and validate winter hydraulic models (IFS 8.5 and Ice Processes 7.6).*	This modification primarily pertains to Study 7.6 (Section 2.4.2) and is similar to NMFS Study 7.6 Modification 4-1 and USFWS Study 7.6 Modification 6. As explained below in Section 2.5.1.2.3, AEA requests FERC not adopt this request as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Ice thickness, water surface elevation and velocity have been and will be measured at Focus Areas as part of the FERC-approved Study Plan. However, AEA's measurements of ice thickness in Focus Areas were not transect-based, but spaced to cover the entire Focus Areas to provide overall characterization of winter conditions. In addition to specific point measurements, the entire Focus Areas were characterized visually in terms of ice coverage, open leads, and seepage-groundwater evidence. AEA believes the ice thickness data recently collected, along with additional ice thickness data to be collected in the future following a directed measurement rather than a transect-based process will meet the goals and objectives of the FERC-approved Study Plan. The estimated cost of collecting additional measurements along 10 or more transects in each Focus Areas as requested by this modification is $550,000-$650,000.
USFWS_pp8.5-14_ph07; NMFS_pp8.5-14_ph06	*Methods for Objective 3:* *The ISR and more recent 8.5 SIR discuss the reservoir operations model (HEC-ResSim and the newly identified MWH-ROM) development and calibration of the Open-Water Flow Routing model (OWFRM) (Version 2.0 and 2.8). AEA discussed and presented "proposed dam operations" but detailed description of operations are not in the ISR. Operational detail is critical information for determining the type and amount of spatial and temporal change that may occur due to Project operations and the effects on instream flow and habitat conditions. OS-1b and the more recently identified ILF-1 has been presented as a worst case operational scenario for load-following to demonstrate potential Project effects, however, realistic load-following operations that may occur have not been presented in detail. Information on how realistic load-following operations will be evaluated to minimize overall Project effects has also not been provided. Alternative operational scenarios should be identified, discussed, and potentially modified through TWG meetings to provide the best case scenario for both hydropower operations and species conservation. Although the reservoir operations model (MWH-ROM) is presented and development and calibration of the OWFRM (Version 2.0 and 2.8) were discussed in the ISR and most recent SIR, only results of the OWFRM associated with pre- and OS-1b post-Project operations were presented. Verification of modeling results was not provided, therefore; post-dam operation impacts could not be evaluated.*	See Section 2.5.1.3.1 (OWFRM) below.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-15_ph02; NMFS_pp8.5-14_ph07	*Hydrology and Flow Routing Version 2 (TM for ISR Part C- Appendix K)* [NMFS notes:] *Because results from OWFRM 2.8 were not presented, we included our evaluation of results from version 2.0.* [The Services state:] *Appendix K states that outputs from the OWFRM will provide fundamental input to the ice dynamics model. The ice process models will be used to simulate flow routing hydrodynamics during the ice-affected period. However, Appendix K does not describe how the OWFRM will provide fundamental inputs to the ice process model for that purpose.*	See Section 2.5.1.3.1 (OWFRM) below.
USFWS_pp8.5-15_ph03; NMFS_pp8.5-15_ph01	*The technical memorandum (TM) (Section 3.1) identifies the model channel geometry and calibration efforts for the HEC-2 model developed in the 1980s but does not include information on how the 1980s HEC-2 model was used to inform the current model.*	The 1980s HEC-2 model was not used in any significant capacity in the current OWFRM. None of the original 1980s transect data was included in the model, instead, the OWFRM is based on 216 transects collected since 2012. The information and modeling work completed in the 1980s was reviewed for informational purposes only. The FERC-approved Study Plan (RSP Section 8.5.4.4.1.1: Hydrologic Data Collection) states: *"During 2012, a number of 1980s cross-section and survey-control points were found and surveyed to current horizontal and vertical datum standards. Additional survey control points will be reviewed from any newly found 1980s information. The potential 1980s information will be evaluated for follow-up field surveying. An evaluation will be made on how to project the 1980s project survey-control datum (horizontal and vertical) to current Project standards."* Due to vertical datum discrepancies and potential changes in channel conditions, the data collected in the 1980s was not used in the current modeling analysis.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-15_ph04; NMFS_pp8.5-15_ph02	*Methodologies of discharge measurements are discussed (Section 3.1), but the ISR TM does not include any comparisons made between discharge measurements, or expected accuracy of the discharge measurements. Section 5.3.2 discusses measurement of profiles-panels of frazil ice but the effective depth for this measurement is not provided. It is not clear if the Project's definition of depth relates to the depth below the frazil accumulation or the depth below the ice cover.*	Methodologies of winter gaging discharge measurements are discussed in Study 8.5 ISR Part A, Section 5.3.1 (note: not Section 3.1 as referenced to in the comment). The measurements were collected following conventional USGS standards for dye dilution, volumetric, and current meter methods. No comparisons or expected accuracies were prepared specific to each winter gaging measurement. Study Plan Section 8.5 (RSP Section 8.5.4.4: Hydraulic Routing and Operations Modeling) states: *"In accordance with current USGS guidance (Mueller 2012), all discharge measurements will include sufficient quality assurance data to rate the measurements as Excellent, Good, Fair, or Poor, corresponding to categories of uncertainty ranging from 0 to over 8 percent."* Mueller 2012 relates to the review and rating of moving-boat ADCP discharge measurements. All ADCP flow measurements presented in the Study 8.5 ISR and Study 8.5 SIR materials contained an uncertainty rating (Table 2 in Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*). Winter gaging measurements were not collected with an ADCP and do not contain an uncertainty rating. The wintertime measurements were not used in any rating curve development so a rating would not be a necessity. Winter gaging mainstem discharge measurements presented in the ISR (Study 8.5 ISR Part C, Appendix K: *Hydrology and Version 2 Open-water Flow Routing Model*, Section 5.3.2) are based on flow calculations using an effective depth as defined as the difference in elevation between the river bed and the bottom of the sub-ice frazil.

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USFWS_pp8.5-15_ph05; NMFS_pp8.5-15_ph03	*Section 5.4.1.1.1 describes the combination of data inputs that were utilized to construct the cross sections for the OWFRM. The TM states that for the majority of cross sections that had split flow or side channels, the water surface elevation of the main channel differed from the secondary channels. To properly simulate the conveyance of water in the 1D HEC-RAS model, transects with multiple channels had to be altered in order to maintain the correct cross sectional flow area. As a result, 125 of the 216 cross sections (nearly two-thirds) had portions of the channel geometry outside of the main channel adjusted vertically. The vertical adjustment was based on the difference in water levels across the section, recorded on the day of the survey. The rational presented for this shift is due to the limitation of the 1D model, and that portions of the section must be adjusted to preserve the flow area. It is unclear if the vertical adjustments were based only on the concept of preserving flow, or if some were adjusted to match computed-to-observed water levels during the calibration process. Based on the methodology described, water levels in the back channel areas will require "post-processing", or readjustment for the provision of predicted water levels in the off-channel habitats for input-integration with complimentary studies. If these adjustments are in fact necessary, they may not be appropriate for other studies that rely on channel geometry for model input (e.g., river ice process model (7.5)).*	The vertical adjustments of bed elevation made to side channels were included in order to preserve the flow area (and flow velocities). If these adjustments were not made, a larger or smaller flow area (and a larger or smaller flow velocity) would be calculated by the model than what was actually observed and the discharge-water surface elevation relationship would not be preserved. The intent of the OWFRM is to simulate mainstem Susitna River conditions, not side channel conditions. Mainstem results of the OWFRM will be used as a boundary condition in any process specific modeling (i.e., Focus Area 2-D modeling). The process specific modeling (such as SRH-2D as documented in Study 6.6 SIR, Attachment 1, Appendix B: *FA-128 2-Dimensional Sediment-transport Model Development and Calibration*) will take into consideration the relationship and differences between the mainstem and side channels. These vertical adjustments to bed elevations were made in the channel geometry of the OWFRM only. The reader is referred to other sections (Study 6.6 Fluvial Geomorphology Modeling ISR and Study 7.6 Ice Processes ISR) for how they incorporated cross-sectional data into the models. See Section 2.5.1.3.1 (OWFRM) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-15_ph06; NMFS_pp8.5-15_ph04	*Section 5.4.2.1 does not provide clear rationale or context for characterization of the referenced low, medium and high flows. The ISR TM should explain how these values compare to the flow duration values and threshold values of percentage exceedance used to determine low, medium and high flows. While the range of flows that were measured and used for model development and calibration for the three referenced flows was shown to have good coverage (80-83%), when looking specifically at the low flow ranges only 56% of the measured data fell within the specified "low flow" range. This raises some concern since the effective habitat in the Middle and Lower River are most affected by low flows. The ability to accurately predict the hydraulics along the river during low flow scenarios is crucial to determine Project effects on fish habitat.*	As stated in the ISR (Study 8.5 ISR Part C, Appendix K: *Hydrology and Version 2 Open-water Flow Routing Model*, Section 5.4.2.1) cross-sections upstream of PRM 102.5 were assessed in reference to the concurrent flow at the USGS gage station at Gold Creek (No. 15292000). *"Flows at transects compared to the Susitna River at Gold Creek were considered high if the flow was greater than 24,000 cfs, medium if they were between 17,700 cfs and 24,000 cfs, and low if they were less than 17,700 cfs."* These values were selected based on exceedance values calculated for the open-water period at the Gold Creek gage. For the June through September flow for the USGS gage station at Gold Creek, 24,000 cfs and 17,700 cfs are the 33% exceedance and 67% exceedance, respectively. Field crews scheduled data collection efforts to target measurement of flows in each of the three ranges, but rapidly changing flows made it difficult to predict the timing of target flow conditions. Data collection efforts of low flows were thwarted in 2012 due to a 25-year flood event that required evacuation of the field team. Additional data were collected throughout the field season in 2013 to fill in any data gaps and to extend the model downstream to PRM 29.9. The 2014 field efforts targeted completion of data collection of Q-WSE pairs at both the upstream and downstream ends of Focus Areas. As described in the SIR (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*, Section 7.2.1), 17 of the 20 Focus Area boundary transects have all three measurements collected corresponding to a low, medium, and high flow conditions. The other three Focus Area boundary transects were missing one of those due to overlap of a similar flow conditions. Although Q-WSE pairs may not have fallen into each of the pre-defined low, medium, and high categories, all three locations had three or more Q-WSE pairs from which a rating curve could be developed, and only one of those (PRM 138.4) did not have a flow measurement in the low flow range. For FA-138 (Gold Creek), although the downstream end did not have a low flow measurement, the transect located just upstream at PRM 138.7 had all three Q-WSE pairs. Overall, data collection efforts sufficiently measured flows in the low flow range. As shown in the SIR (Table 3 in Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*), of the 124 measurements collected between PRM 88 to PRM 187.2, approximately 75% of the transects have a corresponding low flow measurement. Note that the model is not complete below PRM 88.0 and data collection in this reach is still pending during the last year of the study effort.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-16_ph02; NMFS_pp8.5-15_ph05	*The OWFRM was calibrated under steady-state conditions. AEA stated, "Under subcritical flows conditions found in the Susitna River, the water surface elevation at a given cross section is controlled primarily by the shape and water surface elevation of the next downstream cross section and to a lesser extent by roughness coefficients (Manning's n) and expansion-contraction loss coefficients" (Section 5.4.2.1). The context of this statement is not clear with respect to the model calibration. If downstream effects control the water level at a particular section then this further supports the more typical approach for calibration of Manning's n on a reach-by-reach scale. Section 5.4.2.1 describes an unfamiliar (atypical) [e.g., not using accepted scientific methods] OWFRM calibration method. Manning's n was calculated section by section to achieve a specified tolerance of 0.2 feet. Adjustments to Manning's n were limited to a specified range of values and where further adjustments were required, hydraulic control sections were synthesized and added downstream of the calibration section. These synthesized sections have uncharacteristic channel geometry compared to that of the originally surveyed (e.g., vertical shift of 2.6 feet and channel width increased by factor of 2). Based on the calibration results, the ISR TM Appendix does not describe the impact on the performance of other models that rely on geometry from the OWFRM (e.g., ice processes) or how well the models will perform for conditions that are outside of the range of flows utilized in the model calibration.*	Refer to additional information available in the more recent document, *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)* (Study 8.5 SIR, Appendix B). See Section 2.5.1.3.1 (OWFRM) below for information on calibration. The OWFRM will provide flow and stage hydrographs at surveyed cross-sections, and these will be used as input to 2-D hydraulic models of Focus Areas, and also as input to groundwater models in Focus Areas under open-water conditions. Calibration of the OWFRM to match water surface elevations at surveyed cross-sections is very important to provide accurate input to the Focus Area modeling studies. One-dimensional flow routing models have been developed for Fish and Aquatics IFS (Study 8.5), Fluvial Geomorphology Modeling (Study 6.6), and Ice Processes (Study 7.6) studies. All three studies relied on the same set of surveyed cross-sections. Modifications, if needed, were then made to meet the needs of each individual study. The flow routing model developed for instream flow was focused on flows that would occur during the open-water season for flows up to the two-year flood. The ice processes model was focused on low flows that would occur during the winter period. The fluvial geomorphology model was focused on high flows that would transport sediment during the open-water season.
USFWS_pp8.5-16_ph03; NMFS_pp8.5-16_ph02	*The discussion within Section 5.4.2.1 emphasizes that calibrated water levels are within a specified accuracy that is appropriate for assessing fish habitat. To meet this criterion, at a "calibration" cross-section, the water surface profile is adjusted by introducing an artificial control section with geometry that is inconsistent with the actual geometry. This method may achieve the desired effect at the "calibrations" cross section; however, the resulting accuracy of the computed profile throughout the reach of interest is not explained.*	See Section 2.5.1.3.1 (OWFRM) below.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-16_ph04; NMFS_pp8.5-16_ph03	*In Section 5.4.2.2, the methodology used to determine flow accretions for the unsteady flow calibration is different than that used for the steady-state calibration. Flow accretions are back-calculated based on the difference between the routed hydrograph and the measured hydrograph. We recommend a comparative illustration between computed versus observed hydrographs using both methods and with no accretion be provided. Discussion on the difference between the computed and observed hydrographs, including timing of peaks and flow continuity should be provided. The green line plotted in Figure 5.4-22 is not identified in the legend, making it unclear as to what information is being presented.*	During steady-state calibration at each cross-section it was assumed that inflow to a reach just upstream from the cross-section was the same as outflow from a reach just downstream from the cross-section. In other words, it was assumed that accretion flows were negligible just upstream and downstream from each cross-section. If the difference between upstream and downstream hydrographs was calculated with no routing, then negative accretion flows would often occur. By routing the upstream hydrograph to the downstream hydrograph location and then calculating the difference between the two hydrographs, the resulting accretion flows were positive, and the shape of the total accretion flow hydrograph looked reasonable. The green line in Figure 5.4-22 of *Hydrology and Version 2 Open-water Flow Routing Model* (Study 8.5 ISR Part C, Appendix K) is for the USGS gage No. 15291700 Susitna River above Tsusena. Figure 5.4-22 presents the measured USGS gage data for the calibration period of July 28 to August 3, 2013 used in Version 2 of the model. Note that recent information is provided in *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)* (Study 8.5 SIR, Appendix B).
USFWS_pp8.5-16_ph05; NMFS_pp8.5-16_ph04	*Section 6.4.2, states in reference to Figures 6.4-2 and 6.4-3 that, "Excellent agreement was found at Gold Creek and Sunshine, and good agreement was found at Susitna Station." The qualitative assessment appears to be based on a visual comparison of computed versus observed hydrographs. The Project's method for accounting for the flow accretions ensures an excellent fit because they are simply backing-out the difference between observed and computed hydrographs and then applying that difference upstream. This method is not a reflection as to how well the model performs in a predictive mode because it requires the observed data to predict that same observed data. In Section 6.4.3, Figures 6.4-5 through 6.4-7 the plot scale is difficult to discern between computed and observed hydrographs. We suggest that a more quantitative assessment of model validation be presented. For example, an assessment of associated error in water level corresponding to the error in the computed discharge is needed. How this compares to the calibration target of approximately 0.2 feet should be described.*	When the model is used in a predictive mode, the only change to hydrology would be for flow releases to the Susitna River from the dam. The downstream accretion flows would not change. The quantitative assessment referred to in the comment typically occurs during model validation. As described in Study 8.5 SIR, Section 7.3, model validation is not expected to occur until after completion of the entire OWFRM. A quantitative assessment of model performance will be provided in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-17_ph02; NMFS_pp8.5-16_ph05	*Variances for Objective 3: Model calibration* *The RSP stated that 13 mainstem water-level recording stations were to be installed to provide data for calibration of the OWFRM. The ISR states that through initial calibration of Version 1 of the OWFRM and analysis of the gaging station data, 8 of the 13 stations are considered high priority while the remaining 5 are considered low priority. No definitions of "low" and "high priority"; or the criteria for meeting either designation are provided. These types of decisions and analyses should be discussed with the TWG and agreed upon prior to discontinuing data collection at these gaging stations.* [The Services are] *unable to assess the overall affect to meeting Project objectives without the demonstrated ability of the stations to calibrate the OWFRM.*	AEA disagrees that the Service are unable to assess the overall affect to meeting Project objectives. The network of USGS gages was considered to be adequate for calibration of the OWFRM under unsteady flow conditions. See Section 2.5.1.3.1 (OWFRM) below for further discussion. Measured Q-WSE pairs collected at the 13 mainstem gages were used for calibration of those transects. Rating curves at the mainstem ESS stations will be developed in the last year of the study. Once developed, those data would be used for validation of the OWFRM. AEA expects that there would be good agreement between measured and calculated stages at these intermediate locations. The Fish and Aquatics IFS (Study 8.5), Fluvial Geomorphology Modeling (Study 6.6), and Ice Processes (Study 7.6) study teams discussed the 13 stations, and collectively decided which gages should be high priority and which gages should be low priority based on study needs.
USFWS_pp8.5-17_ph03; NMFS_pp8.5-17_ph02	*Conformance with Objective 3* *Model status* *The OWFRM (Version 2.8) is not adequately developed to assess pre- and post-Project effects. It is also not sufficiently developed to integrate information from other study disciplines [e.g., ice processes (7.6), fluvial geomorphology (6.6)]. Information on calibration, validation and sensitivity analysis are lacking. Clarification in the text is needed to describe the results of the 1D HEC-Ras model used for the flow routing analysis to determine the downstream extent of Project impacts. Initial results presented in the ISR associated with OS-1b confirm that post Project operations will drastically change the flow hydrograph in the Middle River throughout the open water portion of the year resulting in maximum potential stage changes ranging from 9.7 feet near the dam, 5.7 feet near Gold creek, and 2.1 feet near Susitna Station in the Lower River. This amount of stage change is huge in terms of river connectivity and the effects on main channel and lateral habitats. Additionally, the hourly stage effects associated with ramping rates for OS-1b (hydro-peaking) ranged from 0-2.1 feet under dry conditions and 0-8.0 feet under wet conditions near the dam site, 0-4.1 feet near Gold Creek, and 0-4.0 feet near the Sunshine gage in the Lower River. While OS-1b is considered a "worst case" scenario, this illustrates that the ramping rates associated with a hydro-peaking operation will have drastic effects on the water surface elevations throughout the river which will greatly affect habitat conditions, lateral habitat connectivity, river processes (instream flow and riparian), and ice processes (flow under and over existing ice formations).*	Refer to the more recent document, *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)* (Study 8.5 SIR, Appendix B). Version 2.8 calibration information is provided in *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)* (Study 8.5 SIR, Appendix B, Section 7.2). Calibration procedures followed a similar procedure as that documented in *Hydrology and Version 2 Open-water Flow Routing Model* (Study 8.5 ISR Part C, Appendix K) except where noted. As stated in the SIR (Study 8.5 SIR, Appendix B, Section 8.4), validation of the OWFRM using 2014 USGS gage data and using the 2012-2014 ESS Station data is intended for the last year of the study. Review comments appear to be related to Version 2 of the model and sufficient information has not been provided to suggest that Version 2.8 is not adequately developed to assess pre- and post-Project effects. Version 2.8 of the OWFRM is adequately developed to assess pre- and post-Project effects from the proposed dam site down to Sunshine gage. Additional cross-sections are planned in the river downstream from Sunshine gage. The portion of the river between Sunshine and Susitna Station will be finalized in the model when these additional cross-sections have been surveyed. Preliminary modeling results show that there would be a reduction in water levels during the summer and an increase in water levels during the winter. These effects would be greatest near the proposed dam site, and would diminish downstream from the proposed dam site. Impacts on habitat conditions, lateral habitat connectivity, river processes, and ice processes have not been assessed. See Section 2.5.1.3.1 (OWFRM) below for further discussion

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-18_ph01; NMFS_pp8.5-17_ph04	Recommendation (USFWS); Modification 3-1 (NMFS): [USFWS recommends:] *Detailed and complete modeling of ILF-1 be developed and provided to stakeholders.* [NMFS recommends:] *the applicant provide details of what discharges ILF-1 will actually release and examples of ramping rates. NMFS recommends water surface elevations from ILF-1 be modeled with latest version of OWFRM using these discharges. NMFS needs to understand the discharges associated with ILF-1 if we are to evaluate projects effects. The applicant's consultants also need these discharges to run the models. Load following was described early on in the study design process as the only operations scenario which would be evaluated. In 2015 the applicant suggested an intermediate alternative ILF-1 but it was not defined. The study was not conducted as provided for in the approved study plan because insufficient information was provided about scenario to allow the stakeholders to evaluate them.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. AEA will provide preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016) in the USR. Preliminary results will include hourly flows at the proposed dam site (PRM 187.1) and flow and stage at select Middle River locations. In addition, files containing a calibrated, executable version of the final OWFRM will be available to licensing participants. The operational scenario will be consistent with the default ramping rates as described by Washington Department of Fish & Wildlife (Hunter 1992). As explained above, this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan (RSP Section 8.5.4.8.1). As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-18_ph02; NMFS_pp8.5-18_ph01	Recommendation (USFWS); Modification 3-2 (NMFS): *Additional operational scenarios (*[USFWS adds:] *for pre- and post-Project information) should be developed and evaluated, including the evaluation of the run-of-river scenario that was required by FERC.* [NMFS adds:] *NMFS needs to understand the discharges associated with the scenarios to evaluate Project effects and rank various scenarios based on the energy the alternatives would provide versus the environmental impacts that could result from the proposed project. The single scenario put forth by the applicant (full load following, OS-1b) does not allow for such "trade-offs "to be evaluated. The studies were not conducted as provided for in the FERC determination (4-1-2013) because run-of-river was not evaluated.*	As explained below in Section 2.5.1.6 (Run-of-River, Habitat Classifications, and PM&E), AEA requests that FERC not adopt this proposed Study Plan modification as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. AEA is currently at the ISR stage of the ILP and the studies have not yet been completed, nor are they expected to be. AEA has already developed the maximum load following and intermediate load following scenarios. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests and address issues including the downstream water temperature. The results of Existing Conditions and a Run-of-River operational scenario will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions. The estimated cost of this modification will vary depending on the number of evaluation metrics developed for each scenario; for planning purposes, analyzing operational scenarios, in addition to those described in Section 2.5.1.6, isestimated to cost approximately $500,000 per scenario.
USFWS_pp8.5-18_ph03; NMFS_pp8.5-18_ph09	Recommendation (USFWS); Modification 3-4 (NMFS): *The mechanism for integrating operational scenarios with other study disciplines is needed to evaluate the utility of ISF modeling efforts.* [NMFS requests that] *this modification be best implemented through a New Study for Model Integration, and included a new study request as an enclosure.*	AEA requests FERC not adopt this proposed Study Plan modification as requesting FERC to adopt a new study proposal does not constitute a modification to a FERC-approved Study Plan nor does this request meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-18_ph04; NMFS_pp8.5-18_ph05	Recommendation (USFWS); Modification 3-3 (NMFS): *HEC-RAS model input and output files be provided to stakeholders. The data is needed to conduct an independent verification of conclusions made by AEA regarding the downstream extent of Project impacts as a result of proposed operational flow scenarios. The USFWS and NMFS current Memorandum of Agreement with the Alaska Department of Natural Resources and AEA, does not allow for any review of "data analysis" conducted by AEA. AEA reported that there are minimal affects downstream of PRM 29.9 and they do not propose to model the area of tidal influence from the mouth upstream to approximately PRM 10 (Fluvial Geomorphology Modeling below Watana Dam Study 6.6 Technical Memorandum, September 2014).* [NMFS also notes that] *output files are not "analysis" but products of the model, and that this minimal effects conclusion is unsupported as the 2014–2015 SIR states that the HEC-RAS model for the middle river is not complete due to a dearth of cross-sections and the fact that it has not been validated. The understanding is that the applicant would conduct scientific studies to illustrate project effects. Open access to methods and products is the standard scientific method.* *Since information is being withheld the objective 3 of the instream flow study was not conducted as provided for in the approved study plan.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the the Services have not established "good cause" as required by the ILP regulations. In addition, the Study Plan as approved by FERC does not require this information to be available at the current ISR stage. Rather, the FERC-approved Study Plan requires this information to be developed and presented within the USR. There is no HEC-RAS Open-water Flow Routing Model (OWFRM) for the portion of river below PRM 29.9. The Fluvial Geomorphology Modeling below Watana Dam Study 6.6 Technical Memorandum, *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 Technical Memorandum* (Study 6.6 TM, September 26, 2014), referred to in the comment relies on the 1-D Bed Evolution Model to make conclusions about the need for bed morphology modeling below PRM 29.9. There is currently a draft OWFRM for the portion of river between PRM 29.9 and PRM 88 and a final version of the model for the portion between PRM 88 and the dam site. Objective 3 requires AEA to develop a mainstem OWFRM that estimates water surface elevations and average water velocity along modeled transects on an hourly basis under alternative operational scenarios (RSP Section 8.5.1.2). As required under this objective AEA has developed the OWFRM with 216 transects that simulates velocity and water surface elevation on an hourly basis which is documented in the ISR Study 8.5 Part C, Appendix K (*Hydrology and Version 2 Open-water Flow Routing Model*) and SIR Study 8.5 Appendix B (*Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*). Delivery of model structure and input and output files during the ISR stage is not a specific requirement under the FERC-approved Study Plan. AEA will provide preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016) in the USR. Information to be provided as part of the USR will include an executable version of the final OWFRM and hourly dam releases for at least one operating scenario for representative average, wet, and dry years. As explained above, this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-19_ph06; NMFS_pp8.5-20_ph03	*Methods for Objective 4:* *Data for the purpose of developing HSC and HSI were collected within the FAs. The FAs were conceptually representative of a geomorphic reach; they contain hierarchical habitats, but only represent known clusters of utilization. The representativeness of these FAs is unknown,* ([USFWS also states:] *though likely not representative of the river as a whole,) even the Middle River where the majority of work was conducted.*	In response to license participant concerns identified in the FERC Study Plan Determination (Study 8.5 SPD, April 1, 2013) regarding Middle River Focus Areas proposed for measurement in the Study Plan (RSP Section 8.5.4.2.1.2), alternate Focus Areas were evaluated and changes were proposed to Middle River Focus Areas consistent with input from the USFWS, NMFS, USGS, ADF&G, and consultants representing these agencies during an April 26, 2013 Technical Team meeting (Study 8.5 TM, May 21, 2013: *Adjustments to Middle River Focus Areas*). Changes to Middle River Focus Areas identified during the Technical Team meeting and described in the TM subsequently became part of the FERC-approved Study Plan Section 8.5. With respect to representativeness of the Focus Areas, AEA completed a detailed evaluation of the representativeness of the ten Focus Areas and reported the results in the ISR (Study 8.5 ISR Part A, Section 5.2.3.1). The analysis included a multi-step evaluation process that included representation and proportionality, representativeness and bias, and a simulation that involved random-systematic sampling of areas within and outside of Focus Areas to compare habitat compositions (Study 8.5 ISR Part A, Section 5.2.3.1.3). As noted in the ISR (Study 8.5 ISR Part A, Section 5.2.3.1.4), the results of the habitat mapping and statistical analysis completed in 2013 indicated that the ten Focus Areas selected in the Study Plan were generally representative of habitat types found in other portions of the Middle River Segment. As a result, those ten Focus Areas were selected for study in accordance with the respective resource-specific Study Plans. A caveat to the above was that the analysis did show that some habitat types within individual geomorphic reaches were not represented in the reach-specific Focus Areas or captured in the existing transects. However, these habitat types were generally relatively small and although they will be considered further, would not result in changes to the Focus Areas.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-20_ph03; NMFS_pp8.5-20_ph06	*AEA proposed that they would develop separate, habitat specific, curves based on stream-specific data (i.e., geomorphic reach, mainstem macrohabitat type, clear vs. turbid water, and upwelling areas) with winter versus summer sampling efforts. This would result in four or five separate sets of HSC curves generated for some species and life stages.*	This comment is incorrect and misleading. The FERC-approved Study Plan states (RSP Section 8.5.4.5.1.1.7): *"HSC curves for each species and life stage will first be developed using pooled data from all sampling areas and time periods,* ***and then (depending on available data)*** *separate curves will be developed based on stream-specific data (i.e., geomorphic reach, mainstem habitat type, clear vs. turbid water, and upwelling areas) and winter vs. summertime sampling efforts."* Additionally, AEA stated in the ISR (Section 5 in Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development*): *"Macrohabitat type has not been included in HSC modeling for the ISR, although differences in habitat preference among macrohabitat types are possible. There are several reasons it has not been included. First, good model fitting would require similar levels of replication within each macrohabitat type. For example, although sampling was designed to capture a range of habitats, most spawning occurred in side channels and side sloughs, leading to large imbalance in sample size (i.e., for "1" spawning locations) among habitat types. Second, including macrohabitat as a fixed effect in suitability criteria would presume that fish preference for each macrohabitat would be static under all possible future flow conditions. This decision will be re-evaluated prior to selection of the final HSC model."* See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.
USFWS_pp8.5-21_ph06; NMFS_pp8.5-22_ph01	*AEA did not meet their determined sample size: AEA notes that they did not meet the minimum sample size of 100 to develop HSC for target species and life stages, and applied bootstrapping to collected samples to achieve the sample size. No statistics were provided for diagnosis of bootstrapping procedures, to determine if this technique would be appropriate.*	This statement is incorrect. As described in the FERC-approved Study Plan, AEA's *goal* (not minimum determined sample size) was to collect 100 habitat use observations for each target species' life stage (RSP Section 8.5.4.5.1.1.4). This target was met and exceeded for many, but not all, of the priority species' life stages (Table 5.2-2 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Bootstrapping procedures have not been applied at this time. For those species' life stages with insufficient site-specific observations for development of robust, statically valid relationships between habitat selection and microhabitat variables, alternative methods for HSC development have been proposed (*Alternative HSC/HSI Development Methods Technical Memorandum*, Attachment 4 to this filing). Bootstrapping is one method that may be used to define confidence intervals around each of the proposed HSC.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-22_ph01; NMFS_pp8.5-22_ph03	*Non-representative substrate classification: Substrate composition was homogenized to include only two gravel size classes (small and large). FERC stated that two size classifications to describe gravel are consistent with substrate classifications used on other HSC-HSI curve development studies. The classification is not representative of the existing substrate. Not accounting for all of the available substrate types may obscure relationships of fish habitat preference. The result may be that the Project would not be able to identify a relationship between substrate composition and fish habitat preference because the substrate classifications used are too coarse. The SP states that "Substrate size (dominant, sub-dominant, and percent dominant) characterized in accordance with a Wentworth grain size scale modified to reflect English units" will be used.*	AEA disagrees with this comment. Substrate composition was simplified to include only two gravel size classes (small and large). The Study Plan states (RSP Section 8.5.4.5.1.1.5): *"Substrate size (dominant, sub-dominant, and percent dominant) characterized in accordance with a Wentworth grain size scale modified to reflect English units."* Field personnel found it impracticable to attempt to accurately differentiate gravel composition into three size classes in turbid water conditions. Using two size classifications to describe gravel is consistent with substrate classifications used on numerous other HSC/HSI curve development studies and is not anticipated to impact HSC/HSI curve development.
USFWS_pp8.5-22_ph02; NMFS_pp8.5-22_ph04	*Truncated water measurement:* *Water velocity criteria inappropriately truncate the range of depth measurements collected (both shallow and deep). And most fish captures occurred using electrofishing, seining or a combination of the two gear-types which did not allow for the identification of fish focal point position (e.g., nose-to-bed) within the water column. AEA stated that the IFS habitat models rely on mean water column velocities and therefore not measuring focal point velocity will have no adverse impacts on HSC-HSI development or on habitat modeling. However, fish nose-to-bed position within the water column is an indicator of water depth preference for a species and-or life stage. Particularly for those species known to hold hierarchical positions within the water column based on size (age-class), such as Grayling. For preferred nose velocities of target species, it may be necessary to measure higher velocities to produce high nose velocities unsuitable for the target species (Martinez-Capel et al. 2008). It is particularly useful when 3D modeling cannot be afforded. The ISR does not describe Project intentions to calculate nose-to-bed for use in the WUA. The SP states that a Price AA current meter will be used to measure the "Location in the water column (distance from the bottom), fish focal point within the water and mean column velocity (fps to nearest 0.05 fps)". Mean water velocities are too coarse a measurement and should not be used.* *Surface and groundwater exchange fluxes: Exchange fluxes were not measured or reported, only VHG. Flux is the product of substrate permeability and VHG. There is no reporting of permeability.*	AEA disagrees with this comment. As described in the ISR (Study 8.5 ISR Part A, Section 4.5) only one velocity measurement (mean column) was recorded for each individual fish microhabitat use observation. The Study Plan states (RSP Section 8.5.4.5.1.1.4.): *"Location in water column (distance from the bottom), focal point and mean column velocity (feet per second to nearest 0.05 fps) measured using a Price AA current meter."* However, most fish captures occurred in turbid water conditions using electrofishing, seining, or a combination of the two methods which precluded the identification of fish focal point position within the water column, as stated in Study 8.5 ISR Part A, Section 4.5. The IFS habitat models rely on mean column water velocities and therefore the lack of focal point velocities will have no adverse impacts on HSC/HSI development or on the habitat modeling. Exchange flux has not been quantified as part of the groundwater assessment (Study 7.5). As specified in the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*), VHG measurements (positive, neutral, negative) were used as an indication of the presence of groundwater upwelling.

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USFWS_pp8.5-22_ph03; NMFS_pp8.5-22_ph06	*Error estimates:* *Mesohabitat type was not collected concurrent with fish observational and FDA (9.5, 9.6) data. Instead, mesohabitat mapping was completed as a desktop exercise as part of RSP Characterization and Mapping of Aquatic Habitats (9.9) study. After the mesohabitat mapping is complete, GIS data layers of observed HSC-HSI fish-use will be compared to GIS data layers containing mesohabitat types. Mesohabitat use by individual fish species and life stages will then be assessed. AEA states that the variance of using a GIS mapping exercise to determine mesohabitat classifications with observed fish-use will not adversely impact the ability to meet Project objectives. However, there is error related to both the accuracy of mesohabitat classification assignment and observed fish-habitat associations using unparalleled approaches. In addition, there are errors associated with (1) mesohabitat classifications provided as part of the FDA study completed by numerous field technicians without consideration of "reader error"; (2) mesohabitat's flow variation; and (3) model changes in mesohabitat under variable Project operational scenarios. These error measurements have not yet been considered.*	AEA disagrees with this comment. Mesohabitat type was collected as part of each Fish Distribution and Abundance Study (9.5 and 9.6) survey. No desktop methods were used in determining mesohabitat type except in main channel areas. As such, no assessment of mesohabitat mapping error was necessary. As described in the FERC-approved Study Plan Section 8.5, HSC sample sites were selected using a stratified random approach based on anticipated Project impact area, geomorphic reach, macrohabitat type, and relative fish use. Mesohabitat type has not been included in the development of HSC models. From a practical standpoint, using habitat-specific HSC models could cause logistical issues and strange patterns in habitat area estimates. For example, under different flows a riffle mesohabitat might be classified as a run and a glide habitat might be classified as a pool. This transition would require a shift in the HSC model used for the same habitat unit, even within a season under a single operational scenario. The developed HSC models are based on conditions that describe the physical habitat conditions experienced by fish, which should be similar to the habitat conditions used to define habitat types. In other words, the character of the habitats changes in response to flow so HSC must be applicable across a range of flows rather than specific habitat type, which is why HSC are not macro- or mesohabitat specific. Macro- or mesohabitat types are not included in the Susitna River habitat model.
USFWS_pp8.5-22_ph07; NMFS_pp8.5-22_ph02	*Omission of spawning redd measurement: Spawning redd dimensions were not collected as part of the 2013-201414 HSC spawning surveys. AEA decided that additional redd measurements were not necessary to develop evaluation metrics. Redd dimension measurements were recorded as part of the 2012 HSC surveys to support the spawning and incubation analysis. The SP states "Redd dimensions (length and width in feet to nearest 0.1 foot) will be collected."*	Redd dimensions were not intended to be used as a variable in the prediction of habitat use selection but rather as ancillary data that could be used as part of other studies (e.g., Effective Spawning Habitat Analysis, hydraulic modeling grid size, varial zone analysis). Redd dimension measurements (length and width in feet to nearest 0.1 foot) were recorded as part of the 2012 HSC surveys. Additional redd measurements were not deemed necessary to develop evaluation metrics. This change will not adversely impact achieving Project objectives since spawning redd dimensions are not an input variable in the Fish and Aquatics IFS habitat modeling.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-23_ph02; NMFS_pp8.5-23_ph02	*Lack of co-located HSC-HSI sample sites: Sampling efforts did not meet those described in the SP. The SP states that River Productivity (9.9) macroinvertebrate "sampling will occur at six stations, each with three sites (one mainstem site and two off-channel sites associated with the mainstem site), for a total of 18 sites. River Productivity sampling occurred at five stations on the Susitna River, each station with three to five sites (establishing sites at all macrohabitat types present within the station), for a total of 20 sites. Four stations were located in FAs (FA-184 [Watana Dam], FA-173 [Stephen lake Complex], FA-141 [Indian River], and FA-104 [Whiskers Slough]). Station RP-81 is located in the vicinity of the mouth of Montana Creek. The SP states that the reduction in macroinvertebrate sampling sites will not adversely impact achieving Project objectives because of the greater sample coverage per site. However, only two macroinvertebrate sampling locations are co-located with Middle River juvenile salmon distribution; thereby limiting invertebrate density input data into fish habitat models.*	AEA disagrees with this comment. The Services are citing the RSP with some details on sampling methods and efforts. The agencies indicated that there was not enough detail, and FERC agreed, requiring AEA to provide an Implementation Plan (IP) with more details on sampling methods, efforts, and proposed sites in a draft IP, and then a final IP. The *Susitna River Productivity Study Implementation Plan* (Study 9.8 IP, March 1, 2013) contains much more specific detail than was given in the RSP (RSP Section 9.8), as was requested and as indicated in Study 9.8 ISR Part D, Section 5, the IP supplements and in some cases supersedes the methods presented in the RSP. In addition, the April 1, 2013 FERC Study Plan Determination made additional requests that further altered several site selections and sampling methodology detailed in the IP, and supersedes both the RSP and IP in those cases. Any departures from these detailed methods and efforts have been documented in the variances in the Study 9.8 ISR Part C and Part D. In regards to the Services' disagreement with the River Productivity site selections, and the repeated requests for establishing sites primarily within the Middle River Focus Areas, please see the response in Section 2.6.4.2.2.1, as well as responses in Section 2.6.4.2.2.3 (Tributary Mouths), Section 2.6.4.2.2.4 (Upland Sloughs), Section 2.6.4.2.2.7 (Side Sloughs), Section 2.6.4.2.2.8 (Side Channels), and Section 2.6.4.2.2.9 (Main Channels).
USFWS_pp8.5-23_ph03; NMFS_pp8.5-23_ph03	*Conformance with Objective 4:* *The FERC determination requested AEA to evaluate which of the recognized microhabitat criteria were relevant to fish habitat selection, and develop HSC models for these criteria. AEA did not do this with the level of sufficient statistical rigor. AEA used univariate HSC curve exploration to identify what criteria would be used in their multivariate HSC models (see discussion below).* [USFWS states further:] *There are fundamental questions regarding AEA's HSC investigations that prevent the USFWS from recommending a reorganized analysis of AEA's existing data.* [NMFS states further:] *There are fundamental statistical problems with multivariate HSC models developed from univariate HSCs that are not acceptable for determining Project effects and limit the usefulness of the collected existing data.*	See Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables) below and response to comment USFWS_pp8.5-06_ph02 and NMFS_pp8.5-07_ph04 for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-24_ph02; NMFS_pp8.5-23_ph05	*The opportunistic sampling approach was spatially and temporally irrelevant and non-scientific. First, habitat measurements need to be taken only when fish are spawning or rearing, not in other periods of time when local microhabitat is irrelevant to occupancy. It is not clear whether microhabitat criteria surveys were conducted when, after, or before surveyed locations were occupied. Next, these measurements need to be taken within and outside the distribution of spawning and rearing (e.g., unoccupied-unused locations). Using transect locations within the distribution of fish to represent unused habitats prevented AEA from considering availability of habitat, outside the distribution of fish. This would not allow AEA to assess biological relevance, which would require comparison of the statistical distribution of microhabitats within and outside the spatial distributions of fish. And because habitat is hierarchical, this effort also had to be stratified by meso and macrohabitats on the longitudinal distribution of the floodplain. AEA's sampling design did not meet these criteria. Instead, it appears that AEA modeled the variability of surface hydraulics, over time (instead of space), and also at the expense of forfeiting any comparison of river and groundwater exchange, at any scale.* *There was also a mismatched agenda and scales in which abundance and microhabitat data were surveyed. There were no adult salmon abundance data, microhabitat data were not integral to the collection of the abundance data, and groundwater data were incomparable, according to AEA. If the microhabitat data were not relevant to the abundance data, the influence of VHG could not be considered, and if adult data were not available, then the 2014 investigation of abundance-microhabitat relationships was irrelevant to the overall effort. AEA stated that their HSC study was more appropriate for the sole purpose of identifying relevant habitat criteria.* [NMFS adds:] *We conclude that the abundance and habitat data was not sufficient for accomplishing study objectives.*	AEA disagrees with this comment. The analysis of relationships between additional microhabitat parameters and fish abundance in *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables Technical Memorandum* (Study 8.5 TM, September 17, 2014) was conducted in accordance with the FERC Study Plan Determination recommendation "where sampling overlaps" (Study 8.5 SPD, April 1, 2013), both spatially and temporally. Outside of the HSC data collection effort, there were a limited number of samples where this comparison was possible, as discussed in the TM. The HSC data were relied upon because the habitat and fish presence data were synoptic in time and space and sampling times were selected with respect to species life stage periodicity. The criticisms of HSC methods are responded to elsewhere. See Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables) below for further discussion.
USFWS_pp8.5-25_ph01; NMFS_pp8.5-24_ph03	*AEA's HSC habitat utilization surveys were not based on stratified-random sampling, structured by the Projects hierarchical habitat model, as proposed. Surveys were focused within "clusters" of known spawning. Surveys were to be systematic with regard to the Project's hierarchical habitat model. AEA's surveys were reported to be "random", but the incorporation of "randomness" into AEA's survey design is questionable. AEA noted that surveys focused on "clusters" of known spawning. If randomness was incorporated within these clusters, it is not mentionable. It is not probable that surveys could have been random, given that measurements of microhabitat were made directly in association with occupied sites. Within clusters, surveys were to be stratified according to the Project's hierarchical habitat model and the distribution of fish, in order to control for the influences of habitat and be discerning about ecological relevance of microhabitats under investigation.*	AEA disagrees with this comment. This comment is not correct, and reveals confusion over the study design. The stratified random selection of 50-100 meter sampling sites was imposed to ensure that diverse habitats were sampled. As described in the SIR (Study 8.5 SIR, Section 4.2.1), HSC *spawning* surveys included **both** randomly selected and historical spawning locations to ensure that spawning would be observed. In each analysis, a fixed factor differentiating the site type (random or selected) was included, and interaction between this fixed factor and the other parameters in the model was tested. Cases where this interaction was significant was noted and discussed to evaluate the potential bias of models fit including the data from historical spawning locations. The alternative would be to use only data from the randomly selected sites, which would result in far fewer observed utilization locations for spawning. See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-25_ph02; NMFS_pp8.5-24_ph04	*The influence of microhabitat (e.g. surface-water hydraulics, river and groundwater exchange [as measured by VHG], and water quality) is uniquely manifested in the context of meso and macro habitats. For example, turbidity, local river and groundwater exchange, and cover condition the role of surface-water hydraulics in habitat selection. The influence of macrohabitat, in the form of channel complexity and regional ground and river water exchange influence local population segregation through spatial segregation of spawning tactics (see Leman 1993; Mouw et al. 2014). AEA did not stratify their surveys of microhabitat criteria in regard to the hierarchy of macro or mesohabitat present on the Susitna River. Since biological relevance of flow hydraulics, VHG, substrate, and other criteria differ amongst the various habitats of the floodplain hierarchy, AEA's ability to draw valid conclusions about flow-habitat relationships is at best, severely limited.* [USFWS adds:] *If AEA was unable to characterize the habitat context in which HSC were surveyed, the entire effort is significantly weakened.*	AEA disagrees with this comment. This comment is not correct, and reveals confusion over the study design. The stratified random selection of 50-100 meter sampling sites was imposed to ensure that diverse habitats were sampled. It is not clear why the commenter doubts the random selection of sites. As described in the SIR (Study 8.5 SIR, Section 4.2.1), HSC *spawning* surveys included **both** randomly selected and historical spawning locations to ensure that spawning would be observed. In each analysis, a fixed factor differentiating the site type (random or selected) was included, and interaction between this fixed factor and the other parameters in the model was tested. Cases where this interaction was significant was noted and discussed to evaluate the potential bias of models fit including the data from historical spawning locations. The alternative would be to use only data from the randomly selected sites, which would result in far fewer observed utilization locations for spawning. See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.
USFWS_pp8.5-25_ph03; NMFS_pp8.5-24_ph05	*Microhabitat surveys were not structured with regard to the distribution of fish, which is almost always contiguous, or highly clumped in space. The most effective way to survey and assess microhabitat relevance to habitat selection is by also structuring surveys with regard to the distribution of fish.* ([USFWS adds:] *This is conceptually basic to ecological study and provided the rationale behind resource agencies requests for assessment of habitat availability.) If habitat is not clearly surveyed within and outside the distributions of fish, on the river's longitudinal dimension, it is not possible to be discerning of ecological relevance. Random surveys of "available" habitat, at the same longitudinal floodplain position meant that AEA could not control for VHG, and therefore could not address whether the statistical distributions of microhabitat criteria differed outside the distribution of fish, or not. This means that AEA cannot make any valid conclusions about the influence of flow hydraulics and holistic conclusions about the influences of substrate and cover.* *Overall, the questions directing the HSC study were where and why fish select habitat. The survey design adopted by AEA only allowed a characterization of microhabitat utilization where fish were most common, in terms of spatial coordinates and microhabitat associations. We essentially have been presented with the distributions of microhabitat utilization, within "clusters" of utilization, with no means of sorting through which associations are relevant.* ([USFWS adds:] *The "why" question, why do fish utilize the habitats they do, has not been addressed by AEA.) Unless relevant habitat criteria are isolated, environmental Project-effects cannot be assessed.* ([NMFS adds:] *Strategic surveys are required to isolate ecological relevance. The study surveys were not strategic because they did not account for the distribution of fish and habitat.)*	HSC sampling was carried out as described in the FERC-approved Study Plan Section 8.5 with only minor variances (Study 8.5 ISR Part A, Section 4.5) and adjustments in response to agency comments (Technical Team meeting notes, Study 8.5, May 17, 2013). See Table 2.5.1-2 below for a description of the meetings, documents, and other communications pertaining to study implementation. For the 2013-2014 HSC/HSI sampling, a stratified random sampling approach based on macrohabitat composition within each Focus Area and relative fish use (Study 8.5 ISR Part A, Section 4.2), was used for selecting sampling locations, with some adjustments made to final locations based on access and safety considerations. This approach enabled representative sampling of the range of macrohabitat types available to fishes within Focus Areas. In addition, HSC/HSI study sites were also selected in four areas outside of the Focus Areas, two within geomorphic reach MR-6 and two in MR-7 (Study 8.5 ISR Part A, Section 4.5). These areas were identified as areas of high fish use during the 1980s and 2012 surveys and were selected in consultation with the Fish Distribution and Abundance in the Middle and Lower Susitna River Study (FDAML Study 9.6). The ISR (Study 8.5 ISR Part A, Section 4.2.1.1) describes the rationale and methods used in river stratification and Focus Area selection. See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-26_ph03; NMFS_pp8.5-25_ph03	*Regarding the distribution of fish, surveys of microhabitat within and outside the distribution of spawning or rearing are needed to identify ecologically relevant criteria. This must be done on the longitudinal floodplain dimension, not the lateral dimension, as conducted by AEA. Regarding the distribution of habitat, surveys stratified by macro and mesohabitat are needed to strategically assess relevance in a valid (statistical, ecological, evolutionary) context. This stratification should have been performed on both the lateral (main-channel to upland) and longitudinal (riffle-pool sequence) dimensions.*	This comment is premised upon a misunderstanding of AEA's implementation of the Study Plan. HSC sampling was carried out as described in the FERC-approved Study Plan Section 8.5 with only minor variances (Study 8.5 ISR Part A, Section 4.5) and adjustments in response to agency comments (Technical Team meeting notes, Study 8.5, May 17, 2013). The stratified random selection of 50-100 meter sampling sites was imposed to ensure that diverse habitats were sampled. It is not clear why the commenter doubts the random selection of sites. As described in the SIR (Study 8.5 SIR, Section 4.2.1), HSC *spawning* surveys included *both* randomly selected and historical spawning locations to ensure that spawning would be observed. In each analysis, a fixed factor differentiating the site type (random or selected) was included, and interaction between this fixed factor and the other parameters in the model was tested. Cases where this interaction was significant was noted and discussed to evaluate the potential bias of models fit including the data from historical spawning locations. The alternative would be to use only data from the randomly selected sites, which would result in far fewer observed utilization locations for spawning.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-27_ph02	*Conclusion: Unstructured surveys prevented valid comparisons. Pooling data, regardless of meso- or macrohabitat, prevented the possibility of performing comparisons where surveys may have inadvertently resulted in potential validity.*	AEA disagrees with these comments. As described in the FERC-approved Study Plan (RSP Section 8.5.4.5.1.1.3), HSC/HSI sampling followed a stratified random sampling approach based on macrohabitat composition within each Focus Area and relative fish use (Study 8.5 ISR Part A, Section 4.2) with some adjustments made to final locations based on access and safety considerations. In an attempt to capture the microhabitat variability within a macrohabitat type, multiple sampling sites were selected from within each representative macrohabitat type. During the 2013 and 2014 HSC data collection effort, site-specific microhabitat use measurements were collected for greater than 2,700 fish observation points, from 129 individual sampling sites, and during 267 unique sampling events (Tables 5.2-1 and 5.2-2 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Additionally, over 5,000 microhabitat availability measurements were collected concurrently with the habitat use information. Even with the tremendous effort, only one species' life stage (Chum Salmon spawning) has a sufficient number of site-specific observations to consider a statistical comparison of habitat selection between different macrohabitat types. Although the development of macrohabitat specific HSC models was identified as a possibility in the FERC-approved Study Plan, it is stated clearly in the ISR that AEA believes that separate HSC models for individual macrohabitat types would be inappropriate, if not invalid (see Section 2.5.1.4.1 (Macrohabitat-specific HSC). HSC sampling occurred during all seasons and river conditions with the exception of ice formation and breakup. Species and life stage periodicity was used extensively to determine sampling time and ensure that the target species were present within the river system during HSC sampling (Section 4.2.1 in Study 8.5 SIR, Appendix D). Microhabitat availability and utilization measurements were collected within each sampling location (Section 4.2.2 in Study 8.5 SIR, Appendix D).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-27_ph05; NMFS_pp8.5-25_ph06	*AEA apparently did survey the "availability" of upwelling and downwelling (VHG), but it was not measured in association with utilization. VHG, therefore, was not assessed at the local level. AEA measurement of VHG was also limited to 3 shoreline measurements at each survey unit. There is no evidence that AEA considered VGH, laterally, within the channel matrix of their survey units. Because AEA did not approach their assessment of VHG hierarchically, there is no way to assess the influence of VHG, with respect to utilization. Salmonids with differing spawning periodicity have been observed spawning in association within different ground and surface water configurations. Fall populations typically spawn in association with localized downwelling, in regions of upwelling (Baxter and Hauer, 1999; Alaska Department of Fish and Game, 2005). Summer populations typically spawn in association with regional downwelling and localized upwelling in regions of downwelling (Leman 1993, Mouw et al. 2014). These different spawning tactics are manifested in the context of very different macro, meso, and microhabitat associations. AEA's study design prevented their ability to assess the relative roles of hierarchical exchanges in ground and surface water in structuring the distribution of spawning and rearing. As with the other habitat criteria, VGH was also not assessed in the context of the Project's hierarchical habitat model.* [USFWS adds:] *Assessment of river and groundwater exchange is critical because it drives population diversification and differences in spawning periodicity. Populations spawning in summer often exhibit two main spawning tactics that differ from that of species spawning in fall. Summer populations are known to spawn in association with downwelling in the main channel and localized upwelling in the secondary channel network. Fall spawning strategies often select regional upwelling. The differences in water quality between localized and regional upwelling water are dramatic.*	AEA disagrees with this comment. In response to the Study Plan Determination (FERC_ppB-87_ph01, April 1, 2013), VHG measurements were collected at both fish utilization (spawning redds) and availability locations within HSC sample sites. VHG measurements were collected longitudinally within a sample site to assess the presence of groundwater upwelling. As described in the FERC-approved Study Plan (RSP 8.5.4.5.1.1.3), HSC sample sites were selected using a stratified random approach based on anticipated Project impact area, geomorphic reach, macrohabitat type, and relative fish use. See Section 2.5.1.4.3 below for further discussion on VHG and spawning site selection.
USFWS_pp8.5-28_ph03	*AEA's failure to account for the hierarchical nature of ground and surface water exchange prevented them from assessing the biological relevance of the statistical distributions of any other microhabitat variable. Had they not been requested by FERC and resource agencies to perform studies with regard to VHG, such an oversight would have a less tangible recourse. Given the fact that FERC recommended AEA consider VHG in the context of a hierarchical habitat model, as requested by resource agencies, AEA's misunderstanding is now more problematic for the performance of realistic environmental assessment.*	AEA disagrees. As requested by FERC (Study 8.5 SPD, April 1, 2013) and described in the ISR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development),* micro-piezometer measurements were used to detect the presence of groundwater upwelling within all HSC sampling sites and in proximity to spawning redd locations. Upwelling-VHG was included as a habitat variable (of those collected synoptic with HSC) used in the statistical analysis to predict fish presence-habitat use. See Section 2.5.1.4.3 (VHG and Spawning Site Selection) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-28_ph04; NMFS_pp8.5-26_ph02	*Accurately capturing habitat variables that influence fish habitat selection is more important than developing the "best fit" from variables that may not be ecologically relevant. AEA showed no evidence of having performed a statistical analysis of ecological relevance for any criterion investigated.* ([USFWS adds:] *This is a non-scientific approach. Utilization curves demonstrate associations with statistical distributions of microhabitats.) They are not informative of the ecological relevance without comparison of the statistical distributions of the same microhabitats outside the distributions of species and life stages under investigation. Statistical comparisons are a basic step of ecological investigation.* *AEA did construct univariate models for certain microhabitats, but offered no way for reviewers to examine relevance of these to fish habitat selection. There is also no way of knowing whether or not any of the other habitat criteria were equally important, or not. AEA reported AIC values for each of the univariate models, but this tells reviewers nothing of the absolute significance of each microhabitat, only the relative significance of each model. As reviewers, the Service has no way of knowing if the models were equally good or poor.* ([USFWS adds:] *Valid surveys, based on valid habitat delineations, were needed, but these were not performed. Data from these surveys would have to also been analyzed in the way, in accordance with the Project's hierarchical habitat model, but this also was not performed.)* *AEA also stated some limitations and assumptions about the surveys of habitat criteria. Methods for collecting fish observational data and microhabitat variables metrics have limitations and assumptions that should be explicitly identified prior to integration into habitat-specific models. For example, the AEA stated that spawning chum salmon do not show a preference for groundwater upwelling in habitats in water depths greater than two feet. It is unclear if (1) spawning areas in surface water greater than 2-feet deep were assessed or (2) VHG was measured in water greater than 2-feet deep. There are no data provided to support the conclusion that depth precludes upwelling or redd site selection. AEA previously stated, "there is some possibility that this interaction is an artifact of the difficulty in sampling VHG in deeper water. This issue will be investigated further prior to the Updated Study Report." AEA still has not performed these additional investigations. Instead, examination of VHG is left out of the results. (*[USFWS adds:] *AEA's univariate analysis of microhabitat criteria is incomplete and unscientific in what was completed.)*	AEA disagrees with this comment. Although utilization histograms were used to compare winter to summer habitat utilization, multivariate preference models were used for statistical HSC curves. The objective of the HSC univariate analyses was to determine whether fish preference for habitats can be predicted using these microhabitat variables. The analysis to date shows which habitat variables demonstrate predictive value and should be included in the HSC model as continuous predictors. Ecologically relevant habitat variables such as temperature and dissolved oxygen that are not included in the statistical model, will still be included in all models as an HSI variable, meaning that habitats with water temperatures and dissolved oxygen falling outside an ecologically relevant threshold will be assumed to be completely unusable, regardless of whether they are also included as a variable that determines the relative value of habitats between unusable and the highest quality. Investigations that have been left until the USR stage of analysis, such as further consideration of upwelling impacts to fish preference, are not completed because we are in the ISR stage (basically a mid-point check-in). All collected habitat data at utilized and available sites are available (http://gis.suhydro.org/reports). R2 Resource Consultants (R2). 2015. HSC/HSI Fish Utilization and Availability Data 2013-2014. Susitna-Watana Hydroelectric Project, FERC Project No. P-14241. Posted October 30, 2015 on the Susitna-Watana Hydroelectric Project GIS Portal on the Geographic Information Network of Alaska (GINA). http://gis.suhydro.org/SIR/08-Instream_Flow/8.5-Fish_and_Aquatics_Instream_Flow/SIR_8_5_Appendix_D_Habitat_Suitability_Criteria/SIR_8_5_IFS_HSC_Database2013-2014_20151030.xlsx.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-29_ph04; NMFS_pp8.5-26_ph06	*Other limitations of the HSC-HSI criteria univariate modeling include the following:* *Results presented for chum salmon spawning were limited to clearwater habitats (NTU<30). It is not clear how the Project is accounting for turbidity and whether or not AEA considered chum salmon spawning in turbid habitats where it is known to exist.*	As described in the FERC-approved Study Plan (RSP Section 8.5.4.5), microhabitat use observations for the spawning life stage required visual observation of active nest-redd construction or defense to verify spawning activity and confirm species. Visual confirmation of active nest-redd construction or defense and species confirmation was generally not possible in turbid (NTU>30) water conditions. Although Chum spawning HSC observations were limited to clearwater (<30 NTU) areas, there is no compelling reason to limit habitat model use to clearwater areas. The final decision on the use of the HSC and habitat models will be made prior to the USR.
USFWS_pp8.5-29_ph05; NMFS_pp8.5-27_ph01	*Turbidity was determined to be a strong predictor of Coho Salmon fry habitat preference with limited fry data from turbid environments. It is not clear how this "preference" was identified, in the absence of any statistical analysis, and how the relationship between HSC and turbidity was determined.*	AEA disagrees with the assertion that no statistical analysis was provided regarding the HSC model for Coho Salmon fry. Section 5.6.4 of Study 8.5 SIR, Appendix D (*Habitat Suitability Criteria Development*) provides a detailed description of the statistical analysis used in development of the HSC model for Coho Salmon fry with particular emphasis on how the variable of turbidity was handed in the model. The relationship between HSC and turbidity was determined using univariate polynomial logistic regression. The best-fit model included the cover/turbidity factor, a quadratic relationship with depth, and a linear decreasing relationship with velocity (Table 5.6-13 in Study 8.5 SIR Appendix D). If the AIC value for a model containing turbidity is lower than the AIC value for the null model (with no predictors), then turbidity is retained as a variable in the global multivariate logistic regression. Categorical variables are problematic in multiple regression, particularly when samples sizes are low and unbalanced among different levels of the categorical factor. In consideration of this, an exploratory analysis, displayed in the SIR (Table 5.6-11 in Study 8.5 SIR, Appendix D), is used to determine whether turbidity should be included in the model as a type of cover or as a factor that may interact with cover. For example, if more fish are using clear water than are using turbid water, no model would find that fish are using turbidity as cover. However, in this case, there appeared to be a difference in the use of cover, depending on turbidity. The exploratory analysis was not used to test statistical significance of this hypothesis. Rather, this potential interaction between turbidity and cover was included in the model, and the predictive capability of this interaction (over the null model) was assessed using AIC.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-29_ph06; NMFS_pp8.5-27_ph02	*VHG, temperature, DO, specific conductivity and turbidity were measured in only three locations per 50m reach length within FAs.* ([USFWS adds:] *AEA states, "during field sampling, some utilization locations that were near existing water quality measurements were not uniquely sampled." At locations where these measures were not taken it was assumed that the nearest value (on same transect) would be representative, or a linear extrapolation between measures would be representative.) By assuming three measurements per 50m reach length is adequate for each variable they also assume that those measures at meso- and microhabitat levels are homogenous on a 50m scale. This may not be a valid assumption for some variables (e.g., DO, temperature, specific conductivity), and one that should be tested prior to reducing sampling efforts.* ([USFWS adds:] *VHG was not considered locally, in association with spawning, nor was it considered hierarchically.)*	AEA strongly disagrees that VHG was not considered in association with spawning salmon. The number and distribution of VHG measurements within a sample site followed protocol described in the FERC-approved Study Plan (RSP Section 8.5.4.5). Although this study did not identify upwelling-downwelling (as measured by VHG) as a strong predictor of habitat preference for spawning Chum or Sockeye Salmon, AEA has proposed additional evaluation of the scale and specific influence of groundwater upwelling-downwelling in habitat selection (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). See Section 2.5.1.4.3 (VHG and Spawning Site Selection) below for further discussion.
USFWS_pp8.5-29_ph08; NMFS_pp8.5-27_ph03	*Within FAs VHG is assumed to be either (1) upwelling or (2) 'no-upwelling' which could be negative or neutral. The Project Proponent reported that less than 6% of locations sampled had negative (downwelling) VHG. Surface-groundwater exchange is pronounced and highly variable in the Susitna River making it very questionable that only 6% of FAs are reported to be downwelling. This strongly suggests that the surveyed locations were not representative of utilized habitats and certainly not the habitat available to salmon. Downwelling is also important to macroinvertebrate productivity and species life history stages.*	The number and distribution of VHG measurements within a sample site followed protocol described in the FERC-approved Study Plan (RSP Section 8.5.4.5). Although this study did not identify upwelling-downwelling (as measured by VHG) as a strong predictor of habitat preference for spawning Chum or Sockeye Salmon, additional evaluation of the scale and specific influence of groundwater upwelling-downwelling in habitat selection has been proposed (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). See Section 2.5.1.4.3 (VHG and Spawning Site Selection) below for further discussion.
USFWS_pp8.5-30_ph02; NMFS_pp8.5-27_ph04	*Water temperature was not found to be important for chum salmon spawning site selection, but given the fact that all data were pooled, regardless of macrohabitat, this is not surprising AEA needed to consider the role of temperature in accordance with their hierarchical habitat model. Water temperature also needed to be evaluated more robustly and under alternate operational scenarios.* *DO and specific conductivity was determined to have no influence on chum salmon spawning site selection. Given the fact that all data were pooled, regardless of macrohabitat, this is not surprising. AEA needs to consider the role of DO and specific conductivity in accordance with their hierarchical habitat model.* *Criteria were not evaluated on the basis of macrohabitat, according to the RSP.*	Although water temperature, dissolved oxygen, and specific conductance can be important variables in defining the suitability of fish habitat, they were not found to be strong statistical predictors of site selection by spawning Chum Salmon. There are an insufficient number of site-specific observations for most species' life stages to develop strong statistical predictors of habitat use in each macrohabitat type. Comparisons of habitat utilization between seasons (summer vs. winter) and river segment (Middle vs. Lower) showed very little difference for most species' life stages (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Water temperature measured at fish utilization points ranged from 2.7 to 24.2 °C and was evaluated using the same statistical methods as applied to all other water quality variables. Although water temperature is not included in the statistical HSC model for most species and life stages, it will be included for all species and life stages as an HSI variable as displayed in the SIR (Table 5.5-1 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.

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USFWS_pp8.5-30_ph05; NMFS_pp8.5-27_ph06	*Criteria were not evaluated with the target sample sizes specified in the FERC determination.*	See response to NMFS_pp8.5-22_ph01; USFWS_pp8.5-21_ph06.
USFWS_pp8.5-30_ph06	*The Project used the results of the univariate model to select input variables to the multivariate model. The ISR states that, "Based on the univariate model results, only depth, velocity, substrate, and upwelling would be included in the multivariate model." We request that this determination be re-evaluated. AEA's use of univariate habitat associations to identify which criteria to use in their multivariate models is unscientific. As previously stated (and see below in the review of Statistical Analyses), univariate utilization functions cannot be used demonstrate ecological relevance. This means that the multivariate modeling exercise was incomplete before it was started.* *Multivariate Model (of Fish Habitat Suitability)* *Proposed Project operational scenarios will result in conditions that are outside those of the natural system. The ISR states, "Note that these models are not displayed beyond the conditions under which spawning was observed (spawning observed at depths between 0.20 - 3.3 feet and velocities up to 2.2 ft-sec). Suitability criteria beyond these conditions have not yet been determined and cannot be determined using statistical methods". The preliminary multivariate model for chum salmon, for example, does not represent conditions beyond the observed conditions (0.20 – 3.3 feet and velocities up to 2.2 ft-s). The coho salmon fry (ISR Appendix M, pages 9-12) initial curve development is limited by data collection restricted to the open water period, at depths less than 3 feet, with lower turbidity levels.*	Sample sizes are small, particularly for binary outcomes. Model fitting for mixed effects models can be unstable if too many variables are included in a global model. Also, the habitat variables are generally considered to covary and therefore cause multicollinearity issues. For these reasons, the variables to include in the global model were reduced by fitting univariate models to look for relationships prior to producing the global model. AEA believes this to be a sound statistical process.
NMFS_pp8.5-27_ph07	*The study used the results of the univariate model to select input variables to the multivariate model. The study's use of univariate habitat associations to identify which criteria to use in their multivariate models is invalid. Univariate utilization functions cannot be used demonstrate ecological relevance.* *Multivariate Model (of Fish Habitat Suitability):* *Proposed Project operational scenarios will result in conditions that are outside those of the natural system. The ISR states, "Note that these models are not displayed beyond the conditions under which spawning was observed (spawning observed at depths between 0.20 - 3.3 feet and velocities up to 2.2 ft-sec). Suitability criteria beyond these conditions have not yet been determined and cannot be determined using statistical methods." The preliminary multivariate model for chum salmon, for example, does not represent conditions beyond the observed conditions (0.20 – 3.3 feet and velocities up to 2.2 ft-s). The coho salmon fry (ISR Appendix M, pages 9-12) initial curve development is limited by data collection restricted to the open water period, at depths less than 3 feet, with lower turbidity levels.*	The models used are not utilization models, because habitat availability measurements are included. Both univariate and multivariate models are preference models. Sample sizes are small, particularly for binary outcomes. Model fitting for mixed effects models can be unstable if too many variables are included in a global model. Also, the habitat variables are generally considered to covary and therefore cause multicollinearity issues. For these reasons, the variables to include in the global model were reduced by fitting univariate models to look for relationships prior to producing the global model. AEA believes this to be a sound statistical process.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-30_ph08; NMFS_pp8.5-27_ph09	*Curve development should be based on conditions beyond those observed in the natural system. For example, tails of the graph representing the curves should go to zero value at either end. Models must include values that are outside of baseline conditions in order to have predictive capabilities for anticipated Project effects.* *Additionally, the model substrate inputs are limited to cobble or gravel-dominated substrate and do not consider the full spectrum of substrate heterogeneity. Therefore, the model cannot account for conditions beyond those observed; it does not include all conditions that were observable.*	AEA disagrees with the Services' contention that the HSC graphs should go to zero value at either end. Statistical models were not extrapolated beyond the observed data. Instead, as stated in the Study 8.5 SIR, Appendix D (*Habitat Suitability Criteria Development*), HSC values for habitat conditions beyond the observed data are based on biological theory. For example, there is a velocity beyond which spawning is assumed to be zero (Table 5-5.1 in Study 8.5 SIR, Appendix D) and a minimum depth that an adult salmon needs to remain upright during spawning activity. In these cases, threshold values (minimum and maximums) have been proposed to provide end points to the tails of the HSC model graphs (Table 5.5-1 in Study 8.5 SIR, Appendix D). As another example, all available substrates have been observed and because no spawning is observed in some substrates (e.g., 100% fines or boulders), HSC is assumed to be zero for these substrates. Data for depth, velocity, and other variables in locations with these substrate types are not used to model multivariate HSC because AEA assumes the substrate type is the driving factor for the lack of spawning. Including these depths would bias the overall pattern of habitat selection.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-31_ph01; NMFS_pp8.5-28_ph03	*Macrohabitat Specific Criteria (post-Project conditions)* *The ISR discussion of multivariate models points out that all macrohabitats exhibited variability. Based on the discussion, macrohabitat type within the HSC modeling efforts have not been considered and should be included. AEA stated, "Macrohabitat type has not been included [in HSC modeling], although differences in habitat preference among macrohabitat types are possible" (AEA 2014 Appendix M). AEA considered it prohibitive to account for macrohabitats within the realm of HSC modeling because replication of observations at each habitat type is needed for this purpose. They also state that the model assumes that post-Project macrohabitat relationships would be static and use this limitation as rationale against the development of macrohabitat specific criteria. This same rationale is applied related to other HSC variables, such as temperature and turbidity, representing the observations under the pre-Project conditions, but not the range of post-Project conditions. Unless AEA examines the relevance of microhabitat criteria on the basis of their hierarchical habitat model, it will be impossible to evaluate flow-habitat relationships for this project. Even in the 1980's there were separate curve sets developed for main and offchannel sites, given the extreme differences in habitat and patterns in habitat utilization among these extremely different sets of habitats.*	This comment is factually incorrect. Below is the statement made by AEA in the ISR (Section 5 of Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development*): *"Macrohabitat type has not been included in HSC modeling for the ISR, although differences in habitat preference among macrohabitat types are possible. There are several reasons it has not been included. First, good model fitting would require similar levels of replication within each macrohabitat type. For example, although sampling was designed to capture a range of habitats, most spawning occurred in side channels and side sloughs, leading to large imbalance in sample size (i.e., for "1" spawning locations) among habitat types. Second, including macrohabitat as a fixed effect in suitability criteria would presume that fish preference for each macrohabitat would be static under all possible future flow conditions. This decision will be re-evaluated prior to selection of the final HSC model."* As stated above, using macrohabitat-specific HSC models would presume static conditions. AEA did not think this was a good presumption, and that is given as a reason that macrohabitat-specific models were not created. As described in the FERC-approved Study Plan (RSP Section 8.5.4.5), macrohabitat type was a major factor in the number and distribution of HSC sampling within individual Focus Areas. During the 2013 and 2014 HSC data collection effort, site-specific microhabitat use measurements were collected for over 2,700 fish observation points, from 129 individual sampling sites, and during 267 unique sampling events (Tables 5.2-1 and 5.2-2 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Additionally, over 5,000 microhabitat availability measurements were collected concurrently with the habitat use information. Even with the tremendous effort, only one species' life stage (Chum Salmon spawning) has a sufficient number of macrohabitat-specific observations (>80) to allow for a meaningful statistical comparison of habitat selection between different macrohabitat types. An exploratory evaluation of the differences in predicted habitat selection between different macrohabitat types for Chum Salmon spawning will be completed prior to the USR. See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.
USFWS_pp8.5-31_ph03; NMFS_pp8.5-28_ph05	*The following are identified limitations on the HSC-HSI criteria multivariate model inputs that should be addressed to advance conformance with Objective 4:* *• Water depth- initial results show that a 1.5 foot depth is the preferred depth among Coho Salmon fry. There is no analysis or discussion of data collection efforts and therefore we do not know if measurements were taken at depths beyond the 1.5 foot depth. And if so, where or to what extent the sampling effort was applied.*	The entire dataset used for all analyses was provided with the Study 8.5 ISR and the SIR (http://gis.suhydro.org/reports). Coho Salmon fry have been observed at depths up to 3.2 feet, but 78% of the fry utilized depths of 1.5 feet or less. Depths of up to 5 feet were available in 50-100 meter sample sites used in the analysis. AEA will consider providing more comprehensive data summaries in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-31_ph04; NMFS_pp8.5-28_ph06	*Velocity - The ISR reports that velocity has a relatively low influence on habitat utilization, especially when cover is present, yet velocity is used in many models without reporting its significance, whatsoever.*	AEA disagrees with this comment. The significance of velocity as a predictor of habitat preference for each species life stage is determined using univariate polynomial logistic regression. If the AIC value for a model containing velocity is lower than the AIC value for the null model (with no predictors), then velocity is retained as a variable in the global multivariate logistic regression. In the multivariate stage, velocity is again assessed against all sub-models of the global model using AIC. If a model that does not contain velocity has a lower AIC value than all models that do contain velocity, then velocity is not used in the final model.
USFWS_pp8.5-31_ph06; NMFS_pp8.5-28_ph08	*Groundwater downwelling - The Service requested that downwelling be included in the assessment of microhabitat variables for HSC development. The Project combined downwelling with neutral gradient masking any potential relationship to fish habitat preference related to downwelling. Given the importance of surface water-ground water exchange to salmon, this approach does not provide sufficient resolution, especially when neutral gradients are avoided by spawning salmon (Leman 1993; Mull et al. 2007).*	AEA disagrees that groundwater downwelling was not included as a potential HSC microhabitat variable. During the 2013-2014 Susitna River HSC sampling, over 650 VHG measurements were collected during spawning surveys with more than half of all measurements made in randomly selected sites. HSC samples were classified into three categories: 1) upwelling if the measured VHG was positive; 2) downwelling if the measured VHG was negative; and 3) neutral if the VHG was 0. VHG measurement within 50-meter sampling sites were consistently identified as upwelling or downwelling sites if all measurements within the site were a mix of upwelling and neutral or a mix of downwelling and neutral. All neutral VHG and unsampled locations within these sites were assigned as upwelling or downwelling according to the site designation. There were four sites that had a mixture of positive and negative VHG measurements. Each of these sites was divided into a predominately downwelling and-or upwelling segment based on where the transition occurred longitudinally in the segment. See Section 2.5.1.4.3 (VHG and Spawning Site Selection) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-31_ph07; NMFS_pp8.5-29_ph01	*Surface water temperature – A strong relationship between decreased habitat use and increasing water temperature was observed. The ISR states however, that based on the observed range of water temperatures AEA was not convinced of the importance of temperature and may exclude water temperature from future modeling efforts.* ([USFWS adds:] *This is unscientific.) The data ought to dictate what is or is not significant to habitat selection. Data collection efforts were also limited due to small sample sizes; and the analysis combines all species, life stages, and macrohabitat samples for comparison.* ([USFWS adds:] *This is also unscientific.) Stakeholders went to great length with AEA to develop a relevant hierarchical habitat model and species periodicity tables to account for the great variability in habitat and periodicity of utilization on the Susitna River. AEA must survey and analyze data accordingly, not pool all data together. This is not scientifically defensible.*	AEA disagrees with this comment. An HSC model that predicts increased preference with water temperature is likely an artifact of a relationship between water temperature and another unmeasured habitat variable. If this relationship is retained in the HSC model, habitats with higher water temperature will be given more value in the weighted usable area estimates. When temperature is not retained in the HSC statistical model, it does not mean it is ignored as an important ecological variable – obviously fish cannot survive in all water temperatures. The temperature ranges beyond which habitat will be considered unsuitable are displayed in the SIR (Table 5.5-1 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). The assertion that all data have been pooled is misleading. AEA assumes this comment refers to not considering macrohabitat type in the HSC models. The random effect for sampling event in the statistical model provides for different levels of fish use, while assuming the relationship between individual covariates and habitat preference is consistent. This does not amount to combining utilization data "regardless of the habitat context". See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion.
USFWS_pp8.5-32_ph02; NMFS_pp8.5-29_ph02	*DO –An inverse relationship between DO and juvenile coho salmon presence was indicated with Project data. AEA stated that this relationship didn't make ecological sense, but we suggest that this relationship is biologically valid. coho salmon fry may utilize low DO habitats to avoid competition and predation from species that are less tolerant to those conditions (e.g. Chinook salmon, rainbow trout, Dolly varden). This relationship should be tested during winter as well.* *Specific conductivity—no relationship between habitat utilization and specific water conductivity was identified. As with all other microhabitat criteria, no diagnostics were reported to support the exclusion of this variable.*	AEA disagrees with this comment. Like temperature, when dissolved oxygen displayed a relationship that would yield higher suitability value for low dissolved oxygen levels, it was not used in the statistical model, but was instead included as an HSI variable (Table 5.5-1 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). This decision can be revisited in the USR. Conductivity is not part of the water quality modeling, so there will be no way to use conductivity as a predictor of habitat use when comparing operational scenarios. This is the reason no results are shown for conductivity.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-32_ph04; NMFS_pp8.5-29_ph04	*Winter Sampling:* *The ISR presents findings from the 2012-2013 Instream Flow Winter Pilot Studies (Part C- Appendix L). The pilot study tested the proposed approach for monitoring water quality and water stage conditions at salmon spawning locations while recording fish habitat use. The study objective was to develop winter criteria by species-lifestage and macrohabitat. A review of 2012-2013 Instream Flow Winter Pilot Studies (Part C- Appendix L is provided in Appendix 1. The 2012-2013 pilot study was a pre-cursor to the 2013-2014 Instream Flow Winter Studies. No new information was presented on the examination of winter criteria or development of winter HSC in ISR Part D, Appendix D. Separate HSC are not proposed by AEA for winter, instead the same curves are proposed for all seasons and all habitats.* [NMFS adds:] *2013-2014 Instream Flow Winter Studies Technical Memorandum: The Instream Flow Winter Studies Technical Memorandum was released September 17, 2014. The objective of the winter study was to evaluate potential relationships between mainstem Susitna River stage and the quality and quantity of winter aquatic habitats that support embryonic, juvenile, and adult life stages of fish species. For the most part, existing conditions are described, but the Technical Memorandum lacks a description of post-Project conditions under proposed operational scenarios. The study background indicates that winter streamflow is fed primarily by groundwater and consequently discharge is stable. This is true for the current winter conditions, but post-Project conditions will be drastically altered due to increased winter flows and intra-daily pulse-flow fluctuations. Post-Project conditions need to be studied. For example, HSC-HSI curves for fish species have not been developed to describe the response of fish to relatively short-term flow fluctuations (i.e., ramping), especially during winter conditions.*	As stated in the SIR (Section 2 of Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*) there were two primary objectives of the IFS winter studies: 1) evaluate potential relationships between mainstem Susitna River stage and the quality and quantity of winter aquatic habitats that support embryonic, juvenile, and adult life stages of fish species; and 2) to record fish behavior and habitat utilization **in support** of Habitat Suitability Criteria (HSC)-Habitat Suitability Indices (HSI) development. As presented in the SIR (Section 5.3 in Study 8.5 SIR, Appendix A), 288 site-specific observations of microhabitat use were collected during the ice cover period. This data was compared to habitat utilization measurements made for similar species' life stages during the open-water period. In response to seasonal variation in microhabitat use by fry and juvenile Chinook and Coho Salmon, an adjustment to the velocity preference model for the winter period was proposed in the Study 8.5 SIR, Appendix A. Multiple study leads (e.g., Winter Studies, Water Quality, Groundwater, and Ice) are working together to evaluate how post-Project conditions may affect winter aquatic habitat conditions. Developing HSC/HSI to describe fish response to short-term flow fluctuations without the capability to manipulate flow condition within the Susitna River will require modeling of assumed responses. Seasonal maximum ramping rates will be developed in consultation with the licensing participants prior to completion of the USR.
USFWS_pp8.5-32_ph06; NMFS_pp8.5-30_ph01	*The FAs were selected for the 2013-2014 ISF winter study because they contain a diversity of habitat types with groundwater influence. The Service requested that habitats used by fish, as well as habitats not used by fish be studied for purposes of developing HSC-HSI criteria. Therefore, selected winter study sites should include both used and unused sites. To assess whether groundwater is influential to fish habitat site selection we need to understand whether or not fish are using winter habitats that both do and do not have groundwater influence. This cannot be determined without studying sites with groundwater influence and those without groundwater influence.*	Collection of winter habitat availability information was not part of the FERC-approved Study Plan Section 8.5. Preliminary comparisons of microhabitat use show similarities between seasons for most variables with the exception of mean column velocity. In response to seasonal variation in microhabitat use by fry and juvenile Chinook and Coho Salmon, an adjustment to the velocity preference model for the winter period was proposed in the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Mapping of groundwater upwelling during the winter period is not yet completed. Once completed, GIS overlays of fish distribution and groundwater upwelling can be used to assess the influence of groundwater upwelling on habitat selection during winter-ice-cover conditions.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-34_ph05; NMFS_pp8.5-31_ph05	*Because of the study objective variances and limitations and because of a failure to address post-Project conditions related to Objective 4, we find that the current effort is not in conformance with the intent of Objective 4. We are concerned that habitat variables have not been adequately assessed to determine their importance to fish. The purpose of the Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables TM (September 17, 2014) was to address Objective 4 in further detail, however our review of the methodologies and statistical analysis presented in the TM concludes that AEA has not sufficiently abated resource agencies concerns or met FERC's SPD.*	At the request of FERC (Study 8.5 SPD, April 1, 2013), AEA filed a Technical Memorandum (Study 8.5 TM, September 17, 2014: *Evaluation of Relationships Between Fish Abundance and Specific Microhabitat Variables*) with FERC that discusses the relevancy of eight microhabitat variables (surface flow and groundwater exchange fluxes, dissolved oxygen [intergravel and surface water], macronutrients [i.e., nitrogen and phosphorus], temperature [intergravel and surface water], pH, dissolved organic carbon, alkalinity, and Chlorophyll-a) in the context of instream flow modeling, then presents the data that are available for evaluating relationships between these variables and fish abundance, and finally describes the subset of data that are synoptic with fish presence or abundance measurements. In cases where statistical evaluation of the relationships between biological data and these microhabitat variables is appropriate, the statistical analyses were provided in this TM. See Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-34_ph06	*Recommendation* *Continuing concerns include (1) the limited microhabitat variables being assessed by the Project, (2) the unscientific nature of microhabitat criteria selection, (3) the scale at which microhabitat criteria are being assessed, (4) the ability of the Project to model the variables pre- and post-Project, and (5) the ability to integrate the relevant variables into synthetic evaluation of alternatives and DSS. We recommend no further work be conducted until a new study is developed to address these concerns.*	In response, while not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was not implemented as provided by the approved Study Plan. With respect to the USFWS's assertion that there have been insufficient meeting opportunities, see Table 2.5.1-2 below for Habitat Suitability Criteria Development (2012-2016) Technical Reports, Presentations, and Meeting Notes, documenting the communications with USFWS on HSC methods and results. The study methods and results have been discussed to a sufficient level of detail for determination of AEA's progress in implementing the FERC-approved Study Plan. The repeated list of general criticisms are addressed elsewhere as follows: (1) the limited microhabitat variables being assessed by the Project: for comments USFWS_pp8.5-23_ph03 and NMFS_pp8.5-23_ph03, see Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables) below and response to comment USFWS_pp8.5-06_ph02 and NMFS_pp8.5-07_ph04. (2) the unscientific nature of microhabitat criteria selection: for comments USFWS_pp8.5-04_ph04; NMFS_pp8.5-37_ph01 USFWS_pp8.5-28_ph04; and NMFS_pp8.5-26_ph02, see responses in Table 2.5.1-1 and Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables) below. (3) the scale at which microhabitat criteria are being assessed: for comments USFWS_pp8.5-28_ph04 and NMFS_pp8.5-26_ph02, see responses in Table 2.5.1-1. (4) the ability of the Project to model the variables pre- and post-Project: for comment TNC_pp018_ph04, see response in Table 2.5.1-1; and (5) the ability to integrate the relevant variables into synthetic evaluation of alternatives and DSS: Section 3.4 (New Study Request: Integrated Modeling and Decision Support System).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-35_ph02; NMFS_pp8.5-32_ph01	*Because of incomplete sampling across focus areas and inconsistent sampling efforts within individual focus areas, additional studies are needed to better understand current fish populations and habitat requirements for over-wintering fish stocks including any groundwater influence winter habitat areas under current conditions in the Susitna river watershed. In addition, modeling efforts to quantify and describe current water quality conditions, groundwater flow, and fish communities within the Susitna River watershed are not sufficiently described to assess the amount of uncertainty included in model outputs.*	One year of Winter Studies sampling has been conducted in accordance with the FERC-approved Study Plan Section 8.5. One additional year of winter sampling is planned for the next year of study. IFS Winter Studies will continue to work closely with Study 5.5 (Baseline Water Quality), Study 7.5 (Groundwater), and Study 9.6 (Fish Distribution and Abundance in the Middle and Lower Susitna River) to better understand habitat requirements for over-wintering fish populations. Response functions to describe and-or predict the relationship between ice-cover, groundwater, water quality and Susitna River flows are still under development and as such were not included as part of the ISR. Once completed, these models will be used to describe how proposed Project operations are anticipated to affect the quality and quantity of over-wintering habitat. Proposed methods for quantifying individual model output uncertainty are described in the *Decision Support System Uncertainty* Technical Memorandum (Attachment 6 to this filing).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-35_ph04; USFWS_pp8.5-36_ph05	*Recommendations* • *Increase the number of winter seasons of macrohabitat variable data collection used to assess fish habitat. FERC requested an evaluation of winter sampling, (page B-96) stating that, "There would be additional opportunities throughout ILP prefilling study implementation to evaluate the effectiveness of winter sampling methods and, if found to be effective, apply additional winter sampling efforts throughout the study area. These sampling efforts include the summary of results of the 2012–2013 ISF winter pilot studies and proposed methods and sites for the 2013–2014 winter studies in the fall of 2013 as proposed by AEA, and in response to information contained in the Initial and Updated Study Reports (sections 5.15(c)(2) and 5.15(c)(4))." We make our recommendation based on our review of these documents and our knowledge that Susitna River winter habitats and ice conditions are highly variable within a winter and between winters.*	While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation. AEA concurs that data collection beyond 2013 and 2014 is necessary to complete all data collection efforts. See Study 8.5 SIR, Section 7.5.1: Proposed Methodologies and Modifications for Winter Studies: *"Conduct fish behavior and fish habitat utilization studies during an additional winter period. Coordinated fish monitoring and sampling will occur in association with IFS and FDAML winter studies to describe relative distribution of fish among macrohabitat types and site-specific microhabitat utilization. Water level will also be monitored at selected habitat features such as side channel or side slough hydraulic controls/inlets that may help discern changes to aquatic habitat conditions through the winter period. Data collection will primarily occur in FA-104 (Whiskers Slough), FA-128 (Slough 8A) and FA-138 (Gold Creek) and secondarily in Focus Area habitats proximal to these areas (e.g., FA-141 [Indian River]) and accessible during winter."*
USFWS_pp8.5-36_ph04	*Recommendations* *Verification of prediction curves (predicting fish distributions from which they were derived) and validation (predicting secondary data sets from FDA data and 1980's data) of prediction curves for aquatic habitat models as a result of fish or productivity sampling and model development under Objective 5.*	This comment is vague, and it is unclear to which study or studies the comment refers. "Prediction curves" may refer to HSC models. Validation of the fitted HSC models (including "overall quality of the model fit") is ongoing and has not been completed. Final HSC models will be developed during the USR stage of the Project. The recommended methods for HSC validation are presented in *Discussion of Habitat Suitability Criteria Model Validation* Technical Memorandum (Attachment 5 to this filing).
USFWS_pp8.5-36_ph05	*Recommendations* *Minimum of two years of macrohabitat fish data needs to be completed as described in the FERC-approved study plan.*	This comment is vague, and it is unclear to which study or studies the comment refers. AEA does not consider the 2013 and 2014 data collection as completing all data collection efforts. See Study 8.5 ISR Part D, Section 8: Steps to Complete the Study, for a description of additional data collection efforts for the IFS Study; data collection efforts for other riverine process models is described in Section 8 of their respective ISR Part D documents.

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USFWS_pp8.5-36_ph06	*Recommendations* *Numerical measurement of groundwater upwelling, downwelling, neutrality in FA's for HSC and HSI should be collected to assess the importance of relative gradients. Small differences in gradient are relevant to fish at the micro- scale.*	See response to USFWS_pp8.5-31_ph06; NMFS_pp8.5-28_ph08.
USFWS_pp8.5-36_ph07	*Recommendations* *Sample the full suite of microhabitat variables influential to fish habitat site selection through HSC-HSI sampling in FAs. In cases where microhabitat variable assessment was incomplete, the full suite of variables should be completed at HSC-HSI sampling locations.*	AEA disagrees with this recommendation. See Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables) below for further discussion.
USFWS_pp8.5-36_ph10	*Recommendations* *Modify data collection where appropriate to meet FERC's requirement that model conditions must be able to be demonstrated for both pre- and post-Project in order to assess Project impacts (FERC regulation section 5.9(b)(5)).*	This comment is too vague for AEA to directly respond.

Reference Number	**Comment or Study Modification Request**	**AEA's Response**
USFWS_pp8.5-35_ph03; NMFS_pp8.5-37_ph06; USFWS_pp8.5-36_ph03;	Recommendation (USFWS); Modification 4-9 (NMFS): *Increase replicates of macrohabitat observations for winter studies to be consistent with resource agencies request during the study plan development. Specifically, resource agencies request that winter sampling for juvenile salmon occur at a minimum of six replicate tributary mouths, main channel or side channel backwaters, side sloughs, and upland slough habitats. This sampling effort should be used to create winter macrohabitat preference criteria and habitat models for site specific habitat variables.* ([NMFS adds:] *Sampling should be done monthly.)* [USFWS recommends under a separate bullet:] *Conduct monthly winter sampling at all FAs to develop HSC for winter fish habitat use by species and life stages among Middle River macrohabitats. This recommendation is based on the review of the 2012-2013 Instream Flow Winter Pilot study.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Increasing replicates of macrohabitat observations for winter studies is not necessary to meet Study Plan objectives. Winter Studies sampling was consistent with the FERC-approved Study Plan (RSP Section 8.5.4.5). Focus Area and macrohabitat sampling sites were selected based on habitat with groundwater influence, documented fish utilization by multiple fish species and life stages, and safely considerations. Collection of site-specific, microhabitat utilization measurements were extremely challenging during ice-cover conditions. Ice-cover limited not only the areas of habitat that could be sampled, but the methods of sampling as well. Only those sampling techniques (electrofishing, under ice video, seining) that allowed for identification of fish species, life stage, and microhabitat selection were used. Although baited minnow traps and fyke nets are effective ways of capturing juvenile fish during winter sampling, data from those sampling techniques would not provide the information necessary to identify microhabitat selection. With that said, a comparison of summer and winter microhabitat use observations was completed to determine if difference in microhabitat (water depth and velocity) selection between seasons justifies development of separate (summer and winter) HSC models. The comparison could only be made for those species and life stages with sufficient (>10) habitat use observations between the two seasons (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Although there were insufficient site-specific observations to construct unique winter HSC models for most species' life stages, seasonal thresholds for microhabitat use and selection have been proposed that reflect differences in habitat use (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). A summary of the Winter Studies sampling sites by Focus Area and macrohabitat type is presented in the SIR (Table 5-1 in Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*). As described in Study 8.5 ISR Part D, Section 8, remaining steps to complete the HSC-HSI study component include monitoring stage and water quality data at main channel and off-channel sites in FA-104 (Whiskers Slough), FA-128 (Slough 8A), and FA-138 (Gold Creek) and winter sampling to include fish observation, capture, and monitoring to discern seasonal habitat use patterns. The estimated cost of expanding this effort as requested by this modification is $350,000-$450,000.

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USFWS_pp8.5-36_ph02; NMFS_pp8.5-38_ph04	Recommendation (USFWS); Modification 4-10 (NMFS): *HSC-HSI curves should be developed for fish behavioral response to short-term flow fluctuations (i.e., ramping) under the proposed OS-1b-ILF-1.* [NMFS adds:] *Ramping from 4,000 cfs to 12,000 cfs twice daily will change the habitat that fish select. At some life stages certain species will move in and out of habitats that are dewatered on a daily basis. Other species will simply abandon using these habitats. Currently there is no information on how fish change their selection of habitat in a river subject to extreme winter ramping. The study design did not suggest a way to take into account habitat selection changes due to ramping and this makes it impossible to assess the complete effects of the projects. The study, as conducted, will not meet the overall goal of assessing projects effects.*	See Section 2.5.1.5.4 (Stranding and Trapping) below for further discussion. AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. HSC sampling (summer and winter) was consistent with the FERC-approved Study Plan (RSP Section 8.5.4.5). Development of HSC to reflect fish habitat selection in response to short-term fluctuations (i.e., ramping) in flow would require that flow levels in the Susitna River be manipulated to simulate ramping conditions. Flow manipulation in the Susitna River is currently not possible. At the request of the resource agencies (NMFS [Eric Rothwell] email dated June 4, 2013 with attachment containing comments on the May 17, 2013 Technical Team meeting presentation updated on May 22, 2014: 2013 HSC Data Collection Revisions), HSC data collection was given precedence over stranding and trapping surveys. Because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. As a fallback to site-specific data on potential stranding and trapping of juvenile fish, ramping criteria developed in Washington State (Hunter 1992) will be proposed during effects analyses. The Services do not provide any information regarding a potential study design modification; however, the estimated cost of conducting field surveys following natural reductions in river flow is estimated to cost $250,000 to $350,000.
USFWS_pp8.5-36_ph08; NMFS_pp8.5-49_ph05	Recommendation (USFWS); Modification 5-6 (NMFS): *Thoroughly addressing the ability to model stranding and trapping under the rapid and perpetual flow fluctuations in side channels and side sloughs during proposed winter flows.* ([NMFS adds:] *If juvenile fish are stranded on bare gravel mid-winter the availability of excellent habitat the next day will be null.) The SP indicates that "field surveys will be conducted at potential stranding and trapping areas on an opportunistic basis following up to three flow reduction events during 2013." Opportunistic observations of potential stranding and trapping areas were recorded during substrate classification surveys conducted during falling river stage conditions in September 2013.* [NMFS adds:] *There needs to be more focus on this important process. While the observations may need to be opportunistic the overall study of stranding and trapping needs more definition. The study, as conducted, will not meet the overall goal of assessing projects effects.*	As explained below in Section 2.5.1.5.4 (Stranding and Trapping), AEA requests that FERC not adopt this proposed Study Plan modification as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. As described in the ISR (Study 8.5 ISR Part D, Section 6.2), during a May 17, 2013 Technical Team meeting, participants indicated that site-specific stranding and trapping studies should be a low priority. Because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. As documented during the May 17, 2013 TWG meeting, ramping criteria developed in Washington State (Hunter 1992) will be proposed as fallback criteria during Project effects analyses. The cost of conducting field surveys following natural reductions in river flow is included in the response to NMFS Modification 4-10 (NMFS_pp8.5-38_ph04).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-36_ph09; NMFS_pp8.5-49_ph09	Recommendation (USFWS); Modification 5-7 (NMFS): *Address the need to provide habitat persistence for holding (e.g., at river mouths)* ([USFWS adds:] *and over wintering fish species) by developing thresholds for lateral and longitudinal geomorphic habitat change and connectivity and alterations to the hydrograph.* [NMFS adds:] *For smaller tributaries, fish often hold for a period of days to weeks waiting for an appropriate flow to move up the tributary and spawn. To evaluate the projects effects on these fish, the stakeholders need to know if the holding areas will still exist. Currently the coarseness of the HEC-RAS Bed evolution model does not seem allow for such precision. The study, as conducted, will not meet the overall goal of assessing projects effects.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Consistent with the FERC-approved Study Plan (RSP Section 8.5.4.7.1.1), the combination of 1-D and 2-D hydraulic modeling will provide depth, velocity, water surface elevation, and other parameters over the range of hourly flows for Existing Conditions and alternate operating scenarios. Analysis of fish habitats within Focus Areas utilizes SRH-2D modeling to calculate channel hydraulics with a 2-D mesh consisting of tens of thousands of elements per Focus Area (Study 8.5 ISR, Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). The mesh was varied to have fine resolution in areas identified by the IFS team, medium resolution in the main channel, and coarse resolution in the overbank. The typical side length of the triangular and quadrilateral elements in the fine mesh areas is 6 feet (~2 meters). The size of the fine mesh will allow for the evaluation of holding areas. AEA agrees that habitat persistence is an important component of Project effects evaluations and has proposed both habitat time series and effective habitat time series as evaluation metrics. The effective-habitat time series (RSP Section 8.5.4.6.1.5) is developed specifically to evaluate the effects of potential load-following operations. Effective-habitat time series are used to calculate the habitat condition that persist for the duration of interest. As described in the FERC-approved Study Plan (RSP Section 8.5.4.7.1.1), the selection of final habitat metrics and appropriate time steps will be developed in consultation with the TWG. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-36_ph11; NMFS_pp8.5-37_ph05	Modification (USFWS); Modification 4-8 (NMFS): *Develop a SP for macrohabitat specific utilization models (HSC-HSI) for open and ice covered periods for fish species and life-stages. The new study should be designed to address resource agencies concerns about the assessment of relevant microhabitat variables and their influence on fish habitat site selection. This new study will address FERC's SPD statement of the need to develop "a detailed evaluation of the comparison of fish abundance measures (e.g., number of individuals by species and age class) with specific microhabitat variable measurements, to determine whether a relationship between a specific microhabitat variable and fish abundance is evident." FERC also stated that if there is evidence of strong relationships between the microhabitat variables and fish abundance for a target species and life stage then the sampling should be expanded in future study.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. This modification specifically states "utilization" models should be used. Utilization models are models which disregard the availability of habitat as a factor in selection of habitat, as opposed to preference models as used in this study. It is unclear whether the agency comments are expressing a request that simpler and more uncertain utilization methods be used, which would disregard availability of habitat attributes as a factor. For response to modification request, see Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables). The estimated cost of conducting a separate study to develop utilization HSC as requested by this modification is $800,000-$900,000.
USFWS_pp8.5-37_ph07; NMFS_pp8.5-32_ph07	*The second problem area has to do with reporting the results, which were found to be incomplete and not consistent with the approved study plan. Fish and Aquatics Instream Flow Study (8.5), 2014-2015 Study Implementation Report, Appendix D reports on a large number of curves developed for the purposes habitat suitability estimation. Although this report contains a considerable body of information, it does not contain adequate information to review the quality of the estimated curves, to review the adequacy of the model fit to the data, nor to review the validity of the model for use in predicting flow-habitat relationships.*	AEA disagrees with this comment. The HSC models are not yet complete. Validation of the fitted HSC models (including "overall quality of the model fit") is ongoing and has not been completed. Final HSC models will be developed during the USR stage of the project. The recommended methods for HSC validation are presented in *Discussion of Habitat Suitability Criteria Model Validation Technical Memorandum* (Attachment 5 to this filing).
USFWS_pp8.5-37_ph08; NMFS_pp8.5-32_ph08	*The equations, such as the examples found in Appendix D, seem to be the only presentation of the numerical results of the regression analysis, and this presentation is quite incomplete and insufficient. The accompanying statistical information centered on the Akaike information criterion, or AIC value (we agree that this is a very important quantity for review) and information on multicolinearity (which is also important). Important material to judge the statistical significance of the overall model (see Zuur et al. 2009, the reference AEA directed us to for a description of the use of mixed effects models, for a discussion of how to test for statistical significance of these models), the statistical significance of the model parameters, the overall quality of the model fit, and information on model validation was not provided. There was also no reported sampling error (e.g., confidence intervals or standard errors) for the individual parameter estimates. It is impossible to evaluate AEA's proposed HSC models without this basic information.*	AEA disagrees with this comment. Upon reviewing recommendations by top researchers developing methods for generalized mixed effects models, AEA developed the process outlined in the Study 8.5 SIR. Recommended methods for validation under consideration by AEA are provided in *Discussion of Habitat Suitability Criteria Model Validation Technical Memorandum* (Attachment 5 to this filing). The TM also provides a discussion of confidence intervals on the predicted HSC. Confidence intervals on individual parameter estimates are not typically provided in this context, and AEA prefers selecting parameters based on the generally accepted modern statistical practice, which is AIC. AEA contends that the information provided to date is adequate for FERC to assess and comment on the process used for development of the HSC models. The assessment of final models should be completed in the USR stage of the licensing process.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-38_ph01; NMFS_pp8.5-32_ph09	*What is known about model development is extremely concerning. In the analysis of their data, AEA combined their utilization data, regardless of the habitat context, and modeled the probability of utilization in the context of availability data collected in a different dimension and habitat context (random cross section locations). This method of data analysis can only operate on the assumption that associations with local microhabitat are spatially invariant. In other words, the association between utilization and any given microhabitat variable is assumed to be the same, regardless of the habitat context (e.g. main channel or side slough). Not only would this be counterintuitive, this assumption does not fare well when exposed to the scientific literature AEA has cited (e.g. Leman 1993; Mouw et al. 2014).*	AEA disagrees with this comment. Sample locations within different macrohabitat types and different reaches were not combined by AEA. The random effect for sampling event in the statistical model provides for different levels of fish use, while assuming the relationship between individual covariates and habitat preference is consistent. This does not amount to combining utilization data "regardless of the habitat context". See Section 2.5.1.4.1 (Macrohabitat-specific HSC) below for further discussion. Table 2.5.1-2 below provides a listing of technical reports, presentations, and meeting notes related to HSC development.
USFWS_pp8.5-38_ph02; NMFS_pp8.5-33_ph01	*No basic descriptive statistics of the range or variability of parameter values was given, globally or on a macrohabitat basis. How did the ranges and variability of occupied parameter values differ amongst habitats? How did the ranges and variability of occupied parameter values differ from unoccupied parameter values, outside the distributions of fish? AEA's inability to answer these questions makes it impossible to evaluate their study, perhaps drawing the conclusion that the study is fatally flawed. In some cases, AEA may have the data to address these questions, but it is clear that some of these, most notably whether or not the statistical distributions of occupied microhabitat parameter values differed from those outside the spatial distributions of utilization, cannot be answered by AEA. AEA did not develop a survey design that would allow them to answer this question, apparently for any species or life stage.*	AEA disagrees with this comment. HSC data were collected as described in the FERC-approved Study Plan Section 8.5. The data collected during HSC surveys can be used to answer any of these questions, and was provided to the Services and other parties with the Study 8.5 ISR and SIR (http://gis.suhydro.org/reports). AEA chose to use the data in the statistical analyses outlined in the SIR (Study 8.5 SIR, Section 4.5). Exploratory comparison of habitat distributions for utilized and available habitat as suggested in the comment would provide a much cruder analysis that would result in fewer, not more, "significant" parameters. R2 Resource Consultants (R2). 2015. HSC/HSI Fish Utilization and Availability Data 2013-2014. Susitna-Watana Hydroelectric Project, FERC Project No. P-14241. Posted October 30, 2015 on the Susitna-Watana Hydroelectric Project GIS Portal on the Geographic Information Network of Alaska (GINA). http://gis.suhydro.org/SIR/08-Instream_Flow/8.5-Fish_and_Aquatics_Instream_Flow/SIR_8_5_Appendix_D_Habitat_Suitability_Criteria/SIR_8_5_IFS_HSC_Database2013-2014_20151030.xlsx.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-38_ph03; NMFS_pp8.5-33_ph03	*In addition to the invalidity these comparisons, no basic exploratory data analyses were performed to isolate which habitat criteria were ecologically relevant and which were not. Instead, AEA used univariate HSC curve exploration to identify what criteria would be used in their multivariate HSC models. Of all the issues with AEA's data analysis, this is the most problematic.* ([USFWS adds:] *Indeed it appears fatal.*) *Associations with criteria are only relevant to habitat selection if the statistical distributions of occupied microhabitat differed from that of unoccupied habitat, outside the local (spatial) distributions of species and life stages under investigation.*	AEA disagrees. AEA conducted exploratory analyses as part of the modeling process for individual variables. However, AEA does not believe it is appropriate to provide all exploratory data analyses with extensive graphics in the SIR. When data considerations impacted the selected model, they were discussed in the results sections of the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). For example, the following paragraph from the SIR (Study 8.5 SIR, Appendix D, Section 5.6.2.1) discusses the considerations that were made in the use of data sets for channel substrate and upwelling: *"The univariate regression models are displayed with AIC results in Table 5.6-5. The random effects model did not improve the fit for any univariate models, so the fixed effects model was used for the HSC analyses in this Section. The original depth analysis showed that the best fit was a 3rd-order polynomial with a steep increase and high preference for the deepest observed locations (3.5-5 feet deep; Figure D5-2). There are only a small number of utilization and availability observations with depths greater than 3.5 feet, mainly in small deep pools in otherwise wadeable areas. These results were having undue influence on the model, so the analysis was re-fit on observations with depths less than 3.5 feet. This selection was revisited during the multivariate analysis. Cover, depth (linear), and velocity (linear) are selected to include in multivariate analysis based on the model results. A decreasing relationship between DO and preference improves predictions, but it is not an ecologically reasonable relationship and is therefore not included in multivariate analysis (Figure D5-2)."* In addition to the text of the report, all data have been provided, and additional plots could be generated to answer specific questions that the reviewer may have.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-38_ph04; NMFS_pp8.5-33_ph04	*AEA's Use of Logistic Regression* *AEA used logistic regression to model probabilities of utilization, based on incomparable data, with incomplete model diagnosis. The AIC criterion, the diagnostic AEA provided, is a measure of relative quality and cannot be used to distinguish whether or not a set of models is equally poor or good. AEA seemed to have used logistic regression to test hypotheses about the biological relevance of the various HSC and their role in structuring the distribution of fish spawning and rearing. But, their models primarily utilized surface water depth and velocity, because their use of hydraulic habitat modeling required this. There was no diagnosis of the models or the model parameters (e.g., microhabitat criteria).* [Additionally the Services are concerned with:] *The AIC can be valuable when assessing the relative quality of statistical models, once their quality is known. … AEA would have benefitted from a more appropriate and strategic use of logistic regression. … AEA could have surveyed VHG at occupied sites and then moved up or downstream to unoccupied locations within the same habitat stratum (e.g. a side slough riffle) and surveyed VHG there. With replication of such valid comparisons of like habitat (apples to apples) within and outside the distribution of fish, the role of VHG would either emerge into one of relevance, or not. … AEA would have benefitted from its use for exploration within their data as a whole, not to model HSC with an arbitrary subset of microhabitat parameters, or those directly associated with a hydrodynamic model (depth and velocity). … Instead AEA reported that they used the univariate curve generation process to sort through the various microhabitats used in the multivariate process of curve generation.*	AEA disagrees with this comment. The statistical methods used by AEA are sound, and are used quite commonly in the resource selection literature (Boyce et al. 2002; Gillies et al. 2006; Johnson et al. 2006; McRae et al. 2012). The methods and results have been reviewed by ADF&G biometricians (ADNR_ADFG_pp11_ph04): *"ADF&G biometricians have reviewed proposed HSC-HSI methods and analysis and concur with the chosen approach and use of a generalized linear mixed model. Information collected has been informative and meets study objectives for the primary target species. Secondary target species were acknowledged to be of lower density and would be more difficult to meet HSC goals. Accordingly, the study plan anticipated this potential outcome and identified alternative methods to complete this information, if necessary."* Methods for model validation outside of AIC are discussed in *Discussion of Habitat Suitability Criteria Model Validation* Technical Memorandum (Attachment 5 to this filing).
USFWS_pp8.5-39_ph05; NMFS_pp8.5-34_ph04	*It is also difficult to interpret the random effects and constants in AEA's modeling effort. The significance of the additional factors inserted into the modeling effort, to account for site selection and longitudinal effects, was not reported. The significance of these needed to be reported, compared, and evaluated in context with the other parameters in the model. For example, if the longitudinal component was ever of equal or greater significance than any microhabitat parameter, then ecological relevance becomes questionable.* *AEA stated, "The candidate models included polynomial effects when non-linear relationships were reasonable ecological hypotheses." Had AEA's data collection design resulted in data that could be analyzed in the context of their hierarchical habitat model, ecological interpretation could have been reasonable. But AEA pooled all data from every habitat context that was surveyed, making ecological interpretation impossible.*	AEA disagrees with this comment. The significance of the random effect was evaluated using AIC as for other model parameters. When the random effect did not improve the model fit, it was not included. This is discussed in the SIR (Study 8.5 SIR, Section 5.6). AEA disagrees with the contention that ecological relevance is questionable if the random effect is significant. Determining the relative magnitude of impacts of individual habitat parameters is not an objective of the HSC analysis.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-40_ph03; NMFS_pp8.5-34_ph06	*AEA wound up with models predicting ranges of probabilities as low as 0 to 0.20. Clearly these ranges in probability bring the relevance of the models into question. Low predicted probabilities of utilization may or may not be reflective of model quality, depending upon sample sizes, but they raise questions about model effectiveness, when making predictions about future conditions resulting from the operation of the proposed project. The ranges in predicted probability did range in excess of 0.9, but this was only achieved at the expense of controlling for other variables. The necessity to control for other variables in the multivariate models is, on one hand, predictable, given AEA's pooling of data from all habitats. On the other hand, the necessity to control for certain habitat criteria brings the realism of the models into question. How useful would such a model be in the prediction of future conditions?*	Low predicted probability ranges from a logistic regression do not indicate poor model quality, and the Services have not provided support for this claim. Many habitats are unused in a system as large as the Susitna River, and low probabilities of habitat use are not unexpected. Models for species/life stages that are more prevalent have wider ranges of predictions. Although most HSC models are scaled to bring the maximum value to 1, this is not necessary and was not done in this case. There was no "pooling of data from all habitats", model fitting was consistent with generally accepted practice in ecology.
USFWS_pp8.5-40_ph04; NMFS_pp8.5-35_ph02	*AEA's effort also resulted in models predicting the probability of use for sets of highly narrow conditions. For example, AEA's chum salmon curve predicts the probability of spawning for a given substratum and a fixed depth of 1.2.* ([USFWS adds:] *Their inability to predict spawning as a function of velocity, regardless of, or in some way combined with depth, is very telling. The ecological relevance of AEA's curves is highly questionable, yet this was predictable, given their study design.) Had AEA controlled for VHG (lurking variables), and stratified their study and data analysis, based on their hierarchical habitat model, AEA would have been able to clearly demonstrate the relevance (or irrelevance) of the variables they explored. The necessity to build models at fixed conditions is likely a product of pooling data from a wide range of habitat types with a wide combined range of all microhabitat variables involved. This pooled set of conditions is being forced to represent variable patterns of utilization that are known to significantly vary amongst the various habitats and across all seasons, where utilization also differs. AEA appeared to present their HSC models as representative of all conditions and all seasons.* ([USFWS adds:] *There were no separate curves for winter.) This does not make sense, ecologically.*	AEA disagrees with this comment and suggests there is a misunderstanding of basic multiple regression plotting tactics. The comment appears to relate to a graphic (Figure 5.6-5 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*) wherein the relationship between velocity and habitat preference is displayed by *fixing depth* at a moderate value (1.2 feet). This is done for display purposes, to avoid graphics in higher dimensions. It does not *in any way* imply that depth was not used in the model as a continuous variable. In fact, the full model is displayed in the SIR (page 37 of Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*) and clearly shows that depth is a continuous variable used in the multiple regression. Comparison of seasonal microhabitat use is presented in the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Adjustments to the open-water HSC have been recommended to account for seasonal variation in velocity utilization. HSC model development based on winter data alone would be unstable due to the limited data available during ice conditions.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-43_ph03; NMFS_pp8.5-39_ph06	*Methods for Objective 5:* *Proposed methods* *MWH-ROM has been proposed for reservoir modeling, 1D HEC-RAS for open water flow-routing, River 1D to model ice processes, and River 2D to model open water flows in the Middle River FAs. Modeling in the Lower River is proposed to be 1D modeling at "select" sites and currently there are only two FAs study sites at the upper extent of the Lower River.* [USFWS adds:] *The remaining Lower River FA study sites are proposed to be identified during year 2 studies with input from the ISF TWG. The lower extent of modeling efforts is currently at Project River Mile (PRM) 29.9, just below the tri-rivers confluence.* [NMFS adds:] *Just above the proposed Watana dam site, MWH-ROM will be used to model the reservoir instream flow reservation and power curves of water delivery to provide outputs of river discharge downstream of the proposed dam. Reservoir model outputs become the inputs for the 1D HEC-RAS OWFRM which extends to the Lower River. HEC-RAS 1D allows for the modeling of mainstem open water flow routing, but is not able to properly account for the flow routing outside of the mainstem in complex lateral side channel habitats.*	The methods used to model riverine processes are consistent with the FERC-approved Study Plan and are consistent with generally-accepted practice. To correct the agency comments, the 1-D flow routing models (both open-water and ice) are used to provide input to open-water and ice 2D models of the Focus Areas. The SRH-2D model is used to model open-water flows and River2D is used to model ice processes in the Middle River Focus Areas (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling: Proof of Concept*). The OWFRM is used to model mainstem flow and provide input to the SRH-2D model which is designed to account for flow routing in complex lateral side channel habitats (Study 8.5 ISR Part C, Appendix N).
USFWS_pp8.5-43_ph04; NMFS_pp8.5-40_ph01	*Just above the proposed Watana dam site, MWH-ROM will be used to model the reservoir instream flow reservation and power curves of water delivery to provide outputs of river discharge downstream of the proposed dam. Reservoir model outputs become the inputs for the 1D Hec-Ras OWFRM which extends to the Lower River. Hec-Ras 1D allows for the modeling of mainstem open water flow routing, but is not able to properly account for the flow routing outside of the mainstem in complex lateral side channel habitats.*	AEA disagrees with the relevance of NMFS's statement about an inability of HEC-RAS 1-D to properly account for the flow routing outside of the mainstem in complex lateral side channel habitats, because it is not used for modeling side channel habitats for this Project. Consistent with the FERC-approved Study Plan, the 1-D flow routing models (both open-water and ice) were designed to calculate main channel stage and flow at downstream locations. The 1-D model output is used to provide input to open-water and ice 2-D models of the Focus Areas. The SRH-2D model is used to model open-water flows and River2D is used to model ice processes in the Middle River Focus Areas (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling: Proof of Concept*). The 2-D models will account for flow routing in complex lateral side channel habitats (Study 8.5 ISR Part C, Appendix N). See Section 2.5.1.3.1 (OWFRM) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-43_ph05; NMFS_pp8.5-40_ph02	*River 1D is proposed to model winter flows during the ice covered period. Output from the 1D Hec-Ras or River 1D, depending on the time of year, provide water elevation and discharge at a given time step (time and date) and location. Output from the 1D modeling provide the starting input data for the River 2D modeling in Middle River FAs.*	Consistent with the FERC-approved Study Plan, the River2D model is only intended to model ice conditions at Middle River Focus Areas. The 1-D flow routing models (both open-water and ice) were designed to calculate main channel stage and flow at downstream locations. The 1-D model output is used to provide input to open-water and ice 2-D models of the Focus Areas. The SRH-2D model is used to model open-water flows and River2D is used to model ice processes in the Middle River Focus Areas (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling: Proof of Concept*).
USFWS_pp8.5-44_ph01; NMFS_pp8.5-40_ph04	*As an example, to start FA modeling in the Middle River for a given date and time during 1985, the analysis will use output from the 1D Hec-Ras OWFRM or River 1D ice process model for that particular time step. One of the 1D model outputs will consist of discharge and corresponding water surface elevation for a given location and time step (date and time) which are required as inputs to the River 2D model being used in the Middle river FAs.* *Existing conditions for channel geometry (mainstem and FAs) come from ADCP and bathymetry profile data. Measured channel geometry data are used as inputs for the 1D Hec-Ras, River 1D and River 2D models. To run historical flows at time 0 (present conditions) along the mainstem Susitna River channel geometry, for example, 1D cross section measurements and LiDAR are used. In the FAs where 2D modeling is being conducted, more detailed measurements of the channel geometry have been collected using the ADCP and bathymetry profiles at a much finer scale (1-10 meters) laterally compared to the main stem (> 10 meters) and include longitudinal traces as well as lateral traces throughout the entire FA in order to define complex lateral channel habitats.*	AEA provides clarification of the modeling processes. The Services briefly describe the riverine modeling process; and while the description of data inputs is essentially correct; the modeling description is erroneous. The SRH-2D model is used to predict hydraulic conditions in main channel and lateral habitats in Focus Areas during open-water periods, while River2D is used to model Focus Areas during ice conditions (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling: Proof of Concept*). The combination of 1-D and 2-D models will facilitate modeling both longitudinally and laterally in Focus Areas.
USFWS_pp8.5-47_ph02; NMFS_pp8.5-43_ph04	*Initial univariate modeling was used to select Chum Salmon spawning microhabitat variables (8.5 Fish and Aquatics Instream Flow study, Part C 2 of 2, Appendix M: Habitat Suitability Curve Development) for input to the multivariate model. We have removed our review of Appendix M because we were told by AEA that this information has been superseded by ISR Part D, 2014-2015 SIR, Appendix D. Our review of the Part D SIR is included in this document under Objective 4.*	AEA confirms that Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development* supersedes Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Criteria Development*, as described by the Services. In the ISR (Study 8.5 ISR Part D, Section 5), AEA stated that Study 8.5 SIR, Appendix D: *"proposes multivariate HSC for 12 species-life stages and provides greater detail on data analysis procedures; this appendix supersedes Part A, Appendix G (HSC Histogram Plots) and Part C, Appendix M that provided draft HSC for Chum Salmon spawning and Coho Salmon fry."*

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-47_ph03; NMFS_pp8.5-43_ph05	*On September 17, 2014, after the release of the June 2014 ISR, the Project released the Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables TM. The TM was to address FERC's requirement to assess microhabitat variables that may be used to assess Project effects. Our review of this TM was removed from this document because our understanding is that this TM is also superseded with ISR Part D, 2014-2015 SIR, Appendix D.*	To clarify, the brief summary and reference to *Evaluation of Relationships Between Fish Abundance and Specific Microhabitat Variables* contained in the SIR should not be interpreted as superseding the September 17, 2014 TM. As stated in the SIR (Section 4.4 in Study 8.5 SIR, Appendix D: *Habitat Suitability Curve Development*): *"In response to the April 1, 2013 FERC Study Plan Determination (SPD) (FERC 2013), a detailed evaluation of fish abundance measures and eight additional habitat variables (surface flow and GW exchange flux, surface and intergravel DO and temperature, macronutrients, pH, dissolved organic carbon [DOC], alkalinity, and chlorophyll-a) was completed to determine whether relationships were evident and if additional HSC curve development was warranted. A Technical Memorandum, Evaluation of Relationships Between Fish Abundance and Specific Microhabitat Variables (R2 2014e), describing the results of the evaluation was submitted to the FERC on September 17, 2014."*
USFWS_pp8.5-47_ph04; NMFS_pp8.5-43_ph06	*Variances for Objective 5* *Inadequate data* *The overarching variance for the ISF aquatic habitat modeling noted by* [the Services] *is that the time series cannot be developed until a minimum of two consecutive years of data collection has occurred. Year one of study data collection occurred during 2013, and according to the Project Proponent the second year of data collection for the majority of the FA's occurred in 2014. However, at this time the Services do not consider the 2014 data collection as "second year data" since the first year of data collection (2013) has not been officially approved by FERC through the ILP process. In addition, winter data collection across disciplines is limited.*	AEA does not consider the 2013 and 2014 data collection as completing all data collection efforts. The time series analysis is not dependent on two consecutive years of data collection but on obtaining channel, hydraulic, and biological data to characterize Existing Conditions and support development of riverine process and fish habitat models to evaluate Project operations. Physical and hydraulic measurements used as input to the 1-D routing models and the 2-D Focus Area models have been completed for all eight Middle River Focus Areas below Devils Canyon and half of the 1-D PHABSIM transects in the Lower River. However, the remaining two Middle River Focus Areas above Devils Canyon, additional Lower River 1-D transect measurements, and additional HSC open-water and winter measurements will be completed in the next study year (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study). Therefore, AEA concurs that data collection beyond 2013 and 2014 is necessary to complete all data collection efforts.
USFWS_pp8.5-47_ph05; NMFS_pp8.5-44_ph01	*A variance of incomplete FA interdisciplinary data collection in 2013 was reported with the statement that this would not impact the ability to achieve study objectives (also addressed under Objective 2). The absence of temporal and spatial sampling of interdisciplinary studies across FAs impacts the ability to complete Instream Flow (8.5) analyses (under other 8.5 Objectives) in reaches without sufficient data. Currently there are some FAs with two years of data for an individual discipline, (i.e., 1D and 2D hydraulic modeling data in Slough 8A for the groundwater study) but data collection in several FAs is not complete for interdisciplinary studies.*	AEA does not consider the 2013 and 2014 data collection as completing all data collection efforts. See Study 8.5 ISR Part D, Section 8: Steps to Complete the Study, for a description of additional data collection efforts for the IFS Study; data collection efforts for other riverine process models is described in Section 8 of their respective ISR Part D documents.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-48_ph03; NMFS_pp8.5-44_ph04	*Conformance with Objective 5:* *Although an update on ongoing habitat-specific 1D-and 2D-model development, preliminary POC application for FA-104, and initial development of WUA analyses were discussed in the ISR, habitat modeling results were not presented. As such, no detailed assessment of the habitat modeling analysis-output can be provided at this time. Although no results were presented within the ISR, the Services have concerns related to the development of the habitat-specific models, the proposed analyses in the ISR, and the Project's current state of conformance with Objectives 5-8 in order to meet the licensing process timeline. There are many complex analyses to do, and limited time under the ILP to run models, QA-QC efforts, and allow for an iterative review process before the draft and final license applications would be due. Some specific concerns related to the developmental status of models are mentioned below.*	AEA acknowledges the overall complexity of the analyses and has continued to make progress since the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting in the integration of the different resource model outputs as outlined in the analytical framework described in Study Plan Section 8.5 (RSP Section 8.5.4.1). The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). This will include an evaluation of Project effects over an assumed 50-year licensing period using 1-D and 2-D bed evolution models to calculate changes in physical channel conditions that will provide input to the fish habitat and other riverine process models. Additional information on the linkages-coupling between the Fish and Aquatic Instream Flow Study and other dependent studies is presented in the ISR (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof Of Concept*).
USFWS_pp8.5-48_ph05; NMFS_pp8.5-45_ph02	*One way to account for the multitude of variables that are linked to habitat quality is to integrate these requirements-preferences in a GIS-project analysis rather than trying to include all of them in the HSC development. This could help account for the full suite of variables that resource agencies have requested. This GIS approach using a range of acceptable values (e. g., thresholds) would be implemented based on whether habitat conditions fall inside or outside of acceptable values for a given species-life stage. This would require a referenced spatial layer analysis where each habitat "condition" has to be true in order for it to be considered "good" or available habitat. The effective habitat would then be determined based on whether the habitat conditions fall within or outside of the acceptable values for a given species and life stage. The Project appears to be attempting this type of GIS analysis for variables such as groundwater upwelling, scour, substrate, cover, and distance to cover, but it is unclear if plans are in place to follow through with the GIS analysis or incorporate additional variables at requested scales. In addition, the Services have concerns about whether the data collected under each of the independent study disciplines are able to be used to address the detailed habitat criteria that is required to assess effects throughout the Project area. For example, water quality and groundwater are part of the integration component to determine effective spawning and incubation habitat, and it is not clear that the data is being collected at the appropriate scale to be able to answer that question for a given "cell" within FAs. It is also not clear what modeling steps occur when results from various physical models do not agree (e.g., 2D hydraulic model shows presence of water in off-channel locations but the water quality model shows no water present).*	To clarify, the integration of models will incorporate a wide breadth of variables. Although site-specific observations were used to define habitat preference for all species and life stages with sufficient site-specific observations, limits or thresholds have been proposed for certain variables to help define the minimum and maximum range of habitat preference predictions within the HSC models (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Threshold values proposed for use in the HSC models are based on either: minimum and maximum habitat use values observed in the HSC database, ranges of habitat use reported in literature, water quality standards set by the Alaska Department of Environmental Conservation (ADEC 2012), or limitations in sampling. Threshold values for additional HSC model variables may be necessary as limitations in the ability of other resource models (e.g., ice processes, groundwater, water quality) to develop response functions in relationship to proposed Project operations are revealed. Final threshold values related to HSC/HSI will be presented in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-49_ph02; NMFS_pp8.5-45_ph03	*The metric generated from habitat-flow relationships for fish and macro-invertebrate species and lifestages is expressed as WUA. WUA is an index of habitat area provided at a given flow. The general approach and application of WUA metrics are described in the ISR in Section 8.5.6.4.1 and Figures 8.5.6-11 through 8.5.6-22. In the ISR and at the POC meeting, WUA and available-effective habitat calculations for a given time series for a given species and lifestage within a given FA (i.e., FA128) were demonstrated. However, the details of these analyses have not been described nor have they been decided for the full range of species and lifestages and study sites with input from the TWG. Additional details of model linkages and both spatial and temporal scales used to calculate WUA metrics to determine Project effects on instream flow habitat for various species and lifestages throughout the Susitna River are needed.*	Additional details of model linkages and both spatial and temporal scales used to calculate WUA metrics to determine Project effects on instream flow habitat for various species and life stages throughout the Susitna River will be provided in the USR.
USFWS_pp8.5-49_ph03; NMFS_pp8.5-45_ph04	*WUA is being used in Middle River FAs to model existing conditions and Project effects. In the Lower River, WUA is being used for limited analyses and it does not appear that the analyses will include anything in the Lower River outside of the 1D representative sites. Currently there are two Lower River WUA "study sites", which may be too few to represent the entire Lower River.*	See response to USFWS_pp8.5-52_ph03. Also, the Lower River study sites were never intended to be "representative" of the Lower River overall. Rather, the sites were selected on specific tributaries that were known, based on the 1980s studies and current information, to be important for salmon spawning. The primary objectives of the Lower River IFS studies are to develop hydraulic-habitat models that could be used in evaluating Project effects related to fish passage-connectivity and habitat availability between the mainstem river and tributaries. This approach was similar to that employed in the 1980s studies, and was approved by FERC in the Study Plan Determination (Study 8.5 SPD, April 1, 2013).
USFWS_pp8.5-49_ph04; NMFS_pp8.5-45_ph05	*Proposed methods for conducting habitat modeling under winter ice conditions in the Lower River are not included in the ISR. The Project's ability to model flows under winter ice conditions is a significant concern that is yet to be resolved.*	The SIR (Study 7.6 SIR, Appendix C: *River2D Open-Water Modeling Report Focus Area 128 (Slough 8A))* applies only to model development and calibration for open-water conditions; details of model development and calibration for ice-covered conditions will be included in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-50_ph01; NMFS_pp8.5-46_ph02	*Lateral habitat groundwater and water quality—Scale* *Based on the description in the ISR the lateral habitat (off-channel habitat) and water quality analysis will provide categorical zones (e.g. "bins") of groundwater flux (upwelling, downwelling, neutral), temperature, and DO for most of these habitats. These categorical zones for the unmodeled habitat variables in off-channel habitats associated with groundwater and water quality will not be comparable to the much finer scale individual cell-specific hydraulic conditions (i.e., depth and velocity) associated with the 2D hydrodynamic modeling. This is because the groundwater and water quality data and models are at a much coarser scale and therefore the results for a given area are applied over a much larger scale. The 2D hydrodynamic model results are on a scale of 1-10 meter grids while the water quality results are on a 30-100 meter grid, and the groundwater is on an even larger scale. Therefore a single "cell" value for water quality gets applied to 30-100 cells in the hydraulic model. Detecting and estimating how the categorically zoned variables change under post-Project conditions (different stages, main channel temperatures, and bed topography) will be very difficult. We do not understand how a robust analysis of all relevant habitat variables will be achieved. This is especially problematic because off-channel habitats are very important for fish and because the unmodeled physical variables are significant (relative to depth and velocity) and influential to fish use of these habitats.*	AEA provides additional information to clarify this comment. While the water quality and groundwater models are unfinished, they are expected to be developed at a coarser scale than the 2-D Focus Area hydrodynamic models. Water quality parameters driven by mainstem flow fluctuations are expected to change at a much coarser scale than depth and velocity. Dividing a 180-meter-long upland slough into six water quality cells will still allow for the evaluation of water quality effects of Project operations on fish use of the slough. Groundwater modeling is also at a coarser scale than the 2-D hydrodynamic models but the resolution will be refined by incorporating FLIR imagery, VHG measurements, and other empirical data to identify the effects of Project operations on groundwater at a scale that is relevant to spawning salmon. The water quality and groundwater models will continue to be developed through the next study year. Preliminary modeling results for all models required by the FERC-approved Study Plan, including modeling results for Existing Conditions and an operating scenario, will be provided in the USR (FERC_ppA-1_ph01, June 23, 2016).
USFWS_pp8.5-50_ph02; NMFS_pp8.5-46_ph03	*Winter Habitat—Scale and Unobservable conditions* *The winter habitat assessment has the same potential scale issues as the lateral habitat assessment (e.g., water quality and groundwater upwelling) with additional concerns surrounding sampling effort and fish habitat response curve characterization. The winter habitat assessment lacks the ability to predict winter fish habitat preference for novel conditions that are currently unobservable (e.g., new mid-winter ice-free reaches under post-Project operations).* *The ISR describes long-term 1D moveable bed simulation, short-term 2D moveable bed simulation, 1D ice-formation simulation, and short-term breakup simulation experiments related to channel alteration. It will be challenging to integrate multiple alterations of channel geometry with habitat valuations calculated from fixed geometry – especially given the episodic and difficult-to-model or observe geomorphic effects of mechanical ice breakup. It is likely that ice breakup may cause more channel disturbance than what occurs during open-water conditions. If we are not able to model predictively how ice breakup and ice dams alter the channel geometry then we can't really assess how Project operations will change the channel geometry or resulting habitats. This will result in massive uncertainty in predicted post-Project impacts.*	AEA disagrees with this comment. Fish habitat HSC/HSI have been collected during winter conditions under both ice-cover and open-water habitats (Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*), and fish habitat modeling will be able to evaluate Project effects under ice-cover and open-water winter conditions. During 2013 and 2014, both ice-covered and open-water areas were observed and mapped in the Middle River (Study 7.6 TM, September 17, 2014: *Detailed Ice Observations October 2013 – May 2014*). Project operations may greatly expand the open-water area immediately below the proposed dam site, but fish habitat modeling will be applicable to both open-water and ice-cover under Existing Conditions and operating scenarios. AEA acknowledges the importance of modeling ice breakup and ice dams, and their effects on fish habitat.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-50_ph04; NMFS_pp8.5-47_ph01	Varial zone analysis "Varial" zones resulting from intra-daily flow fluctuations (i.e., down ramping) have dramatic primary and secondary effects on fish. Primary effects include fish stranding while secondary effects include mixing of mainstem surface water with longer-residence water and groundwater in lateral habitats. Effects on fish habitat include reduced habitat complexity and disconnection of habitats (e.g., proximal feeding and rearing areas). Even if we could confidently predict the resulting physical habitat conditions, there are no Susitna River field data specific to effects of down ramping to support fish response curves or the development of HSC for repeated intra-daily flow fluctuation. This is a problem for both model prediction and validation capabilities for the proposed load-following operational scenario.	As described in RSP Section 8.5.7.4.1.1, the main channel OWFRM and habitat models will be used to process output from the Project operations model. This will be done for different operating scenarios, hydrologic time periods (e.g., ice free periods: spring, summer, fall; ice-covered period: winter [will rely on model from Ice Processes Study 7.6]), Water Year types (wet, dry, normal), and biologically sensitive periods (e.g., migration, spawning, incubation, rearing) and will allow for the quantification of Project operation effects on the varial zone area (i.e., the area that may become periodically dewatered due to Project operations, subjecting fish to potential stranding and trapping and resulting in reduced potential invertebrate production). AEA acknowledges limited Project-specific data to *directly* address the effects of ramping rates on fish, which is based on priorities set for the Project through consultation. As described in ISR (Study 8.5 ISR Part D, Section 6.2), during a May 17, 2013 Technical Team meeting, participants indicated that site-specific stranding and trapping studies should be a low priority. Because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. As documented during the May 17, 2013 TWG meeting, ramping criteria developed in Washington State (Hunter 1992) will be proposed as fallback criteria during Project effects analyses. Although the proposed load-following operations will induce hourly flow fluctuations on an almost year-round basis, the Susitna basin currently experiences pronounced diurnal patterns during the summer months as a result of the dominance of glacier meltwater over precipitation (Study 8.5 ISR Part A, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*, Figure 18). Modeling will allow for the comparison of hourly streamflow and stage changes under Existing Conditions to hourly changes under alternate operating scenarios.
USFWS_pp8.5-51_ph03	*Recommendations* • *Groundwater transect data within and along FA boundaries so that predictive 3D groundwater models can be developed at a scale relevant to fish and fish habitat. This is necessary to provide information to aquatic habitat models that are based upon groundwater discharge. For example, Chum Salmon spawning is associated with upwelling, yet detailed data on current upwelling conditions and predictive modeling of future conditions under Project operations is not available. Since we do not know the current conditions, we cannot predict how upwelling will change in Chum Salmon spawning habitats.*	See response to USFWS_pp7.5-15_ph02; NMFS_pp7.5-15_ph03. While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. Also see Section 2.4.1.5.1 for response to comments regarding use of 2-D vs. 3-D groundwater models.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-51_ph04; NMFS_pp8.5-49_ph01	Recommendation (USFWS); Modification 5-5 (NMFS): *An uncertainty analysis of results of aquatic habitat models should be completed, so stakeholders can understand limitations of each model used to assess potential project effects.* [USFWS adds:] *During the November 2013 study integration meetings, the Services expressed concern that an uncertainty analysis was not proposed for habitat models for effects-analysis. The Services requested an uncertainty analysis in our Proposed Study Plan (PSP) for ISF study (8.5).* [NMFS adds:] *How this analysis is conducted should be transparent to all stakeholders. When the HSC-HIS habitat characterization described in objective 4 is complete, it could still be difficult to understand whether the information is useful. The curves might be very good at predicting Chinook Salmon juvenile habitat such as 85% of the juvenile were found in the environments described by the curves. However, it could be poor for predicting Coho Salmon habitat because although they tend towards certain habitat; over half the juveniles were found in habitat is not described by the curves. Similar to needing to understand uncertainty in channel morphology and ice process models, we need to know how well we understand the habitat requirements of the various species. Appropriate habitat suitability curves for salmon in the Susitna have not yet been presented due to the challenges described in objective 4. The issue of uncertainty has not been discussed. The study was not conducted as provided for in the approved study plan because the aquatic models cannot be meaningfully integrated without understanding uncertainty in aquatic habitat.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. This request is already part of the FERC-approved Study Plan and as such, there is no additional cost for implementing this modification. In the FERC-approved Study Plan, AEA proposed to assess uncertainty of aquatic habitat models (RSP Section 8.5.4.5.1 for HSC; RSP Section 8.5.4.7.1.3 for Finalization of Analytical Methods). Uncertainty in the HSC models is discussed in *Decision Support System Uncertainty* Technical Memorandum (Attachment 6 to this filing).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-51_ph05	*Recommendations* *Minimum of two consecutive years of data collection for integrated riverine and physical process studies; and water quality and biologic studies in each FA. This data is necessary to populate and test predictive capabilities of aquatic habitat models for spawning and rearing fish.* *Instream flow WUA metrics and model linkage details at both spatial and temporal scales used in the analysis should be provided. Information that describes how WUA will be calculated and modeled is not provided. The WUA value proposed to be used in the final integration analysis to determine Project effects on habitat for various species and lifestages is not discussed.*	AEA recognizes the need for adequate data to populate and test predictive capabilities of aquatic habitat models for spawning and rearing fish. Physical and hydraulic measurements used as input to the 1-D routing models and the 2-D Focus Area models have been completed for all eight Middle River Focus Areas below Devils Canyon and half of the 1-D PHABSIM transects in the Lower River. The remaining two Middle River Focus Areas above Devils Canyon, additional Lower River 1-D transect measurements, and additional HSC open-water and winter measurements will be completed in the next study year (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study). AEA disagrees with the USFWS's claim that two consecutive years of data are needed for modeling WUA. Development of WUA metrics is not dependent on two consecutive years of data collection but on obtaining channel, hydraulic, and biological data to characterize Existing Conditions and support development of riverine process and fish habitat models to evaluate Project operations. Preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation.
USFWS_pp8.5-51_ph07; NMFS_pp8.5-47_ph10	Recommendation (USFWS); Modification 5-3 (NMFS): *Breaching flows and habitat connectivity analysis be conducted on biologically relevant timelines; such as the five* ([USFWS adds:] *and ten year) time frames, which is the average generational lifespan of a* ([USFWS adds:] *Susitna River) Chinook Salmon. Alterations to channel geometry conditions should address breaching flows of both main channel and lateral habitats because these habitats support critical life stages including spawning, incubation, rearing and migration.* [NMFS adds:] *Breaching of the berm at the head of a side slough is an important event in the life of a juvenile salmon. Within minutes to hour, the water becomes more turbid, cooler, and faster. Currently the number of breaches in a given year is a probability game, with a reasonable chance of at least one breaching event and a minute chance of exceeding some upper limit of breaching events. NMFS needs to know that there will be a similar number of sloughs with similar breaching odds once the dam is built.*	As explained below in Section 2.5.1.5.2 (Breaching Flow Analyses), AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Breaching flow and habitat connectivity analyses are already included as part of the FERC-approved Study Plan; however, developing separate analyses at 5- and 10-year time frames would cost $65,000-$75,000.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-51_ph08	*Recommendation* *Predictive modeling of water quality and surface-groundwater exchange as necessary for developing aquatic habitat utilization models related to fish productivity. One of the major data gaps identified at the November 2013 Riverine Modelers Integration Meeting (RMIM) was the inability of the river water quality monitoring study to provide post-Project estimates for off-channel habitats. Since off-channel habitats are important for spawning and rearing salmon, as well as resident fish, predicting Project effects on water quality in these habitats is crucial.*	AEA disagrees. AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was not implemented as provided by the approved Study Plan. The (2-D) River Water Quality Model with Enhanced Resolution Focus Areas will be used to predict water quality conditions at a finer scale of resolution for off-channel habitats within Focus Areas (Study 5.6 ISR Part A, Section 5.4). These models are embedded within the larger-scale (2-D) River Water Quality Model used for the entire riverine component of the Project area. The higher resolution of the (2-D) River Water Quality Model with Enhanced Resolution Focus Areas will be dynamic, allowing both the temporal and areal extent of the water quality parameter variations associated with various load-following scenarios to be determined for main channel and lateral habitats. Using FA-128 (Slough 8A) as an example, the EFDC grid resolution increases from 57 cells in the entire riverine model structure to 8,372 cells in the embedded fine scale modeling structure. The spatial and temporal water quality results will be provided in formats in which can be easily interpolated for the off-channel habit environments. While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-52_ph02	*Recommendation* *Breaching flows analysis be done at the 25, 50 year, and other predicted channel geometries which show significant change from the geomorphology channel change modeling.*	AEA notes that this recommendation is incorporated into the FERC-approved Study Plan. As described in the FERC-approved Study Plan (RSP Section 6.6.4.2.2.1), a 50-year, continuous period of record that represents the length of the FERC licensing period will be used for 1-D modeling, and shorter modeling periods will be used for the 2-D model due to computational limitations. The 50-year period will be divided into three points in time to provide comparison: year-0, year-25, and year-50. The 1-D model will be applied to address the analysis of reach-scale issues and the 2-D model to address local-scale issues. The detailed analysis at breaching sites within Focus Areas will rely on the 2-D model results with extrapolation to the overall study reach using the 1-D model results and other relevant information from the Geomorphology Study 6.5, IFS Study 8.5, Ice Process Study 7.6 and Barriers Study 9.12, where appropriate, to quantify anticipated Project impacts at the Study Reach Scale. While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-52_ph03	*Recommendations* *Additional Lower River WUA "study sites" should be added to provide adequate representation. Currently there are only 2 Lower River study sites identified.*	While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. AEA disagrees with the comment. The final selection of Lower River Segment study sites in Study Plan Section 8.5 included six sites in geomorphic reach LR-1 consisting of Trapper Creek, Birch Creek, Deshka River, and three mainstem sites located at PRM 97, PRM 96 and PRM 95), and 8-9 sites located in LR-2 consisting of Caswell and Sheep creeks, two side channel complexes, one mid-channel complex and four mainstem sites (Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014*). The Trapper and Birch creek sites, Deshka River site, and the three mainstem sites have been surveyed and preliminary 1-D hydraulic models developed (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). The sites in LR-2 (i.e., Caswell and Sheep creeks, side channels and mainstem sites) remain to be established and surveyed. As noted in the ISR (Study 8.5 ISR Part D), completion of the work in the Lower River will involve: • Finalization of open-water, 1-D hydraulic models in each of the six LR-1 PHABSIM sites that have already been surveyed: (PRM 97, PRM 96, PRM 95, Trapper Creek, Birch Creek, and Deshka River); • Identification of transect locations within targeted habitats for reach LR-2 in the vicinity of Sheep Creek and Caswell Creek; • Collection of open-water field data to support fish habitat modeling at LR-2 fish habitat sites; • Finalization of open-water, 1-D hydraulic models in the LR PHABSIM sites to be located in LR-2 between PRM 65 to PRM 70; and Identification of priority species, life stages and periodicity for LR-1 and LR-2 to use for HSC curve development and to apply to the fish habitat modeling. Assuming AEA would have to collect additional bathymetry, hydrology, HSC, substrate and cover data, the estimated cost of this recommendation would be $300,000-$450,000 per Lower River study site.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-52_ph04	*Recommendations* *The inability to predict winter fish habitat preference for novel conditions that are currently unobservable (e.g., new mid-winter ice-free reaches under post-Project operations) should be addressed.*	AEA disagrees with the stated need for this recommendation. Fish habitat HSC/HSI have been collected during winter conditions under both ice-cover and open-water habitats (Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*), and fish habitat modeling will be able to evaluate novel conditions that are currently unobservable, including Project effects under ice-cover and open-water winter conditions. During 2013 and 2014, both ice-covered and open-water areas were observed and mapped in the Middle River (Study 7.6 TM, September 17, 2014: *Detailed Ice Observations October 2013 – May 2014*). Project operations may greatly expand the open-water area immediately below the proposed dam site, but fish habitat modeling will be applicable to both open-water and ice-cover under Existing Conditions and operating scenarios. While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation.
USFWS_pp8.5-52_ph05	*Modifications* *Include measures of ice thickness, water depth, water temperature and water velocity in ISF (8.5) and ice processes studies (7.6). Measurements should be taken at multiple points along 10 or more transects in each FA for input, calibration and validation of winter hydraulic models.*	As explained below in Section 2.5.1.2.3 (Winter Hydraulic Model Calibration), AEA requests FERC not adopt this proposed modification as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. AEA measurements of ice thickness measurements in Focus Area measurements were not transect-based, but spaced to cover the entire Focus Areas to provide overall characterization of winter conditions. In addition to specific point measurements, the entire Focus Areas were characterized visually in terms of ice coverage, open leads, and seepage-groundwater evidence. AEA believes the ice thickness measurement procedures will meet the goals and objectives of the FERC-approved Study Plan. See AEA's response to NMFS Modification 2-2 (NMFS_pp8.5-13_ph07) for the estimated cost of collecting additional measurements along 10 or more transects in each Focus Areas.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-52_ph06; NMFS_pp8.5-47_ph02	Modification (USFWS); Modification 5-1 (Modification): *Increase sampling effort of subsurface (inter-gravel) water temperature and DO measurements at each FA to address Chum Salmon incubation, and further request that subsurface water temperature and DO data be integrated with the 3D groundwater models to develop HSC curves and WUA analyses.* [USFWS adds:] *These water quality metrics are currently not proposed to be part of the predictive modeling necessary for Project effects analysis of aquatic resources.* [NMFS adds:] *Salmon egg development is dependent on a continuous sufficient supply of water with sufficient dissolved oxygen passing through the spawning gravels, and the rate of development is dependent on water temperature. To assess dam effects NMFS claims they need to know the conditions that currently exist where Chum Salmon spawn. DO and water temperature metrics seem to be only occasionally collected and to be second string to water depth and velocity. The study was not conducted as provided for in the approved study plan because as implemented it is not scientifically rigorous and therefore does not allow for project effects to be quantified.*	As explained below in Section 2.5.1.5.1 (Increased Subsurface Water Temperature and DO Sampling), AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan, and as well, AEA has already collected an extensive array of surface and intergravel temperature data, surface dissolved oxygen data, and intergravel dissolved oxygen data within known spawning areas in accordance with the FERC-approved Study Plan (RSP Section 8.5.4.5.1.2.1). AEA believes the existing data collection efforts will meet study objectives; however, increased sampling effort of subsurface (intergravel) water temperature and dissolved oxygen measurements at each Focus Area is estimated to cost $300,000-$400,000.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-52_ph07; NMFS_pp8.5-47_ph06	Modification (USFWS); Modification 5-2 (NMFS): *Compile a comprehensive aquatic habitat model water quality report of interdisciplinary data collection efforts. This should include all QA-QC procedures and results (calibration dates, quality objectives, accuracy and precision calculations) as part of the ISF (8.5) study, or Water Quality (5.5, 5.6, 5.7) studies or new Model Integration study.* [NMFS adds:] *Compared to the length of river potentially affected, not a lot of water quality data exists. If all the data was collected in a single location it would be easier to understand. The logical location for this report would be in study 5.5. All temperature data collected as part of groundwater 7.5, any data from 8.5 and the water quality data from 5.5 and 5.7 should all be put in this one place and analyzed together. Currently data is scattered which makes it hard to know what data exist, and very difficult to interpret it. The study was not conducted as provided for in the approved study plan.*	AEA does not object to FERC's adoption of this proposed Study Plan modification. Two types of water quality monitoring programs were used to characterize surface water conditions: 1) Baseline Water Quality Monitoring, and 2) Focus Area Monitoring. The large-scale, Baseline Monitoring program will be used to calibrate the Susitna River water quality model (RSP Section 5.5.4.4). Twelve mainstem Susitna River monitoring sites were located below the proposed dam site. In addition, six sloughs were monitored that represent a combination of physical settings in the drainage and that are known to support important fish-rearing habitat. Large tributaries to the Susitna River were monitored including the Talkeetna, Chulitna, Deshka, and Yentna rivers. Smaller tributaries were also monitored including Gold, Portage, Tsusena, Watana, and Oshetna creeks. Consistent with the FERC-approved Study Plan, water quality monitoring was also conducted in Focus Areas using a higher density of sampling within a pre-defined reach length and a higher frequency of sample collection. The purpose for the intensive water quality monitoring in select Focus Areas was to evaluate effects from dam operations on resident and anadromous fisheries (RSP Section 5.5.4.5). In addition to data collected under the Baseline Water Quality Study 5.5, water-level loggers with temperature recording capability were deployed at several Focus Areas during implementation of the Instream Flow Study (RSP Section 8.5.4.4). Where water quality and instream flow data collection sites overlapped, a redundant temperature recorder was deployed for backup year-round temperature measurements. Data used from both historical and current sources met Water Quality Study Plan (Study 5.5/5.6) objectives of calibrating of the hydrodynamic module and the temperature module in EFDC. Additional water quality data collected in IFS Study 8.5 is used to validate predictions within grid cells in the Focus Areas. A description of data used to calibrate the hydrodynamic and temperature riverine model is reported in Water Quality Modeling Study 5.6 SIR, Section 5.2. A full summary of all data used to calibrate and validate the water quality riverine models (Baseline and Focus Areas) will be provided in the Study 5.6 USR. Since this data summary is already part of the Water Quality Modeling Study Plan (5.6), there is no additional cost for this effort. However, developing a comprehensive water quality database of all interdisciplinary data collection efforts, including results from the Study 5.6 (Water Quality Modeling), Study 8.5 (Fish and Aquatics Instream Flow), and Study 7.5 (Groundwater), would represent an additional effort. Cataloguing data used for calibrating and validating the water quality riverine models meets the objectives of the Water Quality Study, but AEA does not object to the Services request for a comprehensive water quality database. The estimated cost of implementing this modification is $125,000-$150,000.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.5-48_ph03	*The results to date do not state whether the berms will become hardened and grow trees, stay the same, or be washed out and not function as berms at all. The POC meetings suggest that Geomorphology Modeling (6.6), Groundwater modeling (7.5), Riparian Vegetation predictions (8.6) and the OWFRM (8.6) will interact on some regular time step such that the fate of berms can be projected. It would be helpful to know that 20% of slough heads close off in the first decade and another 30% by year 50, but that the remaining 50% have an explainable selfmaintenance function that will remain intact in a post dam scenario. The current models do not seem to be able to accomplish this. Without working models, it is reasonable to conclude that these sloughs, which are critical to salmon rearing, will slowly fill in with vegetation.*	Consistent with the FERC-approved Study Plan (RSP Section 6.6.3.1), and as described in *Fluvial Geomorphology Model Development Technical Memorandum* (Study 6.6 SIR, Attachment 1), the combination of 1-D and 2-D models for Existing and with-Project conditions will be used to develop Year-25 and Year-50 conditions. The 1-D bed morphology modeling is intended to evaluate potential reach-scale bed changes. The fine scale 2-D models will be able to quantify changes to localized features such as berms and slough heads within the Focus Areas.
NMFS_pp8.5-48_ph05	*Modification 5-4:* *NMFS recommends that AEA describe and then predict the extent of warmer winter aquatic habitats that have not previously been observed on the Susitna. Some areas immediately below the dam will not ever freeze or only during very brief extreme cold snaps due to the five-fold increase in 4 ^{o}C, highly oxygenated water exiting the dam. Will this be the norm for only the first ½ mile below the dam or will it extend down 50 miles? Will it greatly help rearing salmon or-and will it increase the number of salmon predators such as Northern Pike? Were other rivers that stay warm in Interior Alaska reviewed as analogous situations? Although the water chemistry is very different, these new temperature might mimic conditions in hot spring-fed rivers like the Chena.*	As explained below in Section 2.5.1.5.3 (Modeling Warmer Winter Aquatic Habitats and Middle River Focus Areas Above Devils Canyon), AEA requests that FERC not adopt this proposed Study Plan modification. AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "*prepare and file with the Commission an initial study report describing its overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule*" (18 CFR 5.15(c)(1)). The study has not yet been completed and therefore the results of the Ice Processes modeling (Study 7.6) are not available. Those results will be provided in the USR. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
NMFS_pp8.5-48_ph07	*The information presented to date does not acknowledge the two FAs between Devils Canyon and the dam site are likely to create novel and unique environments which will attract a slightly different mix of species. This is analogous to unnaturally deep pools created by mining in some rivers in the Sierra Nevada Mountains that now act as refuge for catfish (which are known to eat salmon fry). Positive effects are also possible. Post project, out migrating juveniles which were moved over the dam by helicopter, might be deposited at this location. The study was not conducted as provided for in the approved study plan as very little data has been collected at the Stephens Complex and Watana FAs and no effort has been made to quantify the potential magnitude of change immediately below the dam.*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to prepare and file with the Commission an initial study report describing its overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed and as noted in Study 8.5 ISR Part D, Section 8, both field, modeling and analysis work remains to be completed in the upper two Focus Areas (FA-184 [Watana Dam] and FA-173 [Stephan Lake]). Once data are collected, models developed and analysis completed, the results of the habitat analysis for those two Focus Areas will be provided in the USR. See Section 2.5.1.5.3 for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-52_ph11; NMFS_pp8.5-50_ph06	*Implemented* *The ISR and supporting documents do not provide sufficient information related to how the Project will be operated (scenarios) during construction or after construction. The only Project scenario provided in the initial ISR was related to Max-load following (OS-1b) which was described as a worst case scenario but would most likely not be how the project would be operated. In the latest 8.5 SIR (Nov 2015) OS-1b was replaced with a modified scenario to reduce powerhouse discharge variability through assigning peak mode operation to other existing hydropower plants on the Railbelt grid (Integrated Load Following [ILF]-1). AEA states that other ILF operations may be evaluated during the impact assessment but currently is only modeling the ILF-1 scenario.* *Overall the OWFRM (Version 2.8) results demonstrate the general ability to simulate the flow hydrograph through the main channel of the Susitna River during open-water conditions. Comparison of hydrographs and stage changes associated with pre- and post-Project (OS-1b) operations at Gold Creek and Susitna Station locations throughout the Middle River are presented and provide adequate information to address the study objectives in the Middle River under the OS-1b operations. Other than the newly identified ILF-1 operational scenario which will replace OS-1b in the final OWFRM (Version 3.0), no additional operational scenarios are discussed or presented.*	AEA disagrees. The evaluation of alternate operational scenarios will occur as part of the USR using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). The final version of the OWFRM will be used to simulate flow hydrographs for Existing Conditions and all operational scenarios. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests. The results of Existing Conditions, Maximum Load Following, Intermediate Load Following and Run-of-River operational scenarios will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions. See also Section 2.5.1.3.1 (OWFRM) below for further information.
USFWS_pp8.5-53_ph03; NMFS_pp8.5-50_ph08	*Initial flow routing results confirm that post-Project OS-1b operations will drastically change the flow hydrograph in the Middle River throughout the open-water portion of the year resulting in maximum potential stage changes ranging from 9.7 feet near the dam, 5.7 feet near Gold creek, and 2.1 feet near Susitna Station in the Lower River. This amount of stage change is significant in terms of river connectivity and the effects on main channel and lateral off-channel habitats. Additionally, the hourly stage affects associated with ramping rates for OS-1b ranged from 0-2.1 feet under dry conditions and 0-8.0 feet under wet conditions near the dam site, 0-4.1 feet near Gold Creek, and 0-4.0 feet near the Sunshine gage in the upper extent of the Lower River. While OS-1b is considered a "worst-case" scenario, this illustrates that the ramping rates associated with a hydro-peaking operation will have drastic effects on the water surface elevations throughout the river greatly affecting habitat conditions, lateral habitat connectivity, river processes (instream flow and riparian), ice processes (flow under and over existing ice formations), aquatic habitats and fish species and populations.*	AEA agrees that there would be a reduction in water levels during the summer and an increase in water levels during the winter. These effects would be greatest near the proposed dam site, and would diminish downstream from the proposed dam site. Impacts on habitat conditions, lateral habitat connectivity, river processes, ice processes, aquatic habitat, and fish species and populations will be presented in the USR for one operating scenario and further in the draft and final license applications. AEA acknowledges the importance of ramping rates but notes that because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. However, as documented during the May 17, 2013 TWG meeting, AEA proposes to utilize ramping criteria developed in Washington State (Hunter 1992) during Project effects analyses. Related to this, AEA also notes that although the proposed load-following operations will induce hourly flow fluctuations on an almost year-round basis, the Susitna basin currently experiences pronounced diurnal patterns during the summer months as a result of the dominance of glacier meltwater over precipitation (Study 8.5 ISR Part A, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*, Figure 18). Modeling will allow for the comparison of hourly streamflow and stage changes under Existing Conditions to hourly changes under alternate operating scenarios.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-54_ph02; NMFS_pp8.5-51_ph02	[USFWS states:] *Mr. Happla noted that the simulation does not include ramping rate restrictions and uses environmental flow requirements from the 1980s studies. Resource agencies asked when those assumptions might be updated. AEA indicated that due to the ongoing nature of the studies that will support the development of environmental flows, there is not an ETA for an operational scenario with updated environmental flows. Resource agencies asked how ROR scenarios were being considered. This question was characterized by AEA as a "sideboard discussion" and not addressed further. The ILF-1 scenario appears to be a consideration driven by power generation and one that has not at all been evaluated for Project effects on aquatic resources.* [NMFS states:] *During the September 9-11, 2014 Fish Passage Brainstorming Workshop AEA's consultant, Mr. John Happla of MWH, presented a new Operational Scenario referenced as "ILF-1 Intermediate Load Following." ILF-1 was also briefly presented by Jon Zufelt (HDR) during a seminar hosted by USGS on Susitna River Ice Processes (January 15, 2015). Mr. Zufelt stated that this operational scenario would also result in "significant jumps and surges" in discharge throughout the Susitna River. The ILF-1 scenario assumes that the other Railbelt hydropower plants (Bradley Lake, Eklutna Lake and Cooper Lake) will provide load-following to the extent possible. Susitna-Watana would be assigned the remainder of the load-following, with none assigned to the thermal resources." The presentation summarized Project operational scenarios analyzed, based on the Physical, Hydrologic & Engineering Information (Information Items P3 – P5), Operating Scenarios OS-1b and ILF-1, [Sept 9-11, 2014 by MWH information posted to AEA's Susitna-Watana web site]. OS-1b is a maximum load-following scenario being used as a boundary case with maximum variation on hourly, daily, and seasonal time scales. Flow duration curves were presented, along with flow through the turbines, flow through fixed cone valves and reservoir elevation duration curves. ILF-1 is an intermediate load-following scenario that includes using load following at other Railbelt hydropower resources which can accommodate approximately one half of the Railbelt's load variation. In addition, spring inflow forecasting was added to the model. Flow duration curves and reservoir elevation duration curves were presented for both scenarios. Under both operating scenarios the spillway gates are designed to not operate at less than the 50-year flood during full pool conditions. During simulation using 61 years of load and flow data at an hourly time scale, the spillway was never used. The simulations predict the turbines will run 100 percent of the time. The FPTT requested a summary of daily variation in outflow by month for both weekdays and weekends as a data request. Variances for* for *Objective 6 The ROR operational scenario has not been analyzed for pre- and post-Project scenarios as required by FERC.*	AEA disagrees. As indicated by FERC in their June 23, 2016 comment letter (FERC_ppA-1_ph01), analysis of a Run-of-River operational scenario is not required to be available at the current ISR stage. Analyses of Existing Conditions and a Run-of-River operational scenario will be provided in the License Application. The evaluation of alternate operational scenarios will occur as part of the USR using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests. The results of Existing Conditions, Maximum Load Following, Intermediate Load Following and Run-of-River operational scenarios will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-54_ph04; NMFS_pp8.5-51_ph04	Recommendation (USFWS); Modification 6-1 (NMFS): *In the initial ISR, OS-1b load following scenario was presented as a worst-case scenario to demonstrate potential Project effects. In the latest SIR the OS-1b has been replaced with the ILF-1 scenario but no additional realistic operational scenarios, such as the ROR, have been presented. Options for minimizing overall Project effects from operational scenarios is not provided. In order to appropriately study the Project effects associated with post-Project operations, additional alternative operational scenarios in addition to the ILF-1 scenario must be evaluated. Alternative analyses are needed to better understand the overall Project effects throughout the extent of the Middle and Lower River. Understanding of operational scenarios should be linked temporally and spatially with the life history strategies of Susitna River fish species. This is critical information for determining the type and amount of alteration and the associated effects on instream flow and habitat conditions. Alternative operational scenarios should be evaluated to provide the best-case scenario for hydropower operations and species and habitat conservation.* [USFWS adds:] *Recommendations, modifications or new study for second year of study:* • *Evaluate the ROR scenario* • *Evaluate changes to habitat classifications under differing Project operational scenarios.* • *Evaluate other potentially valid operational scenarios to address protection, mitigation and enhancement (PM&E).* [NMFS adds:] *NMFS recommends that other operating scenarios, including run-of-river, be evaluated and their effect on habitat availability be assessed under various Pacific Decadal Oscillation scenarios. These alternative operating scenarios could be used as protection, mitigation and habitat conservation (PM&E). This recommendation is similar to 3.3 but it recommends completing the suite of evaluation steps that come once the OWFRM has been run.* *In order to select an operation scenario that balances energy production with providing adequate fish habitat multiple scenarios must be evaluated.* *The applicant has only partially evaluated full-load following (OS-1b) scenario which is insufficient. The ILF-1 was discussed in meetings but no results from this operations scenario have been presented.* *Run-of-river was specifically required by FERC (4-1-2013). The study was not conducted as provided for in the approved study plan.*	The evaluation of alternate operational scenarios will occur as part of the USR using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests. The results of Existing Conditions, Maximum Load Following, Intermediate Load Following and Run-of-River operational scenarios will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions. As explained below in Section 2.5.1.6 (Run-of-River, Habitat Classifications, and PM&E), AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. The estimated cost of this modification will vary depending on the number of evaluation metrics developed for each scenario. For planning purposes, the estimated cost of analyzing operational scenarios, in addition to those described in Section 2.5.1.6, is provided in AEA's response to NMFS Modification 3-2 (NMFS_pp8.5-18_ph01).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-56_ph04; NMFS_pp8.5-53_ph06	*Conformance with Objective 7* *The Service's RSP comments asked for more detail related to how field data, models, and assumptions from individual studies would be integrated to produce a set of metrics to support a comparison of alternatives. Currently, they have concerns related to model integration stem stemming from (1) the sufficiency of the level of data collection to support model development; (2) model capabilities not being established for both pre- and post-Project conditions; and (3) the demonstrated lacking ability to integrate models to quantify Project effects on fish habitat.* *The relative time allocated to overall studies and study integration is an additional concern.* [USFWS states:] *No substantial progress has been made between 2012-2016.* [NMFS states:] *The applicant has recently begun to acknowledge the importance of model integration, and small changes have been made to standardize data outputs, but notes that the models cannot be integrated at this time and uncertainty remains that they can be fully integrated.* [The Services state:] *Flow routing and habitat mapping results did inform 2013 planning and adjustments (extension into Lower River reach and evaluation of representativeness of FAs), however, the time line was extremely compressed with some study results produced just before the plans for 2013 work were done (e.g., ice processes, 7.6). Some of the integration challenges will involve more sophisticated analyses and more fundamental influences of one study on another. An integrated analysis requiring synthesis across studies will require more time than is available in the planned licensing schedule. The overarching concern is that effective integrated analysis will not be achieved, with the end result being a collection of un-relatable information.*	A Riverine Modeling Technical Team meeting was held with licensing participants on November 13-15, 2013 to provide a forum to review and discuss modeling and study integration efforts. A follow-up Proof of Concept meeting was held April 15-17, 2014 to advance the understanding of riverine process and fish habitat modeling by demonstrating the application of the models specific to two key biological metrics (i.e., effective salmon spawning-incubation habitat and juvenile salmonid rearing habitat) at Middle River Focus Area FA-128 (Slough 8A) (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). These meetings were held early in the study implementation process to allow potential data gaps or format inconsistencies to be identified and resolved. Integration of riverine process models and development of fish habitat metrics is an ongoing process. Preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).

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USFWS_pp8.5-56_ph06; NMFS_pp8.5-54_ph02	*Another concern is that two years of biological and physical process sampling are insufficient to capture natural variability, collect adequate site-specific data, and build models to predict how Project operations will affect ecological relationships. Furthermore, proposed changes to the sampling designs may occur following one year of study, making year-to-year data comparisons difficult. Original requests were for a minimum of five years for all studies related to anadromous fisheries resources to cover the average lifespan of a Susitna River Chinook Salmon, the range of annual environmental variability, and collect sufficient data for model validation.*	AEA disagrees. This comment seeks to second guess the Director's Formal Study Dispute Determination. The RSP (RSP Section 8.5.6) included a proposed schedule for all pre-filing field studies and modeling efforts to be completed over a two-year period. The NMFS request that the study duration should be expanded to include a full generation, from three to five years, of each anadromous target species study was the subject of a February 21, 2013 study dispute pursuant to section 5.14(a) of the Commission's regulations. In their April 1, 2013 Study Plan Determination, FERC determined that AEA's proposed two-year study schedule was consistent with generally accepted practices in the scientific community for evaluating the effects of hydropower projects on fisheries and riparian resources (section 5.9(b)(6)). FERC also noted that licensing participants would have the opportunity to request additional years of data collection after reviewing the initial and updated study reports, and upon a showing of good cause as specified in sections 5.15(d) and 5.15(e) of FERC's regulations. FERC convened a dispute resolution panel, and as documented in the Director's Formal Study Dispute Determination of April 26, 2013, the panel recommended no changes to the Study Plan Determination. While the RSP included a proposed two-year study effort, due to various delays in the pre-filing process, biological field data were collected in 2013 and 2014 and additional biological field data will be collected in the next study year. More over, with respect to Chinook Salmon, adult salmon radiotelemetry studies and fish distribution and abundance sampling in the Upper basin began in 2012. Thus, three years of data has been collected.
USFWS_pp8.5-58_ph01	*Recommendations, modifications or new study for second year of study:* *Recommendations* *Move beyond conceptual stage of study integration, to demonstrate how the integration will work, including an uncertainty analysis.*	AEA has progressed beyond the conceptual stage of study integration, to demonstrate how some of the integration will occur, and will continue this process into the next study year. The Riverine Modeling Technical Team Proof of Concept meeting (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*) provided a demonstration of the status of modeling integration using Focus Area FA-128 (Slough 8A). This demonstration was prepared early in the study implementation process to allow potential data gaps or format inconsistencies to be identified and resolved. Integration of riverine process models is an ongoing process and preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-58_ph01	*Recommendations* *Building off of the POC meetings, conduct a pilot study that would utilize all the new information that has been presented (ILF-1 scenario, OWFM2.8, draft final HSC development, GW-WQ-Ice models, etc) and apply it to two different FAs (FA-128 Slough 8A and FA-138) for a single species (Chum Salmon) and critical lifestages (spawning and incubation) to conduct a complete temporal and spatial habitat analysis and provide an example of how FA model results would be extrapolated to areas outside the FA to determine species specific project effects throughout the middle Susitna River.*	As described in response to comments USFWS_p8.5-56_ph04 and NMFS_pp8.5-53_ph06, AEA acknowledges that the integration of riverine process models and development of fish habitat metrics is an ongoing process. Following up on the November 13-15, 2013 Riverine Modeling Technical Team meeting and the April 15-17, 2014 Proof of Concept meeting (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). Integration of riverine process models is an ongoing process and preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). While not proposed as a modification to the Study Plan, AEA requests FERC not adopt this recommendation as it goes beyond the FERC-approved Study Plan and is not warranted. The request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. However, if a separate pilot study were conducted on two Focus Areas, the estimated cost would be $200,000-$300,000.
USFWS_pp8.5-58_ph03; NMFS_pp8.5-55_ph03	New Study (USFWS); Modification 7-1 (NMFS): [USFWS states:] *Develop a new Model Integration Study to identify methods and mechanisms that will be used to integrate studies and to implement a DSS. They recommend that the Model Integration Study be the next step for the Project, prior to moving forward with additional field studies.* [NMFS states:] *This objective can best be achieved by implementing a New Study for Model Integration. This New Study Request is included in this filing as an enclosure.*	AEA requests FERC not adopt this proposed Study Plan modification as requesting FERC to adopt a new study proposal does not constitute a modification to a FERC-approved Study Plan nor does this request meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).

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NMFS_pp8.5-55_ph04	*Modification 7-2:* *In a single "pilot area" (probably an existing FA) run-coordinate all the current models and show the quantity and quality of various fish species macro and meso habitats over the next 50 years for two operating scenarios (full load following and one other) and no-project alternative.* *The effects of the dam will take decades to be fully realized. Upland slough habitat used by juvenile Coho Salmon might continue to exist for the first decade but cease to exist as trees fill and dry out the sloughs after 30 years. Side slough habitat could be desiccated by the initial filling of the reservoir, but then return over time. NMFS requests that the applicant show that this extremely difficult long-term habitat analysis works and that logical comparison can be made between the effects of different operating scenarios.* *While the applicant has focused on developing individually functional models, it is simply not clear that habitat can be modeled over the 50-year time span to produce comparable results between alternatives in even one small area. Demonstrating that the integration of models is successful in a pilot area would suggest that AEA's efforts could lead to a useful product.* *The approved studies were not conducted as provided for in the approved study plan because to date the model integration is not functioning.*	As explained below in Section 2.5.1.7.1 (Demonstration of Model Integration in Pilot Area), AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
USFWS_pp8.5-59_ph01; NMFS_pp8.5-56_ph04	*Implemented* *Development of the DSS is contingent on data collection and analysis, and subsequent development of resource specific models that will be used to assess Project operations. Data collection was initiated in Q2 2013 and will continue during the second year of study. Model development activities are ongoing and will be completed during the next year of study prior to the USR. As a result, the ISR is limited to presenting potential methods and approaches for developing the DSS and conducting an integrated resource analysis (IRA). These approaches were initially provided in the SP (RSP Section 8.5.4.8), and were discussed briefly during the November 13-15, 2013 IFS TT Riverine Modelers Integration Meeting (RMIM).* [USFWS states:] *We expected that further discussion with the TWG would occur in 2014 and be presented as part of the POC, but this did not happen.* *Variances for Objective 8:* *No variances for Objective 8 were provided. However, the Services consider it a variance that* ([USFWS:] *no progress*; [NMFS:] *very little progress) related to the DSS was made during 2014, 2015, or 2016. The DSS is critically important to understanding if the Project is collecting appropriate information to determine Project effects on fish and wildlife resources.*	AEA disagrees with this claim that a variance for Objective 8 occurred. AEA has implemented the DSS portion of the IFS consistent with the FERC-approved Study Plan. A matrix method, described in the RSP, has been successfully used as a DSS to resolve issues in previous FERC proceedings (RSP Section 8.5.4.8.1); however, AEA remains open to modifying and improving the DSS in a collaborative framework as part of the USR (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study). There are no variances for Objective 8.

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NMFS_pp8.5-56_ph07	*Modification 8-1: Objective 8 can best be achieved by implementing a New Study for Model Integration and DSS. This New Study Request is included in their filing as an enclosure.*	AEA requests FERC not adopt this proposed Study Plan modification as requesting FERC to adopt a new study proposal does not constitute a modification to a FERC-approved Study Plan nor does this request meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4.
USFWS_pp8.5-59_ph04;	*Recommendations* *• In an aquatic habitat approach we want to end up with tallies of different macro, meso, and micro habitats weighted by "value" to various organisms for each proposed alternative. Emphasis should be on how the various modeling efforts can produce side-by-side comparisons of Project alternatives (including a no-Project alternative).* *• DSS development and detailed understanding of data analysis, model interdependencies and outputs need to be provided in order to comment on the applicability of spatial and temporal model integration into a DSS to access project effects on aquatic resources.*	While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt these recommendations because the requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. AEA maintains that the intent of the ISR is to describe AEA's overall progress towards implementing the approved Study Plan. The RSP as approved by FERC does not require that study results or model files be available at the current ISR stage. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions (i.e., no- Project alternative) and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Habitat metrics will be integrated temporally (RSP Section 8.5.4.7.1.1) and spatially (RSP Section 8.5.4.7.1.2) and the results will include tabular listings of habitat metrics. Spatial extrapolation was discussed during the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting (PowerPoint Presentation: *Spatial Extrapolation*) and options presented for extrapolation by linear distance, macrohabitat linear distance, macrohabitat area, and macrohabitat weighted by fish use. There are no anticipated additional costs associated with providing a detailed understanding of data analysis, model interdependencies and outputs as this is already included as part of the FERC-approved Study Plan.
NMFS_pp8.5-57_ph01	*Modification 8-2: NMFS recommends that the applicant produce tallies of different macro, meso, and micro habitats weighted by "value" to various organisms for each proposed alternative as is usual in the aquatic habitat approach.* *Emphasis should be on how the various modeling efforts can produce side-by-side comparisons of Project alternatives (including a no-Project alternative).* *Various operating scenarios will necessarily change the amount of available habitat for each species in each of its life stages. For example at FA-128, full-load following might increase Coho Salmon rearing habitat but decrease Chinook Salmon spawning habitat. These comparisons will need to be made over many project reaches over many years and several climate scenarios. This is a herculean effort, but walking away from this effort means that stakeholders and the applicant should assume Susitna-Watana dam will have a similar level of environmental effects and species extirpation as other similar sized dams.*	AEA requests FERC not adopt this proposed Study Plan modification as requesting FERC to adopt a new study proposal does not constitute a modification to a FERC-approved Study Plan nor does this request meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. AEA maintains that the intent of the ISR is to describe AEA's overall progress towards implementing the approved Study Plan. The RSP as approved by FERC does not require that study results or model files be available at the current ISR stage. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions (i.e., no- Project alternative) and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). See Section 2.5.1.6 (Run-of-River, Habitat Classifications, and PM&E) for additional information. As described in RSP Section 8.5, the IFS will result in the collection of data and development of different types of habitat-flow relationships from spatially distinct

Reference Number	Comment or Study Modification Request	AEA's Response
	To date the focus has been on can the applicant arrive at how much habitat of each type will be available in post project scenarios. AEA believes these habitat values can be determined, and has implied that the DDS will logically combine hundreds of small habitat projections into single comparison of alternatives including no-project alternative. Until this final step has been spelled out it is not clear if this massive modeling effort will lead the applicant and stakeholders to the best decision. The study was not completed as provided for in the approved study plan because the DDS does not exist.	locations within each of the Focus Areas that contain a variety of habitat types. Types of relationships will include, but not be limited to, those founded on PHABSIM that depict WUA or habitat versus flow by species and life stage; effective habitat versus discharge relationships that define how spawning and incubation areas respond to flow changes, varial zone analysis; and groundwater-surface water flow relationships relative to upwelling and spawning habitats. AEA acknowledges the overall complexity of the analyses and has continued to make progress since the April 15-17, 2014 Riverine Modeling Proof of Concept Technical Team meeting in the integration of the different resource model outputs as outlined in the analytical framework described in Study Plan Section 8.5 (RSP Section 8.5.4.1). The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). This will include an evaluation of Project effects over an assumed 50-year licensing period using 1-D and 2-D bed evolution models to calculate changes in physical channel conditions that will provide input to the fish habitat and other riverine process models. Additional information on the linkages-coupling between the IFS and other dependent studies is presented in the ISR (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof Of Concept*). As described in the Study Plan (RSP Section 8.5.4.8.1), development of a DSS-type process, and supporting software to efficiently process data analyses, was to be initiated in collaboration with the TWG after the initial results of the various habitat modeling efforts are available. The intent was to prepare the DSS-type evaluation process to assist scenario evaluations in support of the License Application. AEA initiated model integration early in the study implementation phase and consistent with the FERC-approved Study Plan will continue with development of the DSS in the next study period. AEA's response to the Services' new study proposal for Model Integration and DSS Study can be found below in Section 3.4. The estimated cost of this modification is $150,000-$200,000.
USFWS_pp8.5-59_ph06	*Request for New Study* *• A separate study needs to be developed that will outline the proposed methods for the development and implementation of a DSS.* *Request for new study (included separately in our filing as a stand alone study request)* *• As part of the new Model Integration Study (under Objective 7) develop and implement a Project DSS prior to moving forward with additional field studies.*	AEA requests FERC not adopt this proposed Study Plan modification as requesting FERC to adopt a new study proposal does not constitute a modification to a FERC-approved Study Plan nor does this request meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-62_ph04	*Recommendation* *There are several notational problems with this as written. AEA seems to understand one of our points (that they failed to distinguish parameters from parameter estimates). We agree that the proposed notational changes listed under HSC_2 in AEA's response will fix some problems. Still, that leaves the much larger problem unaddressed. Note that this essentially unexplained quantity p is an out-of-place parameter that is not consistent with the logic behind the regression analysis.* *In other words, the left-hand side of the equation contains a function of a true unknowable parameter (this is the point that AEA misunderstood in their response HSC-3). The equation seems to be saying this unknowable parameter is a function of data and some random quantities. Usually regression analysis involves some kind of function of observed data (not a parameter) on the left-hand side of the equation (called the dependent variable) expressed as a function of some other observed data (called the independent variables) together with a random quantity. Mixed effects models take this same basic form, only they are somewhat more complex. Note, again, the equation above has a parameter—not data—in the function on the left-hand side. How could that true probability be known with certainty in even a few cases? Clearly AEA did not regress the various independent variables on the true probability of Chinook Salmon presence—that would be impossible. They must have used some transformed data as the dependent variable in the regression. However, they have simply skipped one or more steps involved in completely and clearly writing down exactly what they actually did, perhaps thinking that these steps are obvious to anyone as familiar with this study as they are. It is not clear from the report what, exactly, was used as the dependent variable. This is not a small notational problem. The current description is not sufficient, and it does not meet modern standards for scientific reporting. The remedy we are asking for is a report with a clear and complete description of the methods that were used.*	AEA disagrees with this recommendation. The Study Plan as approved by FERC does not require this information to be available at the current ISR stage. Rather, the FERC-approved Study Plan requires this information to be developed as part of the USR. The equation that continues to be inexplicable to USFWS has been approved by ADF&G biometricians, has been presented at the International Statistical Ecology Conference in Seattle (June 2016), and has been discussed with numerous statisticians. AEA provides additional clarification on this in Section 2.5.1.4.5 (HSC Modeling). AEA requests that FERC not adopt this proposed recommendation. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan and as well, AEA has already addressed this request as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this recommendation.
USFWS_pp8.5-64_ph02	*The accompanying statistical information that was presented centered on the Akaike information criterion, or AIC value (we agree that this is a very important quantity for review) and information on multicolinearity (which is also important). What was not provided was important material to judge the statistical significance of the overall model, the statistical significance of the model parameters, the overall quality of the model fit, and information on model validation.*	AEA agrees that no measurement of statistical significance of the overall model has been provided. Rather, the statistical significance of the model parameters is assessed using a comparison of AIC values for models with and without the parameter. This is a likelihood-based approach penalized for the number of total parameters in the model. The AIC values have been provided in the SIR documentation (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Validation of the fitted HSC models (including "overall quality of the model fit") is a work in progress and has not been completed, but is proposed for the USR stage of the project. AEA's proposed methods for validation are provided in *Discussion of Habitat Suitability Criteria Model Validation Technical Memorandum* (Attachment 5 to this filing).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.5-64_ph07	*Irrespective of the correctness of any of these statements about the bootstrap technique, it is clear that the intent was for any reported habitat suitability curves to be reported with a measure of sampling error, an analysis of the sensitivity of assumptions, or some other specific measure of the quality of any parameter estimates.*	AEA agrees with this comment. Confidence intervals on mean predictions from the generalized mixed effects models used for HSC development have been researched and preliminary results can be provided. However, AEA considers this presentation and analysis to be part of the model validation reporting that is not yet completed and should be discussed with the TWG before final methods are determined. It would be inefficient to complete validation of model results prior to reviewing the FERC Director's Determination to verify that the selected methods for HSC model development are appropriate. AEA maintains that the methods and results provided to FERC and licensing participants are sufficient for this determination. Indeed, ADF&G has provided positive feedback on the modeling effort (ADNR_ADFG_pp11_ph04).
USFWS_pp8.5-65_ph02	*We could not find these measures of sampling error, and the estimates themselves were not clearly labeled as such. The estimates that were presented were not conventionally displayed, such as in clearly marked tables. The only presentation we could find of parameter estimates were as numbers in equations where what appeared to be unknown parameters and parameter estimates were mixed together, as we previously explained.*	Parameter estimates have been provided, and AEA agreed (Study 8.5, *Initial Study Report Meetings, March 24, 2016 Action Items: Response to Licensing Participant Comments*, filed with FERC April 29, 2016) that the USR phase should have parameters in tables instead of in equation form. Standard errors can also be provided, although these can be deceptive for this type of model. For example, if the coefficient minus 2 times the standard error is less than zero, it is tempting to conclude that the parameter is "not significant" and should not be included in the model. However, this is not the selected method for determining the best model for predicting habitat preference, and the two methods are not always consistent. This is the reason that AIC has been provided as a method for comparing among alternative models, in lieu of standard errors on parameter estimates. Alternative methods based on sound scientific references will be considered.
USFWS_pp8.5-65_ph03	*Considering AEA's comment HSC-6, we note that Zuur et al. (2009), the reference cited and the reference R2 directed us to for a description of the use of mixed effects models, provides conventional advice to test for statistical significance of these mixed effects models (see Chapter 5 and other places in the book). Also, Zurr et al. describes how to test that individual parameters were statistically significant. This reference also shows how to develop estimates of sampling error (e.g., confidence intervals or standard errors) for the individual parameter estimates. Zuur et al. also offers minimal suggestions, especially in Chapter 5, for model validation. Indeed, Zuur et al. seems to be a sufficient reference to address most of the reporting deficiencies we have tried to describe.*	AEA refers to Chapter 5 in the textbook by Zuur (2009), which is a chapter about linear mixed effects models (i.e., for normally distributed data). Chapter 13 is the chapter by Zuur (2009) that refers to GLMMs – and AEA refers to section 13.2.3 entitled "A word of warning". These methods are approximate, and not simple, and there is no conventional way to verify or validate them. This is the topic of *Discussion of Habitat Suitability Criteria Model Validation Technical Memorandum* (Attachment 5 to this filing).

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USFWS_pp8.5-65_ph04	*In summary, the presentations of habitat suitability curves associated with Study 8.5 are incomplete, technically incorrect, and impossible to review except to say that both the method descriptions and the statistical results are incomplete or appear to be incorrect. Deficiencies in both methods and results must be addressed in the reporting of Study 8.5, it to provide understanding of estimated habitat suitability curves intended to predict fish dynamics as a part of reliably modeling dam effects.*	AEA disagrees with this comment, which refers to the *presentation* of methods and results. Table 2.5.1-2 below presents a listing of the technical reports, presentations, and meeting notes related to development of HSC models for the Project. Additionally, AEA submits that: 1) This presentation has been endorsed by ADF&G biometricians; 2) There seems to have been an expectation of final model presentation results, which is inappropriate for the ISR stage of the process; and 3) AEA will continue to refine the HSC development process and present the final HSC models as part of the USR.
USFWS_NewStudy; NMFS_NewStudy	New Study Request for Susitna-Watana Integrated Modeling and Decision-Support System	AEA requests FERC not adopt this proposed Study Plan modification as requesting FERC to adopt a new study proposal does not constitute a modification to a FERC-approved Study Plan nor does this request meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4.
TNC_pp011_ph01	*In general, the tasks to support study objectives are behind schedule and there is a lack of sufficient progress on preliminary data collection, modeling and analysis to make a determination of whether the study is on the path to meeting objectives established in the RSP for Study 8.5.*	As described in the ISR (Study 8.5 ISR Part D, Section 3: Status, Highlighted Results, and Achievements), AEA has made sufficient progress on preliminary data collection, modeling and analysis to confirm that the study is on the path to meeting objectives established in the RSP for Study 8.5. During the initial study period, AEA collected measurements at 8 of 10 Middle River Focus Areas, completed mainstem channel measurements in the Middle River, developed a calibrated OWFRM model from the proposed dam site (PRM 187.1) downstream to PRM 80, collected 1-2 years of HSC data (depending on the river segment), calibrated 1-D hydraulic models in half of the Lower River 1-D fish habitat sites, conducted winter studies, and demonstrated modeling integration at Proof-of-Concept meetings. AEA believes the study implementation achievements described in ISR Part D meets or exceeds required study implementation at this ISR stage of the licensing process.
TNC_pp011_ph02	*For those tasks that have been completed, many varied from the methods and scope proposed in the RSP for Study 8.5. In all cases, variances resulted in reduced distribution and intensity of data collection in the areas of hydrology, substrate (Habitat Suitability Curves), geomorphic habitat units and fish distribution. AEA has stated that these variances will not impact their ability to meet the objectives of Study 8.5, but they have not provided support for this conclusion.*	AEA described each study variance and the implications of those variances to study results in the ISR (Study 8.5 ISR Part D, Section 6). Contrary to TNC's allegations, some variances resulted in increased sample sizes. As noted in the ISR, five of the original 13 mainstem water-level recording stations were not maintained, but additional mainstem water-level recording stations were installed at select locations resulting in more than 13 mainstem water-level recording sites. While access to some Middle River areas was not available in 2013, access was provided in 2014 and combined 2013-2014 sampling accomplished the ISR study objectives for data distribution and intensity.

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TNC_pp011_ph03	*We appreciate this opportunity to also clarify the overarching goal of Study 8.5. ISR Study 8.5, part A. pg. 2, states, "The goal of Study 8.5 and its component study is to provide quantitative indices of existing aquatic habitats that enable a determination of the effects of alternative project operational scenarios." We disagree and suggest revision in the Updated Study Report (USR). Because this is a new hydropower facility, the goal of Study 8.5 is to inform a determination of the effects of the project. Unlike the re-licensing of hydropower projects where the No Action Alternative (as required by NEPA) is the continued operation of the hydropower facility without modification, the No Action Alternative for a new hydropower project is no project development, therefore the primary goal of the Studies is to enable a determination of the effects of the proposed project as defined in the Preliminary Application Document (PAD) compared to no project.*	AEA and FERC use the term "Existing Conditions" to refer to the baseline of no Project development. In their June 23, 2016 ISR comment letter, the FERC recommended under General Comments (FERC_pp10_ph01) that AEA: *"Include in the USR for each model developed as part of the Commission-approved study plan the preliminary modeling results for at least two scenarios: (a) the existing condition, and (b) the maximum load-following operational scenario".*
TNC_pp011_ph04	*Study deviations discussed below and in the ISR preclude AEA from developing key relationships as required by FERC in the April 1, 2013 Study Plan Determination (SPD), "AEA will evaluate whether there are any relationships between fish distribution and abundance and any of the following microhabitat variables." Adapted study methods and limitations in study approach may preclude this determination.*	AEA disagrees with this comment. As stated in the FERC Study Plan Determination (page B-86 of Study 8.5 SPD, April 1, 2013, with emphasis added): *"We recommend that AEA file with the Initial Study Report, a detailed evaluation of the comparison of fish abundance measures (e.g., number of individuals by species and age class) with specific microhabitat variable measurements <u>where sampling overlaps</u>, to determine whether a relationship between a specific microhabitat variable and fish abundance <u>is evident</u>. We expect the majority of locations where fish sampling and the eight additional microhabitat variable sampling efforts would overlap at a scale where they could be related would occur in focus areas where these sampling efforts are concentrated. <u>If results from these initial comparisons indicate strong relationships may exist between a specific microhabitat parameter and fish abundance for a target species and life stage, expanded sampling may be necessary</u> in 2014 to investigate these microhabitat relationships further. Accordingly, we recommend that AEA include in the evaluation to be filed with the Initial Study Report, any proposals to develop HSC curves for any of the 8 additional parameters as part of the 2014 study season."* AEA completed this analysis as recommended, and produced the *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables Technical Memorandum* (Study 8.5 TM, September 17, 2014).

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TNC_pp011_ph05	*Of more concern, Study 8.5 and associated analyses should support the RSP commitment: 'Resource and process effects will be location- and habitat-specific (e.g. responses are expected to be different in sloughs versus main channel, versus split channel, versus tributary deltas…but there will also be a cumulative analysis that translates effects throughout the Susitna river.' ... TNC has significant concerns about the impact of variances on the scientific basis of the studies, specifically the ability to (1) use collected data to approximate habitat variables at a site and (2) extrapolate site specific approximations (reference variances to data collection and methodology below) to estimate cumulative impacts to the Upper, Middle and Lower river. These concerns are discussed with more specificity in the study sections below.*	AEA does not understand the basis for these concerns. Study 8.5 of the FERC-approved Study Plan has been specifically designed and implemented to allow impact assessments to be location and habitat-specific. The selection and intensive investigation of the ten Focus Areas in the Middle River Segment was intended to capture and ultimately model the major habitat features important to fish and aquatic biota and that are influenced by geomorphic, water quality, groundwater, and ice processes. To date, all but the upper two Focus Areas have been surveyed. Robust data sets have been collected by the different resource studies and AEA is in the process of analyzing the data and in the case of the Middle River Segment, developing different resource models that can be integrated for evaluating Project operational effects on fish, aquatic, and riparian habitats at different spatial scales and by different macro-habitat type. Potential methods for extrapolation have been presented and discussed with the TWG at the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting. These will be discussed further with the TWG. Importantly, the RSP as approved by FERC does not require all of the answers to be provided at the current ISR stage. Rather, the FERC-approved Study Plan requires this information to be provided once all necessary data have been collected.
TNC_pp012_ph01	*For the IFS Analytical Framework, the conceptual methodology for the analysis is presented in Figure 4.1-1. All steps in the methodology are incomplete, so parties are unable to comment on whether the framework will adequately capture the limitations of the individual steps as they accumulate impacts.*	The Conceptual Framework (Study 8.5 SIR, Figure 4.1.1) was presented as an analytical tool to demonstrate study linkages and direct the collection and analysis of data. The RSP as approved by FERC does not require that all of the study steps be complete and results available at the current ISR stage.
TNC_pp012_ph02	*Overall, 'the goal of the stratification step was to define segments-reaches with effectively similar characteristics where, ideally, repeated replicate sampling would result in parameter estimates with similar statistical distributions.' We support the need for meeting this goal in implementation of the studies. The replicability and similarity in statistical distributions should be demonstrated in the USR to support the validity of extrapolating from the segment-reach scale as described in the spatial analysis and DSS.*	AEA agrees that any spatial extrapolation used to produce comparison metrics must be based on valid criteria for extrapolation.

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TNC_pp012_ph03	*The RSP indicated that the interim results of an IHA-type analysis would be presented in the ISR. Interim results were not presented in the ISR. Further, the underlying hydrologic data necessary to conduct this analysis will not be available for public review until the USR is released.10 Alteration to hydrology poses one of the highest environmental and social risks of the proposed project. AEA has stated that the monthly operational scenario boundaries submitted in the Pre-Application Document for OS1b represent a worst case load following conditions, but has yet to distribute its range of potential operating scenarios (AEA 2014).11*	A variance was described and submitted in response to the exclusion of interim IHA results in the ISR. From the SIR (Study 8.5 SIR, Section 4.3.1.6, page 10): *"Candidate metrics and the proposed IHA analysis were presented in the March 21, 2014 IFS TT meeting. A variance in schedule has occurred for the IHA analysis. The determination of the appropriate methodology to apply, and parameters to use, from the Indicators of Hydrologic Alteration continued through Q4 of 2014. The final metrics will be developed with input from the TWG and other resource disciplines after Version 3 of the OWFRM is available. Delay in selecting the final IHA-EFC parameters will not affect the ability to meet study objectives."* See Section 2.5.1.3.2 (IHA) below for further discussion.
TNC_pp012_ph04	*Several riverine process models, including the Geomorphic, Ice Processes, Groundwater and Water Quality models, will rely on the derived hydrologic data in order to calibrate and verify model projections under various project scenarios. Until baseline hydrologic data and a realistic operating scenario are available, the public and conditioning agencies will not have the information necessary to review and definitively comment on the adequacy of individual models, or the integrated modeling effort in simulating habitat-specific and riverine process-specific models. Further, the results of study 8.5 are necessary before analysis can be completed for a majority of the remaining 57 studies, especially those in the categories of Water Resources, Instream Flow Studies, Fish and Aquatic Resources, Recreation and Aesthetic Resources, Subsistence Resources and Socioeconomic and Transportation Resources. Given the lack of progress toward the eight objectives outlined in Study 8.5, and this study's keystone position in ... the assessment, there is serious concern as to the ability of the proponent to meet study objectives within the ILP process and schedule.*	AEA maintains that the intent of the ISR is to describe AEA's overall progress towards implementing the approved Study Plan. The RSP as approved by FERC does not require that study results be available at the current ISR stage. One-dimensional flow routing models have been developed for instream flow, fluvial geomorphology, and ice processes studies. All three studies relied on the same set of surveyed cross-sections and water surface elevation measurements. Modifications, if needed, were then made to meet the needs of each individual study. Model development for each of these models is described in each study section separately. Significant process has been made in development of the OWFRM as described in the SIR (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*). Results from simulation runs of the OWFRM will be used as input to 2-D hydraulic models of Focus Areas, and also as input to groundwater models in Focus Areas under open-water conditions. However, these results are not needed for 2-D model development or calibration. Instead, model development and calibration rely on field data collected during 2012-2014 which have been made available to all studies.
TNC_pp013_ph01	*The software was designed to analyze daily flows, and therefore is not capable of estimating impacts caused by sub-daily variation (TNC 2009, McManamay 2013). While some statistics from IHA may be used to estimate the severity of hydrologic alteration from the proposed project, AEA has not provided access to operational data and therefore it is unclear what the frequency and magnitude of peaking events may be, and therefore, to what extent IHA will be an appropriate analytical tool in this case. Given the lack of information regarding proposed peaking operations and sub-daily variability, we propose the following study suggestions and modifications regarding the underlying analysis of ecologically relevant hydrologic statistics:*	AEA refers to RSP Section 8.5.4.4.1.3 where it is noted that: *"In addition to the analyses using daily flow records, modifications to the analysis package will be developed in collaboration with the TWG to utilize hourly data instead of daily data to evaluate flow components specific to the evaluation of hydropower load-following operations".* AEA is aware of the "canned" metrics provided in the IHA analysis but will be modifying certain metrics to render them more applicable to evaluating Project effects. See also Section 2.5.1.3.2 (IHA) and Section 2.5.1.3.3 (Sub-Daily Metrics) below for additional information on this.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp013_ph02	*Modification 4.3.1: Period of record - we support the effort to include a period of record from 1950 through 2010. A period of record greater than 20 years is suggested to estimate inter-annual variability for most statistics, with a period of 30 to 35 years to capture the periodicity of extreme events like flood flows and droughts (Richter et al. 2007, Huh et al. 2005).*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan (RSP Section 8.5.4.3.2.1). As such, there is no additional cost for implementing this modification. AEA believes that the entire 1950-2010 record should not be used for effects analyses. AEA evaluated the 61-year hydrologic record 1950-2010 and identified several years where the majority of data were synthesized rather than measured. Eliminating those years provided a 50-year hydrologic record (Study 6.6 ISR Part A, Appendix E: Evaluation of 50-Year Simulation Period, Pacific Decadal Oscillation, and Selection of Representative Annual Hydrographs). AEA's proposed 50-year hydrologic record exceeds the 20-year period of record noted by TNC.
TNC_pp013_ph03	*Modification 4.3.2: Comparison of decadal trends – we suggest, for the baseline and proposed operating scenarios, that the scope of assessment include the period of record from 1950-2010, in addition to calculating the statistics discretely for the warm Pacific Decadal Oscillation and the cool Pacific Decadal Oscillation.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA believes that the entire 1950-2010 record should not be used for effects analyses. AEA evaluated the 61-year hydrologic record 1950-2010 and identified several years where the majority of data were synthesized rather than measured. Eliminating those years provided a 50-year hydrologic record (Study 6.6 ISR Part A, Appendix E: *Evaluation of 50-Year Simulation Period, Pacific Decadal Oscillation, and Selection of Representative Annual Hydrographs*). AEA's proposed 50-year hydrologic record exceeds the 20-year period of record noted by TNC. The PDO analysis revealed no identifiable influence of warm or cool PDO periods on wet, average, and dry conditions, except during the winter. Higher winter flows were associated with warm PDO and lower winter flows were associated with cool PDO. Ultimately, candidate years were identified from the 50-year record for representative wet (1981), average (1985), and dry (1970) conditions during periods of warm or cool PDO (Study 8.5 ISR Part A, Section 5.3.4). Once finalized, the hydrology associated with the three representative years will be used in multiple resource modeling efforts. Both the Reservoir Operations Model and the Open-water Flow Routing Model will have the ability to simulate the 1950-2010 period, but these representative years may be used first to evaluate and consider specific operational conditions. Both the ice-processes flow routing and the sediment transport 1-D modeling will have the ability to simulate the abridged 50-year period of record.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp013_ph04	*Modification 4.3.3: Selection and calculation of ecologically-relevant statistics – AEA proposed 11 candidate metrics to estimate the hydrologic impacts of proposed operations on baseline conditions. While environmental flows science has developed considerably in the last three decades, the study of these processes and flow-ecology relationships in cold-regions, including river ice processes and resulting hydraulics, is still an emerging area of science. For cold region rivers like the Susitna, whose habitat template is defined by winter ice cover, scour, snowpack and a spring freshet, Peters et al. (2014) recently published a synthesis of flow-ecology relationships and ecologically relevant hydrologic statistics to consider when assessing the implications of hydrologic alteration (Peters et al. 2014). Similarly, Bevelheimer et al. (2015) cites ecologically-relevant sub-daily statistics that should be considered when reviewing the potential effects of hydro-peaking operations. In Table 1, we propose additional statistics and revisions to proposed methods to account for the ... operational (hydro-peaking and situational (cold-region climate) considerations for the proposed project.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan (RSP Section 8.5.4.4.1.3). As such, there is no additional cost for implementing this modification. The final IHA-type metrics have not yet been selected. The additional statistics proposed by TNC will be considered by the resource studies during selection. Final selection of the IHA-type metrics will be developed in consultation with the TWG. See also Section 2.5.1.3.2 (IHA) below for further discussion regarding the IHA metrics.
TNC_pp014_ph01	*Modification 4.3.4: Interpreting results – because the proposed operations are for peaking and are expected to create significant sub-daily variability, it is inappropriate to use the overall hydrologic index (or the Hydrologic Alteration Factor) to determine impacts (McManamay et al. 2013). Further, the statistics used in IHA have a general and broad application which will be made more meaningful in this assessment if they are related to river-specific life history stages or cues. There is a significant body of literature relating the evolution of salmonids and riparian and floodplain vegetation to daily, monthly, annual and interannual hydrologic patterns and alteration (Poff et al. 2010, Anchor QEA 2015). We recommend incorporating this best available information into the characterization of potential risk of proposed project operations.*	AEA requests that FERC not adopt these proposed Study Plan modifications because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. The final IHA-type metrics have not yet been selected. The additional statistics proposed by TNC will be considered by the resource studies during selection. Final selection of the IHA-type metrics will be developed in consultation with the TWG. Hourly metrics will also be considered. Potential hourly metrics were presented and discussed at the March 21, 2014 Technical Workgroup meeting and will continue to be refined and agreed upon in the last year of study. A schedule variance was described in the SIR (Study 8.5 SIR, Section 4.3.1.6) that states: "*The final metrics will be developed with input from the TWG and other resource disciplines after Version 3 of the OWFRM is available.*" See also Section 2.5.1.3.2 (IHA) below for further discussion regarding the IHA metrics. There are no anticipated additional costs associated with this request

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp014_ph02	***Modification 4.3.5:*** *Transparency and documentation of analysis - for each statistical analysis (including IHA), AEA should publish and make readily available the input data (baseline and operating scenarios), software settings and data outputs in order to assure transparency and replicability of results (Richter et al. 2007).*	AEA requests that FERC not adopt this proposed Study Plan modifications because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA will provide preliminary results (i.e., output files) for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016) in the USR. Information to be provided as part of the USR will include an executable version of the final OWFRM and hourly dam releases (i.e., input files) for at least one operating scenario for representative average, wet, and dry years.
TNC_pp014_ph03	*Modification 4.3.6: Representative years - three years were proposed as representative of wet, average and dry conditions. These three years are wet-warm (1981), average (1985) and dry-cold (1976). The proponent did not include a clear methodology to support the determination of representativeness of the years selected. Further, these years do not coincide with anomalous conditions and data collected during the study period. We recommend the support for this determination be documented in the USR.*	AEA disagrees. The methodology is clearly described in the ISR. Specifically, the ISR (Study 8.5 ISR Part C, Section 7.3.1, page 4-5) states: *"Three years were proposed as representative of wet, average, and dry conditions. These three years are 1981 (wet-warm), 1985 (average), and 1976 (dry-cold). These years were selected collaboratively between Geomorphology (Study 6.6), IFS (Study 8.5), and Ice Processes (Study 7.6) resource needs. The technical rationale for selection of these years was discussed during the IFS-TT POC meetings on April 15-17, 2014 (Tetra Tech et al. 2014) and is provided in ISR Study 8.5, Appendix J and also in ISR Study 6.6 Appendix E of the Geomorphology ISR. Final selection of representative years will be identified prior to the USR with input from the TWG and other resource disciplines."* AEA requests that FERC not adopt this proposed modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request has already been addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp014_ph04	***Modification 4.3.7:*** *Spatial extent - We support the proposal to calculated ecologically-relevant statistics on the Upper (as measured at Gold Creek USGS Gage No. 15292000), Middle (as measured and simulated at Sunshine USGS Gage No. 15292780) and Lower Susitna (as measured at Susitna Station USGS Gage No. 15294350). A reservoir's storage ratio, or the ratio of cumulative upstream storage to mean annual flow at a point in a river, has been demonstrated to be a good first indicator of the potential for ecological risk where a longterm hydrologic dataset is unavailable. Where this ratio exceeds 10 % the reservoir may pose risks to ecosystem services (Dynesius and Nilsson 1994, Richter et al. 2010). Based on a desktop calculation using the proposed Susitna-Watana reservoir capacity (4,100,000 acre-feet) and the mean annual flow at each USGS gage, TNC estimates that the storage ratio as a result of the proposed project would be 58% at Gold Creek, 24% at Sunshine and 12% at Susitna Station. Based on this estimate, the proposed reservoir may affect flows from the reservoir through the Upper, Middle and Lower River to a degree that poses a risk to ecosystem services (Dynesius and Nilsson 1994, Richter et al. 2010). Therefore, site-specific hydrologic statistics should be calculated for each of the three reaches.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA will include the evaluation of alternate operational scenarios as part of the USR and the License Application using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). Site-specific hydrologic statistics will be calculated as requested and needed by individual resource study groups to evaluate Project effects.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp017_ph01	*The ISR does not include model documentation and only includes very generic methods and assumptions for the Reservoir Operations (HEC-ResSim) and the Open-water Routing Model (Open-water model). We support the use of an open source stream flow routing model (HECResSim) with an hourly time-step, but request that model documentation including projectspecific methods and assumptions be provided before the release of the USR. In addition, a model calibration and validation report should be documented for both the HEC-ResSim (Susitna Reservoir specific) and the HEC-RAS (Susitna River specific) models. The primary purpose of the proposed reservoir is to provide hydropower. This section of the ISR does not include the data, methods or model that will be used to link a power production and revenues model to reservoir operations (HEC-ResSim) – specifically, how the reservoir operations model links power supply to projected power demand. We request this information be appropriately documented in the USR. Almost half (5) of the 13 water-level monitoring stations needed to build and calibrate the Open-water model were not maintained in 2013, partially due to lack of landowner access. AEA determined that this would not affect the calibration or validation of the Open-water model, but does not provide sufficient information to support the determination that the loss of this data will not affect their ability to meet study objectives. We recommend the USR document the methods and rational behind this determination or reinstate efforts to collect data. At the remaining 8 maintained monitoring stations, the 2013 record was compromised and includes short and long-term data gaps as a result of ice damage and flooding. Again, the determination of no effect on model development and calibration was not sufficiently articulated.*	Documentation of reservoir operations modeling is provided in Section 12 of the Engineering Feasibility Report (AEA 2014). It should be noted that while HEC ResSim was used for preliminary analyses, reservoir operations analyses have shifted to the MWH-ROM model (MWH Reservoir Operations Model). The MWH-ROM model is used to simulate 61 years of operation on an hourly basis. Hourly releases from the reservoir to the Susitna River (generated by MWH-ROM) are used as input to the OWFRM. Calibration and validation for the OWFRM have been documented in previously prepared reports. The most recent description of calibration and validation is provided in Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8) (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*). Version 2.8 of the OWFRM is the most recent version of this model. Project specific model settings are needed to run this model. These have not been documented yet. The network of USGS gages was considered to be adequate for calibration of the OWFRM under unsteady flow conditions. Data collected from the 13 mainstem water level recording gages could be used for validation of the OWFRM. AEA expects that there would be good agreement between measured and calculated stages at these intermediate locations. Also see Section 2.5.1.3.1 (OWFRM) below for further discussion.
TNC_pp017_ph05	*We support the comments and concerns submitted by NMFS in their September 22, 2014 letter and incorporate by reference herein. We have read the response letter by AEA dated October 7, 2014 and continue to support serious concerns that (1) Fish sampling study plans were not followed and sampling units were inappropriately subsampled and targets for HSC sampling were not met; (2) Fish were misidentified during field sampling; (3) Variances in fish sampling plans resulted in the inability to estimate relative fish abundance; (4) Data were collected and reported at inappropriate mesohabitat scales; and (5) Data were collected during and following anomalous conditions.*	See Section 2.6.1 (Study 9.5 – Fish Distribution and Abundance in the Upper Susitna River Study 9.5) and Section 2.6.2 (Study 9.6 – Fish Distribution and Abundance in the Middle and Lower Susitna River Study 9.6).

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp018_ph03	*Modification 4.6.1: Dual Flow Habitat Analysis - We stress the need for measuring and reporting the metrics of habitat availability that persists through the sub-daily variation between minimum flow releases and generation releases. For hydropower peaking operations, this is often reported in the form of a dual flow analysis across species and life stages (Stalnaker 1992). This is different than the objectives of the varial zone analysis which will predict wet and dry pixels in the river margin to approximate stranding and the effective spawning-incubation model.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. As described in the Study Plan (RSP Section 8.5.4.7.1.1), habitat modeling will be developed using both daily and hourly time steps. A "dual flow" analysis of the duration of fish habitat across time taking into account minimum flows and power flow releases can be calculated. AEA presented other hourly habitat metrics, such as effective-habitat time series (RSP Section 8.5.4.6.1.5) and varial zone modeling (RSP Section 8.5.4.6.1.6), as two examples of sub-daily evaluations of the effects of Project flow fluctuations. In particular, effective-habitat time series are used to calculate the minimum habitat condition on an hourly time step that persists for the duration of the incubation and emergence life stage rather than just a 24-hour period. As described in the FERC-approved Study Plan (RSP Section 8.5.4.7.1.1), the selection of final habitat metrics and appropriate time steps will be developed in consultation with the TWG.
TNC_pp018_ph04	*Modification 4.6.2: Habitat Suitability Curves (HSC) – With current information, it is unclear whether the proposed habitat and riverine process models will be capable of predicting the variables of the HSC curves under various project scenarios.*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA expects that the habitat and riverine process models will be capable of predicting the variables needed in the HSC models and is working closely with all study leads to ensure that ensure this occurs. As part of that effort, a Riverine Modeling Technical Team meeting was held on November 13-15, 2013 to review and discuss riverine modeling and study integration efforts. Following the November meeting, Proof of Concept meetings were held in April 15-17, 2014 to demonstrate modeling coordination between studies (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). The coordination involved Fish and Aquatics IFS (Study 8.5), Fluvial Geomorphology Modeling (Study 6.6), Ice Processes (Study 7.6), Water Quality Modeling (Study 5.6) and Groundwater (Study 7.5) efforts.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp018_ph05	*Modification 4.6.3: Weighted Usable Area - Similarly, the calculation of Weighted Usable Area (WUA) time series for a sub-daily peaking operation is inappropriate because it aggregates the average availability of habitat during a day (Stalnaker 1992). Below a hydropower peaking operation this means the habitat conditions during minimum flows and the habitat conditions during maximum flows (generation releases) are mathematically averaged, resulting in a manifested habitat condition. We recommend a modification to the proposed metric in order to account for sub-daily variability in flows and associated habitat so the WUA be based on the persistent weighted usable area – or the weighted usable area that persists between minimum flow releases and generation flow releases[12]. We also recommend that the validity and methods for developing curves for the Lower River using single-transect PHABSIM modeling as described in the ISR be clarified and justified.*	As explained below in Section 2.5.1.5.5 (Aggregating Sub-Daily Peaking Operations, and Justifying Use of Transect-based (1-D) PHABSIM in the Lower River), AEA requests that FERC not adopt this proposed Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
TNC_pp018_ph06	*Modification 4.6.4: Extrapolation to other parts of the river - In FERC's April 2013 Study Plan* *Determination (SPD), they recommended that AEA, "submit a detailed evaluation of the comparison of fish abundance measures (number of individuals of species by age and … class) with specific microhabitat variable measurements…to determine whether a relationship between a specific microhabitat variable and fish abundance is evident." Variances in experimental design and data collection methods will preclude this analysis. The impact of this variance on the study objectives should be documented in the USR.*	As explained below in Section 2.5.1.4.4 (Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables), AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
TNC_pp019_ph02	*Regarding the temporal analysis, as described in the WUA comments above, use of a habitat time series should not be disaggregated from the sub-daily availability of habitat, or habitat bottlenecks, specifically for sensitive life stages or life stages with low mobility.*	As explained below in Section 2.5.1.5.5 (Aggregating Sub-Daily Peaking Operations, and Justifying Use of Transect-based (1-D) PHABSIM in the Lower River), AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
TNC_pp019_ph03	*Regarding the spatial habitat analysis, given the variances in distribution, intensity, colocation and methodology for collection of fish, substrate, hydrology, and habitat data, it is unclear how AEA proposes to apply a spatial expansion approach from the focus areas to the three river segments. Generic approaches are shared in the ISR including a linear distance extrapolation, microhabitat linear distance, macrohabitat area, and macrohabitat weighted area by fish use.*	AEA agrees that any spatial extrapolation used to produce comparison metrics must be based on valid criteria for extrapolation.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp019_ph04	*The ISR (8.5 Part C, pg 22) references using a sensitivity analysis of the habitat indicators used to evaluate proposed reservoir options. We support the need for a sensitivity analysis but the description of effort and approach is too generic to determine whether it's appropriate to meet the objectives of the study. Further, a sensitivity analysis for each of the independent models does not substitute the need for developing and incorporating a method to account for uncertainty in predicting the power and non-power implication for the No Impact and Proposed Action alternatives, in addition to the range of reasonable alternatives.* *13 Conowingo FERC Project # 405 – Final Study Report: Instream Flow Habitat Assessment Below Conowingo*	Detailed methods for sensitivity analyses have not yet been developed. However, AEA notes that the referenced paragraph from the ISR refers to the sensitivity of final habitat indicators to the inputs from all preceding models. Thus, which, if any, of the models used to estimate the habitat indicator could cause differences in the relative comparison of the operational scenarios.
TNC_pp020_ph02	*As referenced in the study, one DSS that may be explored is the USGS DSS for the Delaware River. The Conservancy has worked directly with USGS during the development and testing in the Delaware River over the last decade. This DSS was developed over more than ten years, not because of the lag in technology, but in large part due to the complex task of defining values across stakeholders quantifying those values in space and over time and calculating representative metrics to approximate whether those values will be met under various scenarios, and lastly, testing the sensitivity of those approximations and optimization functions.*	The USGS DSS for the Delaware River, as stated in the comment, required ten years to develop. This type of model may be useful for adaptive management decision making with respect to license implementation, but is not realistic given licensing schedules.
TNC_pp020_ph03, TNC_pp020_ph04	*The DSS for the proposed Susitna Watana project has yet to document objective functions toward which it would optimize. Further, the ISR lacks a defined methodology to account for and communicate the variance in individual model estimates or to differentiate between the comparative effects between alternatives and model error.* *For example, during winter peaking, flows are estimated to increase by up to 5 x current average flows in a given day, subsiding to base flows during storage. In order to estimate the influence of this operation on the ecosystem, open-water flow routing will need to be linked with the groundwater model, winter temperature estimates from the water quality model and ice process models. Each of these models will have error in simulation and uncertainty (for example, the proposed winter operations, resulting hydrology and thermal regime have never occurred, so their estimate will be outside of the range of empirical data from which the model will be developed). A detailed and formal uncertainty analysis must be incorporated into the integrated modeling process in order to assess the probability associated with model predictions and present the range of alternatives with an informed discussion of boundaries and risks.*	In the ISR (Study 8.5 ISR, Part C, Section 7.8), AEA proposed five key evaluation metrics for anadromous fish habitat, and flow charts were presented detailing the process for developing those metrics. Further, AEA stated that consideration was being given to incorporating several key uncertainties associated with each riverine resource analysis. The models being used to model riverine, riparian, and ice processes as a function of flow in the Susitna River vary in methods, scope, and predictive capabilities. Some of these models are incredibly complex and take extraordinary amounts of time to run even one scenario. Thus, although AEA has agreed to some assessment of uncertainty, the scope and results of that uncertainty assessment have not yet been detailed. No modification is required, however, because this assessment is part of the study integration in IFS Study 8.5. To further advance the process to use for assessing key uncertainties, AEA has developed an example of the estimation of several metrics in the decision support matrix with consideration of uncertainty in the HSC step only. This example is provided in *Discussion of Habitat Suitability Criteria Model Validation Technical Memorandum* (Attachment 5 to this filing).

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp020_ph05a	*Proposed modifications: In general, the tasks to support study objectives are behind schedule and there is lack of sufficient progress on data collection, modeling and analysis to make a determination of whether the study is on track to meet the study objectives. Given this disclaimer, as a summary of the comments above, we propose the following modifications to Study 8.5 including:* *Modification 4.8.1: a revision of the goal statement from a study that informs the differences in effect between operating scenarios to one the informs the difference between the No Action (no project development) and Reasonable Alternatives;*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. This comment raises questions with the Study Plan itself, specifically the goal statement, and not AEA's implementation. As such, it is not relevant to FERC's Study Plan Determination. See Section 2.5.1.6 (Response to Recommendation and Modification Requests Regarding Run-of-River, Habitat Classifications, and PM&E) below for further discussion.
TNC_pp020_ph05b	*Modification 4.8.2: clearer justification of methods in IFS analytical framework that includes fish population endpoints (abundance, productivity, spatial structure and diversity) and the approach to extrapolating data from the Focus Areas to the broader river reaches;*	AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. As described in the FERC-approved Study Plan (8.5.4.6.1.4), evaluation metrics are habitat based rather than population based. The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. This comment raises questions with the Study Plan itself, specifically methods presented in the IFS analytical framework, and not AEA's implementation. As such, it is not relevant to FERC's Study Plan Determination. Regarding extrapolation, see response to SRC_etal_WATER_ppAtt-35_ph02.
TNC_pp021_ph01a	*Modification 4.8.3: revisions to the hydrologic data analysis to use statistics that are appropriate to the Susitna River geography, climate and proposed reservoir operations; and*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA has applied a rigorous statistical analysis, appropriate to the Susitna Project area, to the hydrologic data that has led to development of Version 2.8 of the Open-water Flow Routing Model (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*). See Section 2.5.1.3.1 (OWFRM) below for further discussion.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp021_ph01b	*Modification 4.8.4: a framework to define and communicate uncertainty of the integrated model approach.*	AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. Methods for quantifying uncertainty within the integrated model approach are discussed in the *Decision Support System Uncertainty Technical Memorandum* (Attachment 6 to this filing).
TNC_pp004_ph02	*Unclear methods for integrating multiple models* *The study plan relies on multiple models which have largely been developed independently but must be integrated to inform each other. There is insufficient information on modeling components to determine whether the processes represented in the models are at a resolution that is sufficient to meet the objectives. Some models (e.g. water quality) lack detail on standard model development steps, including specifics on existing data that were used to develop the models. There is a lack of discussion of what metrics (i.e. model outputs) are important to inform the impact of the project. AEA has not produced a decision support framework that includes a clear depiction of how these models will be integrated to inform a decision of whether or not to license the proposed facility."*	See response to SRC_etal_WATER_ppAtt-36_ph04. While it is true that each resource study has developed specific models that will be used to address resource-specific issues, the development of such models has been closely coordinated to ensure that their outputs meet the data dependencies of other resource models. See response to Abt_pp36_ph04 regarding decision support.
SRC_etal_WATER_pp31_ph03	*Modification: I. The Fish and Aquatics Instream Flow Study (8.5) should be modified to require AEA to develop a detailed conceptual model, clearly describe linkages-coupling between Fish and Aquatic Instream Flow Study and other dependent studies and address sources of uncertainty.* *a. AEA should clearly describe linkages or couplings between models* *b. AEA should develop well-defined conceptual models and address sources of uncertainty.*	As explained below in Section 2.5.1.8.1 (Detailed Conceptual Framework for Integrating Process Models) AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp33_ph03	*Modification: I. FERC should require AEA to provide a detailed framework for integrating process models.*[89]	As explained below in Section 2.5.1.8.1 (Detailed Conceptual Framework for Integrating Process Models) AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp33_ph06	*1. Avoiding complicated linkages of separate models in space and time. Instead of attempting to manually couple groundwater flow code MODFLOW with the OWFRM 1-D hydraulic model, EFDC, the 2-D SRH-2D and River 2D models, or Bed Evolution models, AEA could consider using readily available, fully coupled, hydrologic-hydraulic codes.*	The approach taken by AEA follows what was outlined in Study Plan and is adequate for assessing Project effects. See Section 2.5.1.3.1 (OWFRM) below for further discussion.

SRC_etal_WATER_pp34 _ph02	*2. Avoiding over-simplification of tributary inflows. An integrated hydrologic-hydraulic model avoids over-simplification of tributary inflows and distributed lateral "accretions" by calculating these based on physically-based inputs instead of basing them on highly-uncertain estimates, which are based on discharge relations with the basin area. This becomes important when modeling must evaluate future operational scenarios under the influence of climate change (i.e., glaciers melt out and the surface water-groundwater flow conditions change current tributary inflows).*	The tributary inflows are not over-simplified and based on "*highly-uncertain estimates*". The intent of modeling is not to predict future conditions, but to rather reproduce conditions under the identified historical period of record (previously identified as October 1, 1949 through September 30, 2010). As stated in the Study Plan (RSP Section 8.5.4.4) the hydrologic period of record for the Project has been established for the 61-year period extending from Water Years 1950 through 2010 (October 1, 1949 to September 30, 2010). FERC concluded in the Study Plan Determination (Study 7.7 SPD, February 1, 2013) that: *"…we conclude AEA's proposed climate change assessment aspects of the study are not necessary to evaluate project effects."* Based on FERC's Study Plan Determination, the 61-year period of record is instead used to evaluate Project effects. Therefore, tributary inflows need to be reproduced for this same period. Very little measured gage data are available for tributaries to the Susitna River during this period. Daily streamflow records are available from the USGS for the established period of record at multiple locations along the Susitna River (Curran 2012). Total tributary inflows were back-calculated using these mainstem historical records. This approach ensures mass balance and reproduces the observed conditions in the mainstem Susitna River, a necessity when comparing with and without Project conditions. Once the total tributary inflow is determined between gages, the tributary flow attributable to each subbasin is determined using more recent measured data available either from the USGS or from the AEA tributary gaging program. There are a total of 28 tributaries between the proposed dam site and Susitna River at Susitna Station gage. Three of these are major tributaries (Yentna, Chulitna, and Talkeetna rivers) with estimates for the 61-year period of record available from USGS (Curran 2012). Of the remaining 25 tributaries, 14 of the distributions were based on continuous gage data, five were based on measured spot measurements, and the remaining six plus any area between tributaries were based on drainage area alone. Of the 28 tributaries, over 75% of them are based on distributions determined from some kind of flow measurement (either a continuous gage record or spot measurements). In addition, to give some perspective, as shown in Figure 2.5.1-1 below, of the relationship between Project River Mile and drainage area, the Chulitna and Talkeetna Rivers (near PRM 100) and the Yentna River (near PRM 30) are major tributaries with long-term flow records and comprise 86.5% of the total drainage area. The remaining 25 tributaries which are calculated using the method described above only comprise 13.5% of the total drainage area. The major tributaries (Chulitna, Talkeetna, and Yentna rivers) are accounted for as point sources to the OWFRM. Two other tributaries are also accounted for as point sources in the OWFRM. The remaining 23 tributaries were aggregated into eight reaches and accounted for in the OWFRM as distributed lateral inflow.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp34_ph03	*3. Integrating water quality modeling capabilities. Integrated tools allow simulation of integrated fate-transport and water quality modeling, including more robust heat balance tools that simulate a more realistic heat balance, not just in the stream, but also in the subsurface. The current modeling tools only consider heat transport within the stream itself, because MODFLOW does not simulate heat transport. Moreover, groundwater modeling appears to only be planned in FAs and the MODFLOW model is not dynamically coupled to surface hydraulic models. This coupling is a complex process, involving flows through the unsaturated zone. No plan appears to have been offered in the studies reviewed, which attempt to model how either groundwater or heat flow within the subsurface changes due to changes in surface water flows, which respond to operational changes. This defect in the existing approach will not be easily addressed in the DSS scenario.*	AEA is developing methods for the simulation of groundwater heat transport including the use of the mass transport code MT3DMS (Zheng and Wang 1999). The mathematics of heat and mass transport are similar and MT3DMS can be used in conjunction with MODFLOW. MT3DMS has been used by others including Mendez et al. (2010) and Zheng and Wang (1999) for simulation of heat transport in groundwater. The MT3DMS coding will be applied to MODFLOW where applicable. Temperature will be calibrated using the temperature data collected at all groundwater elevation stations as well as shallow streambed temperature profile data. Intergravel data has been collected from six locations in FA-128 (Slough 8A). The intent is to simulate transient changes in short-term streambed temperature effects in spawning habitat areas that result from localizes stage changes. Although the model will not be directly coupled to the stream, the stream temperature and stage will both be used as boundary conditions to the groundwater model. Therefore, functionally they will be dynamically coupled and will be able to model subsurface temperature changes due to operational changes. The coupling of the two models will NOT involve flows through the unsaturated zone because the stream is in continuity with the underlying aquifer. There is no unsaturated zone between the stream and the aquifer.
SRC_etal_WATER_pp34_pp04	*4. Avoiding oversimplification of baseflows. An integrated model calculates distributed baseflow and lateral tributary inflows based on differences in physical characteristics of each contributing subcatchment. It would incorporate important changes due to major changes in subsurface hydrogeology, or surface drainage complexity in each subcatchment. Baseflows (and associated stream temperatures) are critical to correctly assessing habitat-specific models and impacts to changes due to different operational scenarios. The current 1-D hydraulic models (i.e., OWFRM) appear to lump distributed overland flows and baseflows into "accretions," which do not realistically simulate these processes.*	The tributary inflows are not over-simplified. The intent of modeling is not to predict future conditions, but to rather reproduce conditions under the identified historical period of record (previously identified as October 1, 1949 through September 30, 2010). The 61-year period of record is used to evaluate Project effects. See SRC_etal_WATER_pp34_ph02 above for more information on the calculation of tributary flows for each subbasin. The hydrology for the 28 tributaries and any area between tributaries for the 61-year period of record is provided to other resource studies with habitat specific models. The hydrologic inputs from tributaries will not change under different operational scenarios, only the hydrologic input at the proposed dam site will change. The OWFRM aggregates the tributary inflows into eight reaches which are applied in the OWFRM as distributed lateral inflow, but will still accurately simulate water surface elevation and stream in the mainstem of the Susitna River at any of the measured transects. See Section 2.5.1.3.1 (OWFRM) below for further discussion on the OWFRM. The OWFRM is used to model mainstem flow and provide input to the SRH-2D model which is designed to account for flow routing in complex lateral side channel habitats (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*).

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp35_ph01	*Modification: II. FERC should require AEA to expand consideration of uncertainty.[90]*	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. See *Decision Support System Uncertainty Technical Memorandum* (Attachment 6 to this filing) for further discussion.
SRC_etal_WATER_pp35_ph04	*Modification: III. FERC should require AEA to develop and describe methods for extrapolating from Focus Areas to the entire river system to evaluate project impacts.[91]*	As explained below in SRC_etal_WATER_ppAtt-35_ph02, AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_WATER_pp36_ph01	*Modification: IV. FERC should require AEA to incorporate climate change projections into the modeling framework.[92]*	AEA requests that FERC not adopt this proposed Study Plan modification. See Section 1.5.3 (Response to Proposals for Expanded Climate Change Studies) for further discussion.
SRC_etal_WATER_pp36_ph04	*Modification: V. FERC should require AEA to begin DSS scenario evaluations as soon as possible.[93]*	AEA agrees that DSS scenario evaluations should be initiated as soon as possible. These initial scenario evaluations might be completed without the use of specialty DSS software, to provide an example of how the evaluation could be completed without the additional complication of adapting a pre-made software to the Susitna River. There are companies that advertise software for DSS for water resource issues. The use of such software may improve visibility and aid in decision making, but it is not required to meet the objectives of the project. The costs of using pre-made DSS software are unknown, but are expected to be quite large. Extensive investigation into the adaptability of different software packages to the range and scope of the models being employed in the Susitna River would be necessary. It is unrealistic to expect a "black box" DSS software that would adapt immediately to the models being used. AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_pp36_ph06	*Modification: VI. FERC should require AEA to simulate reservoir operations-releases under a full range of scenarios and consider this range across the various studies.*[94]	AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. The evaluation of alternate operational scenarios will occur as part of the USR using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests. The results of Existing Conditions and a Run-of-River operational scenario will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-34_ph01	*Gaging of Tributaries to the Susitna River* *Re: "Tributary inputs in the OWFRM were estimated based on drainage area and then adjusted using available tributary gaging data as described in SIR Study 8.5, Appendix B. Adjustments for Fog Creek were based on spot measurement data collected in three different years (1982, 2014, and 2015). Data gaps associated with the lack of continuous gage data on Fog Creek will not appreciably affect accretion calculations used in the OWFRM."(AEA 2015b, Study 8.5, p. 10).* *Comment: Along with estimations of tributary inputs to the OWFRM based on drainage area, AEA should also evaluate/provide details and implications of uncertainty of drainage area flow estimations on final predictions in the DSS.*	AEA does not agree that additional details and implications of uncertainty of drainage area flow estimates on final predictions is necessary. Mainstem USGS gages are used over the 61-year period of record to calculate total tributary inputs. Relying on mainstem gages for the total calculation of tributary inputs ensures mass balance and reproduces conditions in the mainstem of the river. After total tributary inputs are determined between mainstem gages, the flows are distributed to each subbasin. Prior to the availability of tributary gage measurements, distributions were based solely on drainage area. Once tributary gage data became available, the distribution for those measured drainage areas was based on the observed measurements by comparing tributary measurements for 2013 and 2014 (or other historical record) with the calculated total accretion. The remaining accretion were distributed to the remaining subbasins based on the drainage area. The distributions are summarized in Tables 13, 15, and 17 in Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*. There are a total of 28 tributaries between the Dam Site and Susitna River at Susitna Station gage. Three of these are major tributaries (Yentna, Chulitna, and Talkeetna Rivers) with estimates for the 61-year period of record available from USGS (Curran 2012). Of the remaining 25 tributaries, 14 of the distributions were based on continuous gage data, five were based on measured spot measurements, and the remaining six plus any area between tributaries were based on drainage area alone. The tributary estimates do not impact the total accretion, but rather how the total accretion is distributed to each subbasin. Of the 28 tributaries, over 75% of them are based on distributions determined from some kind of flow measurement (either a continuous gage record or spot measurements). In addition, to give some perspective, not including the Yentna, Chulitna, and Talkeetna rivers with available long-term flow records, the other 25 tributaries only comprise 13.5% of the total drainage basin contributing to the mainstem Susitna River at Susitna Station and the six tributaries and drainages between tributaries with no measurements comprise only 5.7% of the total drainage basin. Therefore, any uncertainty of those flow estimates that are calculated based solely on drainage area will have little impact on the final predictions so is not needed.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-34_ph03	*Development of HSCs* *Re: "Substrate composition was simplified to include only two gravel size classes (small and large). Using two size classifications to describe gravel is consistent with substrate classifications used on numerous other HSC/HSI curve development studies and is not anticipated to impact HSC/HSI curve development." (AEA, 2015b Study 8.5, p. 20).* *Comment: While using two substrate classifications may be more feasible in the field in turbid water conditions, AEA should describe why using two classifications instead of the planned three will not impact the HSC/HSI curves or, more importantly, what effect this may have on the final DSS framework results for different reservoir operation scenarios.*	Substrate composition was simplified to include only two gravel size classes (small and large). The Study Plan Section 8.5 states: *"Substrate size (dominant, sub-dominant, and percent dominant) characterized in accordance with a Wentworth grain size scale modified to reflect English units."* Field personnel found it impracticable to attempt to accurately differentiate gravel composition into three size classes in turbid water conditions. Using two size classifications to describe gravel is consistent with substrate classifications used on numerous other HSC/HSI curve development studies and is not anticipated to impact HSC/HSI curve development. Substrate surveys were coordinated with the different resource study leads to ensure that data necessary for developing the respective models were being collected with a consistent classification system. Completing the statistical analysis for a diverse data set collected over approximately 120 river miles for a wide range of habitat conditions required the grouping or consolidation of some data for specific habitat variables and the expansion or interpretation of habitat conditions within a sample site for other variables. For the substrate variable, due to the large number of categories and combination of substrate and cover types the full suite of data could not be assessed within the same model. To address this, the variables were simplified into groups of similar classes to test the best fit of the HSC model (Section 5.5 in Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*). Including additional gravel size classes would have offered no benefit as it was necessary to simplify gravel size classification into gravel dominant or gravel subdominant categories.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-34_ph05	*Re: The Study Plan indicated that "field surveys will be conducted at potential stranding and trapping areas on an opportunistic basis following up to three flow reduction events during 2013. During a May 17, 2013 TT meeting, participants indicated that site-specific stranding and trapping studies should be a low priority. Because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. Some opportunistic observations of potential stranding and trapping areas were recorded during substrate classification surveys conducted during falling river stage conditions in September 2013, but the observations did not follow robust survey protocols." (AEA, 2015b Study 8.5, p. 20).* *Comment: It is unclear why the priority for potential stranding/trapping was downgraded by participants of the May 17, 2013 TWG, and why September 2013 observations have been omitted because robust survey protocols were not followed. While it may not be possible to replicate the dramatic changes in flow that would occur each day under operational scenarios, an effort should be made to collect this information to the extent possible, so that AEA will have an understanding of this important impact to salmonids.*	See Section 2.5.1.5.4 (Stranding and Trapping) below.
SRC_etal_WATER_ppAtt-35_ph01	*Habitat-Specific Model Development Only one variance is noted: "Surveying of 1-D PHABSIM sites in LR-2 was not conducted in 2014; however, flow data were collected in Sheep and Caswell creeks and the Deshka River (Section 4.3) and HSC data were collected in LR-2 between PRM 65 to PRM 70. Surveying, hydraulic model calibration and habitat modeling of LR-2 sites is needed to complete this study component; this change in schedule will not have a substantive effect on meeting study objectives." (AEA, 2015b Study 8.5, p. 7).* *Comment: Although the authors suggest this schedule variance will not have a substantive effect on meeting study objectives, this is highly vague and no effort is made to demonstrate this is the case, especially if this limits the effective model calibration of a full 1-D PHABSIM model to specific areas/times.*	AEA disagrees. Measurement of 1-D PHABSIM sites in the Lower River is not dependent on two consecutive years of data collection but on obtaining channel, hydraulic, and biological data to characterize Existing Conditions and support development of fish habitat models to evaluate Project operations. In addition to measurement of the 1-D PHABSIM sites in LR-2 (PRM 70 to PRM 65), additional mainstem and tributary channel and flow measurements will be collected in the Lower River in the next year of study and the OWFRM will be calibrated for the lower Susitna River between PRM 87.9 and PRM 29.9 (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study). Preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-35_ph02	*Temporal and Spatial Habitat Analysis* *A primary objective of the spatial habitat analysis is to develop a method for extrapolating habitat-flow relationships from measured locations to other non-modeled locations. It does not appear that this objective has been met. "The final approaches for both the temporal and spatial analysis were to be provided in the ISR (RSP Section 8.5.4.7.1.3); and while discussion occurred during implementation of the Study Plan in 2013 and early 2014, decisions on the final approaches were deferred to 2015." (AEA, 2014 Study 8.5 Part C, p. 23).* *Comment: As with many other components of the ISR, it is difficult to evaluate the adequacy of AEA's data collection efforts when they have not yet articulated their approach to using their field data to inform their models.*	The RSP as approved by FERC does not require this information to be available at the current ISR stage. Rather, the FERC-approved Study Plan requires this information to be developed, as noted in RSP Section 8.5.4.7.1.2: *"…after all data are collected and respective models have been developed. Just like the temporal analysis, the final procedure(s) for completing spatial analysis will be developed collaboratively with the TWG and with input from other resource disciplines."* AEA presented and discussed several options for extrapolation at the April 17, 2014 Riverine Modeling Technical Team Proof of Concept meeting. AEA anticipates further discussions with the TWG once all data are collected and the habitat models have been developed.
SRC_etal_WATER_ppAtt-35_ph05	*AEA Does Not Present Well-Defined Conceptual Models for Study 8.5* *Comment: Based on our review, AEA has not defined, nor described in detail, a well-defined, integrated conceptualization of flow, sediment transport, ice modeling, water quality, and habitat modeling. This conceptual model should be the foundation of all subsequent modeling and data collection efforts. This is standard procedure for any sort of modeling, as summarized by American Society for Testing and Materials (ASTM) standard ASTM D5979-96 (ASTM, 2014) and Kolm (1993).* *For example, AEA should carefully describe and define how all processes (e.g., flow, sediment transport, aqueous geochemistry, ice formation and degradation, surface water-groundwater interactions) interact with each physical domain (e.g., reservoir, mainstem Susitna River, side channels, fans, overland flow, unsaturated and saturated groundwater) through different times of the year. Alternative conceptualizations of how these processes and systems interact should then be developed and considered across all of AEA's modeling studies. Currently, the flow framework is not adequately described and the parameters that feed AEA's models all have very high uncertainties. These uncertainties are compounded by uncertainties related to the model conceptualization.*	AEA disagrees. AEA is fully aware of the importance of demonstrating not only the reliability of the outputs of individual models, but also demonstrating how the respective model outputs will be integrated/combined for evaluating specific effects on riparian (Study 8.6) and fish and aquatic habitats (Study 8.5). Further, AEA has, as part of the FERC-approved Study Plan, already been proceeding with this effort as has been demonstrated during several Technical Team meetings including an initial November 13-15, 2013 Riverine Modeling Technical Team meeting that was designed to discuss modeling and study integration efforts, and the follow-up Proof of Concept meeting held April 15-17, 2014 that demonstrated the application of resource specific (i.e., WQ Study 5.6, FGM Study 6.6, GW 7.5, ICE 7.6, and fish habitat modeling as part of IFS 8.5) in calculating two biological metrics within FA-128 (Slough 8A). Focus Area 128 was selected because it represented one of the more complex areas and as well contained areas known to be important for fish spawning and incubation. This analysis was further described in the ISR (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*) and Study 8.5 SIR. Since then, AEA has continued working on model refinements and integration, and as specified in the FERC comments on the ISR, preliminary results for all models will be presented in the USR for at least two operational scenarios: Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Included in the USR will be a complete description of how each model was configured, parameterized, calibrated, and validated, as well as a description of sensitivity analyses and uncertainties in key model parameters.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-35_ph07	*Calibration of OWFRM Does Not Follow Standard Practice* *Comment: The presentation of the calibration for the Steady State and Transient State OWFRM is non-standard. Key calibration statistics of model performance against observations do not appear to have been presented for either steady state or transient models, as is standard practice (see ASTM D5981, 2002; Moriasi et al, 2007; Bennett et al, 2010). The same issues apply to development and calibration of other models (e.g., habitat-specific models; see Pearce et al., 2000, for predictive performance evaluations).*	See response in Section 2.5.1.3.1 (OWFRM) below and response to USFWS_pp8.5-18_ph04; NMFS_pp8.5-18_ph05]).
SRC_etal_WATER_ppAtt-36_ph02	*Two Different Flow Models Have Been Developed, but Linkages between Models and Steps to Ensure Consistency Are Not Described* *Re: "Two different flow routing models have been developed: an open-water model (HEC-RAS) described in this section of the SIR and a winter model to route flows under ice-covered conditions (Study 7.6)." (AEA 2015b, Study 8.5, p. 11).* *Comment: The development of separate 1-D hydraulic models by different study groups makes little sense and unnecessarily introduces potential inconsistencies between models, errors within individual studies, and confusion among different modelers and studies. A single model should be developed for routing 1-D hydraulic response to different reservoir operations so that each study group is using the best available model.*	AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. has not established "good cause" as required by the ILP regulations, nor has SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Hydraulic routing during the open-water period and during the ice period require different modeling needs and techniques due to the vastly different conditions. As described in the FERC-approved Study Plan Section 7.6, River 1D was the modeling tool identified to simulate ice conditions in the Susitna River. River1D is a hydrodynamic flow routing and thermal model that also models frazil generation, ice-cover progression, and decay (Hicks and Steffler 1992; Andrishak and Hicks 2005a and 2005b; She and Hicks 2006; She et al. 2009; She et al. 2012). The model has the ability to route reservoir releases downstream at small time-steps (hourly or less) and was designed to be able to predict when fluctuating flows can destabilize a winter ice cover (She et al. 2012). Conversely, as described in the FERC-approved Study Plan Section 8.5, HEC-RAS was identified as the appropriate tool to model open-water conditions. This model was selected because it has been proven to be very robust under mixed flow conditions (subcritical and supercritical) as was expected in the Susitna River. The Study Plan identifies two different models to each meet the specific needs of each resource study. Contrary to the SRC et al. comment, by using two different models, each study group is using the best available model for their particular need. Results from the OWFRM will be available during open-water conditions between May through October while results from the River1D model will be available from September through May. The months of May and September/October are overlapping between the two models and the output from which will be integrated to allow simulation of a full 12-month period. Inconsistencies between the models are not anticipated, but any inconsistencies will be addressed before integration.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-36_ph04	*More generally, AEA should provide a clear and concise modeling flow chart that illustrates how all of their process models relate to one another. Here and elsewhere, it is unclear how the specific data, assumptions, parameters, boundary conditions, and outputs are transferred between models. It is much too confusing for any stakeholder/reviewer to get a clear idea of inputs, assumptions, modeling approaches, etc., when critical modeling details are divided up into so many different reports. This in itself is an important limitation of the existing studies. It also makes it extremely difficult to see how AEA will combine all of their models in a DSS framework to make meaningful decisions, or how AEA will assess uncertainty in their model outputs.* *Diagrams in ISR and SIR Study 8.5 Documents Relating Models Are Confusing and Do Not Adequately Describe Integration Of Models* *Re: "The overall goal of the IFS (Study 8.5) and its component study efforts is to provide quantitative indices of existing aquatic habitats that enable a determination of the effects of alternative Project operational scenarios" (AEA 2015b, Study 8.5, p. 4).* *Comment: The flow diagrams in the ISR and SIR 8.5 IFS documents that attempt to show how the various studies and models relate to each other are highly confusing. This information is critical to demonstrate to FERC and stakeholders that all proposed modeling efforts are correctly integrated, consider uncertainty, and fully meet the stated objectives of the aquatic instream flow study (IFS) and riparian instream flow study (RIFS). To clearly and transparently show how the main goal of the IFS and RIFS efforts will be met by these modeling efforts, AEA must make a much more concerted effort to provide better roadmaps showing how all models are integrated, across multiple, representative, and complete years. Below we provide a few examples that are illustrative of this problem.*	AEA disagrees. These comments and the ones on SRC_etal_WATER_ppAtt-37_ph01-09 all center on wanting greater clarification regarding model integration. The modeling charts were presented and described in the FERC-approved Study Plan. In addition, a Riverine Modeling Technical Team meeting was held with licensing participants on November 13-15, 2013 to provide a forum to review and discuss modeling and study integration efforts. A follow-up Proof of Concept meeting was held April 15-17, 2014 to advance the understanding of riverine process and fish habitat modeling by demonstrating the application of the models specific to two key biological metrics (i.e., effective salmon spawning-incubation habitat and juvenile salmonid rearing habitat) at Middle River Focus Area 128 (Slough 8A) (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). These meetings were held early in the study implementation process to allow potential data gaps or format inconsistencies to be identified and resolved. A description of the integration process and an updated modeling flow chart are provided in *Middle River Fish Habitat and Riverine Modeling Proof of Concept* (Study 8.5 ISR Part C, Appendix N); however, the integration of riverine process models and development of fish habitat metrics is an ongoing process. AEA has continued coordination efforts by holding monthly conference calls with representatives from each riverine modeling study to ensure modeling results are correctly integrated, consider uncertainty, and fully meet the stated objectives of the various study plans. Preliminary results for all models required by the FERC-approved Study Plan will be presented in the USR for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-41_ph06	*We recommend that AEA consider using a proven and advanced DSS tool for this purpose (i.e., DHI's DSS: DHI, Undated).*	AEA disagrees with the recommended use of previously proven advanced DSS tool for the Project. AEA has implemented the DSS portion of the IFS consistent with the FERC-approved Study Plan. A matrix method, described in the RSP, has been successfully used as a DSS to resolve issues in previous FERC proceedings (RSP Section 8.5.4.8.1); however, AEA remains open to modifying and improving the DSS in a collaborative framework as part of the USR (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study). There are companies that advertise software for DSS for water resource issues. The use of such software may improve visibility and aid in decision making, but it is not required to meet the objectives of the project. The costs of using pre-made DSS software are unknown, but are expected to be quite large. Extensive investigation into the adaptability of different software packages to the range and scope of the models being employed in the Susitna River would be necessary. It is unrealistic to expect a "black box" DSS software that would adapt immediately to the models being used.
NPS_pp2_ph2	*We request that resource model calibration, validation, and integration between the multiple resource studies that rely on modeling be completed prior to TNYOS and prior to the Updated Study Reports (USR). Consistent time horizons should be used as the models are integrated and run. It should be clear whether predictions involve point-in-time conditions, at say year 50 post impoundment, and when and if steady-state conditions are expected to develop.*	The Study Plan Section 8.5 as approved by FERC does not require this information to be available at the current ISR stage (i.e., before The Next Year of Study (TNYOS). Rather, the FERC-approved Study Plan requires this information to be developed and reported in the USR. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).
Long_160620_pp13_ph4	***Modification:*** *I support the National Marine fisheries Study Request for Model Integration that was presented in the March 23, 2016 ISR meeting in Anchorage. In response, AEA stated that model integration would be discussed in the next day's meeting. But that never happened. Without a strong focus on model integration, stakeholders hold little faith in the analysis of baseline data for future impacts. Currently, there is a high degree of scientific uncertainty in the ISR study data. Without a study of how the multitudes of models and different model versions are integrated, scientific uncertainty will remain high.*	As explained below in Section 3.4 (Susitna-Watana Integrated Modeling and Decision Support System), AEA requests that FERC not adopt this proposed modification since the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan, and this request is already being addressed as part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. As noted, the Services submitted a new study proposal for model integration which must meet the criteria established in 18 C.F.R. §5.15(e). AEA's response to the Services' new study proposal can be found below in Section 3.4. Methods for quantifying uncertainty within the integrated model approach are discussed in the *Decision Support System Uncertainty Technical Memorandum* (Attachment 6 to this filing).

Reference Number	Comment or Study Modification Request	AEA's Response
Long_160810_pp04_ph1	*Study Modification Request to Classify Confluence Focus Area or Sub-Study* *The current 10 Focus Areas were selected for 2 D modeling because they are representative of important habitat types, geomorphic reaches channel classification types and relation to other relevant studies. The Confluence is an important habitat/channel type. It represents a unique geomorphic, hydraulic, riparian system not found in the 10 FAs. And it affects human communities significantly.*	AEA does not object to FERC's adoption of part of this modification request as proposed by AEA. However, AEA requests FERC not adopt designating the Three Rivers Confluence Area as one of the Middle River Focus Areas as a Study Plan modification. In response to TCCI's request to model the geomorphology and ice processes at the Three Rivers Confluence to evaluate the potential for erosion, winter sediment and ice transport (TCCI_pp04_ph2), AEA proposes to perform 2-D hydraulic modeling of the Three Rivers Confluence area for the open water (using SRH-2D for the 2-dimensional area of the confluence and 1-D HEC-RAS model to establish downstream boundary conditions) and ice-cover periods (using River2D for the 2-dimensional area of the confluence and output from River1D to describe downstream boundary and ice conditions). The 2-D modeling would occur in the Sustina River from approximately PRM 98.5 to PRM 104.5 and extend approximately 3 miles up the Chulitna and Talkeetna Rivers during the open water period and 3,000 feet up the Chulitna and 5,000 feet up the Talkeetna during the ice cover period. The modeling would include a range of flows representing existing conditions on each of the three rivers and the concurrent flows on the tributaries coupled with operational flows on the Susitna River, and will provide information on potential Project-related erosion and flooding effects for open water and ice-cover conditions. See Section Section 2.3.2.2.6 (Study 6.6) and Section 2.4.2.2.4 (Study 7.6) for a detailed description of AEA's proposed modification. In concert with AEA's proposed modification to the Fluvial Geomorphology Study (6.6) and the Ice Processes Study (7.6) to perform 2-D hydraulic modeling of the Three Rivers Confluence area, AEA could rely on 1-D fish habitat modeling of the Three Rivers Confluence area to analyze Existing Conditions and alternate operating scenarios similar to the Lower River fish habitat modeling (Study 8.5 ISR Part C, Appendix O: *Fish Habitat Modeling in Lower River*). However, due to the hydraulic complexity of the Three Rivers Confluence, AEA is not proposing to incorporate all riverine process study outputs to the same level of integration and fish habitat analysis as being conducted for the Middle River Focus Areas. The estimated cost of providing 1-D fish habitat analyses of the Three Rivers Confluence area is \$100,000-\$120,000 in addition to the costs identified in Section 2.3.2.2.6 and 2.4.2.2.4.

2.5.1.1. Objective 1

Objective 1: Map the current aquatic habitat in main channel and off-channel habitats of the Susitna River affected by Project operations. This objective will be completed as part of the Characterization and Mapping of Aquatic Habitats Study (9.9).

As noted in USFWS_pp8.5-10_ph03, comments on this objective were submitted for Study 9.9, Characterization and Mapping of Aquatic Habitats. AEA's corresponding responses are similarly found under Section 2.6.5.

2.5.1.2. Objective 2

Objective 2: Select study areas and sampling procedures to collect data and information that can be used to characterize, quantify, and model mainstem and lateral Susitna River habitat types at different scales. This objective will be completed via a collaborative process involving this study, Riparian Instream Flow (Study 8.6), Groundwater (Study 7.5), Geomorphology (Studies 6), Water Quality (Study 5), and Fish and Aquatics (Study 9).

2.5.1.2.1. Response to Recommendation Regarding Representative Site Selection

USFWS (USFWS_pp8.5-13_ph06) recommends that Focus Area study sites and number of sites in the Middle River and Lower River should represent the range of biological use of habitats. USFWS asserts Focus Area study site locations and site numbers are not adequate to determine fish distribution and identify the habitat variables within relevant macrohabitats to assess fish-habitat associations.

In response, while not proposed as a modification to the Study Plan, AEA requests that FERC not consider this recommendation to modify the Study Plan because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was not implemented as provided by the approved Study Plan.

In consultation with licensing participants, a Focus Area sampling approach was developed and employed for the Middle River Segment to describe existing conditions and the response of habitats to proposed Project releases (Study 8.5 ISR Part A, Section 4.2). Per FERC's Study Plan Determination recommendations, this process was described in a Technical Memorandum that was submitted to the FERC (Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for In stream Flow and Joint Resource Studies – 2013 and 2014*) that included application of a set of selection criteria that specified that: a) all major habitat types (main channel, side channel, side slough, upland slough, tributary delta) would be sampled within each geomorphic reach; b) at least one (and up to three) Focus Area(s) per geomorphic reach (excepting geomorphic reaches associated with Devils Canyon – MR-3 and MR-4) would be studied that is/are representative of other areas; c) a replicate sampling strategy would be used for measuring habitat types within each Focus Area, which will include a random selection process of mesohabitat types; d) areas that are known (based on existing and contemporary data) to be biologically important for salmon spawning/rearing in mainstem and lateral habitats would be sampled (i.e., critical areas); and e) some areas for which little or no fish use has been documented or for which information on fish use is lacking would also be sampled. The analysis resulted in the selection of ten Focus Areas for detailed evaluation. Furthermore, a robust statistical analysis was completed to evaluate the "representativeness" of the Focus Areas that found that all ten of the Focus Areas were generally representative of habitat types found in other portions of the river. Thus, these areas do provide a range of habitats from which to gauge biological use.

As provided in the FERC-approved Study, modeling of the Middle River Segment Focus Areas will integrate studies of fisheries, geomorphology, groundwater, riparian, ice processes, and water quality. Hydraulic conditions within these Middle River Segment Focus Areas will be based on 2-D modeling that will be integrated into a PHABSIM-type analysis of potential fish habitat. However, the size and complexity of the Lower River Segment renders a 2-D modeling approach of specific areas infeasible. As a result, AEA did not use the same Focus Area approach as applied in the Middle River segments (Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies 2013-2014*). Rather, study sites in the Lower River Segment were selected in geomorphic reaches LR-1 and LR-2 based on a combination of representative and critical study sites (Study 8.5 ISR Part A, Figures 4.2-11 and 4.2-12; Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for In stream Flow and Joint Resource Studies – 2013 and 2014*). Instream flow sites were limited to these upper two geomorphic reaches in the Lower River Segment since Project effects become more attenuated downstream (based on results of the Open-water Flow Routing Model).

Sampling of sites in LR-1, LR-2, and the Deshka River was originally scheduled for 2013, but sites in LR-2 were not surveyed and have been scheduled for the next year of study (Study 8.5 ISR Part A, Section 4.6.2). Surveying of 1-D PHABSIM sites in LR-2 was not conducted in 2014; however, flow data were collected in Sheep and Caswell creeks and the Deshka River (Study 8.5 ISR Part A, Section 4.3) and HSC data were collected in LR-2 between PRM 65 and PRM 70. The IFS sites in LR-2 must still be surveyed to complete this study component. This change in schedule is not anticipated to have a substantive effect on meeting study objectives.

In terms of fish distribution, the Focus Areas represented one of many areas sampled, with other areas (e.g., tributaries, main channel habitats, and other lateral habitat) being sampled based on a statistically rigorous Generalized Random Tessellation Stratified (GRTS) sampling method (ISR Study 9.6, Part A). The sampling of fish and habitat as part of the IFS HSC/HSI studies and Fish Distribution and Abundance in the Middle and Lower Susitna River (FDAML) Study 9.6 was completed in accordance with the FERC-approved Study Plan, and closely followed specified statistically robust sampling protocols. First, regarding Middle River Focus Areas, those were specifically selected to provide a wide range of macrohabitat types used by fish over different temporal scales that can be modeled to evaluate potential impacts due to Project operations. However, the FDAML study objectives 1A and 1B are to characterize fish distribution and to determine fish-habitat associations, respectively. This study was not limited to just Focus Areas but sampled fish in over 230 mesohabitats within 182 macrohabitats throughout the Middle River as well as in selected tributaries (FDAML Study 9.6 SIR). The numbers of areas and sites that have been sampled on a seasonal basis provides a strong foundation of information from which to define both the seasonal and spatial distribution of fish species within the Susitna River, as well as the habitat variables important for defining fish-habitat associations.

2.5.1.2.2. Response to Modification Request Regarding Lower River Site Selection

The Services (USFWS_pp8.5-14_ph02 [Modification]; NMFS_pp8.5-13_ph02 [Modification 2-1]) request a study modification to require that Project effects on Lower River salmon spawning and rearing are evaluated at known salmon spawning and rearing locations. USFWS states that locations that were considered to be migration barriers in the 1980s were used as sampling sites. The Services believe results from the current adult Salmon Escapement Study (Study 9.7) should be used to identify representative spawning locations, and results from the 1980s or the current Fish Distribution and Abundance in the Middle and Lower Susitna River (FDAML) Study (Study 9.6) should be used to identify important juvenile rearing and overwintering locations. USFWS also states that the overall development of Lower River studies falls behind that of studies in the Middle River. NMFS Modification 2-1 specifically recommends using results from the Escapement Study combined with new surveys to locate salmon spawning and rearing habitat to select representative Focus Areas in the Lower River. NMFS believes Focus Area study sites in the Lower River should represent the range of biological use of habitats.

NMFS claims that the selected Lower River study sites, which 1980s investigators believed may present fish migration barriers, are not representative of the geomorphic reach, were not randomly selected, and are not areas of known spawning and rearing. NMFS would like the studies to identify current use from the 2012-2015 FDAML studies instead of selecting sites from the 1980s data.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have the Services demonstrated that the study was not implemented as provided by the approved Study Plan.

It is unclear from NMFS and USFWS comments whether they are requesting that sites be selected to represent physical and hydraulic habitats in the geomorphic reach, or whether they are requesting that sites be selected based on fish use. Consistent with the FERC-approved Study Plan, AEA measured main channel, side-channel, and tributary mouth habitats in Lower River geomorphic reaches and initiated 1-D model development (Study 8.5 ISR Part A, Appendix I: *Lower River Hydraulic Model Calibration*; Study 8.5 ISR Part C, Appendix O: *Fish Habitat Modeling in Lower River)*. Main channel habitats in the Lower River were not identified as being important to salmon spawning in the 1980s, but AEA included sites in Lower River main channel and side channel habitats to address the full range of fish resources. During the 1980s, most salmon spawning occurred in the tributaries. In response, AEA reviewed tributary mouth habitats that had been identified as important for salmon migration and spawning and selected sites considered potentially sensitive to effects of Project operations during the 1980s. Since the effects of Project operations attenuate in a downstream direction, and in view of the increased size and complexity of the Lower Susitna River, AEA did not use the same Focus Area approach as applied in the Middle River segments (Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies 2013-2014*).

The IFS field surveys at the five LR-1 sites were completed in 2013, and preliminary hydraulic analysis for the Birch Creek and PRM 97 sites were presented in Study 8.5 ISR Part A, Appendix

I: *Lower River Hydraulic Model Calibration*. Transect data were collected at the Deshka River confluence in LR-3 as part of Study 6.6 (Fluvial Geomorphology Modeling). Since the June 2014 ISR, the Trapper and Birch Creek data and mainstem transect data at PRM 95, PRM 96, and PRM 97 sites are undergoing additional analysis (Study 8.5 ISR Part A, Section 4.6.1.2.3). However, field measurements of the LR-2 sites are needed to complete this study component. Surveys of LR-2 are currently scheduled for the next year of study (Study 8.5 ISR Part A, Section 4.6.2)

The relative use of main channel, side channel, and tributary habitats in the Lower Susitna River Segment by adult holding and spawning salmon was generally confirmed by results of the Salmon Escapement Study 9.7 (Study 9.7 SCR). Most salmon spawning occurred in tributaries rather than main channel and side channel habitats and salmon holding was observed at tributary mouths selected for measurement. A summary of the location of holding and spawning salmon by species in the Lower River Segment of the Susitna River is provided below (Study 9.7 SCR).

Chinook Salmon

As reported in Study 9.7 SCR, telemetry results indicated that more than 97 percent of Chinook Salmon tagged in the Lower River likely spawned in tributaries. Proportions of tributary spawners were relatively consistent among years for Chinook Salmon (97-99 percent). Chinook Salmon used the Yentna, Deshka, Talkeetna, and Chulitna rivers in all years.

From 2012 through 2014, 23 radio-tagged Chinook Salmon were identified with potential spawning sites within mainstem macrohabitats of the Lower River (Study 9.7 SCR). Historic surveys only indicated spawning within tributaries and there was no indication of spawning behavior observed at the confluence of tributaries in the Lower River (Barrett et al.1985a; Barrett et al. 1985b; Thompson et al.1986).

Results of 2012-2014 radio-tagging surveys identified potential Chinook spawning locations within the area encompassing the LR-1 PHABSIM sites selected for measurement (Study 9.7 SCR, Figure D-11).

Coho Salmon

During 2012-2014, Coho Salmon tagged in the Lower River moved mostly into Lower River tributaries. The primary Lower River tributary destinations were the Yentna (22.8 percent), Deshka (12.1 percent), Talkeetna (11.6 percent), and Chulitna (24.8 percent) rivers (Study 9.7 SCR).

Only 2.8 to 6 percent of the Lower River tagged Coho Salmon were classified as having mainstem destinations in the Lower River. Results of 2012-2014 radio-tagging surveys identified potential Coho spawning locations within the the area encompassing the LR-1 PHABSIM sites selected for measurement (Study 9.7 SCR, Figure D-16).

Chum Salmon

From 2012 to 2014, 31 of 1,080 radio-tagged Chum Salmon were identified with potential spawning sites within mainstem habitat of the Lower River as based on 400 tags applied in the Lower River in 2012, and 680 tags applied in the Middle River from 2012-2014 (Table 2.5.1-3).

Results of 2012-2014 radio-tagging surveys identified potential Chum spawning locations within or in close proximity to PHABSIM sites selected for measurement in LR-1 and LR-2 (Study 9.7 SCR, Figure D-13).

Pink Salmon

More than 85 percent of the Pink Salmon tagged in the Lower River as part of Study 9.7 (Section 2.6.3) moved into Lower River tributaries. The primary Lower River tributary destinations were the Yentna (21.6 percent), Deshka (12 percent), Talkeetna (5 percent), and Chulitna (21.3 percent) rivers, and Willow (7 percent) and Montana (5.5 percent) creeks (Study 9.7 SCR). Similarly, Barrett et al. (1985a; 1985b) indicated that, historically, most of the Pink Salmon caught in the Lower River also had destinations in the Lower River and tributaries.

Results of 2012-2014 radio-tagging surveys identified potential Pink spawning locations within or in close proximity to PHABSIM sites selected for measurement in LR-1 and LR-2 (Study 9.7 SCR, Figure D-18).

Sockeye Salmon

In 2012, all 100 Sockeye Salmon tagged in the Lower River moved into Lower River tributaries. The overwhelming majority moved into the Yenta River (96 percent), however fish also used Deshka (1 percent) and Chulitna (2 percent) rivers (Study 9.7 SCR).

None of the Lower River tagged Sockeye Salmon were classified as having mainstem destinations in the Lower River. Similarly, most Sockeye salmon destinations from historic surveys in the Lower River were also within tributaries (Fair 2009; Yanusz et al. 2011a; Yanusz et al. 2011b).

2.5.1.2.3. Response to Modification Request Regarding Winter Hydraulic Model Calibration

The Services (USFWS_pp8.5-14_ph04 [Modification]; USFWS_pp8.5-52_ph05 [Modification]; NMFS_pp8.5-13_ph07 [Modification 2-2]) comment that measurements of ice thickness, water depth, water temperature and water velocity at multiple points along 10 or more transects in each Focus Area are needed to accurately model ice thickness and calibrate and validate winter hydraulic models (IFS 8.5 and Ice Processes 7.6).

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The requested modification is not necessary to meet the Study Plan goals and objectives. AEA believes the ice thickness data recently collected, along with additional ice thickness data to be collected during the next study year, will meet the goals and objectives of the FERC-approved Study Plan.

As described in the FERC-approved Study Plan (RSP Section 7.6.2: Existing Information and Need for Additional Information), ice thicknesses, elevations and other ice processes were documented in the Middle and Lower segments of the Susitna River during studies conducted in the 1980s (R&M 1981, 1982, 1983, 1984, 1985, 1986). Other entities (National Weather Service, U.S. Geological Survey, and U.S. Army Corps of Engineers also have collected and compiled ice thickness, break-up, and freeze-up data for various locations on the Susitna River (Bilello 1980). These data further our understanding of ice processes in the Susitna River and are relevant to ongoing modeling efforts.

The Study Plan (RSP Section 7.6.2: Existing Information and Need for Additional Information) described the need for ice thickness and other ice processes data but the plan did not identify the number and spacing of ice thickness measurements. During measurement of winter discharge in 2013 and 2014, ice thickness, snow depth, and water velocity were measured at each of the ESS stations. Ice thickness data were also collected at FA-104 (Whiskers Slough), FA-113 (Oxbow 1), FA-115 (Slough 6A), and FA-128 (Slough 8A). However, these Focus Area measurements were not transect-based, but spaced to cover the entire Focus Areas to provide overall characterization of winter conditions. In addition to specific point measurements, the entire Focus Areas were characterized visually in terms of ice coverage, open leads, and seepage-groundwater evidence.

2.5.1.3. Objective 3

Objective 3: Develop a mainstem Open-water Flow Routing Model (OWFRM) that estimates water surface elevations and average water velocity along modeled transects on an hourly basis under alternative operational scenarios.

2.5.1.3.1. Response to Comments Regarding the Open-water Flow Routing Model

The Services provided many comments related to the OWFRM (USFWS_pp8.5-14_ph07, USFWS_pp8.5-15_ph02, USFWS_pp8.5-15_ph05, USFWS_pp8.5-16_ph02, USFWS_pp8.5-16_ph03, USFWS_pp8.5-17_ph02, USFWS_pp8.5-17_ph03, USFWS_pp8.5-43_ph04, USFWS_pp8.5-52_ph11, NMFS_pp8.5-14_ph06, NMFS_pp8.5-14_ph07, NMFS_pp8.5-15_ph03, NMFS_pp8.5-15_ph05, NMFS_pp8.5-16_ph02, NMFS_pp8.5-16_ph05, NMFS_pp8.5-17_ph02, NMFS_pp8.5-40_ph01, NMFS_pp8.5-50_ph06). In terms of model development, comments stated that the calibration lacked information and used unfamiliar procedures by relying on synthesized cross-sections, that verification and validation of the modeling results were not provided, and documentation did not adequately describe the impact on other models that rely on the OWFRM for conditions outside the calibration range. They state that the OWFRM is not able to properly account for the flow routing outside of the main channel in complex lateral side channel habitats. Comments stated that the OWFRM was not adequately developed to integrate information from other study disciplines, and documentation did not describe how the OWFRM will provide fundamental inputs into the ice process model.

The SRC et al. comments state that AEA should consider using readily available, fully coupled, hydrologic/hydraulic codes to avoid complicated linkages of separate models in space and time, that current 1-D hydraulic models (i.e., OWFRM) appear to lump distributed overland flows and baseflows into “accretions”, which do not realistically simulate these processes, and that key calibration statistics were not presented as is standard practice (SRC_etal_WATER_pp33_ph06;

SRC_etal_WATER_pp34_pp04; SRC_etal_WATER_ppAtt-35_ph07). TNC commented that AEA did not provide sufficient documentation to support the determination that reduction of the water level monitoring stations would not affect the calibration or validation of the OWFRM (TNC_pp017_ph01).

Contrary to the previous comments, the Services (USFWS_pp8.5-52_ph11; NMFS_pp8.5-50_ph06) also commented that:

> *Overall the OWFRM (Version 2.8) results demonstrate the general ability to simulate the flow hydrograph through the main channel of the Susitna River during open-water conditions. Comparison of hydrographs and stage changes associated with pre- and post-Project (OS-1b) operations at Gold Creek and Susitna Station locations throughout the Middle River are presented and provide adequate information to address the study objectives in the Middle River under the OS-1b operations.*

In response, 1-D flow routing models have been developed for instream flow, fluvial geomorphology, and ice processes studies. FERC approved the use of HEC-RAS when approving the Hydraulic Routing and Operations Modeling portion of the IFS Study Plan (RSP Section 8.5.4.3). As explained in the RSP, these methods are generally accepted in the scientific community and are sufficient for FERC to evaluate Project effects and identify potential protection, mitigation and enhancement measures. Alternative modeling methods proposed in this comment are not needed to meet the FERC-approved Study Plan objectives.

Riverine process studies (i.e., Water Quality Study 5.6, Fluvial Geomorphology Modeling Study 6.6, Ice Processes Study 7.6 and Fish and Aquatics Instream Flow Study 8.5) relied on the same set of surveyed cross-sections. Modifications, if needed, were then made to meet the needs of each individual study. For instance, Fluvial Geomorphology Modeling used the transects in developing a 1-D model to evaluate reach-scale channel morphology under channel-forming flows (Study 6.6 SIR, Attachment 1: *2014 Fluvial Geomorphology Model Development*). The flow routing model developed for instream flow was focused on low to moderate flows during the open-water period up to the two-year flood. Calibration of the OWFRM to match water surface elevations at surveyed cross-sections provided accurate input to the Focus Area modeling studies.

To assess the impacts of Project operations on downstream riverine ecology, it will be important to accurately predict downstream water surface elevations (USGS 2012a), especially in the vicinity of Focus Areas. The Project will be capable of altering downstream water surface elevations on seasonal, daily, and hourly time scales. Accurate water surface elevations will be needed to evaluate the effects of Project operations: on surface/groundwater interactions; on the formation and breakup of ice; on the connectivity of the mainstem river with adjacent sloughs and side channels; on inundation of riparian communities; and on hydraulic conditions at tributary mouths.

The OWFRM was developed using the HEC-RAS River Analysis System model (USACE 2010a, 2010b, and 2010c). To accurately predict water surface elevations, the model was calibrated to match observed water surface elevations. The model has several methods for calibration:

- Adjustment of hydraulic roughness coefficients;

- Adjustment of contraction and expansion loss coefficients;
- The use of ineffective flow areas in cross-sections; and
- The use of interpolated cross-sections.

These methods have been available for calibration since the 1960s, when the hydraulic model HEC-2 (predecessor to HEC-RAS) was initially developed (USACE 1990). Generally the first three methods are used for calibration. However, those three methods may not be sufficient, and it may be necessary to also use interpolated cross-sections to calibrate the model and predict accurate water surface elevations (Hoggan 1989).

Although the Services did not specify which of the OWFRM calibration methods "*used unfamiliar procedures*", the OWFRM calibration procedures used are described in the SIR (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*, Section 7.2.1). The network of eight USGS gages was considered adequate for calibration of the OWFRM under unsteady flow conditions. The calibration approach was to first adjust Manning's *n* within reasonable values such as those reported by the United States Geological Survey (USGS 1967) and Hicks and Mason (1998). If further adjustments were needed, then a single cross-section was interpolated about 1,000 feet downstream from the upstream transect using the HEC-RAS cross-section interpolation utility. This HEC-RAS utility provides a gradual transition in cross-section shape between an upstream and downstream cross-section. No adjustments were made to the width of the interpolated cross-section. The elevation of this artificial cross-section was adjusted up or down to match surveyed water surface elevations. This approach was needed more frequently when there were two or more surveyed water surface elevation/discharge pairs.

The calibrated model will be most accurate at the surveyed cross-sections where water surfaces were surveyed and flows were measured. The accuracy of flow hydrographs between surveyed cross-sections will be representative of measured conditions due to the field data collected upstream and downstream. The accuracy of stage hydrographs between surveyed cross-sections is unknown because no field measurements of water surface elevation were made between surveyed cross-sections. However, results from the OWFRM will only be extracted and provided for surveyed cross-sections. As stated in the SIR (Study 8.5 SIR, Appendix B, Section 8.4), validation of the OWFRM using 2014 USGS gage data and using the 2012-2014 ESS Station data is intended for the last year of the study. Given the availability of complete data sets at seven locations (three ESS stations and four USGS stations), and 10 additional water-level recording stations installed in response to data needs at fish habitat Focus Areas and Lower River study sites, sufficient hydrology and stage data will be available to achieve Study Plan objectives.

The OWFRM will provide flow and stage hydrographs at surveyed cross-sections, and these will be used as input to 2-D hydraulic models of Focus Areas, and also as input to groundwater models in Focus Areas under open-water conditions. Consistent with the FERC-approved Study Plan, the 1-D flow routing models (both open-water and ice) were designed to calculate main channel stage and flow at downstream locations. The SRH-2D model is used to model open-water flows and River2D is used to model ice processes in the Middle River Focus Areas (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling: Proof of Concept*). The 2-D models will account for flow routing in complex lateral side channel habitats (Study 8.5 ISR Part

C, Appendix N). The SRH-2D model will extract results from the OWFRM from the range of flows for which it was developed and is applicable for. The Services' comments (USFWS_pp8.5-52_ph11; NMFS_pp8.5-50_ph06) establish that they understand the intent of the OWFRM was to predict main channel stage during the open-water period. Preliminary modeling results show that there would be a reduction in water levels during the summer and an increase in water levels during the winter. These effects would be greatest near the proposed dam site, and would diminish downstream from the proposed dam site. Impacts on habitat conditions, lateral habitat connectivity, river processes, and ice processes will be assessed through implementation of the FERC-approved Study Plan. The RSP as approved by FERC does not require project effects to be available at the current ISR stage.

Accretions in the OWFRM were calculated from daily streamflow records available from the USGS for the established period of record at multiple locations along the Susitna River (Curran 2012). These daily streamflow records are based on observed conditions and were used to back-calculate tributary inputs and accretions between measured gage data. This method preserves the observed conditions in the mainstem Susitna River and effectively calculates the observed conditions for the 61-year period of record. When the model is used in a predictive model (i.e., with project simulation), no changes are made to the tributary inflows or accretions. Instead, the only hydrology change is to the flow releases to the Susitna River from the dam. Therefore, the simulation effectively simulates historical conditions under Project operations. Overall, the OWFRM developed for the Susitna River meets the objectives outlined in the Study Plan Section 8.5 and will be an effective tool to evaluate existing and with Project conditions in the mainstem of the Susitna River. The Services' comments (USFWS_pp8.5-52_ph11, NMFS_pp8.5-50_ph06) support this conclusion.

2.5.1.3.2. Response to Comments Regarding Indicators of Hydrologic Alteration (IHA)

TNC (TNC_pp012_ph03, TNC_pp013_ph01, TNC_pp013_ph04 [Modification 4.3.3], and TNC_pp014_ph01 [Modification 4.3.4]) provided several comments related to IHA. These comments state that the IHA software was designed to analyze daily flows and is inappropriate because it is not capable of estimating impacts caused by sub-daily variation. Further, they state that an IHA-type analysis was not presented in the ISR and the underlying hydrologic data needed to do this type of analysis will not be available until the USR.

In response, AEA disagrees. As stated in RSP Section 8.5.4.4.1.3:

> *In addition to the analyses using daily flow records, modifications to the analysis package will be developed in collaboration with the TWG to utilize hourly data instead of daily data to evaluate flow components specific to the evaluation of hydropower load-following operations.*
>
> *AEA cited similar modifications to the IHA package developed to evaluate load-following operations on the glacially-fed Baker River (Hilgert et al. 2008). In the ISR (Study 8.5 ISR Part C, Executive Summary), AEA reiterated the need to analyze hydrologic effects on a time scale finer than daily and referenced "hourly" rather than "sub-daily". Potential hourly metrics were presented and discussed at the March 21, 2014 Technical Workgroup meeting and will continue to be refined and*

> *agreed upon in the last year of study. A schedule variance was described in the SIR (Study 8.5 SIR, Section 4.3.1.6) that states:*
>
> *The final metrics will be developed with input from the TWG and other resource disciplines after Version 3 of the OWFRM is available.*

Ultimately the IHA-type analyses will be used to evaluate and compare hydrologic conditions under existing conditions (i.e., without Project) and with Project operations. Delay in selecting the final IHA/EFC parameters will not affect the ability to meet study objectives. As stated in the RSP, the IHA/EFC programs will be used to evaluate Existing Conditions and alternative operational scenarios for the Susitna-Watana Hydroelectric Project. Given that additional work is proposed for the OWFRM during the last year of study, the metrics to evaluate Project impacts are not necessary until model results are complete.

2.5.1.3.3. Response to Comment Regarding Sub-Daily Metrics

TNC (TNC_pp013_ph01) states that the IHA software is not capable of estimating impacts caused by sub-daily variation and further that since AEA has not provided access to operational data TNC cannot evaluate to what extent IHA will be an appropriate analytical tool.

In response, AEA disagrees. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Preliminary results will include hourly flows at the proposed dam site (PRM 187.1). Further, AEA acknowledged the need to utilize metrics on more than a daily average basis in the ISR (Study 8.5 ISR Part C, Section 7, page 5-7):

> *AEA is also considering other hydrologic metrics that can be calculated on an hourly basis as a means to evaluate potential load-following that could occur under Project operations. Traditional IHA-EFC parameters are based on daily average flow values that would not be sensitive to hourly flow changes associated with load following. As a result, a set of metrics are being considered that can characterize both high and low flows, as well as the variability in flows on an hourly basis. This set of metrics has the additional benefit of simplifying the analysis to a readily understandable and meaningful number of parameters, reducing the complications that can arrive from attempting to consider all 67 traditional IHA-EFC parameters.*
>
> *AEA has identified the following candidate metrics (some of which could be computed on a daily basis from the IHA, or otherwise calculated outside of the IHA on an hourly basis) for assessing load-following impacts:*
>
> *Annual Low Flows*
>
> - *7-day minimum*
> - *Baseflow*
> - *Number of low pulses*

> • *Duration of low pulses*
>
> *Annual High Flows*
>
> • *Maximum 1-hour flow*
>
> • *Number of high pulses*
>
> • *Duration of high pulses*
>
> • *Number of freshets (where the average daily flow is greater than 1.5 times the average flow of the previous 3 days)*
>
> *Seasonal Flow Variability*
>
> • *Monthly flow medians*
>
> • *Monthly 2-day minimum*
>
> • *Monthly 2-day maximum*
>
> *These metrics were presented and discussed at the March 21, 2014 TWG meeting. (AEA 2014a). AEA will utilize the results from Version 3 of the Open-water Flow Routing Model (available in 2015) for the IHA analysis."*

See Section 2.5.1.3.2 (Indicators of Hydrologic Alteration) for additional information.

2.5.1.4. Objective 4

Objective 4: Develop site-specific Habitat Suitability Criteria (HSC) and Habitat Suitability Indices (HSI) for various species and life stages of fish for biologically relevant time periods selected in consultation with the TWG. Criteria will include observed physical phenomena that may be a factor in fish preference (e.g., depth, velocity, substrate, embeddedness, proximity to cover, groundwater influence, turbidity, etc.). If study efforts are unable to develop robust site-specific data, HSC/HSI will be developed using the best available information and selected in consultation with the TWG.

2.5.1.4.1. Response to Modification Requests Regarding Macrohabitat-specific HSC

The Services (USFWS Modification 1 [USFWS_pp8.5-03_ph03]; USFWS Modification 2 [USFWS_pp8.5-03_ph04]; USFWS Modification 6 [USFWS_pp8.5-04_ph03]; NMFS Modification 4-1 [NMFS_pp8.5-35_ph04]; NMFS Modification 4-2 [NMFS_pp8.5-34_ph07]; NMFS Modification 4-6 [NMFS_pp8.5-36_ph08]) provided many comments and multiple modification requests in regards to macrohabitat-specific HSC. In multiple study modification requests, the Services have requested that habitat criteria be surveyed to a hierarchical habitat model and that the HSC must be developed for individual macrohabitat types. They contend that the HSC study proposed the development of separate, habitat-specific, curves based on stream-specific data (i.e., geomorphic reach, mainstem macrohabitat type, clear vs. turbid water, and upwelling areas) with winter versus summer sampling efforts. They state that only when the habitat criteria are surveyed and analyzed in the context of the approved hierarchical habitat model will the study be able to address the approved Study Plan and consider the ecological relevance of the habitat criteria determined by FERC. They also contend that unless habitat criteria are examined according to a hierarchical habitat model, differences in utilization cannot be considered, habitat-specific criteria cannot be evaluated, and habitat-specific responses cannot be identified.

In response, AEA requests that FERC not adopt these proposed Study Plan modifications because the requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan. The request also mischaracterizes the methods presented in the FERC-approved Study Plan.

Section 4.5.1.1.3 of Study 8.5 states that the distribution and number of HSC study areas for the 2013 and 2014 data collection will be based on a stratified random sampling approach that is not only based on the hierarchical classification system, but several other attributes that include levels based on river segment, geomorphic reach, mainstem habitat composition, relative fish use, number of instream flow Focus Areas, mesohabitat composition, and site-specific attributes including the presence of groundwater upwelling, water clarity (turbid vs. clear water areas), and safety concerns. The study plan also indicates that a stratified random sampling scheme will be used to select study areas to cover the range of habitat types. The request and associated comments neglect these other considerations and are strictly focused on adherence to the hierarchical classification system.

Importantly, the Study Plan as approved by FERC does not require the development of habitat specific models. HSC sampling was conducted in accordance with the FERC-approved Study Plan, and data collection included measurements within habitat types as defined by the hierarchical classification system. Figures 5.2-1 through 5.2-10 in ISR SIR 8.5 Appendix D, depict locations of randomly selected study sites for HSC sampling in 2014. These figures clearly show sampling within a diversity of macrohabitat types as defined in the classification system. Tthese same sites include different mesohabitat types as defined in the classification system and HSC sampling included both measurements of turbidity and groundwater upwelling (via VHG measurements.

After reviewing all possibilities for formulating HSC for the Susitna River system, AEA chose not to create macrohabitat-specific HSC models. Macrohabitat-specific HSC models are not only unnecessary, they would also be untenable based primarily on the fact that macrohabitats change with flow conditions. Instead, differences in macrohabitats are defined by specific habitat conditions in relation to flow, and varying suitability in sample locations is accounted for with the random site effect used in the HSC modeling process. These points are discussed in detail below, beginning with the reference to this topic in the Study Plan approved by FERC. To clarify, the following is the statement in the FERC-approved Study Plan (RSP Section 8.5.4.5.1.1.7, page 8-56; emphasis added):

*For comparative purposes, HSC curves for each species and life stage will first be developed using pooled data from all sampling areas and time periods, and then (**depending on available data**) separate curves will be developed based on stream-specific data (i.e., geomorphic reach, mainstem* *habitat type, clear vs. turbid water, and upwelling areas) and winter vs. summertime sampling efforts. Thus, for certain species and life stages, four or five separate HSC curves* ***may*** *be generated.*

The section of the FERC-approved Study Plan referenced above identifies the possibility of separate models by habitat type, AEA clarified the current plans in the ISR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development*):

> *Macrohabitat type has not been included in HSC modeling for the ISR, although differences in habitat preference among macrohabitat types are possible. There are several reasons it has not been included. First, good model fitting would require similar levels of replication within each macrohabitat type. For example, although sampling was designed to capture a range of habitats, most spawning occurred in side channels and side sloughs, leading to large imbalance in sample size (i.e., for "1" spawning locations) among habitat types. Second, including macrohabitat as a fixed effect in suitability criteria would presume that fish preference for each macrohabitat would be static under all possible future flow conditions.*

After completing a detailed review of HSC models developed during the 1980s for the Susitna River (Vincent-Lang et al. 1984a, 1984b and Suchanek et al. 1984) and similar efforts throughout Alaska (Baldrige 1981, Lyons and Nadeau 1985, Estes and Kuntz 1986, and PLP 2011) it was clearly evident that none of the other studies developed macrohabitat specific models (Study 8.5 TM, March 25, 2013: *A Summary review of Susitna River aquatic and instream flow studies conducted in the 1980s with relevance to proposed Susitna – Watana Dam Project – 2012: A Compendium of Technical Memoranda*). An informal review of HSC model development efforts for large river systems in the Pacific Northwest, confirms the Alaska findings that HSC models are generally not developed for specific macro- or mesohabitat types.

HSC models represent an assumed functional relationship between one or more habitat variables and the suitability or preference of the variable to a particular species and life stage. AEA has proposed three crucial requirements to be met for habitat variables to be included in HSC development. The first is that there is a predictive and direct relationship between the habitat variable and fish presence; second, that changes to the habitat variable as a function of flow can be spatially and quantitatively predicted at the Focus Area scale; and third, that predicted changes in the variable are observable at a temporal scale (hours to days) similar to changes in flow conditions in response to Project operations. If any of these criteria cannot be met, then AEA recommends that the individual variable not be included as part of site-specific HSC curve development.

Macrohabitat-specific HSC models would not meet the requirements noted above. The point of the HSC modeling is to define habitat selection based on flow condition anywhere in the river. Flow in side sloughs that provide juvenile rearing habitat tend to have lower velocity than in side channels, but under high flow conditions when a slough might become a side channel under Project operations, the velocities would be higher. This change should be measured by velocity, rather than by the change in the category of the habitat unit. It may be valid to say that variables other than velocity (such as temperature or turbidity) impact the selection of habitat, but the assertion that one such variable is the *name of the habitat type* is not valid. The developed HSC models are based on conditions that describe the physical habitat conditions experienced by fish, which should be similar to the habitat conditions used to define macrohabitat types. In other words, the character of the macrohabitats change in response to flow so HSC must be applicable across a range of flows rather than specific macrohabitats - which is why HSC are not macrohabitat specific. Further, in practical terms, using macrohabitat-specific HSC models is likely to cause logistical issues and strange patterns in total weighted usable area estimates. For example, under different flows within the same habitat unit, a transition from side slough to side channel would require a shift in the HSC model used for the same habitat unit, even within a season under a single operational scenario. This could result in incoherent and dramatic shifts in habitat estimates merely due to a human-created definition of macrohabitat types.

2.5.1.4.2. Response to Modification Requests Regarding HSC Sampling Scale

The Services (USFWS_pp8.5-03_ph05 [Modification 3]; NMFS_pp8.5-36_ph02 [Modification 4-3]) requested that:

> *To identify which microhabitat criteria were ecologically relevant, the statistical distributions of utilized criteria must be compared to the statistical distribution of these criteria outside the local distributions of fish species' life stages.*

The general assertion is that microhabitats must be surveyed in locations (50-100 meter sample sites) occupied by fish and in locations unoccupied by fish (i.e., areas outside of the 50-100meter sample sites). The Services believe that HSC surveys conducted outside the localized distributions of fish (expanded scale) would improve the comparisons with occupied microhabitat. Additionally, they requested that habitat criteria be surveyed with respect to the distribution and periodicity of fish species' life stages present in the river (USFWS Modification 4 [USFWS_pp8.5-03_ph06] and NMFS Modification 4-4 [NMFS_pp8.5-36_ph04]).

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan.

With respect to NMFS Modification 4-4 and USFWS Modification 4, HSC sampling (habitat utilization and availability) was conducted as described in the FERC-approved Study Plan Section 8.5 and in consultation with the resource agencies (Table 2.5.1-2). Species' life stage periodicity developed during the 1980s studies were used extensively to determine sampling timing and ensure that the target species were present within the river system during HSC sampling. HSC sampling occurred during both the open-water and ice cover periods (Study 8.5 SIR, Table 5.2-1 and 5.2-3).

Further, NMFS Modification 4-3 and USFWS Modification 3 seem to be based on faulty information and apparent confusion regarding sampling scale. Surveys of available habitat were performed as described in the FERC-approved Study Plan Section 8.5 and included habitats immediately adjacent to occupied habitats, both laterally and longitudinally, within the same habitat units that were utilized. Identifying and sampling unoccupied habitats as requested by the

Services would first require that the site be sampled to determine if fish were present. If fish were present, then another site would need to be selected until an unoccupied site in an identical macrohabitat could be located. This type of sampling was not part of the FERC-approved Study Plan and the Services have not provided "good cause" to modify the Study Plan.

With respect to sampling, spatial scale is of course, continuous, but the response herein will focus on three scales within the Susitna River for example. The Focus Area could be thought of as one relatively large scale to discuss fish utilization. Some species' life stages may not have ever been observed in particular Focus Areas. For example, juvenile Chinook Salmon were not observed during HSC surveys in the Middle River above Devils Canyon. Including information in statistical models about, for example, depths available and unused in the Middle River above Devils Canyon would bias results, because surely the reason that juvenile Chinook Salmon are not using those habitats has nothing whatsoever to do with depth.

The next scale to consider is a 50- or 100-meter reach within a Focus Area. AEA has sampled multiple reaches within multiple habitat types in each Focus Area. At this scale, it is unclear whether completely unutilized sites for a particular species/life stage should be included in an analysis of the relationship between, for example, depth and utilization of habitat. The current analysis does not include these sites for several reasons. AEA believes that the presence or absence of fish in different areas of a macrohabitat type within a Focus Area is more likely to be based on random clustering of species over space or variables that are not being measured, such as proximity to tributaries or larger-scale upwelling. Exploratory analyses conducted by AEA indicate no obvious patterns in utilization with measured variables at this scale. Further, the large number of zeros in the statistical model causes issues with model fit.

Random locations were sampled for both utilization and availability on the river. Surveys of available habitat were performed in habitats immediately adjacent to occupied habitats, both laterally and longitudinally, within the same habitat units that were utilized.

Originally, 100-meter sampling sites were planned for all locations, but in consultation with the TWG, sampling sites in off-channel habitats were reduced to 50-meter sites so that more sites could be sampled (*Technical Team Meeting Notes: 2013 HSC Data Collection*, Study 8.5, May 17, 2013). The utilized sites with a species' life stage present are given a value of '1', and the systematic random availability locations within each site (regardless of any species presence) are given a value of "0". The logistic regression model models the probability of "1", using both the availability and the utilization data within each site. Within the modeling exercise for a particular species' life stage, 50 or 100 meter sites with no utilization were not included in the model.

Although site-specific observations were used to define habitat preference for all species and life stages with sufficient site-specific observations, limits or thresholds (HSI values) have been proposed for certain variables to help define the minimum and maximum range of habitat preference predictions within the HSC/HSI models. Threshold values proposed for use in the HSC/HSI models are based on either: minimum and maximum habitat use values observed in the HSC/HSI database, ranges of habitat use reported in literature, water quality standards set by the Alaska Department of Environmental Conservation (ADEC 2012), or limitations in sampling (Study 8.5 SIR, Table 5.5-1).

2.5.1.4.3. Response to Modification Request Regarding Vertical Hydraulic Gradient (VHG) and Spawning Site Selection

The Services provided many comments (USFWS_pp8.5-27_ph05; USFWS_pp8.5-28_ph03; USFWS_pp8.5-29_ph06; USFWS_pp8.5-29_ph08; USFWS_pp8.5-31_ph06; NMFS_pp8.5-25_ph06; NMFS_pp8.5-27_ph02; NMFS_pp8.5-27_ph03; NMFS_pp8.5-28_ph08) and a modification request in regards to VHG and spawning site selection. The Services (USFWS_pp8.5-04_ph02 [Modification 5]; NMFS_pp8.5-36_ph06 [Modification 4-5]) recommend that the HSC study experimental design compare the dependence of fish habitat selection on VHG. Although the Services admit that availability of upwelling and downwelling (VHG) was measured as part of the HSC surveys, they contend that VHG measurements were not made locally in association with habitat utilization (spawning or rearing) and that utilized and available habitats were located in the same longitudinal positions and therefore could not be used to characterize habitat selection. They also state that VHG measurements were not conducted using a hierarchical sampling approach and were limited to shoreline areas. As such, they assume there is no way to assess the influence of VHG, with respect to habitat utilization. They also question the results of the VHG measurements and suggest that surveyed locations were not representative of utilized habitats, particularly for spawning salmon. The Services request that groundwater downwelling be included in the assessment of microhabitat variables for HSC development. They express the importance of including downwelling in the analysis given the importance of groundwater exchange to salmon and the avoidance of neutral gradients by spawning salmon.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

Over the past 25 years, numerous authors have identified groundwater upwelling as an important and often essential variable in salmonid spawning sites selection and the survival of salmonid embryos and alevins during the incubation period (Bjornn and Reiser 1991; Peterson and Quinn 1996; Geist et al. 2002; Maclean 2003; Burrill et al. 2010; McRae et al. 2012). During the 1980s study of the Susitna River, Vining et al. (1985) suggested that groundwater upwelling was the single most important feature in maintaining the integrity of Chum and Sockeye Salmon spawning/incubation sites. Knowing this, special attention was given to identifying the presence of groundwater (upwelling and downwelling) in association with Susitna River spawning activity and HSC model development.

The Services appear to be criticizing the HSC study design as provided in the FERC-approved Study, rather than AEA’s implementation of the Plan, and requesting that VHG sampling be conducted within and outside of individual sampling locations. AEA disagrees with this recommendation as the Services have not demonstrated good cause to modify the FERC-approved Study, which was implemented by AEA. For the 2013-2014 HSC/HSI sampling, a stratified random sampling approach based on macrohabitat composition within each Focus Area and relative fish use (Study 8.5 ISR Part A, Section 4.2) was used for selecting sampling locations, with some adjustments made to final locations based on access and safety considerations. This approach enabled representative sampling of the range of macrohabitat types available within Focus Areas. The stratified random selection of sampling sites was imposed to ensure that diverse habitats were sampled. As described in the SIR (Study 8.5 SIR, Section 4.2.1), HSC *spawning* surveys included *both* randomly selected and historical spawning locations to ensure that spawning would be observed and areas with no spawning activity were also sampled.

At the recommendation of FERC (April 1, 2013 Study Plan Determination page B-86), a micro-piezometer was used to detect the presence of groundwater upwelling and downwelling within individual HSC sampling sites, including utilization and availability sites. Use of the micro-piezometer was found to be effective in detecting groundwater upwelling and downwelling within HSC sampling sites, and samples were taken both laterally and longitudinally within each site. The HSC sampling design, site locations, and sampling methods were presented in the ISR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development*), the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*) and during numerous Technical Workgroup meetings (Table 2.5.1-2).

During the 2013 HSC sampling, VHG measurements were recorded at a minimum of three locations (downstream most, center, and upstream most end) within the length (50-100 meters) of each sampling site following procedures described by the USGS 2000 Fact Sheet. Additional measurements were collected near clusters of spawning redds/nest if large differences were noted between any of the three measurements within the sampling site. In 2014, the number of VHG measurements within a sampling site was expanded to 5-10 measurements longitudinally along the length of the site (50-100 meters) and laterally within the site at all active fish spawning locations (HSC/HSI Fish Utilization and Availability Data 2013-2014, http://gis.suhydro.org/SIR/08-Instream_Flow/8.5-Fish_and_Aquatics_Instream_Flow/SIR_8_5_Appendix_D_Habitat_Suitability_Criteria/SIR_8_5_IFS_HSC_Database2013-2014_20151030.xlsx). During the 2013-2014 Susitna River HSC sampling, over 650 VHG measurements were collected during spawning surveys with more than half of all measurements made in randomly selected sites. Both upwelling and downwelling were included in the sampling, and the selected sites are representative of utilized habitats.

In an attempt to develop a robust relationship between upwelling and spawning, VHG sampling was scaled to the 50-100 meter sample site level. Most sample sites were categorized entirely as upwelling or downwelling sites, but 4 were split into partial upwelling and partial downwelling sites. When this factor is evaluated alone, there is a preference for upwelling, with 52 percent of upwelling sites utilized by spawning Chum Salmon as opposed to only 28 percent of the downwelling sites. Thus, the data at this scale conform to the notion that upwelling is correlated with spawning. However, they do not conform to the notion that upwelling is essential (at this temporal and spatial scale) for site selection.

The HSC models for this study are multivariate statistical models. When evaluating the predictive strength of multiple variables, the categorical substrate variable is a much stronger predictor of site selection/preference than upwelling for Chum Salmon spawning. When two or more categorical variables are included in a model, especially ones that are potentially correlated and interacting, replication is needed in each combination of the two factors to test the predictive value. With the current data set, not enough of the spawning sites were found to be downwelling to keep both of these factors (upwelling and substrate) in the model separately. After combining them into one factor with downwelling as one category and upwelling with different substrate combinations as the other, the results indicate that the model with substrate alone is still a better predictor of habitat use/preference by spawning Chum Salmon.

Although the spawning HSC models presented in the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*) do not include upwelling/downwelling as a predictor of habitat preference, AEA will continue to evaluate the influence of groundwater upwelling/downwelling in habitat selection by spawning Chum, Sockeye, and Pink salmon. Particular emphasis will be placed on coordination with Groundwater Study 7.5 to determine if groundwater mapping efforts can be used to shed additional light on the relationship between groundwater and spawning site selection.

2.5.1.4.4. Response to Modification Requests Regarding Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables

The Services (USFWS_pp8.5-36_ph07; USFWS_pp8.5-23_ph03; USFWS_pp8.5-24_ph02; USFWS_pp8.5-34_ph05; NMFS_pp8.5-23_ph03; NMFS_pp8.5-23_ph05; NMFS_pp8.5-31_ph05) provided many comments and several modification requests in regards to evaluation of relationships between fish abundance and specific microhabitat variables. The Services (USFWS_pp8.5-04_ph04 [Modification 7]; USFWS_pp8.5-36_ph11 [Modification]; NMFS_pp8.5-37_ph01 [Modification 4-7]; NMFS_pp8.5-37_ph05 [Modification 4-8]) recommend that AEA evaluate microhabitat criteria by comparison and examination of relationships between abundance and microhabitat criteria. They go on to say that the study must use statistical methods to identify which criteria are ecologically relevant to fish habitat selection and develop HSC models for the relevant criteria. The Services assert that the use of exploratory univariate HSC analysis is not appropriate for this type of evaluation and, although no other methods are recommended, they feel that other methods would be more appropriate for this type of analysis. They contend that due to study variances, limitation, and a perceived failure to address post-Project conditions that the current effort has not met the objectives of the Study Plan.

TNC states that variances in experimental design and data collection methods will preclude determining whether a relationship between a specific microhabitat variable and fish abundance is evident, as FERC recommended in the SPD (Study 8.5 SPD, April 1, 2013), and recommends that the USR include documentation of the impact of this variance on the study objectives (TNC_pp018_ph06 [Modification 4.6.4]).

In response, AEA requests that FERC not adopt these proposed Study Plan modifications because the requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

To clarify, the FERC Study Plan Determination (Study 8.5 SPD, April 1, 2013) regarding microhabitat criteria for HSC reads as follows (page B-86, emphasis added):

> *We recommend that AEA file with the Initial Study Report, a detailed evaluation of the comparison of fish abundance measures (e.g., number of individuals by species and age class) with specific microhabitat variable measurements **where sampling overlaps**, to determine whether a relationship between a specific microhabitat variable and fish abundance **is evident**. We expect the majority of locations where fish sampling and the eight additional microhabitat variable sampling efforts would overlap at a scale where they could be related would occur in focus areas where these sampling efforts are concentrated. **If results from these initial comparisons indicate strong relationships may exist between a specific microhabitat parameter and fish abundance for a target species and life stage, expanded sampling may be necessary** in 2014 to investigate these microhabitat relationships further. Accordingly, we recommend that AEA include in the evaluation to be filed with the Initial Study Report, any proposals to develop HSC curves for any of the 8 additional parameters as part of the 2014 study season.*

AEA produced the *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables Technical Memorandum* (Study 8.5 TM, September 17, 2014) in response to this FERC recommendation. The Services' contention that statistical methods were not used to identify relevant criteria is not accurate, and their comment reveals a fundamental misunderstanding of the methods employed. As described in the ISR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Criteria Development*) and the SIR (Study 8.5 SIR, Appendix D: *Habitat Suitability Criteria Development*), the point of these analyses was to determine whether fish preference for habitats can be predicted using these microhabitat variables. The univariate HSC analysis compared the null model predicting fish preference (the model with no predictors) to several models (e.g., linear, quadratic) containing each respective predictor using Akaike Information Criteria (AIC). These models are not utilization models; they are preference models with binary response = 1 for locations utilized by fish and 0 for availability locations. Any strong underlying relationship between that specific parameter and fish habitat preference would result in an improvement in likelihood for models including the predictor. The Services' contention that this method is invalid is not supported by any citations or evidence. Exploratory comparison of habitat distributions for utilized and available habitat would provide a much cruder analysis that would result in fewer, not more, "significant" parameters.

The analysis to date shows which habitat variables show predictive value and should be included in the HSC model as continuous predictors. Ecologically relevant habitat variables such as water depth, velocity, temperature, dissolved oxygen, pH, and distance to water's edge will be included as HSI variables, meaning that habitats that fall outside of an ecologically relevant threshold (minimum or maximum) will be assumed to be completely unusable, regardless of whether they are also included as a variable that determines the relative value within the HSC models.

For each of the HSC variables, analyses were conducted using logistic regressions with random effects for sites, which allow the overall probability of fish presence to vary by site after accounting for measured habitat variables. Using availability and utilization data, the HSC regressions predict the probability of fish presence as a function of a set of habitat variables, which include two of the additional variables (surface water dissolved oxygen and temperature) requested by FERC. These models were compared based on weight of evidence using Akaike's Information Criteria (AIC).

A description of these analyses and preliminary results are described in the ISR (Study 8.5 ISR Part C, Appendix M: *Habitat Suitability Curve Development*).

Of the eight variables requested by FERC for further investigation, three (VHG as a surrogate for surface and groundwater exchange flux, surface water dissolved oxygen, and temperature) will continue to be collected in ongoing HSC sampling events, and analyzed as part of the HSC suitability curve development process in the USR. Intergravel dissolved oxygen and temperature will also continue to be collected, but this data will be used to develop threshold (highs and lows) that can be applied as part of the effective spawning habitat analysis. Although not specifically requested by FERC, specific conductance will continue to be collected and included as part HSC curve development. For four of the remaining five variables (pH, dissolved organic carbon, alkalinity, and chlorophyll-a), statistical analysis has been completed to estimate the probability that these variables are "strong" predictors of habitat use by the target species and life stages. The remaining variable, macronutrients, had no data from 2013 that could be used to compare to fish abundance measures.

AEA recommends that a pH range of 6.5-9 is used as a threshold by which to evaluate the loss or gain in habitat area. Due to limitation in the water quality analysis, no analysis of potential relationships between macronutrients and fish abundance measures could be completed as part of this effort (Study 8.5 TM, September 17, 2014: *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables*). There is no evidence that dissolved organic carbon can be used as a predictor of fish abundance or habitat use in the Susitna River. As such, AEA recommends dissolved organic carbon not be added as a variable to predict fish habitat use as part of the HSC curve development process. Since alkalinity levels are not being collected or modeled on a Focus Area scale and the generally weak relationship between alkalinity and fish abundance, AEA recommends alkalinity not be added as a variable to predict fish habitat use as part of the HSC curve development process. Since both macroinvertebrates and algae are direct food sources for several of the target fish species and life stages, it is AEA's recommendation to use the HSC curves developed from the River Productivity Study 9.8 for benthic macroinvertebrates and algae. To reduce duplication of effort, it is AEA's recommendation to not add chlorophyll-*a* in development of HSC curves for the IFS Study (Study 8.5 TM, September 17, 2014: *Evaluation of Relationships between Fish Abundance and Specific Microhabitat Variables*).

2.5.1.4.5. Response to Recommendation Regarding HSC Modeling

USFWS (USFWS_pp8.5-62_ph04) requested notational changes to the HSC model equations to better define the probability function. They assert that AEA has provided insufficient documentation to define dependent variables within the model and that the current model description does not meet current scientific reporting standards.

In response, while not proposed as a modification to the Study Plan, AEA disagrees with this recommendation and requests that FERC not adopt this recommendation as it does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. The Study Plan as approved by FERC does not require this information to be available at the current ISR stage. Rather, the FERC-approved Study Plan requires this information to be developed as part of the USR. The equation that continues to be inexplicable to USFWS has been approved by ADF&G biometricians, has been presented at the International Statistical Ecology Conference in Seattle

(June 2016), and has been discussed with numerous well-known statisticians. An initial attempt to respond to USFWS was provided in writing to the points raised in the letter (Study 8.5, *Initial Study Report Meetings, March 24, 2016 Action Items: Response to Licensing Participant Comments*, filed with FERC April 29, 2016). Below is another attempt to clarify.

When one has collected data that consist of 0/1 results, it is common in many fields of study including fisheries to model these data by way of a logistic transformation. The data themselves (the 0/1 observations) are assumed to come from a Bernoulli distribution with a single population parameter that expresses the probability that a "1" will be observed. This parameter is denoted by "p" in the equation below and is explained as "the probability of Chinook Salmon fry presence." Because conventional linear regression assumes normal distribution for model residuals, these types of data are very commonly transformed using the logit function, which can be more reasonably assumed to be normally distributed. Thus, rather than predicting a 0 or 1 at any given point, the linear regression model predicts a logit transformation of the "p", the probability of a 0 or 1 at any given location within a 50-100 meter site. In statistical software packages such as R, the 0/1 data comprise the response variable, and the user specifies the logistic regression. The regression is then fit by the software using iterative reweighted least squares, maximum likelihood, or restricted maximum likelihood, or other methods. The assertion that regression analysis "usually involves some kind of function of observed data (not a parameter) on the left side of the equation" indicates lack of familiarity with logistic regression. Here is the definition of logistic regression from Wikipedia (https://en.wikipedia.org/wiki/Logistic_regression, accessed: July 25, 2016), for example:

> *In statistics, logistic regression, or logit regression, or logit model[1] is a regression model where the dependent variable (DV) is categorical.*
>
> *Logistic regression was developed by statistician David Cox in 1958.[2][3] The binary logistic model is used to estimate the probability of a binary response based on one or more predictor (or independent) variables (features).*
>
> *Logistic regression can be seen as a special case of the generalized linear model and thus analogous to linear regression. The model of logistic regression, however, is based on quite different assumptions (about the relationship between dependent and independent variables) from those of linear regression. In particular, the key differences of these two models can be seen in the following two features of logistic regression. First, the conditional distribution $y|x$ is a Bernoulli distribution rather than a Gaussian distribution, because the dependent variable is binary. Second, the predicted values are probabilities and are therefore restricted to (0,1) through the logistic distribution function because logistic regression predicts the probability of particular outcomes.*

HSC sampling has measured habitat variables such as depth at locations occupied by fish within selected sites in the river. These locations have dependent data values of "1", with the associated depth measurement. The entire 50 or 100 meter site is then sampled using systematic random sampling to document the available habitat within the site. These systematic randomly sampled sites have dependent data values of "0" with associated depth measurements. These are the data used to fit the logistic regression in R statistical software. The "0" measurements in this case are not true "absence" locations, because fish could very well have used or even be using the availability site. However, this presence/availability type of logistic regression is used fairly commonly in studies of resource selection when absence measurements are hard to attain (Johnson et al. 2006; Manly et al. 1993). The result is then not exactly a probability of fish presence, but perhaps better thought of as the probability above random chance. In any case, it is a ranking of habitat preference.

Because the data have been provided and the methodology described, another researcher familiar with logistic regression and mixed effects models should be able to repeat the study. However, to make this process even more transparent, AEA is providing the R-script that can exactly replicate the results when beginning with the data provided on the public website:

R-script: http://gis.suhydro.org/SIR/08-Instream_Flow/8.5-Fish_and_Aquatics_Instream_Flow/March2016_ISRD_MeetingResponse/

Data: http://gis.suhydro.org/SIR/08-Instream_Flow/8.5-Fish_and_Aquatics_Instream_Flow/SIR_8_5_Appendix_D_Habitat_Suitability_Criteria/

2.5.1.5. Objective 5

Objective 5: Develop integrated aquatic habitat models that produce a time series of data for a variety of biological metrics under existing conditions and alternative operational scenarios.

2.5.1.5.1. Response to Modification Request Regarding Increased Subsurface Water Temperature and DO Sampling

The Services (USFWS_pp8.5-52_ph06 [Modification]; NMFS_pp8.5-47_ph02 [Modification 5-1]) requested increased sampling effort of subsurface (intergravel) water temperature and dissolved oxygen measurements at each Focus Area to address Chum Salmon incubation. Subsurface water temperature and dissolved oxygen data should be integrated with the 3-D groundwater models to develop HSC curves and WUA analyses. Salmon egg development is dependent on a continuous sufficient supply of water with sufficient dissolved oxygen passing through the spawning gravels. The rate of development is dependent on water temperature. To assess dam effects, the Services stated they need to know the conditions that currently exist where Chum Salmon spawn. These two variables are essential to the predictive modeling necessary for Project effects analysis of aquatic resources.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

In all Focus Areas associated with spawning habitat and potential groundwater influence, AEA has collected an extensive and spatially expansive set of water temperature data that includes both surface and subsurface (intergravel)/groundwater temperature (Study 7.5 ISR Part A, Tables 4.5-1 through 4.5-4; Study 5.6 SIR, Section 5.2; Study 8.5 SIR, Appendix A: *2014 Instream Flow*

Winter Studies). In addition, surface dissolved oxygen measurements have been collected as part of the IFS HSC, and at several spawning locations (as specified in the FERC Study 8.5 SPD, April 1, 2013) intergravel dissolved oxygen has been continuously monitored. Those data sets are being reviewed and where applicable will be integrated into the groundwater analysis. AEA is aware of the importance of water temperature on the development and survival of salmonid embryos and is in the process of developing analytical approaches for directly considering potential Project induced changes to intergravel temperature on embryo development and survival, and fry survival and emergence timing. For example, in FA-128 (Slough 8A), the groundwater modeling is developing methods for simulating groundwater heat transport that will include the use of the mass transport code MT3DMS (Zheng and Wang 1999). The objective of this analysis is to link the groundwater temperature information with the habitat models so that Project related effects on egg incubation (survival and duration of incubation period) and fry emergence (timing) can be evaluated (see Groundwater Study 7.5 response to USFWS_pp7.5-14_ph04 and NMFS_pp7.5-14_ph06). For this, several Temperature Unit models will be used including the analysis completed by Wangaard and Burger (1983) that was specific to Chum and Sockeye Salmon of the Susitna River. Analytical methods for evaluating these effects at other Focus Areas will be developed based on temperature and dissolved oxygen data collected in each Focus Area and associated groundwater/surface water relationships.

Water temperature is one of the major components that has been monitored throughout the river (Study 5.6 SIR, Figure 3-1) and is explicitly incorporated into the EFDC water quality model that will be used in evaluating potential effects of Project operations at different locations downstream from the dam. Water temperature and dissolved oxygen data have also been collected at multiple locations within the Focus Areas including and in particular, areas of known spawning activity. For example, during the winter studies of 2013/2014, water temperatures were continuously monitored at 26 locations that included FA-104 (Whiskers Slough), FA-128 (Slough 8A), and FA-138 (Gold Creek) (Table 1 in Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*). Two continuous recording dissolved oxygen meters collected intergravel dissolved oxygen data at FA-128 and FA-138. Further, as noted in the SIR (Study 8.5 SIR, Section 4.5.7) a total of 18 water level loggers and 53 water quality instruments (consisting of 51 surface and intergravel temperature loggers and 2 combined intergravel temperature and dissolved oxygen loggers) were redeployed at select sites to collect additional data through the winter 2015/2016 in the Susitna River main channel and in salmon spawning habitats of FA-104 (Whiskers Slough), FA-128 (Slough 8A), FA-138 (Gold Creek), FA-141 (Indian River), and FA-144 (Slough 21). The areas selected for 2015/2016 water quality monitoring included prominent spawning habitats and areas in which limited data have been collected. AEA does not consider the extent to which temperature and dissolved oxygen data have been collected as "occasional" sampling.

Concerning the final comment, the HSC data collection was conducted in accordance with the FERC-approved Study Plan (RSP Section 8.5.4.5), and in addition and relative to water temperature and dissolved oxygen, the FERC Study Plan Determination (April 1, 2013) that specified AEA monitor temperature, dissolved oxygen, and water level data at one or more select Chinook, Pink and Coho spawning locations with the Middle River Focus Areas. As noted above, AEA has periodically monitored water temperature and dissolved oxygen data in five of the Focus Areas that have been shown to be used for spawning by Chum, Sockeye, Coho, and Pink Salmon. No Chinook Salmon have been observed using lateral habitats for spawning (Study 8.5 SIR,

Appendix E: *Fish Habitat Modeling Data: Surficial Substrate and Cover Characterization and Salmon Spawning Observations by Focus Area*).

2.5.1.5.2. Response to Recommendation and Modification Request Regarding Breaching Flow Analyses

The Services (USFWS_pp8.5-51_ph07 [Recommendation]; NMFS_pp8.5-47_ph10 [Modification 5-3]) request that breaching flows and habitat connectivity analysis be conducted on biologically relevant timelines; such as the five and ten-year time frames, which is the average generational lifespan of a Susitna River Chinook Salmon. Alterations to channel geometry conditions should address breaching flows of both main channel and lateral habitats because these habitats support critical life stages including spawning, incubation, rearing and migration.

In response, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

AEA agrees that determining the relationship between mainstem river flow and overtopping or breaching of sensitive off-channel habitats features is necessary to evaluate potential effects of Project operations (RSP Section 8.5.4.6.1.1.5). Breaching of off-channel habitats due to alteration of flow regime and possibly channel aggradation or degradation is an example of a multiple resource issue that will be addressed through an integrated riverine process analysis. Changes in sediment transport and associated changes in the morphology of off-channel habitats will be addressed through Fluvial Geomorphology Modeling below Watana Dam (RSP Section 6.6.4.1.2.1); and the effects of Project operations on aquatic habitat conditions will be evaluated through the IFS (RSP Section 8.5.4.6.1.1.5). One of the steps to complete Fluvial Geomorphology Modeling Study 6.6 and IFS Study 8.5 includes measuring inlet elevations at major Middle River side channels and sloughs to calculate breaching flows that affect habitat connectivity. Breaching flows will be analyzed within Middle River Focus Areas and at major side channels and sloughs outside of the Focus Areas to evaluate the representativeness of Focus Area data. The IFS breaching flow analysis will also be complementary to the Fish Passage Barriers Study 9.12 that is designed to evaluate existing and future potential barriers to fish movement. The breaching flow analyses will be conducted using hourly time steps for representative years. In addition, a multi-year, continuous flow record will be evaluated to identify year-to-year variations independent of average, wet or dry conditions (RSP Section 8.5.4.4.1.2). As described in the FERC-approved Study Plan (RSP Section 8.5.4.4.1.2): *“The specific representative years and duration of the continuous flow record will be selected by AEA in consultation with the TWG”*. Whether a 5-year or 10-year time frame is appropriate, and which specific years should be modeled, should be the results of consultation with all TWG participants.

The results of the 1-D Bed Evolution Model, conducted under Fluvial Geomorphology Modeling Study 6.6 (Study 6.6 SIR, Attachment A: *1-D Bed Evolution Model of the Middle and Lower Susitna River*) indicated that the Lower River tends to be aggradational for both existing and Max Load Following OS-1b conditions, but slightly less so under the Project condition. In the Lower River, reach-average bed elevation change over 50-years ranged from 0.65 to 3.5 feet for existing conditions and from 0.43 to 3.2 feet for Max Load Following OS-1b conditions. This information, combined with the prediction of 10 percent or less adjustment of the channel width under the with-Project condition resulted in a conclusion that the basic channel form and character of the Susitna River will remain the same, but with slightly narrower channels. As described in IFS Study 8.5 *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies* (Study 8.5 TM, March 1, 2013), aquatic habitat sites in the Lower River were selected to describe the mix of channels, alluvial island complexes, and sloughs in the Lower River. The area around Trapper Creek near PRM 94.5, and the area around Caswell Creek near PRM 67, were selected as representative habitat types. Aquatic habitat in the Lower River Segment will be modeled using a 1-D approach involving transects which will provide information on water depths and velocities in select Lower River side channels and sloughs under Existing Conditions and alternate Project operations.

2.5.1.5.3. Response to Modification Request and Comment Regarding Modeling Warmer Winter Aquatic Habitats and Middle River Focus Areas Above Devils Canyon

NMFS (NMFS_pp8.5-48_ph05 [Modification 5-4]; NMFS_pp8.5-48_ph07) recommends that AEA describe and then predict the extent of warmer winter aquatic habitats that have not previously been observed on the Susitna. NMFS stated that some areas immediately below the dam will not ever freeze or only during very brief extreme cold snaps due to the five-fold increase in 4^{0}C, highly oxygenated water exiting the dam.

NMFS stated that the information presented to date does not acknowledge the two Focus Areas between Devils Canyon and the dam site are likely to create novel and unique environments which will attract a slightly different mix of species. NMFS stated that the study was not conducted as provided for in the approved Study Plan as very little data has been collected at the Stephens Complex and Watana FAs and no effort has been made to quantify the potential magnitude of change immediately below the dam.

In response, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the Study Plan and schedule and the data collected, including an explanation of any variance from the Study Plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed and therefore the results of the Ice Processes modeling (Study 7.6) are not available. Those results will be provided in the USR.

More broadly and consistent with the FERC-approved Study Plan (RSP Section 7.6.3.1), the potential effect of various Project operational scenarios, including the extent of warmer winter aquatic habitats downstream of the proposed Watana Dam site (PRM 187.1) will be analyzed using modeling and analytical methods pertaining to several studies. One-dimensional modeling (River1D) will be used to determine the extent of the open water reach between the proposed dam site and the Three Rivers Confluence near Talkeetna (from PRM 187.1 to PRM 100) and determine the changes in timing and ice-cover progression and ice thickness and extent. Detailed 2-D modeling (River2D) (RSP Section 7.6.3.3) will be conducted in Middle River Focus Areas, including two Focus Areas (FA-184; Watana Dam and FA-173; Stephan Lake) located between the proposed Dam Site (PRM 187.1)(FA-184; Watana Dam) and Devils Canyon (PRM 169.6). As described in the ISR (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study), measurement of the two remaining Focus Areas in the Middle River above Devils Canyon (FA-173 [Stephan Lake Complex] and FA-184 [Watana Dam] will be completed along with additional HSC measurements above Devils Canyon. The integration of Ice (Study 7.6), Water Quality (Study 5.6), Fluvial Geomorphology (Study 6.6) and IFS (Study 8.5) will support the evaluation of Project effects on riverine processes and fish habitats.

2.5.1.5.4. Response to Recommendationand Modification Request, and Comment Regarding Stranding and Trapping

The Services and SRC et al. (USFWS_pp8.5-36_ph08 [Recommendation]; NMFS_pp8.5-49_ph05 [Modification 5-6]; SRC_etal_WATER_ppAtt-34_ph05) request that AEA thoroughly address the ability to model stranding and trapping under the rapid and perpetual flow fluctuations in side channels and side sloughs during proposed winter flows. The Study Plan indicates that: *"Field surveys will be conducted at potential stranding and trapping areas on an opportunistic basis following up to three flow reduction events during 2013."* Opportunistic observations of potential stranding and trapping areas were recorded during substrate classification surveys conducted during falling river stage conditions in September 2013. There needs to be more focus on this important process. While the observations may need to be opportunistic the overall study of stranding and trapping needs more definition.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services and SRC et al. have not established "good cause" as required by the ILP regulations, nor have the Services and SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

As described in Study Plan Section 8.5 (RSP Section 8.5.4.6.1.6.1), stranding and trapping involves the evaluation of the effects of water surface elevation fluctuations in the varial zone. Stranding and trapping indices utilize results of the mainstem flow routing models to determine the water surface elevations on an hourly basis within Focus Areas. Stage fluctuations are applied within Focus Areas using the digital terrain models to quantify the frequency, timing, and magnitude of stranding events under Existing Conditions and alternate operational scenarios. The results of the mainstem flow routing models and the digital terrain models are also combined to quantify the frequency, timing, and duration of trapping events for discrete channel features within Focus Areas. The stranding and trapping analyses track the period of dewatering (stranding) or the period of disconnection (trapping) to calculate evaluation indices.

During the winter period, wetting and drying will be modeled using River1D modeling to predict mainstem flow and stage, and River2D modeling to predict ice cover and hydraulic conditions within Focus Areas (RSP Section 7.6.4.8). See *River2D Open-Water Modeling Report Focus Area 128 (Slough 8A)* (Study 7.6 SIR, Appendix C, Section 3.4: Wetting and Drying) for additional information on the use of River2D modeling to calculate hydraulic conditions that will feed into the analysis of stranding and trapping.

As described in the ISR (Study 8.5 ISR Part D, Section 6.2), during a May 17, 2013 Technical Team meeting, participants indicated that site-specific stranding and trapping studies should be a low priority. Because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. As documented during the May 17, 2013 TWG meeting, ramping criteria developed in Washington State (Hunter 1992) will be proposed as fallback criteria during Project effects analyses.

2.5.1.5.5. Response to Modification Request Regarding Aggregating Sub-Daily Peaking Operations, and Justifying Use of Transect-based (1-D) PHABSIM in the Lower River

TNC (Modification 4.6.3 [TNC_pp018_ph05]; TNC_pp019_ph02) requested that AEA not calculate Weighted Usable Area (WUA) time series for a sub-daily peaking operation because it aggregates the average availability of habitat during a day (Stalnaker 1992). They recommend a modification to the proposed metric in order to account for sub-daily variability in flows and associated habitat so the WUA be based on the persistent weighted usable area – or the weighted usable area that persists between minimum flow releases and generation flow releases. TNC stated that the use of a habitat time series should not be disaggregated from the sub-daily availability of habitat, or habitat bottlenecks, specifically for sensitive life stages or life stages with low mobility. They also recommend that the validity and methods for developing curves for the Lower River using single-transect PHABSIM modeling as described in the ISR be clarified and justified.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, TNC has not established "good cause" as required by the ILP regulations, nor has TNC demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

As described in the Study Plan (RSP Section 8.5.4.7.1.1), habitat modeling will be developed using hourly time steps. AEA agrees aggregating the average availability of habitat during a day can mischaracterize the effects of Project operations on aquatic resources, and notes that the effective-habitat time series (RSP Section 8.5.4.6.1.5) is developed using an hourly time step without aggradation on a daily basis. Developed specifically to evaluate the effects of potential load-following operations, effective-habitat time series are used to calculate the minimum habitat condition that persists for the duration of the incubation and emergence life stage on an hourly time step. Calculation of hourly minimum and maximum Weighted Usable Area values within each 24-hour period can be one of the evaluation metrics. As described in the FERC-approved Study Plan (RSP Section 8.5.4.7.1.1), the selection of final habitat metrics and appropriate time steps will be developed in consultation with the Technical Workgroup.

Regarding the use of 1-D PHABSIM modeling in the Lower River, FERC approved these methods when approving the Instream Flow Study Plan for the Lower River (Study 8.5 TM, March 1, 2013: *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014*, Section 4.2.1). These methods are generally accepted in the scientific community and are sufficient for FERC to evaluate Project effects and identify potential protection, mitigation and enhancement measures (Hilgert et al. 2008).

2.5.1.6. Objective 6

Objective 6: Evaluate existing conditions and alternative operational scenarios using a hydrologic database that includes specific years or portions of annual hydrographs for wet, average, and dry hydrologic conditions and warm and cold Pacific Decadal Oscillation (PDO) phases.

2.5.1.6.1. Response to Modification Request for Run-of-River Scenario

NMFS (NMFS_pp8.5-18_ph01 [Modification 3-2]; NMFS_pp8.5-51_ph04) recommends that other operating scenarios, including Run-of-River, be evaluated. USFWS (USFWS_pp8.5-18_ph02; USFWS_pp8.5-54_ph04 [Recommendation]) recommends evaluating the Run-of-River scenario.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was not implemented as provided by the approved Study Plan.

AEA will provide the evaluation of alternate operational scenarios as part of the USR and License Application using tools and procedures developed as described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1). AEA has already developed the maximum load following scenario and an intermediate load following scenario. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). Following the USR, AEA will collaborate with licensing participants to develop and evaluate alternate scenarios that affect multiple interests. The results of Existing Conditions and a Run-of-River operational scenario will be evaluated to identify sideboards in the range of potential Project effects. The results of those evaluations, along with an operational scenario preferred by AEA will be presented in the Draft License Application. The Final License Application will contain the results of Existing Conditions and Run-of-River scenarios and an AEA proposed operational scenario or Settlement Scenario depending on results of pre-filing discussions.

It is premature to select additional operational scenarios at this time. Importantly, this modification is not needed because the necessary data to model additional scenarios is already being collected as part of the FERC-approved Study Plan.

2.5.1.6.2. Response to Recommendation Regarding Habitat Classifications under Alternate Scenarios

USFWS (USFWS_pp8.5-54_ph04 [Recommendation]) recommends evaluating changes to habitat classifications under differing Project operational scenarios.

While not requested as a modification to the Study Plan, AEA requests that FERC not adopt this recommendation as a Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

As described in the FERC-approved Instream Flow Study Plan, the evaluation of Project effects on fish and other aquatic resources incorporates modeling of Weighted Usable Area habitat metrics at ten Middle River Focus Areas (RSP Section 8.5.4.6.1.4). Under Study 8.5, predictions of physical and hydraulic conditions are combined with habitat suitability criteria to develop weighted usable area values for Existing Conditions and alternative operational scenarios. Spatial extrapolation of weighted usable area values can be based on geomorphic reach, linear distance of focus areas, or by macrohabitat type (RSP Section 8.5.4.7.1.2). While macrohabitat characterizations are influenced by changes in flow, habitat typing procedures were implemented to minimize the effects of flow fluctuations on habitat characterizations. Under Study 9.9, the characterization of macrohabitat types included criteria based on the proportion of main channel flow (RSP Section 9.9, Table 9.9-4). Habitat typing was conducted at reference flows that encompassed the majority of post-Project operational flows while being observable under pre-Project conditions. Selecting a reference flow that represented both baseline and post-Project flows minimized the influence of main channel flow changes on habitat characterizations. In view of the FERC-approved Study Plan, the USFWS has not provided justification for this recommendation. Incorporating flow-related changes in microhabitat characterizations would add increased complexity to an already complex riverine modeling effort without providing benefit to the decision-making process. The FERC-approved methods are sufficient for FERC to evaluate Project effects and identify potential protection, mitigation, and enhancement measures.

2.5.1.6.3. Response to Modification Request for Protection, Mitigation, & Enhancement Scenarios

The Services (NMFS_pp8.5-51_ph04 [Modification 6-1]; USFWS_pp8.5-54_ph04 [Recommendation]) recommend that AEA develop alternative operating scenarios that could be used as protection, mitigation and enhancement (PM&E).

In response, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project. The information generated in these studies will be used to prepare an impact assessment, which will appear in the draft license application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the draft license application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.

2.5.1.7. Objective 7

Objective 7: Coordinate instream flow modeling and evaluation procedures with complementary study efforts including Riparian (Study 8.6), Geomorphology (Study 6), Groundwater (Study 7.5), Baseline Water Quality (Study 5.5), Fish Passage Barriers (Study 9.12), and Ice Processes (Study 7.6). If channel conditions are expected to change over the license period, instream flow habitat modeling efforts will incorporate changes identified and quantified by riverine process studies.

2.5.1.7.1. Response to Modification Request for Demonstration of Model Integration in Pilot Area

NMFS (NMFS_pp8.5-55_ph04 [Modification 7-2]) recommended that AEA run-coordinate all the current models for a single "pilot area" (probably an existing Focus Area) and show the quantity and quality of various fish species macro and mesohabitats over the next 50 years for two operating scenarios (full load following and one other) and no-Project alternative. NMFS notes that the effects of the dam will take decades to be fully realized based on effects of the initial filling of the reservoir and trees filling and drying out the sloughs over time. NMFS requests that the applicant show that this extremely difficult long-term habitat analysis works and that logical comparison can be made between the effects of different operating scenarios.

NMFS acknowledges that the applicant has made progress in developing individually functional models, but comments that demonstrations of model integration beyond the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting are needed. They request another integration meeting be held for AEA to demonstrate all aspects of river process modeling and habitat analysis for multiple scenarios over a 50-year period.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The integration of riverine process models is an ongoing process and will continue in the next study period. The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). This will include an evaluation of Project effects over an assumed 50-year licensing period using 1-D and 2-D bed evolution models to calculate changes in physical channel conditions that will provide input to the fish habitat and other riverine process models. Additional information on the linkages-coupling between the Fish and Aquatic Instream Flow Study and other dependent studies is presented in the Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof Of Concept*). Additional details regarding bed evolution modeling are provided in the Fluvial Geomorphology Modeling SIR (Study 6.6 SIR, Attachment 1: *2014 Fluvial Geomorphology Model Development*, Section 2.2: Comprehensive Modeling Approach).

2.5.1.8. Objective 8

Objective 8: Develop a Decision Support System-type framework to conduct a variety of post-processing comparative analyses derived from the output metrics estimated under aquatic habitat models.

2.5.1.8.1. Response to Modification Request Regarding Detailed Conceptual Framework for Integrating Process Models

SRC et al. (SRC_etal_WATER_pp31_ph03 [Modification I]; SRC_etal_WATER_pp33_ph03) propose a Study Plan modification that AEA provide a detailed understanding of data analysis, model interdependencies, and outputs in order to comment on the applicability of spatial and temporal model integration into a DSS to evaluate Project effects on aquatic resources. In comparison to the Services' proposal for a New Model Integration and DSS Study, this modification requests additional detail earlier in the licensing process.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. has not established "good cause" as required by the ILP regulations, nor has SRC et al. demonstrated that the study was not implemented as provided by the approved Study Plan. See also AEA's response to the Services' new Model Integration and DSS Study request below in Section 3.4.

The Conceptual Framework was presented in the FERC-approved Study Plan as an analytical tool to demonstrate study linkages and direct the collection and analysis of data (RSP Section 8.5.4.1). The Conceptual Framework figure presented in the ISR (Study 8.5 ISR Part A, Figure 4.1.1) was an adaptation of the Conceptual Framework presented in the RSP (Section 8.5, Figure 8.5-10). A Riverine Modeling Technical Team meeting was held with licensing participants on November 13-15, 2013 to provide a forum to review and discuss data analysis, model interdependencies, model outputs, and study integration efforts. A follow-up Proof of Concept meeting was held April 15-17, 2014 to advance the understanding of riverine process modeling (i.e., WQ (Study 5.6), Fluvial Geomorphology Modeling (Study 6.6), Groundwater (Study 7.5), Ice Processes (Study 7.6) and fish habitat modeling (Study 8.5) by demonstrating the application of the models specific to two key biological metrics (i.e., effective salmon spawning-incubation habitat and juvenile salmonid rearing habitat) at Middle River FA-128 (Slough 8A). Meeting agenda topics included options for spatial and temporal model integration into a DSS (Study 8.5 ISR Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). These meetings were held early in the study implementation process to allow potential data gaps or format inconsistencies among the various riverine models to be identified and resolved. Integration of riverine process models, resolving model interdependencies, and spatial and temporal model integration into a DSS is an ongoing process and will continue in the next study period.

As described in the Study Plan (RSP Section 8.5.4.8.1), development of a DSS-type process, and supporting software to efficiently process data analyses, was to be initiated in collaboration with the TWG after the initial results of the various habitat modeling efforts are available. The intent was to prepare the DSS-type evaluation process to assist scenario evaluations in support of the

License Application. AEA initiated model integration early in the study implementation phase and consistent with the FERC-approved Study Plan will continue with development of the DSS in the next study period. The initial evaluation of alternate operational scenarios will occur as part of the USR, and the USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016).

2.5.1.9. References Cited

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Table 2.5.1-2. Susitna-Watana Hydro Project Habitat Suitability Criteria Development (2012-2016) Technical Reports, Presentations, and Meeting Notes.

Document	Reference
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March 24, 2016: ISR Part D and 2015 ISR Meeting Materials	Transcript: Study 8.5 Alaska Energy Authority (AEA). 2016. Meeting Transcript, Studies 7.6, 8.5, 8.6, and 11.6: Initial Study Report Meeting No. 2, March 24, 2016. Susitna-Watana Hydroelectric Project, FERC Project No. P-14241 Submittal: April 26, 2016. http://www.susitna-watanahydro.org/wp-content/uploads/2016/04/Att_3_2016_03_24_ISR_MTG_TRANSCRIPTS.pdf. Summary: Study 8.5 Alaska Energy Authority (AEA). 2016. Meeting Summary, Studies 7.6, 8.5, 8.6, and 11.6: Initial Study Report Meeting No. 2, March 24, 2016. Susitna-Watana Hydroelectric Project, FERC Project No. P-14241 Submittal: April 26, 2016. http://www.susitna-watanahydro.org/wp-content/uploads/2016/04/2016_03_24_ISR_MeetingSummary.pdf. Presentation: Study 8.5 R2 Resource Consultants (R2). 2016. Meeting Presentation: Study 8.5 Initial Study Report Meeting No. 2, March 24, 2016. Susitna-Watana Hydroelectric Project, FERC Project No. P-14241 Submittal: April 26. http://www.susitna-watanahydro.org/wp-content/uploads/2016/03/ISR-8.5-1.pdf.
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Study 8.5 SIR	Sections 4.5, 5.5, 6.5, and 7.5 R2 Resource Consultants (R2). 2015. Fish and Aquatics Instream Flow Study 8.5 2014-2015 Study Implementation Report. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: November 9, 2015, 2014-2015 Study Implementation Report, Study 8.5. http://www.susitna-watanahydro.org/wp-content/uploads/2015/11/08.5_IFS_SIR_1_of_2.pdf and http://www.susitna-watanahydro.org/wp-content/uploads/2015/11/08.5_IFS_SIR_2_of_2.pdf. Appendix D: Habitat Suitability Criteria Development R2 Resource Consultants (R2). 2015. Habitat Suitability Criteria Development. Susitna-Watana Hydroelectric Project, FERC No. P-14241 Submittal: November 9, 2015, 2014-2015 Study Implementation Report, Study 8.5, Appendix D. Prepared for Alaska Energy Authority, Anchorage, Alaska. http://www.susitna-watanahydro.org/wp-content/uploads/2015/11/08.5_IFS_SIR_App_D_HSC.pdf.
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April 15, 16, and 17, 2014: Proof of Concept Technical Team Meeting Materials	Summary Alaska Energy Authority (AEA). 2014. Meeting Notes: Riverine Modeling Proof of Concept Technical Team meeting on April 15, 16, and 17, 2014. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2014/05/2014_04_15-17TT_POC_Notes.pdf. • Topics covered: o General overview of previous topics, with context for how HSC curves will be used in the process.
March 21, 2014: Instream Flow Technical Team Meeting Materials	Presentation: Update HSC Curve Development R2 Resource Consultants (R2). 2014. Study 8.5 IFS: Update on HSC Curve Development. PowerPoint Presentation, Technical Team Meeting on March 21, 2014. Prepared for Alaska Energy Authority, Anchorage, Alaska. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014-03-21TT_IFS_Presentation-HSC.pdf. Summary Alaska Energy Authority (AEA). 2014. Meeting Notes: Instream Flow Technical Team meeting on March 21, 2014. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/2014-03-21TT_IFS_Notes.pdf. • Topics covered: o Detailed review of 2013 data collection o Discussion of types of curves o Detailed discussion of possible methods for HSC curve development o Rationale for AEA selection of HSC curve development methods o Preliminary/Example results for curves o Options for Species/Life Stages with limited data o Overview of planned 2014 data collection
November 13, 14, and 15, 2013: Riverine Modelers Technical Team Meeting Materials	Summary Alaska Energy Authority (AEA). 2013. Meeting Notes: Riverine Modelers Technical Team meeting on November 13, 14, and 15, 2013. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2014/02/2013.11.13Modelers_Notes.pdf. • Topics Covered: o Information on how HSC/HSI will be used in the process
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Document	Reference
NMFS Comments	National Marine Fisheries Service (NMFS). 2013. NOAA-NMFS Alaska Region Technical Comments on May 17, 2013 TWG meeting: Focus Area data collection for site specific habitat criteria development for the Susitna-Watana Hydropower Project, FERC No. P-14241. Letter filed with Federal Energy Regulatory Commission. June 4, 2013. http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20130604-5127. National Marine Fisheries Service (NMFS). 2013. Instream Flow Study Technical Work Group meeting comments, May 17, 2013, of NOAA Fisheries Service, Alaska Region. Susitna-Watana Hydropower Project, FERC No. P-14241. Letter filed with Federal Energy Regulatory Commission. May 22, 2013. http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20130523-5008.
May 17, 2013: Instream Flow Technical Team Meeting Materials	Presentation: Fish and Aquatics Instream Flow 2013 HSC Data Collection R2 Resource Consultants (R2). 2013. 2013 HSC Data Collection. PowerPoint Presentation, Technical Team meeting on May 17, 2013. Prepared for Alaska Energy Authority, Anchorage, Alaska. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2013/05/2013-05-17TWG_IFS_Presentation-HSC.pdf. Summary Alaska Energy Authority (AEA). 2013. Meeting Notes: Technical Team meeting on May 17, 2013. Prepared for Alaska Energy Authority, Anchorage, Alaska. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2013/06/2013-05-17TWG_IFS_Notes.pdf. • Topics Covered: o Details on HSC target species and data collection methods for 2013
FERC Revised Study Plan Determination	Federal Energy Regulatory Commission (FERC). 2013. Study Plan Determination on 14 remaining studies for the Susitna-Watana Hydroelectric Project. Issuance 20130401-3022. Susitna-Watana Hydroelectric Project FERC No. P-14241. April 1, 2013. http://elibrary.FERC.gov/idmws/file_list.asp?accession_num=20130401-3022.

March 27, 2013: Instream Flow, Riparian Instream Flow and Groundwater Resources Technical Workgroup Meeting Materials	Presentation: Update on Habitat Suitability Criteria Development
	R2 Resource Consultants (R2). 2013. Update on Habitat Suitability Criteria Development. PowerPoint Presentation, Technical Workgroup meeting on March 27, 2013. Prepared for Alaska Energy Authority, Anchorage, Alaska. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2013/03/2013-03-27TWG_HSC_Materials.pdf.
	Summary
	R2 Resource Consultants (R2). 2013. Meeting Notes: Technical Workgroup meeting on March 27, 2013. Prepared for Alaska Energy Authority, Anchorage, Alaska. Susitna-Watana Hydroelectric Project, FERC No. P-14241. http://www.susitna-watanahydro.org/wp-content/uploads/2013/05/2013.03.27TWG_Notes.pdf.
	• Topics covered:
	  o Review of HSC curves/process
	  o 1980s studies, periodicity
	  o Review of 2012 Pilot Study
	  o Proposed 2013 sampling, including priority species, site selection, and variables
	  o HSI process
	  o Brief introduction of HSC analysis methods

Document	Reference
A Summary Review of Susitna River Aquatic and Instream Flow Studies Conducted in the 1980s with Relevance to Proposed Susitna – Watana Dam Project – 2012: A Compendium of Technical Memoranda	Section 5: Selection of Target Species and Development of Species Periodicity Information for the Susitna River, Technical Memorandum R2 Resource Consultants (R2). 2013. A Summary review of Susitna River aquatic and instream flow studies conducted in the 1980s with relevance to proposed Susitna – Watana Dam Project – 2012: A Compendium of Technical Memoranda. Susitna-Watana Hydroelectric Project, FERC No. P-14241. Prepared for Alaska Energy Authority, Anchorage, Alaska. 495 pp including appendices. March 2013. http://www.susitna-watanahydro.org/wp-content/uploads/2013/03/SuWa_R2_Compendium_TechMemos.pdf and http://www.susitna-watanahydro.org/wp-content/uploads/2013/10/SuWa_R2_Compendium_TechMemos-Appendix3.pdf. Section 6: Habitat Suitability Curve Development Studies for the Susitna River Technical Memorandum R2 Resource Consultants (R2). 2013. A Summary review of Susitna River aquatic and instream flow studies conducted in the 1980s with relevance to proposed Susitna – Watana Dam Project – 2012: A Compendium of Technical Memoranda. Susitna-Watana Hydroelectric Project, FERC No. P-14241. Prepared for Alaska Energy Authority, Anchorage, Alaska. 495 pp including appendices. March 2013. http://www.susitna-watanahydro.org/wp-content/uploads/2013/03/SuWa_R2_Compendium_TechMemos.pdf and http://www.susitna-watanahydro.org/wp-content/uploads/2013/10/SuWa_R2_Compendium_TechMemos-Appendix3.pdf.
RSP 8.5	Section 8.5.4.5: Habitat Suitability Criteria Development Alaska Energy Authority (AEA). 2012. Fish and Aquatics Instream Flow Study 8.5 Revised Study Plan: Susitna-Watana Hydroelectric Project FERC Project No. 14241. December 2012. Prepared for the Federal Energy Regulatory Commission by the Alaska Energy Authority, Anchorage, Alaska. http://www.susitna-watanahydro.org/wp-content/uploads/2012/12/03-RSP-Dec2012_3of8-Sec-7-8-HydrologythroughInstreamFlowStudies-v2.pdf.

Table 2.5.1-3. Number of adult salmon radio-tagged in the Susitna River Basin from 2012-2014 by species and tagging location (Source: Study 9.7 SCR)

Species	Tagging Location	2012	2013	2014	Total
Chinook	Lower River	442	580	659	1,681
	Middle River	352	603	622	1,577
Chum	Lower River	400	0	0	400
	Middle River	279	201	200	680
Coho	Lower River	399	596	658	1,653
	Middle River	184	242	212	638
Pink	Lower River	401	197	198	796
	Middle River	230	200	201	631
Sockeye	Lower River	100	0	0	100
	Middle River	70	139	200	409

2.5.1.10. Figures

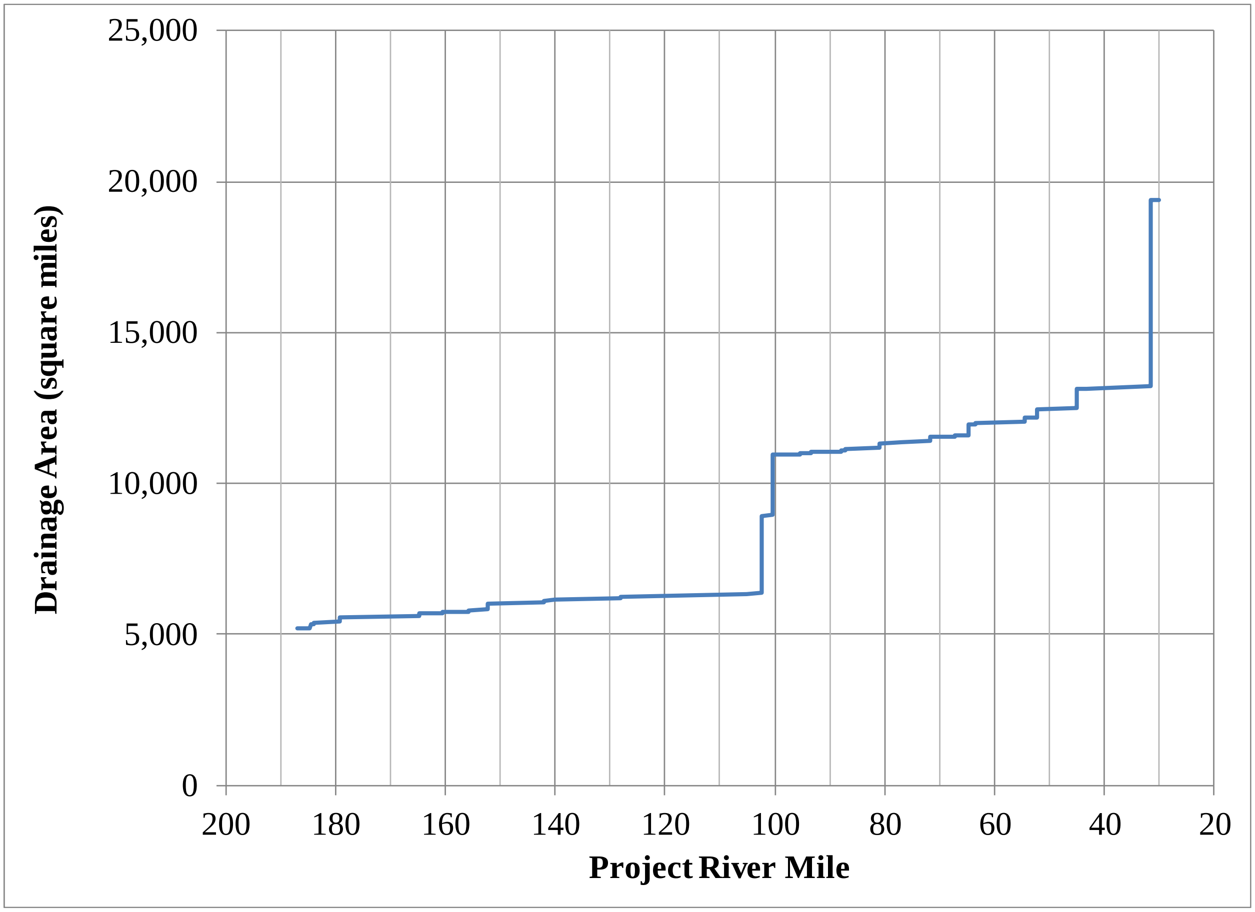

Figure 2.5.1-1. Susitna River Project River Mile and drainage area relationship.

2.5.2. Study 8.6 – Riparian Instream Flow Study

As established by the Riparian Instream Flow (RIFS) Study 8.6 Study Plan[23], the goal of the RIFS Study is to provide a quantitative, spatially-explicit model to predict potential impacts to downstream floodplain vegetation from Project operational flow modification of natural Susitna River flow, sediment, and ice process regimes. To meet this goal, a physical and vegetation process modeling approach will be used. First, existing Susitna River groundwater and surface

23 The FERC-approved Revised Study Plan (RSP) Section 8.6 for the Riparian Instream Flow (RIFS) Study as modified by FERC's Study Plan Determination (Study 8.6 SPD, April 1, 2013), the *Riparian Instream Flow, Groundwater, and Riparian Vegetation Studies FERC Determination Response Technical Memorandum* (Study 7.5, 8.6, and 11.6 TM, July 1, 2013), the *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014 TM* (Study 8.5 TM, March 1, 2013), and the *Adjustments to Middle River Focus Areas TM* (Study 8.5 TM, May 31, 2013) is collectively referred to herein as the Study Plan Section 8.6.

water (GW/SW) flow, sediment and ice process regimes will be measured and modeled relative to floodplain plant community establishment, recruitment, and maintenance requirements. Second, predictive models will be developed to assess potential Project operational impacts to floodplain plant communities and provide operational guidance to minimize these impacts. Third, the predictive models will be applied spatially in a Geographic Information System (GIS) to the riparian vegetation map produced by the Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (RIP) Study 11.6 to produce a series of maps of predicted changes under alternative operational flow scenarios.

Riparian IFS objectives are as follows:

- Synthesize historic physical and biological data for Susitna River floodplain vegetation, including 1980s studies, studies of hydro project impacts on downstream floodplain plant communities, and studies of un-impacted floodplain plant community successional processes.
- Delineate sections of the Susitna River with similar environments, vegetation, and riparian processes, termed *riparian process domains*, and select representative areas within each riparian process domain, termed *Focus Areas*, for use in detailed 2013–2014 field studies.
- Characterize seed dispersal and seedling establishment groundwater and surface water hydroregime requirements. Develop a predictive model of potential Project operational impacts to seed dispersal and seedling establishment.
- Characterize the role of river ice in the establishment and recruitment of dominant floodplain vegetation. Develop a predictive model of potential Project operational impacts to ice processes and dominant floodplain vegetation establishment and recruitment.
- Characterize the role of erosion and sediment deposition in the formation of floodplain surfaces, soils, and vegetation. Develop a predictive model of Project operations changes to erosion and sediment deposition patterns and associated floodplain vegetation.
- Characterize natural floodplain vegetation groundwater and surface water maintenance hydroregime. Develop a predictive model to assess potential changes to natural hydroregime and potential floodplain vegetation change.
- Develop floodplain vegetation study, Focus Area to riparian process domain scaling and Project operations effects modeling**.**

As detailed in Study 8.6 ISR Part D, Section 7, and presented during the ISR meeting for this study held on March 24, 2016, AEA proposes two modifications to RSP Section 8.6:

1. For the seedling establishment and recruitment study (RSP Section 8.6.3.3.2), AEA will quantitatively characterize where and how balsam poplar clonal establishment and recruitment is occurring. Transect sampling at select Focus Area mid-channel islands and lateral floodplain margins will be determined in the field.
2. For the floodplain vegetation groundwater and surface water study (RSP Section 8.6.3.6), AEA will not conduct a second year of sap-flow and stomatal conductance

evapotranspiration (ET) measurements. This was agreed to during an April 2014 Technical Work Group meeting because the Susitna Valley region is not precipitation limited. Evapotranspiration modeling will use the results of the 2013-2014 measurements.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, ADF&G, USFWS, NMFS and SRC et al. submitted comments on Study 8.6. NMFS submitted 3 study modification proposals for Study 8.6 and USFWS submitted none. ADF&G supported both of AEA's proposed modifications to Study 8.6. The USFWS and NMFS both supported AEA's second proposed modification as outlined above, as well as the addition of Rapid Vegetation Transects to the RIFS GW/SW riparian vegetation study as detailed in *Riparian Instream Flow, Groundwater, and Riparian Vegetation Studies FERC Determination Response Technical Memorandum* (Study 7.5, 8.6, and 11.6 TM, July 1, 2013). AEA received no comments opposing these AEA-proposed modifications. AEA's responses to all of the comments can be found in Table 2.5.2-1, and more detailed responses to the study modification requests are presented below. The majority of Riparian IFS USFWS and NMFS comments were identical or nearly so and have been combined accordingly. Comments are identified by the entity, page number, and paragraph number. In cases where multiple paragraphs are included in the table as a single "comment", the comment is identified by the first paragraph.

Table 2.5.2-1 Study 8.6 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
Study Plan Modifications		
ADNR_ADFG _pp12_ph2	*The purpose of this study is to assess the effects of the proposed project and its operations on the floodplain plant communities in the Susitna River basin. The study will model potential impacts to downstream floodplain vegetation from project operational flow modification of the existing flow, sediment, and ice regimes. Observations of ice effects and tree ice scar mapping have provided insight on these processes and relationships. We agree that additional evapotranspiration measurements are not warranted based on the determination that the Susitna Valley region is not a precipitation limited region. We agree that evaluating habitat associations by size instead of age will continue to meet the objective of documenting the seasonal life stage use, growth, and condition of species by habitat type. We believe significant progress has been made and that the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's review of the ISR, ADF&G's support for AEA's two proposed modifications to the FERC-approved Study Plan as described in ISR Part D Section 7 and support for AEA's implementation of the FERC-approved Study Plan thus far.
NMFS_pp8.6-04_ph04; USFWS_pp8.6-04_ph01	With respect to AEA's variances and proposed modifications under Objective 6 as follows: (*1) introduction of new RVT (Rapid Vegetation Transect) sampling method for acquiring vegetation-groundwater paired sites for constructing vegetation-hydrology response curves; (2) moving groundwater wells outside of vegetation plots in some cases to avoid trampling; (3) likely less use of 2-D groundwater models and more use of observed and interpolated simple gradients and zones of river- or upland groundwater influence; and (4) less emphasis on evapotranspiration field work to parameterize the RIP-ET package for MODFLOW groundwater modeling. MODFLOW is the USGS's three-dimensional (3D) finite-difference groundwater model. In general,* [the Services] *concur with these decisions. They were all discussed at the Technical Working Group meetings to some extent. Suggestions for scaling back on evaporation-transpiration field work came as much from technical reviews as from the investigators.* [The Services] *support this decision based on the perspective that detailed variation in transpiration is not likely to be relatively important in the Susitna Valley region because it is not a precipitation limited region.*	AEA appreciates the Services' support for AEA's approach to implementing these studies and AEA's proposed modification to the FERC-approved Study Plan to not collect a second year of sap-flow and stomatal conductance ET measurements, as described in Study 8.6 ISR Part D Section 7.2, and the introduction of Rapid Vegetation Transect sampling, as described in RSP Section 8.6.3.6.2: Floodplain Vegetation Groundwater and Surface Regime Functional Groups.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.6-07_ph03; NMFS_pp8.6-08_ph03	*Study plan variances and conformance are identified in ISR and SIR 8.6. The most important modifications apply to future work and consist of (1) a reduced emphasis on transpiration measurement and modeling, and (2) modified vegetation-groundwater sampling for the purposes of quantifying vegetation-response curves. Although there are some potential limitations associated with both, they do seem generally reasonable and efficient.* [The Services concur] *with the reduction in transpiration measurements to (1) stomal conductance in 2013; and (2) sap flow in 2013 (partial) and 2014 (full).* [The Services also concur] *with the modification of paired vegetation-hydrology samples to include the Rapid Vegetation Transect approach and more use of groundwater transects, recognizing that there is some potential decrease in accuracy in order to achieve a reasonably large sample size.*	AEA appreciates the Services' support for AEA's approach to implementing these studies and AEA's proposed modification to the FERC-approved Study Plan to not collect a second year of sap-flow and stomatal conductance ET measurements, as described in Study 8.6 ISR Part D, Section 7.2, the introduction of Rapid Vegetation Transect sampling, as described in RSP Section 8.6.3.6.2: Floodplain Vegetation Groundwater and Surface Regime Functional Groups, and the concomitantly increased effort concerning quantifying vegetation-response curves for assessing vegetation and groundwater relationships to be used in the Projects effects analysis. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 4.6 and 5.6), and the SIR (Study 8.6 SIR, Appendix A: *Riparian Vegetation Groundwater / Surface Water Study Sampling Design*), Rapid Vegetation Transect (RVT) vegetation sampling procedure will be used, along with groundwater depth statistics, for the purposes of quantifying riparian vegetation-response curves under existing conditions.
NMFS_pp8.6-03_ph05; USFWS_pp8.6-03_ph02	NMFS (Modification 3-1); USFWS (Recommendation): [The Services recommend] *estimating seedling winter mortality in order to get a sense of what locations are likely to result in ultimate pole and tree recruitment, and to help identify the importance of asexual reproduction in recruiting mature stands. Dendrochronology will continue to be a key tool in making these distinctions, along with recording ages of individuals by transect distance.*	As explained below in Section 2.5.2.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this analysis, over winter mortality, is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. Three sequential field seasons of seedling survival have been completed as designed in the FERC-approved Study Plan for this study (2013-2015). Using existing data from this three-year field effort, overwinter mortality will be estimated in the final statistical analyses. Ages of seedlings by transect distance will be noted. The final analysis will be presented in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp8.6-02_ph05; NMFS_pp8.6-03_ph03	*Although not in the FSP, we recommend that AEA develop estimates of overwinter mortality of the seedlings because it is likely that winter mortality is very high in the presence of ice.*	Estimates of overwinter mortality of seedlings will be conducted in the final statistical analysis using the existing seedling data set and presented in the USR. As indicated in the ISR Part D, one of the steps to complete the study consists of the following: *Quantitatively describe and compare ice-influenced and non-ice-influenced floodplain plant community composition, abundance, age, and spatial pattern to assess the role and degree of influence ice processes have on Susitna River floodplain vegetation. For example, ice shearing of low elevation mid-channel islands generates and maintains forest stands in an early tall alder successional phase often dominated by felt-leaf willow.*
USFWS_pp8.6-03_ph01; NMFS_pp8.6-03_ph04	*It will be very important to continue to distinguish between seedling and asexual reproduction. Seedling cohorts need to be summarized not just by elevation, but hydraulic position (e.g. inundating discharge) in order to link seedling establishment with flooding characteristics, using flow records. It is also critical that seedling patterns be characterized by distances along transects, in order to discern positions of unique cohorts. Only in this way can any secondary recruitment be identified.*	AEA agrees that it is important to distinguish between seedling sexual and asexual reproduction because the ice process seedling disturbance regime will likely be more pronounced at specific channel positions where exposure to ice mechanical disturbance is more pronounced. Sites where mechanical ice shearing impacts are prevalent will be reflected in the type of seedling reproduction observed in local cohorts. Seedling cohort physical variables analyzed include: elevation, geomorphic (hydraulic) position, inundating discharge, flood depth associated bed shear stress value, sediment type, groundwater depth (at a select subset of seedling transects), and historic flow records for 2013-2015. Seedling patterns will also be characterized by distances along transects, in order to discern positions of unique cohorts. This analysis will be reported in the USR.
NMFS_pp8.6-07_ph05	*Modification G-1: NMFS recommends conducting a careful analysis of the current data to determine which lines of investigation should be called complete and which should be pursued further.* *The study delay actually provides an opportunity to greatly improve/expand the vegetation studies because the time span is now longer so growth trends will be easier to see.* *The study was commenced as provided for in the approved study plan; however the huge snowpack in the 2012/2013 winter led to anomalous groundwater levels and growing conditions (environmental conditions) during the 2013 summer. Re-measuring the vegetation plots a few years after establishment would greatly increase the value of the study.*	As explained below in Section 2.5.2.2, AEA requests that FERC not adopt this proposed Study Plan modification because the request is not necessary to meet the Study Plan objectives. The request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. The estimated cost of additional vegetation sampling is $300,000. However, resampling of the vegetation seed plots would not be possible as they have already been removed from the field and cannot be accurately reinstalled.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.6-02_ph02	*G-2 (Global Modification) Integrate the Riparian Instream flow with other studies specifically the 8.5 Open Water Flow Model and 6.6 Fluvial Modeling.*	As explained below in Section 2.5.2.3, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. *See Riparian Physical Process Modeling Technical Memorandum* (Study 8.6 TM, March 25, 2013) for further information on Riparian IFS (8.6) model integration.
Objective 1: Literature Review of Dam Effects on Downstream Vegetation		
USFWS_pp8.6-01_ph05; NMFS_pp8.6-02_ph03	*Study methods are appropriate, and merging the review with the Fluvial Geomorphology Study (6.6) review into a single technical memorandum (R2 Resource Consultants, Inc. and Tetra Tech, Inc. 2014) resulted in a better product.*	AEA appreciates the Services' support for the variance implemented by AEA in completing this task, as described in Study 8.6 ISR Part A, Section 4.1.2.
Objective 2: Riparian Process Domain Delineation and Focus Area Selection		
NMFS_pp8.6-02_ph05; USFWS_pp8.6-01_ph07	*There remains some confusion about what constitutes pseudo-replication. One of Hurlbert's (1984) main points has to do with at what level replication was conducted and how the results are used to make predictions based on inferential statistics. Thus, "…the number of adequate sample sites necessary to perform robust statistical analyses, is addressed in the hierarchical riparian process domain sampling design …" (ISR 8.6, Part A – Page 5, last paragraph) is only true if a sufficient number of focus areas per RPD are sampled to attain the desired power of the statistic. One to three focus areas per RPD (i.e., ISR 8.6, Appendix A, Figure 1) are unlikely to be sufficient for "robust statistical analyses."*	To clarify, Focus Areas are not considered replicate samples. Focus Areas are modeling reaches selected to capture the variability of both physical processes and plant community diversity within a Riparian Process Domain (RPD) − channel, floodplain, and plant community types. Focus Areas provide regions of the river where physical modeling (groundwater, surface water, fluvial geomorphic) is conducted in support of riparian vegetation studies. It is not possible to conduct 2-D hydraulic and groundwater modeling over 140 miles of the Project area. The number of replicate vegetation samples for a robust statistical analysis includes sample plots located both within Focus Areas, and in additional satellite areas where necessary to capture the variability of riparian vegetation types within each RPD. Riparian vegetation sampling design is detailed in RSP Section 11.6 (Riparian Vegetation Study), Riparian IFS RSP Section 8.6, and Study 8.6 SIR, Appendix A: *Riparian Vegetation Groundwater / Surface Water Study Sampling Design.*

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.6-02_ph06; USFWS_pp8.6-02_ph03	*The innovative way RPDs were delineated, and the focus areas selected to represent the RPDs, are appropriate. We caution, however, against claiming statistical rigor for scaling-up the results to RPDs. Results need to be scaled up to RPDs, but our level of confidence in the scaled-up results will need to be supported by means other than inferential statistics based on the current study design.*	The scaled-up application of Focus Area results will be done using a mechanistic, process-based model. For example, the Focus Area seedling survival studies will identify what physical variables best predict seedling survival (sediment type, groundwater depth, flood related shear stress, geomorphic position) from both a statistical and mechanistic perspective. Once these relationships are established at the Focus Area scale, the results will then be scaled-up to the Riparian Process Domain (RPD) using hydraulic modeling and GIS. Finally, Project operations flow regime effects will be modeled and analyzed at the RPD scale.
NMFS_pp8.6-02_ph07; USFWS_pp8.6-02_ph03	*For ISR 8.6, Appendix A, we suggest normalizing the results by Project River Mile. As acknowledged in Appendix A, RPD 3 has the most herbaceous vegetation based on the total transect length per RPD (e.g., Figure 2), but this is also the longest riparian process domain in the Middle River so it might be expected to have the largest total areas. In contrast, if the vegetation area were normalized by river mile, then the relative distribution of vegetation within RPDs would be more apparent.*	Normalizing results by Project River Mile to examine the relative distribution of vegetation types within RPDs can be accomplished within the current design of the FERC-approved Study Plan and reported in the USR.
NMFS_pp8.6-02_ph07; USFWS_pp8.6-02_ph03	*A final iteration of RPD delineation will be necessary to incorporate variation in ice processes and additional Lower River area, as acknowledged in SIR 8.6 Part D (2015).*	A final iteration of RPD delineation is planned under the current design of the FERC-approved Study Plan and will be reported in the USR.
NMFS_pp8.6-03_ph01; USFWS_pp8.6-02_ph04	*We continue to question the adequacy of the focus areas representing herbaceous vegetation for the RPDs, since the analyses used to justify selecting the focus areas (ISR 8.6, Section 5.2 refers to Appendix A) continues to lump all herbaceous communities into one community type (herbaceous), while a number of woody communities with much less representation in the RPDs were used to justify the representativeness of the focus area.*	AEA understands the concern, however, this comment does not consider AEA's expanded study design presented in the SIR that describes the differentiation of herbaceous plant communities into five types, not as one community type. As described in the SIR (Study 8.6 SIR, Appendix A: *Riparian Vegetation Groundwater / Surface Water Study Sampling Design*), the five distinct herbaceous plant communities typed for sampling and analysis (Study 8.6 SIR, Table 2) include: lowland organic-rich bluejoint-herb meadow; riverine loamy large umbel meadow; riverine loamy ostrich fern meadow; riverine sandy bluejoint-herb meadow; and riverine wet sedge-forb marsh. These herbaceous vegetation types represent the range of variability within the Project area as determined by a quantitative estimate of the total area of vegetation types within the Project area and Focus Areas as reported in SIR (Study 8.6 SIR, Appendix A: *Riparian Vegetation Groundwater / Surface Water Study Sampling Design*) and therefore are representative of the herbaceous community types.

Reference Number	Comment or Study Modification Request	AEA's Response
	Objective 3: Seed Dispersal and Seedling Establishment	
NMFS_pp8.6-03_ph02; USFWS_pp8.6-02_ph05	*The methodology for synchrony of seed dispersal is appropriate, although it* [would be desirable] *to sample more Salix spp at PRM 88 (i.e., ISR 8.6, Table 5.3-1) if additional specimens are available at that site.*	While AEA appreciates the Services' desire for more sampling of *Salix spp* at PRM 88, AEA does not believe it is necessary to meet the original objectives of the seed dispersal study design as described in RSP Section 8.6.3.3.1. Specifically, the seed dispersal study was to: (1) measure cottonwood and *select* willow species seed dispersal timing; (2) model local Susitna River valley climate, and associated peak flows, relative to cottonwood and willow seed dispersal; and (3) develop a recruitment box model of seed dispersal timing, river flow regime. AEA maintains the existing seed dispersal study as implemented meets the objectives of the FERC-approved Study Plan, and that additional sampling will not make the study results stronger with respect to assessing Project effects. Also, sampling additional *Salix* spp. at PRM 88 would entail an additional year of study at all four study sites to have comparable results with the two years of field data for all species sampled at all sites. An additional study year of data collection is beyond the scope of the FERC-approved Study Plan and is not necessary to meet study objectives. Additional cost estimate for a year of sampling would be approximately $20,000.
USFWS_pp8.6-02_ph05; NMFS_pp8.6-03_ph03	*The methodology for seedling establishment and recruitment is reasonable. Changing the Final Study Plan (FSP) definition of balsam poplar and willow seedlings from plants with stems less than one-meter high to plants less than one year old, because it was difficult to differentiate between clonal and sexual recruitment without destructive sampling, was a good decision.*	AEA appreciates the Services' support for AEA's proposed approach and variance to the FERC-approved Study Plan implemented as described in Study 8.6 ISR Part A Section 4.3.2. As explained, AEA modified the definition of balsam poplar and willow seedlings from plants with stems less than one-meter high to plants less than one year old, because it was difficult to differentiate between clonal and sexual recruitment without destructive sampling. A clonal reproduction study will be done to characterize asexual recruitment patterns and the results will be presented in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
Objective 4: River Ice Effects on Floodplain Vegetation		
NMFS_pp8.6-04_ph01; USFWS_pp8.6-03_ph03	*Objective 4 components are innovative, effective, and well developed. The ice scar mapping has continued through 2014 filling in sections of the Middle River and extending coverage into the Lower River. Preliminary results point to the importance of ice as a physical disturbance operating on a lateral extent that is large relative to open water flooding. Thus it may be important to characterize the frequency distribution of ice disturbance as a determinant of riparian succession and vegetation distribution.* [USFWS suggests and NMFS recommends] *that although not critical as a requested study modification, that AEA explore how well multiple scarring events could be quantified by full "cookie" slabs (e.g., on downed or sacrificed trees). These cross-sections of the tree trunk can extend the historical frequency of scarring by revealing older ice scars that have completely grown over and are no longer detectable by external examination.*	AEA requests that FERC not consider or adopt this comment as a proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. While frequency of ice disturbances could be determined through an additional extensive tree ice scar sampling study, the requested actions are not necessary to meet Study Plan objectives. An additional tree ice scar study sufficient to address frequency of ice disturbances would cost approximately $130,000. Although the ice dam floodplain vegetation disturbance regime (frequency, magnitude and geographic extent of floodplain vegetation disturbance) is of scientific interest, the current Riparian IFS study design of mapping the areas of ice impacted floodplain surface will provide a geographic map of the "ice flood affected area. These data will be used, along with the ice processes modeling, to measure the area affected by ice processes and to project the potential area of impact under the with-Project ice regime.
Objective 5: Floodplain Stratigraphy and Floodplain Development.		
NMFS_pp8.6-04_ph02; USFWS_pp8.6-03_ph04	*Work on this objective is being accomplished cooperatively with the Riparian Vegetation Study (11.6). Soil stratigraphy excavations are being conducted in association with Study 11.6 vegetation sampling locations, with a subset of the sediment cores being dated using radioisotopes. A substantial number of stratigraphic samples have been collected, including some collections from previously sampled vegetation plots in 2014. Some concerns have been raised about soil stratigraphy excavations occurring within permanent vegetation plots, but it seems reasonable to defer to the investigators to appropriately balance disturbance with slightly decoupling the soil and vegetation observations.*	As designed in the FERC-approved Study Plan (RSP Section 8.6), the sediment stratigraphic sampling was conducted at sites outside of permanent vegetation plots. Therefore, there is no potential for disturbing permanent vegetation plots.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.6-04_ph03; USFWS_pp8.6-03_ph05	*Less detail and progress has been reported for methods and measurement of erosion rates and integration of erosion with sediment accretion to produce synthetic analysis of floodplain turnover and development.*	Floodplain turnover and erosion rates were examined by the Geomorphology Study 6.5 (Study 6.5 TM, September 26, 2014: *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950's, 1980's and Current Aerials*). Floodplain development and sediment deposition study design is described in the Riparian IFS FERC-approved Study Plan (RSP Section 8.6.3.5: *Characterization of the role of erosion and sediment deposition in the formation of floodplain surfaces, soils and vegetation*).
Objective 6: Riparian GW/SW Hydroregime and Plant Transpiration.		
NMFS_pp8.6-04_ph04; USFWS_pp8.6-04_ph01	[The Services continue] *to have concerns about how well groundwater information will be able to drive vegetation distribution, especially with respect to scaling-up from focus areas and in predicting responses to Project alternatives that produce altered shallow aquifer water levels.*	AEA understands the Services' concerns regarding the need to assess the relationship between groundwater and vegetation distribution. However, AEA believes the FERC-approved Study Plan will adequately address (1) the causal relationship between groundwater and vegetation distribution and (2) scaling-up from Focus Area to Riparian Process Domain potential effects of Project operational alternatives on shallow aquifer water levels. As described in RSP Section 8.6 and the Study 8.6 ISR Part A, Sections 4.6, the modeling analyses will be completed in the final study year. Modeling results and scaling-up of Project operations effects will be included in the USR for baseline conditions and one operational scenario.
Objective 6: Riparian GW/SW Hydroregime and Plant Transpiration - Stable Isotope Analyses (ISR Section 4.6.2.1).		
NMFS_pp8.6-05_ph03; USFWS_pp8.6-04_ph03	*Investigating potential water sources for dominant woody and herbaceous species (i.e., precipitation, surface water from main and off channel areas, offsite groundwater sources) by stable isotope analysis is a sophisticated technique, although it may not directly produce a prediction of altered plant composition. To be most useful, plant xylem water should be collected during times of critical water stress (e.g., extended periods without precipitation and low groundwater levels), as well as times of abundance (e.g., periods of precipitation or high groundwater levels due to high river stage). These periods are not always easily defined in advance, but the June, July, and September sampling periods come close. Reporting the antecedent conditions for precipitation, river stage and groundwater for each sample period will be helpful in evaluating the potential to separate water sources for each sample period.*	AEA agrees that the June, July, and September sampling periods adequately address variation in weather conditions during a typical summer period. AEA will report the antecedent conditions for precipitation, river stage and groundwater for each sample period in evaluating the potential to separate water sources for each sample period. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 4.6), the modeling analyses will be completed in the final study year. Modeling results of Project operations effects will be included in the USR for one operational scenario.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.6-05_ph04; USFWS_pp8.6-04_ph04	[After the TWG meeting recommended by FERC's Study Plan Determination to discuss the sampling design for collecting plant xylem water,] *comments were submitted to AEA and FERC (USFWS, Henszey 2013). Concern was expressed that the end-member mixing analysis (EMMA) proposed to estimate the different water sources used by plants requires n-1 independent tracers to uniquely identify n water sources (Phillips and Gregg 2001, Barthold et al. 2011). Currently there are four potential water sources (n = 4), and only two tracers (Hydrogen and Oxygen isotopes), so at least one additional tracer will be needed to meet the required minimum of three independent tracers to guarantee a unique solution. In addition, the two proposed stable isotope tracers may not be independent, since their isotopic fractionation processes scale each other. Fieldwork has proceeded using only two tracers. However, substantial insight into water sources may be obtained with only two tracers. Thus it is not critical to expand analysis to include additional tracers at this point. Analysis of the collected isotope data is needed to explore how much separation of sources in plant water can be obtained without analyzing for additional tracers.*	AEA understands the Services' comment concerning end-member mixing analysis criteria, and specifically the opinion that to estimate water sources used by plants requires n-1 independent traces to uniquely identify n water sources. However, AEA maintains that adequate insight into water sources may be obtained with only two tracers as stipulated in the FERC-approved Study Plan. Therefore, AEA agrees with the Services that it is not critical to expand analysis to include additional tracers at this point. Analysis of the collected isotope data will be conducted exploring how much separation of sources in plant water can be obtained with two tracers. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.6), the stable isotope analyses will be completed in the final study year and presented in the USR.
Objective 6: Riparian GW/SW Hydroregime and Plant Transpiration - Characterization of Rooting Depths (ISR Section 4.6.2.2).		
NMFS_pp8.6-05_ph05; USFWS_pp8.6-05_ph02	*The root depth of dominant floodplain plants will be characterized by observing exposed roots along riverbanks, in trench excavations, and from soil core samples to determine root mass density. Observing exposed roots along riverbanks and in trench excavations is a generally accepted practice in the scientific community for describing root distribution dating back to at least Weaver (1915, 1919). There are methodological concerns about observations of root density (e.g., importance of non-suberized roots and details of washing roots from cores, Larenroth and Whitman 1971 and Sluiter et al. 2008).*	AEA finds that although it has been reported in the scientific literature that there may be methodological concerns characterizing non-suberized roots and details of washing roots from cores (Larenroth and Whitman 1971; Sluiter et al. 2008), the RIFS root characterization as described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.6), will adequately characterize the rooting depths to meet the objectives of the study design as stated in RSP Section 8.6.3.6.3. The river bank root depth characterization (Study 8.6 ISR Part A, Section 4.6) follows standard accepted methods as developed by Rood et al. (2011). Analyses will be completed in the final study year and reported in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.6-06_ph02; USFWS_pp8.6-05_ph04	*A substantial amount of root depth data has been collected and more sampling is proposed. However, the utility of that data needs to be considered before embarking on substantially more field data collection. Some of the original motivation for collecting rooting depth data was its importance as a component of the RIP-ET (Baird and Maddock 2005) module for MODFLOW (Harbaugh 2005, Baird and Maddock 2005) groundwater modeling. It is currently unclear that this module will be needed or implemented in the Groundwater Study (7.5).*	As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.6), RIP-ET module for MODFLOW modeling analyses will be completed as part of the Groundwater Study (RSP Section 7.5) in the final study year. This question was raised during the March 2016 ISR meetings. Modeling results of Project operations effects will be included in the USR. Rooting depth characterizations collected to date will be used in the riparian vegetation groundwater analyses to elucidate individual plant species and riparian plant community type groundwater depth relationships. Additional rooting depth field sampling will be completed and reported in the USR. The rooting depth analyses will inform not only the RIP-ET module, they provide individual plant species and community type rooting depths that will be utilized in the Riparian GW/SW study (Study 8.6 SIR, Appendix A: *Riparian Vegetation Groundwater / Surface Water Study Sampling Design*), and in the Riparian groundwater Project effects analyses.
Objective 6: Riparian GW/SW Hydroregime and Plant Transpiration - GW/SW and Riparian Vegetation Modeling (ISR Section 4.6.2.3).		
NMFS_pp8.6-06_ph03; USFWS_pp8.6-05_ph05	*There are two parts of this work. The first is to develop the RIP-ET module of MODFLOW in collaboration with the Groundwater Study 7.5 using data on rooting depths, plant transpiration, groundwater levels, leaf area, and weather observations. A considerable amount of uncertainty has developed about how widely MODFLOW will be utilized and whether the RIP-ET component will be used as a part of MODFLOW applications. RIP-ET was developed for arid and semi-arid regions where rivers are often strongly "losing," few trees and very low leaf areas are common away from the immediate vicinity of a river, precipitation is low, and potential evapotranspiration is high. Few of those conditions hold for the Susitna and vegetation-driven variation in ET may thus be considerably less important than in the locations where RIP-ET is most commonly used.*	As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.6), the modeling analyses will be completed in the final study year. The RIP-ET module will be developed for final MODFLOW applications using the transpiration measurements (ET; evapotranspiration) collected to date. However, consistent with AEA's proposed modification to eliminate further ET sampling (Study 8.6 ISR Part D, Section 7.2, Page 9; Study 8.6 SIR, Section 7.6.1, Page 15), further ET measurements will not be collected. This is likewise consistent with licensing participant recommendations resulting from a Riparian Technical Team meeting held April 29-30, 2014, and the understanding that the Susitna River valley is not a precipitation limited ecological region. However, an ET model will be developed to quantitatively assess the impact of ET as measured within the study Focus Areas to document that the study area is not precipitation limited relative to plant growth. The ET model results will be used in the RIP-ET module. Final modeling results of Project operations effects will be included in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp8.6-06_ph04; USFWS_pp8.6-06_ph01	*The second part of this work is the development of a data set of vegetation (collected in collaboration with Study 11.6) with concomitant surface water and groundwater conditions (produced by a combination of surface water and groundwater models, interpolation, and direct observation). The Rapid Vegetation Transect (RVT) vegetation sampling procedure was proposed in the 8.6 Study Implementation Report of 2015 to facilitate obtaining sufficient vegetation-hydrology replications. Additionally groundwater conditions at vegetation sampling locations will be obtained by a combination of direct well measurements, surface water observations of exposed groundwater, interpolation, and groundwater modeling. This seems likely to work for examining the current distribution of vegetation across sampled plots. It is less clear how well future conditions at other locations and under Project alternatives will be predicted with this approach to groundwater.*	As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.6), the modeling analyses will be completed in the final study year. Additionally, as described in the SIR (Study 8.6 SIR, Appendix A:*Riparian Vegetation Groundwater / Surface Water Study Sampling Design*), Rapid Vegetation Transect (RVT) vegetation sampling procedure will be used, along with groundwater depth statistics, to characterize riparian vegetation / groundwater relationships under existing conditions. Future conditions under Project operations alternatives will be assessed based upon these baseline conditions and future groundwater conditions as modeled by MODFLOW. Modeling results of Project operations effects will be reported in the USR.
Objective 6: Riparian GW/SW Hydroregime and Plant Transpiration - Riparian Plant-Frequency Response Curves (ISR Section 4.6.3).		
NMFS_pp8.6-07_ph02; USFWS_pp8.6-06_ph03	*This study component will develop quantitative relationships for dominant floodplain plant species and communities as determined by the GW/SW hydroregime. It will be valuable to include not only the deeper-rooted forest and shrub communities, but also the dominant shallower-rooted herbaceous communities. The shallower-rooted plant species and communities are likely to be more sensitive to regulated Project flows than the deeper-rooted species and communities.*	AEA agrees that an analysis of plant species rooting characteristics relative to groundwater regimes is an important element of the FERC-approved Study. The riparian plant-frequency response curve analysis is designed to identify which plant communities are dependent upon shallow groundwater conditions and which are not. Therefore, the Project effects analysis of GW/SW regime response to Project flow regime will address the question of rooting depth sensitivity to regulated Project flows and potential changes in groundwater regimes. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 4.6 and 5.6), the modeling analyses will be completed in the final study year. Deeper-rooted forest and shrub communities and dominant shallower-rooted herbaceous communities are included in the analysis. Modeling results of Project operations effects will be included in the USR.
NMFS_pp8.6-07_ph03; USFWS_pp8.6-06_ph04	*The biggest concern is how to use vegetation-response curves that depend on predicting hydrology at unsampled locations (scaling up) or under new conditions (post-Project). Reasonable capabilities for doing this with open-water surface water are available. Parallel capabilities for ice-covered surface water and groundwater are less certain to be available.*	AEA agrees that parallel capabilities for ice-covered surface water and groundwater are less certain; however, given the state of the science, AEA maintains that the FERC-approved Study Plan is adequate to meet the objectives and assess Project impacts. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 1-6, 8-10), the modeling analyses will be completed in the final study year. Modeling results of Project operations effects will be included in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
Objective 7: Floodplain Vegetation Modeling Synthesis and Project Scaling.		
NMFS_pp8.6-07_ph04USFWS_pp8.6-07_ph02;	*The proposed approach is sophisticated and ambitious. It has potential for providing excellent information for comparing alternatives at multiple scales. However, it depends on results of several other studies and a number of predictive models that are not yet built. As noted above, the aspects most likely to be limiting in both scaling up from focus areas and in predicting Project impacts are (1) groundwater regimes, and (2) physical disturbance from ice.*	The FERC-approved Study Plan (RSP Section 8.6) is adequate to characterize (1) groundwater regimes, and (2) ice processes physical disturbance regime. Scaling up from Focus Area to Riparian Process Domains and predicting Project impacts will be implemented as designed in RSP Section 8.6.3.4 (Characterization of the role of river ice in the establishment and recruitment of floodplain vegetation), RSP Section 8.6.3.6 (Characterization of natural floodplain vegetation groundwater and surface water maintenance hydroregime), and RSP Section 8.6.3.7 (Floodplain vegetation synthesis), Focus Area to riparian process domain model scaling, and Project operations effects modeling. These individual RIFS studies will produce results that are scalable utilizing the Riparian Process Domain approach described in RSP Section 8.6.3.2. Ice processes disturbance regimes are documented in the RIFS tree ice scar mapping study (RSP Section 8.6.3.4). These empirical results document the geographic areas of ice floodplain disturbance within the Project area under existing baseline conditions. The Ice Processes Study (7.6) modeling will predict where these ice processes will change due to Project effects. Together, the RIFS results and the Ice Process modeling of Project effects will identify areas where changes in the ice disturbance regime may have effects on floodplain vegetation. Additional discussion concerning the upscaling of groundwater is found above in Response to Comments, Section 2.4.1.2.2. Modeling results of Project operations effects will be included in the USR.
NMFS_pp8.6-08_ph06; USFWS_pp8.6-08_ph01	*Depth to groundwater and the time since successional resets caused by ice scour may be very strong determinants of riparian vegetation along the Susitna River. Observations on existing ice scars and groundwater near or between wells will support a reasonable analysis of the relationships between these variables and current vegetation. However, using these relations to scale up from focus areas or to predict post-Project vegetation will require models to predict these physical variables. Some of these issues have been acknowledged and discussed with respect to groundwater in a recent Technical Memorandum (Geo-Watersheds Scientific and R2 Resource Consultants, Inc. 2014). However, there is considerable uncertainty about whether the ice processes and groundwater studies will be able to generate physical predictions well enough to support vegetation predictions.*	Ice processes Project effects modeling will identify reaches of the Middle River where the volume and extent of ice formation will change. The identification and mapping of current Project area ice process floodplain effects and tree ice scar mapping study element (RSP Section 8.6.3.4), together with Ice Processes modeling (Study 7.6) will provide results necessary to identify where Project affected ice processes will change. These results will be used to identify riparian process domain reaches where vegetation will change in response to the change in physical process conditions. The Ice Processes modeling (RSP Section 7.6) will characterize the reduction in ice volumes and probable predicted locations of future ice jams under with-Project conditions. The Ice Process modeling (RSP Section 7.6) is state-of-the-science as of 2016. Together, Ice Processes (7.6) modeling predictions of Project-induced changes to the volume and spatial extent of ice formation, and empirical tree

Reference Number	Comment or Study Modification Request	AEA's Response
		ice scar analysis of floodplain ice influenced zones, will allow a reduction in the ice processes study uncertainty relative to the Project effects analysis results. The identified reaches of physical ice process change will then be analyzed as to the potential response of the existing plant communities to the changes in the ice process regime. Regarding the uncertainty concerning areas of groundwater Project effects, substantial progress has been made in the development and integration of groundwater models with other riverine models. Importantly, the design of the Groundwater Study (Study 7.5) was closely coordinated with the Riparian IFS (Study 8.6) and Fish and Aquatics IFS (Study 8.5) to meet the objectives of those studies. Model selections were based on resource needs within each Focus Area as well as Focus Area complexity. This resulted in the installation of wells that were largely transect oriented in FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek), with additional wells installed in FA-128 (Slough 8A) due to its complexity. Correspondingly, AEA is in the process of developing a 3-D MODFLOW model for FA-128; and 2-D transect based MODFLOW models for the other Focus Areas. These groundwater models will provide necessary outputs to support the vegetation predictions. Focus Area ice processes and groundwater Project effects will be used to scale-up to the riparian process domain. Finally, an analysis of identified Project effects change areas will be conducted evaluating existing vegetation communities and their GW/SW requirements as identified and quantified in the riparian vegetation-response curve analysis. Together, vegetation response predictions will be made for these reaches of projected groundwater regime change. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 1-6, 8-10), the modeling analyses will be completed in the final study year. Modeling results of Project operations effects will be included in the USR.
SRC_etal_WATER_ppAtt-42_ph04	*Although the fieldwork appears to have been largely completed, the final laboratory isotope analysis has not been completed. The majority of modeling analysis has yet to be initiated. Internal discussions appear to have only addressed the conceptual model for how spatially explicit floodplain models will respond to Project operations.*	The floodplain sediment and erosion study analyses will incorporate the results of the sediment isotope geochronological analysis in developing a model of how Susitna River floodplain terrain develops and how Project operations may or may not impact these processes. As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 1-6, 8-10), the modeling analyses will be completed in the final study year. Modeling results of Project operations effects will be included in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-42_ph12	*Comment: It is unclear how the ice-process modeling study will incorporate dynamic changes in bed evolution and vegetation with time. AEA needs to clarify how trees and other vegetation influence ice development and breakup and whether these are considered in the current ice modeling work. In addition, AEA needs to clarify how calibration error, predictive uncertainty, and limitations on simulating the correct physics of ice modeling (e.g., water flow over ice, breakup dynamics, anchor ice) will be tracked and fully considered in their DSS. Finally, AEA needs to clarify how local-scale (FA) ice process modeling will be up-scaled to the entire Middle River and Lower River.*	The Ice Process Study (7.6) is developing a calibrated model of dynamic thermal and ice processes. Channel bed evolution modeling is being developed by the Fluvial Geomorphology Modeling Study (Study 6.6). As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.4), the characterization of the role of river ice in the establishment and recruitment of dominant floodplain vegetation will be completed in the final study year. Questions regarding the DSS were common in a number of licensing participant comments, and AEA provided a consolidated response in Section 3.4.
SRC_etal_WATER_ppAtt-43_ph02	*Comment: Although fieldwork appears to have been completed, the majority of modeling analysis has yet to be started. As a result, it is difficult to comment on how Project operations will influence sediment transport and soil development, or plant community succession on floodplains. It is clear that a major impediment to making more progress on both the IFS and RIFS studies is lack of the projected range of hydraulic responses to reservoir operations. We recommend AEA use the recently developed hydraulic models (i.e., OWFRM version 2.8) to provide all studies with an initial possible range of hydraulic responses to Project operations. Important conceptualizations for individual studies would greatly benefit from knowing what the maximum hydraulic impacts might look like. Stakeholders are likely most interested in knowing what the maximum or worst-case impacts might be for any given operational scenario. This should be a critical component of individual studies.*	As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 4.5 and 5.5), the analysis of riparian vegetation response to Project operations effects on sediment transport, soil development, and plant community succession will be completed in the final study year. Modeling results of riparian vegetation hydraulic responses under Existing Conditions and one operating scenario, including maximum hydraulic impacts, will be included in the USR. See also AEA's consolidated response to Modification Requests, Section 3.4 (Susitna-Watana Integrated Modeling and Decision Support System).

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-43_ph03	*Comment: We question the use of MODFLOW for groundwater-surface water evaluations. It is well known that MODFLOW only simulates saturated flow conditions, and oversimplifies plant transpiration processes. Better tools exist to model the subsurface variable saturation conditions and associated recharge/evapotranspiration dynamics. As described in Section 4 of this memorandum, we recommend that AEA consider using more sophisticated, physically-based, and fully integrated tools that can much more readily incorporate surface water dynamics into this evaluation. As indicated above, MODFLOW also lacks the ability to simulate 3-D heat flow in groundwater, which is an important factor associated with the upwelling/downwelling associated with the salmon lifecycle. AEA should consider using a more appropriate code such as the Integrated Hydrology Model (InHM), Hydrogeosphere, or a similar code to evaluate the 3-D heat balance in groundwater. As described in the comments on Study 7.5, above, more work also needs to be done to consider how to upscale the FA groundwater/surface water coupling/modeling to the Project area.*	As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Section 4.6), the analysis of riparian vegetation response to the existing groundwater / surface water hydro-regime will be completed in the final study year. Modeling results of riparian vegetation response under Existing Conditions and one operating scenario will be included in the USR. FERC has approved the use of MODFLOW and RIP-ET (riparian-evapotranspiration MODFLOW package; Maddock et al. 2012) for riparian vegetation groundwater-surface water evaluations. Importantly, the design of the Groundwater Study (Study 7.5) was closely coordinated with the Riparian IFS (Study 8.6) and Fish and Aquatics IFS (Study 8.5) to meet the objectives of those studies. Model selections were based on resource needs within each Focus Area as well as Focus Area complexity. This resulted in the installation of wells that were largely transect oriented in FA-104 (Whiskers Slough), FA-115 (Slough 6A), and FA-138 (Gold Creek), with additional wells installed in FA-128 (Slough 8A) due to its complexity. Correspondingly, AEA has been developing a 3-D MODFLOW model for FA-128; and 2-D transect based MODFLOW models for the other Focus Areas. These groundwater models will provide necessary outputs to support the vegetation predictions. The Riparian IFS analysis of riparian vegetation groundwater / surface water interactions has no need for a 3-D heat flow factor model as it does not play a role in riparian vegetation physiology. However, AEA disagrees that there are no known methods for considering water temperature within a MODFLOW model platform. AEA has been developing methods for the simulation of groundwater heat transport including the use of the mass transport code MT3DMS (Zheng and Wang 1999). The mathematics of heat and mass transport are similar and MT3DMS can be used in conjunction with MODFLOW. MT3DMS has been used by others including Hecht-Mendez et al. (2010) and Zheng and Wang (1999) for simulation of heat transport in groundwater. The MT3DMS coding will be applied to MODFLOW where applicable. Temperature will be calibrated using the temperature data collected at all groundwater elevation stations as well as shallow streambed temperature profile data. This will be reported in the USR for Study 7.5.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WATER_ppAtt-43_ph04	*Comment: Details associated with the flow chart (Figure 8) associated with the April 29–30, 2014 TWG meeting (R2, 2014) below should be significantly revised to more clearly show how data, models, and critical decisions actually feed into each other. It should also be made consistent with other primary flow charts presented above (i.e., Figures 4.1-1a and 4.1-1b in the 8.5 IFS study). These flow charts are critically important for showing all stakeholders how data are used/transferred between studies, and how the various model inputs and outputs are shared. More importantly, these flow charts provide the basis for showing how the most important modeling, the scenarios linking all models in the DSS scenario, will be used to (1) assess impacts of Project operations on all resources, (2) summarize how Project operations may be optimized to minimize damage to these resources, and (3) characterize the considerable number of sources of uncertainties and their magnitudes. As in AEA's other attempts to show model interdependencies, these diagrams become confusing and contain inconsistencies. For example, in Figure 8, AEA needs to clarify which model(s) each of the blue ellipses actually depends on, and whether the blue ellipses are meant to indicate key decision points, or analyses. AEA also needs to articulate how this flow chart will fit into the larger, more important task of evaluating, via the DSS scenario, the various Project operational scenarios and their impacts on habitat. For example, in a DSS framework this figure should be reframed as loop system that clearly shows decision points and key outputs.* *The diagrams and descriptions in the ISRs and SIRs do not provide a clear understanding of how the complex studies/models will be integrated over space and time.*	As described in the FERC-approved Study Plan (RSP Section 8.6) and ISR (Study 8.6 ISR Part A, Sections 1-6, 8-10), the modeling analyses, including DSS scenario simulations, will be completed in the final study year. Modeling results of Project operations effects (DSS scenarios) will be included in the USR.

2.5.2.1. Response to Modification Request to Estimate Winter Mortality of Seedlings

NMFS (Modification 3-1; NMFS_pp8.6-03_ph05) and USFWS (Recommendation; USFWS_pp8.6-03_ph02) recommend estimating seedling winter mortality in order to get a sense of what locations are likely to result in ultimate pole and tree recruitment, and to help identify the importance of asexual reproduction in recruiting mature stands. They note that dendrochronology will continue to be a key tool in making these distinctions, along with recording ages of individuals by transect distance.

AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this analysis, over winter mortality, is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

The ISR Part D, Section 8 outlines the remaining steps to complete the FERC-approved Study Plan, with consideration of AEA's proposed modifications as outlined above as well as in ISR Part D, Section 7. Three sequential field seasons of seedling survival have been completed as designed in the FERC-approved Study Plan for this study (2013-2015). AEA maintains that the data collected is adequate to establish recruitment. Using existing data from this three-year field effort, overwinter mortality will be estimated in the final statistical analyses and ages of seedlings by transect distance will be noted, as provided for in the FERC-approved Study Plan (RSP Section 8.6.3.3).

As indicated in ISR Part D as one of the remaining steps to complete the study, ice-influenced and non-ice-influenced floodplain plant community composition, abundance, age, and spatial pattern will be quantitatively described and compared to assess the role and degree of influence ice processes have on Susitna River floodplain vegetation. The overwinter mortality analysis will be used with the quantitative descriptions of ice process influenced areas, as determined in the tree ice scar mapping, along with the Ice Process (Study 7.6) modeling results, to assess and characterize those channel margin and floodplain areas as potential seedling establishment zones that will be affected by Project-induced effects on the ice processes.

These analyses, when completed, will be presented in the USR.

2.5.2.2. Response to Modification Request to Estimate Winter Mortality of Seedlings

NMFS (Modification G-1; NMFS_pp8.6-07_ph05) and USFWS recommend conducting a careful analysis of the current data to determine which lines of investigation should be considered complete and which should be pursued further. NMFS states that the study was commenced as provided for in the approved Study Plan, but asserts that the huge snowpack in the 2012/2013 winter led to anomalous groundwater levels and growing conditions (environmental conditions) during the 2013 summer. NMFS suggests that since there is a delay in implementing the study, re-measuring the vegetation plots a few years after establishment would allow for observation of growth trends, increasing the value of the study.

AEA requests that FERC not adopt this proposed Study Plan modification because the request is not necessary to meet the Study Plan objectives. The request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established “good cause” as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Although NMFS claims that anomalous weather conditions occurred in 2013, as explained in Section 1.5.1, 2013 did not involve “anomalous environmental conditions” for the purposes of 18 CFR 5.15(d)(2).

It is true that 2013 was characterized by prolonged winter conditions and an unusually late arrival of spring conditions. However, meteorological conditions in 2013 would not be expected to affect the Riparian Vegetation Study (11.6) or Riparian IFS (8.6) vegetation study sampling results due to the fact that the predominant riparian vegetation communities are perennial plants and are adapted to the type of natural meteorological variability exhibited in 2013.

Historically, winter conditions and severity vary widely from year to year in Alaska and they can be expected to continue to vary in the future. As indicated by the following observations, conditions encountered during this study were within the range of expected conditions (J. Zufelt, HDR, Inc., 2016 personal communication):

- 2013 – early freeze-up, average winter overall (not “huge snowpack”, as asserted by NMFS), late break-up;
- 2014 – average freeze-up, slightly warmer than average winter overall, early break-up;
- 2015 – late freeze-up, warm winter overall, early break-up;
- 2016 – late freeze-up, warm winter overall, early break-up.

Late-winter and spring break-up conditions in 2013 were just within the range recorded in the 67 years of record, with 1964 being very similar but a bit later and colder and 1985 being slightly earlier.

The Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and NMFS makes no showing that the meteorological conditions in 2013 impaired the value of the data collected for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of gathering additional years of vegetation surveys would be high.

In addition, delays in the ILP do not constitute “good cause” per the ILP regulations to modify a FERC-approved Study Plan to extend the years of data collection. AEA implemented the Study Plan, gathered three years of data and will meet the study objectives with the existing data set. Additional years of data collection is not necessary to meet the study objectives.

Finally, it is not necessary to modify the Study Plan as NMFS requested to include an evaluation of the data gathered thus far as this is inherent to the FERC-approved Study Plan. As described in RSP Section 8.6 and Study 8.6 ISR Part A, riparian vegetation sampling has proceeded as designed. The 2013 summer environmental conditions (groundwater levels and growing conditions) were not outside the natural range of variability and therefore re-measuring vegetation plots during additional years is not necessary to complete the study as designed or meet the Study Plan objectives. As designed in the FERC-approved Study Plan, study leads continually conduct careful analysis of the data gathered to evaluate meeting study objectives and thus determine which lines of investigation are considered complete and what additional data is necessary to meet the study objectives. This has been occurring within studies and as a coordinated effort between the Riparian Vegetation Study (RSP Section 11.6) and the Riparian IFS (RSP Section 8.6), as well as other integrated riverine modeling studies.

In summary, the proposed modification to add additional years of vegetation sampling due to alleged anomalous environmental conditions and a delay in the ILP would add excessive cost to this study, and may not be feasible. Since the vegetation sampling was conducted as provided for in the FERC-approved Study Plan and the study objectives were met, the seedling sampling plots have already been removed from the field. The estimated cost of additional vegetation sampling is approximately $300,000 for two years of data collection—even though AEA has already collected data over three years and over a range of environmental conditions. Importantly, the seedling vegetation plots cannot be *resampled* because they cannot be accurately reinstalled.

For these reasons, AEA concludes that NMFS's proposed Study Plan modification is unnecessary and should not be adopted by FERC. Vegetation data already collected during this study are sufficient to fulfill the study objectives.

2.5.2.3. Response to Modification Request to Integrate Models

NMFS (Modification G-2; NMFS_pp8.6-02_ph02) requests the riparian instream flow modeling be integrated with other study models, specifically the Open-water Flow Routing Model (Study 8.5) and the fluvial geomorphology model (Study 6.6).

AEA requests that FERC not adopt this proposed Study Plan modification because the request is not necessary to meet the Study Plan objectives. The request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

Model integration is already part of the FERC-approved Study Plan and the goals and objectives of this study will be sufficiently met through the existing FERC-approved studies.

AEA has expended significant effort coordinating riverine modeling efforts and has demonstrated significant progress in model integration for the current ISR stage of licensing. AEA held a 3-day Riverine Modeling Technical Team meeting on November 13-15, 2013, and held a 3-day Proof of Concept meeting on April 15-17, 2014. AEA is continuing to gather baseline data, develop and calibrate riverine and other models, and ensuring model integration by continued coordination between resource study leads. For example, coordination meetings among riverine modelers were held in 2016 on May 9, June 1, June 21, July 27, August 31, and September 22 to resolve model interdependencies, ensure modeling results are correctly integrated, consider uncertainty, and fully meet the stated objectives of the various Study Plans.

The *Riparian Physical Process Modeling Technical Memorandum* (Study 8.6 TM, March 25, 2013), was specifically written to provide in depth documentation of physical process modeling integration supporting the Riparian IFS Study 8.6. See pages 1-2 (Section 1: Introduction) and page 4 (Section 2.3: Geomorphology and Floodplain Vegetation) for a summary of the requested integration. The objective of the *Riparian Physical Process Modeling Technical Memorandum* (Study 8.6 TM, March 25, 2013) was to provide: (1) a description of the various Riparian IFS physical process modeling elements, (2) illustrations of how each model contributes to specific Riparian instream flow studies, and (3) an integrated schedule of model deliverables. Table 1 in this TM provides the schedules for completion of studies that will be integrated into the Riparian IFS modeling. Tables 2 and 3 in this TM outline physical modeling input and output parameters that will be needed from or provided to other studies.

To date, Middle River Segment Open-water Flow Routing Model and SRH-2D hydraulic model have supported Riparian IFS in the preliminary analyses of 100-year floodplain inundations and FA-128 (Slough 8A) riparian seedling transect shear stress value modeling for August 2013 peak flow event, respectively. Further model refinements will include Middle River 1-D modeling of the 2-year, 50-year, and 100-year events in support of the ice processes and floodplain sedimentation study analyses (RSP Section 8.6). FA-104 (Whiskers Slough), FA-113 (Slough 6A), and FA-128 (Slough 8A) seedling transect shear stress values for the August 2013 peak flow will be modeled using the Fluvial Geomorphology Modeling (Study 6.5) 2-D modeling (RSP Section 8.6).

For completion of the FERC-approved Study Plan, Riparian IFS physical process modeling support will be conducted as detailed in the *Riparian Physical Process Modeling Technical Memorandum* (Study 8.6 TM, March 25, 2013). Specifically, the following Riparian IFS study elements will utilize physical process modeling support as reported in the RSP: RSP Section 8.6.3.2 (Focus Area selection-riparian process domain delineation), RSP Section 8.6.3.3 (Characterization of seedling establishment groundwater and surface water hydroregimes), RSP Section 8.6.3.3.1 (Synchrony of seed dispersal, hydrology, and local Susitna River valley climate), RSP Section 8.6.3.4 (Characterization of the role of river ice in the establishment and recruitment of dominant floodplain vegetation), RSP Section 8.6.3.5 (Characterization of the role of erosion and sediment deposition in the formation of floodplain surfaces, soils, and vegetation), RSP Section 8.6.3.6 (Characterization of natural floodplain vegetation groundwater and surface water maintenance hydroregime), and RSP Section 8.6.3.7 (Floodplain vegetation study synthesis), Focus Area to riparian process domain model scaling, and Project operations effects modeling.

Baseline conditions and one alternative operational scenario will be reported in the USR for all Riparian IFS (8.6) physical process modeling as detailed in *Riparian Physical Process Modeling Technical Memorandum* (Study 8.6 TM, March 25, 2013).

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2.6. Fish and Aquatic Resources

2.6.1. Study 9.5 – Study of Fish Distribution and Abundance in the Upper Susitna River

As established in the Study Plan[24] (RSP Section 9.5.1), the goal of this study is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous fish species as well as freshwater rearing life stages of anadromous salmonids in the Upper Susitna River.

There are eight specific objectives of the Fish Distribution and Abundance in the Upper Susitna River Study, as described in the RSP (Section 9.5.1). Data collected as part of this study will be used to provide a baseline characterization of fish assemblages in the Susitna River, to identify and evaluate potential Project-induced effects on fish assemblages, and inform development of any necessary protection, mitigation, and enhancement measures. This goal will be achieved by completing the following eight objectives.

- Objective 1: Describe the seasonal distribution, relative abundance, and fish habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes.
- Objective 2: Describe seasonal movements of juvenile salmonids and selected fish species such as Rainbow Trout, Dolly Varden, Humpback Whitefish, Round Whitefish, Northern Pike, Pacific Lamprey, Arctic Grayling and Burbot within the hydrologic zone of influence upstream of the Project.

[24] The FERC-approved Revised Study Plan (RSP) Section 9.5 for the Fish Distribution and Abundance in the Upper Susitna River Study (FDAUP) as modified by FERC's Study Plan Determination (Study 9.5 SPD, April 1, 2013) and *Final Susitna River Fish Distribution and Abundance Implementation Plan* (Study 9.5 and 9.6 IP, March 1, 2013) is collectively referred to as Study Plan Section 9.5.

- Objective 3: Describe early life history, timing, and movements of anadromous salmonids.
- Objective 4: Characterize the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type.
- Objective 5: Determine whether Dolly Varden and Humpback Whitefish residing in the Upper River exhibit anadromous or resident life histories.
- Objective 6: Determine baseline metal concentrations in fish tissues for resident fish species in the mainstem Susitna River (see Studies 5.5 and 5.7).
- Objective 7: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (Northern Pike).
- Objective 8: Collect tissue samples to support the Genetic Baseline Study for Selected Fish Species (Study 9.14).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes nine modifications to Study Plan Section 9.5:

1. ELH sampling to take place every two weeks from ice breakup through the end of June;
2. at each site, 25 fish per species/life stage will be weighed and measured and PIT tagged if appropriate;
3. PIT antennas will be relocated to smaller water bodies to improve stream coverage;
4. single-pass sampling will be used;
5. tributary sampling lengths and distances will be modified as described in the September 17, 2014 Tech Memo: *Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation Technical Memorandum*;
6. a hybrid sampling approach will be implemented so that the mainstem transect target will be reduced from 10 to 20 and sampling in off-channel habitat types will be increased as described in the September 17, 2014 Tech Memo: *Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation Technical Memorandum*;
7. rotary screw traps will be operated at the mouth of the Oshetna River and PRM 200 and a fyke net will be used at mouth of Kosina Creek and its clearwater plume;
8. direct sampling will be used to sample unnamed tributaries 197.7, 204.5, and 206.3, as described in the September 2014 Tech Memo; and
9. the gear specifications and descriptions of field application outlined in IP Appendix 3: *Protocol for Site-Specific Gear Type Selection, Version 5* will be followed.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, licensing participants submitted comments and proposed study modifications for Study 9.5. On June 22 and 23, 2016, AEA received comments on Study 9.5, including its proposed modifications outlined above from ADF&G, NMFS, and USFWS. Comments from the agencies included 20 study modifications, some of which overlapped between agencies, and numerous comments about study details. AEA's responses to the proposed modifications and comments can be found in Table 2.6.1-1 and below. For the narrative responses, AEA organized similar comments by topic to provide integrated responses and facilitate review.

To supplement responses to agency comments, AEA has prepared two technical documents. The purpose of these reports is to provide stakeholders with detailed study status updates related to the FERC-approved Study Plan. The first technical memorandum, *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (FUHI), demonstrates AEA's approach to combining catch-per-unit-effort (CPUE) metrics for multiple gear types to evaluate relative abundance and habitat associations under Objective 1 (Attachment 7). Multiple gears were necessary to capture the diversity of fish species and life stages present in the study area in the most efficient and consistent manner to meet Objective 1. The second technical report, *2013-2015 Radiotelemetry Implementation Report*, is a detailed analysis of the movement of radio-tagged fish in support of study Objectives 2, 5, and 7 (Attachment 8). This fish movement memorandum uses data that was put through a rigorous quality control process to describe the whereabouts and home range size of fish during different seasons, the use of tributaries and the mainstem, use of the reservoir inundation zone/zone of hydrologic influence, and movements (including past the proposed Watana Dam location).

Table 2.6.1-1. Study 9.5 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp12_ph3	*We were consulted on the variety of methods used for sampling. … We support the sampling design and use of the generalized random tessellation stratified samples methodology, and the proposed modifications to provide a more robust and representative sampling effort.*	AEA appreciates ADF&G's constructive participation in the development of this study plan and review of study plan implementation within the context of the FERC ILP.
ADNR_ADFG_pp12_ph3	*We agreed with replacing the rotary screw trap in Kosina Creek with fyke nets near the confluence of Kosina Creek and the Susitna River and siting a rotary screw trap in a mainstem Susitna River location near the proposed damsite.*	Comment is noted.
ADNR_ADFG_pp12_ph3	*We support AEA's tagging efforts and concur that variances will not impact AEA's ability to meet the study objective of describing seasonal movements of selected fish species within the zone oh hydrologic influence upstream of the project.*	Comment is noted.
ADNR_ADFG_pp12_ph3	*We concur and acknowledge some of the areas likely support low densities of fish species and information from other studies can help describe the seasonal use of habitats.*	Comment is noted.
ADNR_ADFG_pp12_ph3	*We believe significant progress has been made and that the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's constructive participation in their review of study implementation within the context of the FERC ILP. AEA concurs that the study is on track to meet the FERC-approved study objectives.
ADNR_ADFG_pp13_ph1	*Section 2.1: The last sentence needs to be corrected to convey the actual length sampled if the entire unit was not. Currently it says the sample length was up to 00 m (656328 ft). We believe it should read 200m (656 ft).*	The last sentence of section 2.1 of the *Evaluation of 2014 Study Modifications in the Black River TM* (Study 9.5 TM, December 17, 2014) referring to 2013 sampling should read: "Specifically, within a selected Generalized random tessellation stratified sampling (GRTS) panel, fish sampling occurred in either a complete mesohabitat unit or up to 100 meter (328 feet) per mesohabitat for each mesohabitat type present." (Study 9.5 ISR, Section 7.1.2.4)
ADNR_ADFG_pp13_ph2	*4.3.1.1 Field Methods: Capture efficiency varies by species/life stage, habitat and gear type. Comparisons of CPUE between gear types will not provide reliable information. Collecting CPUE using multiple gear types will make comparisons between habitat types (or species, sites or life stages) unrealistic, if each habitat type (or other factor) is sampled with different gear.*	Multiple gears were necessary to capture the diversity of fish species and life stages present in the study area. AEA chose to employ the most efficient gear types at each mesohabitat unit given the conditions at the time of sampling. To address the difficulty of making comparisons of fish abundance with different gear types, AEA developed a statistical method to combine the CPUE of various gears.

Reference Number	Comment or Study Modification Request	AEA's Response
		This method is described in the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7). See response to USFWS_pp2_ph4, Section 2.6.1.5.1 below.
NMFS_pp9.5-1_ph3	*First, Alaska Energy Authority (AEA) must describe the basic process of how the results of the study will be used to estimate project effects on fish populations, and provide statements about what is an acceptable level of accuracy and precision. Second, data collected in all sampling activities need to be made accessible and fully documented. And third, the data should be appropriately summarized and interpreted and statistical methods used in this process should be fully documented.*	See Section 2.6.1.4. below.
NMFS_pp9.5-2_ph2	*Many study components of Study 9.5 remain incomplete or not attempted at all. These include a mark recapture study to estimate rotary trap efficiency that was not conducted; association of movement patterns in relation to water conditions (discharge, temperature, and turbidity) that was not summarized; collection of tissue samples for mercury and other baseline metals that was below goal (and only mercury concentrations were measured); and only opportunistic fish stranding and trapping data were collected and not analyzed.*	AEA disagrees with the Services' characterization of study completeness, specifically, that certain study components were not attempted or were below goals. See Section 2.6.1.1.1 below.
NMFS_pp9.5-2_ph3	*The objectives of the FDA study were not met through implementation of the first study year field methods (2013 and 2014) and data analyses as described within the Initial Study Report (ISR) and associated technical memoranda.*	AEA disagrees with this statement. The ILP process includes two years of data collection. To date, through the ISR, the 2014 SIR, and associated Technical Memoranda one year of data collection has been completed for most of the study components in the FERC-approved Study Plan, although three years of field data collection has occurred in the Upper River. AEA has demonstrated progress towards meeting study objectives. AEA expects that the Study Plan objectives will be met upon completion of the second year of the study.
NMFS_pp9.5-3_ph12	*Modification 1: NMFS recommends the sampling of fish distribution and abundance be modified to include the mainstem and tributaries upstream of the inundation zone. The approved Upper River FDA study was developed to document existing conditions within areas that would potentially be altered directly, indirectly, or cumulatively by the proposed project. We now have good information proving salmon presences above the dam site which we did not have when the study plan was written. This new information justifies the modification.*	As explained below in Section 2.6.1.2.2, AEA requests that FERC not adopt this proposed Study Plan modification. NMFS does not provide details in their modification request on where and how intensively sampling would occur making it difficult to estimate costs. Seasonal sampling upstream of the current study area up to the East Fork of the Susitna River at a similar level of effort would include an additional 20 selected tributary streams and 76 miles of mainstem

Reference Number	Comment or Study Modification Request	AEA's Response
		sampling using a GRTS approach, and operation of a downstream migrant trap on the mainstem upstream of the Oshetna River. The estimated cost of implementing this modification is $3,200,000.
NMFS_pp9.5-4_ph3	*Modification 2: NMFS recommends the fish distribution and habitat association sampling be modified to use the Proposed Study Plan and Revised Study Plan proposed site selection method, consistent with our comments (11/14/2012 & 3/18/2013). This method included using systematic-random selection of 10 or more replicate sampling units per macrohabitat. The FDA Implementation Plan (FDAIP) altered this to 30 total systematic transects in the Upper Susitna. Finally NMFS recommends again that in the upper Susitna, three macrohabitats (main channel, split main, multiple split main) are treated as one and called simply "main channel".*	As explained below in Section 2.6.1.6.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming 60 days of effort to complete seasonal sampling of five macrohabitats at each of 30 transects, the estimated cost of implementing this modification is $1,260,000 annually.
NMFS_pp9.5-4_ph4	*The mainstem habitat sampling approach of the FDA Implementation Plan using systematic transects inadequately represents the Upper River main channel and off-channel fish distribution and habitat association.* *The sampling methodology reported in the 2014–2015 Study Implementation Report (SIR) was incomplete and inconsistent with the FERC approved study plan. Methods for site selection were changed in AEAs FDA Implementation Plan to select sites crossed by only 20 (reduced from 30) systematically placed transects. AEA did not sample all transects as proposed within the FDA Implementation Plan, and the sampling approach did not provide adequate replication of macrohabitats in the 2013 or 2014 sampling seasons. The SIR states that six side sloughs and six upland sloughs were sampled. However, AEA only sampled four upland sloughs, with two sampling units each in two sloughs (SIR, Figure A4). In one of the sampled sloughs, sampling units P90 and P94 were 120 meters (SIR, Table 4.3-4) instead of sampling the entire 240 m sampling reach as one sample site as provided for in the approved plan.* *This sampling effort does not meet the minimal requirements of the FERC approved study plan and should be considered insufficient to describe fish distribution, relative abundance and habitat association for the Upper River segment of the Susitna River. Further, we still maintain the FERC approved FDAIP methods are inadequate to meet our requested study objectives. Therefore, we request FERC reconsider our RSP comments (3/18/2013) regarding mainstem site selection.*	The Upper River was sampled using systematic random sampling of available habitats at all 20 transect locations, as detailed in the Fish Distribution and Abundance Implementation Plan (IP) a component of the FERC-approved Study Plan. Variances in methods did occur and all variances including: sampling lengths and number of transects sampled were described in Section 4.1.6.1.1 of Study 9.5 ISR Part A. AEA agrees that the systematic sampling in 2013 did not result in sufficient replicates of the less common side and off-channel habitats. In Section 7.1.2.5 of Study 9.5 ISR Part C, AEA proposed modifications to the mainstem sampling approach. AEA then implemented these modifications in 2014, reported the efforts in the *Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation TM* filed September 17, 2014, and recommended that this approach be continued for future studies. See Section 2.6.1.6.1 for further discussion on AEA implementation and pilot study results.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.5-5_ph3	*Modification 3: NMFS recommends sampling entire tributary mouths as a macrohabitats at the confluence of tributaries and the Susitna River or its side channels. Sampling in this macrohabitat should not be limited to clear water plumes based on visual estimates of clarity. Sampling within tributary mouths should include the portion of the tributary influenced by the mainstem (zone of hydraulic influence) and 200 m downstream whether or not a clearwater plume is visible.* *FERC's study plan determination recommended that clearwater plumes be classified at level 4 (dividing main channel habitat into pool, riffle, run and rapid mesohabitats) and defined tributary mouth sampling units to extend 200 m downstream. AEA did not sample these entire tributary mouth sampling units but selected to sample clearwater plumes independent from tributary mouths. AEA, therefore, did not implement the FERC approved study plan. We recommend FERC require AEA to conduct the study as required.* *AEA's selection of clearwater plumes as a unique sampling unit disassociates this habitat feature from the associated tributary. As such, the completed studies are inconsistent with how this habitat feature is included. There are instances in which only the clearwater plume was sampled verses the tributary mouth and not the mainstem habitat downstream from the tributary mouth. Tributary mouths are the level 3 classification type and are clearly identifiable during all seasons; they should not be refined in the field, based solely on one day's visual observations. Biotic (invertebrates) and abiotic (chemistry, water quality, temperature, etc.) characteristics will be different between the mainstem downstream from a tributary mouth and should be sampled as complete units.*	AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions. During the study planning process, it was determined that tributary mouth and clearwater plumes are unique features, consistent with 1980s. Therefore, consistent with the overall study design, tributary mouth and clearwater plumes were considered unique strata for the selection of sampling units. While this approach disassociates particular mouths from plume as they are selected independently, it allows for data collection that is more representative and biologically meaningful regarding how these features are used by fish. It is not clear how paired samples of these geomorphically unique habitat features would have been categorized in the context of the hierarchical habitat approach, one a level four main channel feature dominated by mainstem process and the other a level three feature dominated by tributary processes. Additionally, if no clearwater plume were present downstream of a tributary mouth, which occurred for several tributaries, then sampling would have represented an additional mainstem sampling unit and AEA already had sufficient replicates of mainstem habitats. When present, the influence of clearwater plume habitats in the mainstem were highly variable, for example half (14 of 28) of the plumes sampled in the were less than the recommended 200-meter sample length and some were as small as 10 meter, and in rare instances the plume was dissociated from the tributary because no tributary mouth was present (water went sub-gravel). Furthermore, the sampling of replicate clearwater plumes and tributary mouths was expanded in 2014 with AEA proposed modification to implement a hybrid sampling approach in the Upper River (see Section 2.6.1.6.2 below regarding hybrid approach). Assuming that

Reference Number	Comment or Study Modification Request	AEA's Response
		all 50 tributary mouths and clearwater plumes in the Upper River are sampled seasonally, the estimated cost of implementing this modification is $800,000 annually.
NMFS_pp9.5-6_ph1	*Modification 4: NMFS recommends sampling be conducted over the area described in the FERC study determination. All sampling units of side sloughs, upland sloughs and tributary mouths should be 200 meters long. Sampling within upland and side sloughs should begin at the confluence with the mainstem, include the mixing zone of turbid and clear water, when present, and extend upstream into the slough. For main channel and side channel sampling locations boat electrofishing and set or drift nets should effectively sample the entire 500 m sampling unit. We further recommend modifying this study to include subsampling units of 200 m of shoreline using baited minnow traps and backpack electrofishing to sample for juvenile salmonids and resident fish species as proposed in our RSP comments (03/18/2013) and as proposed by AEA.*	As explained below in Section 2.6.1.8.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming 12 sloughs are available for sampling in the Upper River, the estimated cost of implementing this modification is $150,000 annually.
NMFS_pp9.5-6_ph4	*Modification 5: NMFS recommends fish sampling occur throughout the entire tributary sampling units as required in the FERC study determination, and that sampling units include 25% of the tributary length as proposed. Sampling unit lengths are 200 m, 400 m, or 800 m based on drainage area as described in the FDA implementation plan for fish distribution and abundance.* *AEAs proposed study modification (ISR Part C 7.1.2.4) is unclear. Analysis presented in AEA's Black River Technical Memorandum does not support a reduction in tributary sampling area. AEA is not proposing to sample the entire sampling unit, but "apportioning the additional sampling length within existing panels [sampling unit] by increasing the number of replicates of mesohabitats units sampled per panel."*	As explained below in Section 2.6.1.7.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming that tributary GRTS panels are sampled in their entirety as described in the RSP (over 33,000 meters each season), the estimated cost of implementing this modification is $3,500,000-$5,000,000 annually.
NMFS_pp9.5-7_ph3	*The ISR proposed modification is to sample stream lengths based on the recommendations by Kirsch et al. (2014) and sample units as required in the FERC approved study plan. In all the sampled tributaries (except for the Black River), modified sampling lengths proposed in the ISR for future sampling are up to 5 km less than the tributary sampling lengths in the FERC approved study plan (Table 1). The Technical Memorandum demonstrates that the subsampling conducted in 2013 is insufficient to meet study objectives; however, it does not evaluate whether targets proposed as a study modification, which are a reduction from sampling lengths in the FERC approved study plan, are adequate to meet study objectives.*	As explained in Section 2.6.1.7.1, AEA disagrees that the proposed modifications to tributary sample length are inadequate. AEA developed and tested the modified tributary sample lengths based on generally accepted scientific practices.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.5-8_ph2	*Modification 6: NMFS recommends spring sampling be conducted as proposed in the RSP for fish distribution and abundance in May or early June (in addition to the two summer and a fall sampling events) at all sampling locations.*	As explained below in Section 2.6.1.3.2, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming the same level of effort as NMFS Modification 5, the estimated cost of implementing this modification is $1,200,000-$3,500,000 annually.
NMFS_pp9.5-9_ph2	*NMFS recommends a minimum of two years of data collection needs to be completed as described in the FERC approved study plans.*	AEA asserts that two years of data collection under the FERC ILP process is sufficient for baseline characterization of aquatic resources to support impact analysis. The Upper Susitna River has been subject to intensive study of both juvenile (Study 9.5 and 9.8) and adult (Study 9.7 and 9.8) Chinook Salmon distribution. AEA implemented data collection in the Upper River in 2012, 2013, and 2014, exceeding the expectations of the FERC-approved Study Plan and an additional year of sampling is planned as proposed in Sections 7 and 8 of the ISR Part D. It has become clear that a very small number of Chinook Salmon spawn in the Upper River and that the distribution of juveniles, while patchy, is limited to several spawning tributaries and the downstream migration corridor.
NMFS_pp9.5-9_ph4	*Modification 7: NMFS recommends the study plan be expanded to include a description of how the various data will be turned into quantitative estimates so that rigorous comparisons can be made across species, river habitat types and time.* *The sampling plan should be reevaluated so that there is a tight linkage between the sampling design and the estimates and statistical inferences that will be drawn from the data. Estimates should be presented with appropriate measures of sampling error (confidence intervals or standard errors). NMFS recommends that statistical tests are used to determine if differences in mean relative abundance measures are significantly different among habitat classifications at all classification levels 1 through 3.*	As explained below in Section 2.6.1.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. AEA has demonstrated how relative abundance estimates are combined and rigorous comparisons are made across habitat types and seasons in the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7). As such, there is no additional cost for implementing this modification.
NMFS_pp9.5-9_ph6	*Modification 8: NMFS recommends sampling a minimum of 20 baited minnow traps fished for 20 to 24 hours for every 200 m of sampling unit length to document the seasonal distribution and relative abundance of juvenile Chinook and Coho Salmon. Fyke nets and hoop traps, and beach seines can be used to augment minnow trapping and electrofishing for fish distribution, but should not be used to derive estimates of relative abundance.*	As explained below in Section 2.6.1.5.3, AEA requests that FERC not adopt this proposed Study Plan modification. Minnow trapping is only appropriate in certain habitats and is species and size selective and would not adequately sample the diversity of fish species present in the study area. AEA proposed to continue to implement an approach where the most effective gear types are used in each

Reference Number	Comment or Study Modification Request	AEA's Response
	The generally accepted scientific practice is to apply consistent methods and effort among sampling units (mainstem macrohabitats and tributary sampling reaches) to properly compare relative abundance by species and age class among habitat classification types. This supports testing for statistical differences in fish abundance or community composition among habitat types or trends in fish metrics due to differences in physical or chemical characteristics. This is a critical step to meet the approved study objective. We found no record of a published scientific study where relative abundance using different sampling methods was compared among sampling sites (i.e. electrofishing at one site compared to fyke nets or minnow traps at another).	habitat type and had developed a statistical approach to combine catch-per-unit metrics in the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7). Assuming that the study is redesigned and re-implemented the estimated cost of implementing this modification is $3,400,000-$5,500,000 annually.
NMFS_pp9.5-10_ph2	*The ISR describes fish collection methods that varied in sampling area, sampling methods, and sampling effort. Fish data were collected at one location or sampling date using electrofishing; a fyke net data during another sampling location; and minnow trap data at a third. Electrofishing time varied among sampling locations from seconds up to 20 minutes. Units of metrics of relative abundance or community composition were different and not comparable among sites (i.e. catch/time/area, catch/trap/area, or catch/net/area). The data cannot be compared among sites and, therefore, the study goal of evaluating distribution and habitat association cannot be achieved.*	See Section 2.6.1.5.2 below.
NMFS_pp9.5-10_ph4	*Lastly, all sampling locations, sample unit length and area, sampling date, sampling methods, effort for each method (electrofishing time, number of seine hauls, number of minnow traps and hours fished, snorkel time, number of fyke nets and hours fished), macrohabitat classification, and length and area of each mesohabitat within the sampling unit, be recorded and reported. A consistent methodology with statistically sound data and well documented methodology is the generally accepted scientific practice.*	All data collection efforts that support analysis of the ISR (http://gis.suhydro.org/isr/09-Fish_and_Aquatics/9.5-Fish_Dist_and_Abund_UpperSusitna/) and SIR (http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.5 Fish_Dist_and_Abund_Upper_Susitna/) were made available in a relational database as described in the Implementation Plan (Study 9.5 and 9.6 IP, March 1, 2013: *Final Susitna River Fish Distribution and Abundance Implementation Plan*) and FERC Study Plan Determination (April 1, 2013). These datasets include requested documentation of sampling location, date, habitat type, length, width, methods, effort, and catch. Field data were collected and entered in a database and checked for quality assurance/quality control in a consistent, rigorous, and well documented manner including copies of draft field forms, as described in great detail in the Implementation Plan (Appendices 10-12).

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NMFS_pp9.5-10_ph5	*Modification 9: FDA studies in the main and side channel should be modified to include methods in addition to boat electroshocking such as baited minnow traps and backpack electroshocking along the adjacent bank to capture juvenile salmon.*	As explained below in Section 2.6.1.8.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. AEA proposes to continue the use of the most effective gear types in each habitat at the time of sampling.
NMFS_pp9.5-10_ph7	*Modification 10: NMFS recommends that sampling of fish distribution and abundance should be geographically expanded to include the mainstem and tributaries upstream of the inundation zone.*	As explained above in NMFS Modification Request 1 and below in Section 2.6.1.2.2, AEA requests that FERC not adopt this proposed Study Plan modification. NMFS does not provide details in their modification request on where and how intensively sampling would occur making it difficult to estimate costs. Seasonal sampling upstream of the current study area up to the East Fork of the Susitna River at a similar level of effort would include an additional 20 selected tributary streams and 76 miles of mainstem sampling using a GRTS approach, and operation of a downstream migrant trap on the mainstem upstream of the Oshetna River. The estimated cost of implementing this modification is $3,200,000.
NMFS_pp9.5-11_ph3	*Adult salmon escapement studies (ISR 9.7) have documented the movement of Chinook Salmon into the headwaters of the Susitna River. AEA contractors have stated during fish passage Technical Team meetings that large 2+ Chinook salmon have been captured in Upper River tributaries. Since Chinook Salmon are known to have a 1 year freshwater residency, these fish were more likely Coho Salmon (see our Study 9.6 comments (9/22/14) for a discussion on Fish Identification errors). The Tyone River, Maclaren River and Clearwater Creek all appear to provide abundant salmon spawning and rearing habitat (see ADFG enhancement Report). With salmon identified above the proposed inundated area as well as spawning habitat, there is a need to understand the out migration behavior of these species.*	See Section 2.6.1.2.3 below.
NMFS_pp9.5-11_ph4	*Modification 11: NMFS recommends a downstream migrant screw trap at the proposed dam location and an additional one at the reservoir head be installed and operated for a minimum of two years during the open water seasons as required in the FERC determination.*	As explained below in Section 2.6.1.10.2, AEA requests that FERC not adopt this proposed Study Plan modification. This modification would require operation of two additional downstream migrant traps for two years at a cost of

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		$300,000 per trap per year. Half of this cost would be duplicative with cost of downstream migrant trapping under Modification 1. The estimated cost of implementing this modification is $1,200,000.
NMFS_pp9.5-12_ph3	*Modification 12: NMFS recommends that FERC reconsider NMFS's RSP comments (3/18/2013) which recommended that rotary screw traps be placed in the main channel just downstream from the mouth of the Oshetna and Kosina Creeks to capture fish migrating from these tributaries and fish migrating downstream within the Susitna River mainstem. The screw traps at the mouth of the Oshetna and Kosina Creeks should be operated 7 days a week to document the movement of juvenile Chinook Salmon to mainstem rearing and overwintering habitats. AEA should conduct the population estimates and assess the efficiency of the migrant trap as described within the FERC approved study plan.*	As explained below in Section 2.6.1.10.1, AEA requests that FERC not adopt this proposed Study Plan modification. To increase the trapping schedule to seven days a week would increase the per-trap cost to approximately $850,000 annually. The estimated cost of implementing this modification for two study years is $5,100,000.
NMFS_pp9.5-12_ph4	*Following the 2013 sampling season, AEA has requested a study modification to move the Oshetna screw trap to the Susitna River and replace the Kosina Creek trap with fyke nets. We support the screw trap be relocated to the Susitna River mainstem downstream from the confluence with the Oshetna Creek. We do not support AEAs modification to replace screw traps with fyke nets in Kosina Creek.*	See Section 2.6.1.10.2 below.
NMFS_pp9.5-12_ph6	*AEA has not tested the efficiency of using a fyke net instead of screw traps. We are concerned with the use of fyke nets set for 20 to 24 hours at a time. It is our experience that maintaining ¼ mesh net in flowing water for this duration is difficult if not impossible as nets become clogged with debris. While fyke nets may have been effective at catching fish in Kosina Creek as AEA asserts (ISR Part C), AEA did not test the efficiency of these traps or provide a description of trap condition over time. Rotary screw traps were designed to overcome the limitations of maintaining a fine net in flowing water.*	See Section 2.6.1.10.1 below.
NMFS_pp9.5-13_ph2	*Modification 13: NMFS recommends assessing the migration of juvenile Chinook from Kosina Creek and Oshetna River into the Susitna downstream from the confluence through sampling once a month June through September in both the tributaries and directly downstream in the Susitna. We recommend expanding the data collection using differences in the relative abundance of juvenile salmonids in tributaries over time, in addition to screw trap data to determine movement patterns. Based on 2013 results, it does not appear that the PIT tagging study will provide any useful data regarding fish movement patterns or growth rates of juvenile salmonids.*	As explained below in Section 2.6.1.9.2, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming that 10 days a month per tributary are allocated for directed sampling efforts in Oshetna and Kosina Creeks, the total estimated cost of implementing this modification for two years is $1,000,000.

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	…There were not enough recaptures or tag detections to meet study objectives. There were no results for Chinook Salmon movements due to few tagged fish, and no recaptures of tagged individuals. The RSP stated that all juvenile salmon would be tagged yet only 22 of 242 captured Chinook Salmon were tagged in 2013. Only Arctic grayling had enough PIT tagged fish recaptures to provide results for movement between habitats. However, all but one of these recaptures show longitudinal movements within tributaries, upstream of the hydrologic zone of influence (at PIT antennas and rotary screw traps), and the movements are incorrectly described as between macrohabitat types. The macrohabitats described were single, split, and complex tributary channels, all which would be main channels of a tributary according to the tiered habitat classification system. *Our RSP comments recommended that more intensive tributary and mainstem sampling replace the PIT tag study to determine movement patterns of juvenile salmon. We reiterate the need to expand the sampling capacity.*	
NMFS_pp9.5-15_ph3	*The RSP, Implementation Plan, and ISR do not state the mesh size of screw trap live boxes. Depending on mesh size emergent fry may not be retained in live boxes. The study methodology should clearly describe features of the screw trap. Mesh size used to construct live boxes should be < 2 mm or ~ 1/8 inch. We want to ensure that juvenile salmon, grayling, and other resident fish that emerge from tributary spawning locations and migrate downstream to the Susitna River are retained within trap live boxes.*	Rotary screw traps have a galvanized wire mesh rotary debris drum with a mesh size smaller than 1/8-inch diameter. See Section 2.6.1.10.3 below.
NMFS_pp9.5-15_ph4	*Modification 14: NMFS recommends the first 100 of each species on each sampling date at each sampling location should be weighed to the nearest 0.1 gram. All fish captured as part of the FDA study should be measured to fork length as required in the study plan determination. Differences in average lengths and weights over time and among habitats can be an indication of differences in growth and habitat quality. Differences in lengths or weights over time and among locations can be analyzed relative to water quality parameters to determine those variables influencing the growth rates of resident fish and juvenile salmonids. The fork length of all salmonids should be measured in the field as required in the study plan determination. In collecting weight of fish, AEA measured juvenile salmonids to the nearest gram. At a minimum, AEA should obtain weights to the nearest 0.1*	AEA requests that FERC not adopt this proposed Study Plan modification. In the ISR Part D, AEA proposed to continue to measure the length and weight of a represented subsample of 25 individuals per species, per life stage. Weighing and measuring a subsample of fish reduces excessive holding time and stress and is practical when large numbers of juvenile fish are collected. Collecting lengths on all fish collected is time prohibitive and would result in high mortality when large numbers of fish are caught, held, and handled. Weighing and measuring a subsample of fish is a standard practice in fisheries science. To date AEA has weighed small fish up to 200 grams to the nearest 0.1 grams using digital scales and to the nearest 1 gram for larger fish using spring scales. In most cases, weights are taken with calibrated digital scales to the

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		nearest 0.1 grams. Lengths and weights were collected from 5,084 individuals in 2013 and 5,912 individuals in 2014 (Study 9.5 ISR, Table 4.7-2; Study 9.5 SIR, Table 4.5-2); this is approximately 72 percent and 76 percent of the fish handled in each study year. AEA believes the subsampling approach is providing sufficient and representative documentation of fish size consistent with generally accepted scientific practices. Assuming that the processing of additional fish increases the amount of time required at each macrohabitat site by two hours, the estimated cost of implementing this modification is $450,000.
NMFS_pp9.5-16_ph3	*In collecting weight of fish, AEA measured juvenile salmonids to the nearest gram. Obtaining fish weights to the nearest gram does not provide the precision necessary to evaluate differences in condition factors among sampling locations. … At a minimum, AEA should obtain weights to the nearest 0.1.*	To date AEA has weighed small fish up to 200 grams to the nearest 0.1 grams using digital scales and to the nearest 1 gram for larger fish using spring scales. In most cases, weights are taken with calibrated digital scales to the nearest 0.1 grams.
USFWS_pp9.5-1_ph3	*First, AEA must describe the basic process of how the results of the study will be used to estimate project effects on fish populations, and provide statements about what is an acceptable level of accuracy and precision. Second, data collected in all sampling activities need to be made accessible and fully documented. And third, the data should be appropriately summarized and interpreted and statistical methods used in this process should be fully documented.*	See Section 2.6.1.4 below.
USFWS_pp9.5-2_ph3	*Many study components of Study 9.5 remain incomplete or not attempted at all. These include a mark-recapture study to estimate rotary trap efficiency that was not conducted; association of movement patterns in relation to water conditions (discharge, temperature, and turbidity) that was not summarized; collection of tissue samples for mercury and other baseline metals that was below goal (and only mercury concentrations were measured); accurate location of spawning grounds and capture of holding Humpback and Round Whitefish and Burbot to assess gonadal condition that was not done; collection of Dolly Varden and Humpback Whitefish otoliths was far under sample goals and no documentation of analysis of these otoliths was provided; and only opportunistic fish stranding and trapping data were collected and not analyzed.*	AEA disagrees with the Services' characterization of study completeness, specifically, that certain study components were not attempted or were below goals. See Section 2.6.1.1.1 below.
USFWS_pp9.5-2_ph4	*Modification 1: The efficiency of each sampling gear type should be evaluated and compared so counts among sampling methods can be made comparable, interactions between sampling methods can be understood, and future sampling*	As explained below in Section 2.6.1.5.2, AEA requests that FERC not adopt this proposed Study Plan modification. AEA has streamlined the use of the most effective gears in

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	activities can be made more efficient. If such comparisons prove to be difficult or highly variable, then sampling gear should limited to the most effective gear types and deployment of this gear remain consistent. *The use of multiple sampling methods to measure fish abundance and distribution across a diversity of habitat types remains problematic. Different sampling gears have resulted in different, non-comparable measures of abundance. The effect of one sampling method on abundance estimates obtained in subsequent sampling activities is unknown. The same sampling gear-type is not used consistently (e.g. different electrofishing times or different densities of minnow traps). The use of block nets seems to be inconsistent.* *The generally accepted scientific practice is to apply consistent methods and effort among sampling units to properly compare relative abundance by species and age class among habitat classification types. Studies 9.5 and 9.6 have collected a vast amount of abundance data. USFWS recommends that these data be evaluated to identify the most efficient and repeatable sampling protocol and this protocol remain consistent for all abundance measurements.*	the revised gear selection protocol (Study 9.5 and 9.6 IP, Appendix 3: *Protocol for Site-Specific Gear Type Selection; Version 5*, November 14, 2014) and has developed a statistical approach to combine catch-per-unit-effort for multiple gears for making comparisons among sites (*Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum*, Attachment 7). Assuming this effort require only analysis of existing data, the estimated cost of implementing this modification is $250,000.
USFWS_pp9.5-3_ph1	*Modification 2: Develop a complete operational plan for relative abundance sampling that adheres to the statistical methodology used to designate sampling sites and provides estimates with acceptable precision. Expand the geographic range of sampling to include mainstem and tributaries upstream of the reservoir inundation zone. Implement this plan with no variances.*	AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions. AEA has developed the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7) for comparing relative fish abundance across habitat consistent with the study design and providing a more comprehensive consideration of fish-habitat associations. For discussion of FUHI see comment response to USFWS_pp9.5-2_ph4, Section 2.6.1.5.2. Regarding expanding the Study Area to include mainstem and tributaries upstream of the reservoir inundation zone, see Section 2.6.1.2.1. USFWS does not provide details in their modification request on where and how intensively sampling would occur making it difficult to estimate costs.

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		Seasonal sampling upstream of the current study area up to the East Fork of the Susitna River at a similar level of effort would include an additional 20 selected tributary streams and 76 miles of mainstem sampling using a GRTS approach, and operation of a downstream migrant trap on the mainstem upstream of the Oshetna River. The estimated cost of implementing this modification is $3,200,000.
USFWS_pp9.5-3_ph4-1	*Although the data collected during Upper River abundance sampling activities are incomplete, ambiguous, and limited, they may provide a basis for designing a sampling program that would provide levels of precision necessary to achieve study objectives. Accurate and verified mapping of the Upper River drainage also provides another source of information that improves sample design over earlier study plans. In this planning process, USFWS recommends that main channel, split main, and multiple split macrohabitats be classified as a single main channel macrohabitat and tributary mouth sampling should be conducted as other macrohabitat sampling and not limited to clearwater plumes.*	See Section 2.6.1.6.2 below.
USFWS_pp9.5-3_ph4-2	*The mainstem Susitna River and drainages that enter into the Susitna River above the inundation zone should be included in the selection of habitats to be sampled. The streams include the Tyone River, Maclaren River and Clearwater Creek.*	See response to USFWS Modification Request 2 (USFWS_pp9.5-3_ph1).
USFWS_pp9.5-3_ph4-3	*Scale aging for juvenile salmon is a proven method for allocating fish to different age groups and should be employed for these fish. Scale aging, fin ray aging, or other simple and non-destructive means to age other species of fish should be investigated.*	AEA agrees that scale aging is a reliable technique for allocating fish to age groups as demonstrated by Study 9.8, River Productivity. Under Objective 5 AEA is to document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type. Because of the variability in growth rates within the Susitna basin and between habitat types; AEA proposed in the ISR Part D to use size (life stage) instead of age to characterize habitat association of juvenile salmonids and resident fish. AEA has documented at least two year classes of juvenile Chinook Salmon in the Upper River with fish reaching 114 mm in length. The bimodal length-frequency distribution of juvenile Chinook Salmon collected in 2013 and 2014 suggests that two age classes may be present, i.e., a portion of 2013 year class out-migrated in 2013 while other parr reared in the Upper River over the 2013-14 winter and

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		out-migrated as larger 1+ fish. It is not clear how the additional information on fish age would be used as opposed to modal length analysis as currently proposed. If deemed appropriate to collect scales from juvenile Chinook Salmon in the Upper River for aging purposes, a subsampling approach should be employed specifically targeted at the size range of specimens of interest.
USFWS_pp9.5-3_ph4	*Fish should be weighed to the nearest 0.1 gram and lengths measured for all captured fish.*	See response to NMFS Modification Request 14 (NMFS_pp9.5-15_ph4).
USFWS_pp9.5-3_ph5	*Modification 3: Develop a complete and rigorous early life history sampling program that better integrates the intergravel monitoring component of the early life history studies and focuses on the location and timing of Chinook Salmon emergence. This sampling program should also be integrated with the abundance and distribution sampling program to provide an understanding of the early spring distribution of fish species and life stages.*	As explained below in Section 2.6.1.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming that the requested ELH program includes spawning site determination, incubation monitoring, and sampling for emergence timing takes three years to complete, the estimated cost of implementing this modification is $1,000,000-$1,500,000.
USFWS_pp9.5-4_ph2	*A spring sampling program that is comparable to the summer and fall sampling program should be considered in the operational planning of a relative abundance sampling program (Modification 2). These data would help determine if resident fish overwinter in tributaries or the mainstem. Additional early life history sampling in areas of known Chinook Salmon spawning and redd construction would help identify the timing and water conditions of emerging Chinook Salmon and provide information on migration to rearing habitat. The 2014 early life history sampling in the Middle River proved to be very systematic and effective, capturing over 18,000 juvenile salmon (SIR 9.6 2015). The design of this sampling program could provide a good model for design of the Upper River early life history sampling.*	See Section 2.6.1.3.2 below.
USFWS_pp9.5-4_ph3	*Modification 4: Continue and expand downstream migrant trap operations for two years. Evaluate the ability of these traps to describe the timing of fish migrating past these sites.* *Under a schedule of two days of trap operation, followed by three nonoperational days, poor performance under some stream conditions, and seasonal limits imposed by icing, Upper River rotary screw traps were marginally successful in accurately describing downstream migration of some fish species and effectively unsuccessful for other species. The small number of fish caught in Upper River traps (especially Chinook Salmon, which averaged less than 10 fish per trap over*	As explained below in Section 2.6.1.10.1, AEA requests that FERC not adopt this proposed Study Plan modification. To increase the trapping schedule to seven days a week would increase the per-trap cost to approximately $850,000 annually. The estimated cost of implementing this modification for two study years is $5,100,000.

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	the entire season), the generally uniform catches throughout the season, sometimes increasing during the last days of operation in the fall, and the inability to operate in early spring when fish may initiate downstream migration all indicate that the sampling was unsuccessful. *The performance of rotary screw traps, to date, has been poor and provided little information on migration for most species, especially Chinook Salmon. Modifications to trap operations need to be discussed, implemented, and evaluated to determine if data needs are being met. These modifications may include expanding operations to seven days a week, assessing the efficiency of traps, relocating traps to areas immediately downstream from tributary mouths, relocating traps to waters more favorable to trap operations, and the use of alternative capture methods.*	
USFWS_pp9.5-5_ph1	*Modification 5: Evaluate the effectiveness and value of the PIT tagging program.* *The value of the 2013 and 2014 PIT tagging and detection program to describe fish movements is questionable. PIT array antennas were not installed in sequential spatial intervals at antenna sites, eliminating the ability to both discriminate upstream or downstream movement and assess the detection efficiency. Very small numbers of tagged fish were captured outside the areas where they were tagged. No Chinook Salmon tagged in the Upper River were recaptured Interpretation of results from the few fish that are recaptured are problematic since tagging effort is not representatively distributed over habitat types or behavior characteristics.* *A detailed evaluation of the results of PIT tagging activities and discussion among involved researchers may provide insights into ways to i*mprove and expand the existing sampling and tagging program, to redirect tagging objective to more attainable results (e.g. intensive study of a limited section of river), or to abandon the PIT tagging program and direct resources to other sampling activities.	As explained below in Section 2.6.1.9.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming that planning efforts take approximately $60,000 and potential expansion of the PIT tagging program includes expansion of sampling or monitoring efforts, the estimated cost of implementing this modification is $300,000-$1,000,000.
USFWS_pp9.5-5_ph4	*Modification 6: Continue the planning and implementation of radio-tagging studies. Evaluate results from the two years of tagging and almost three years of locating tagged fish and assess if tagging goals are appropriate and achieve stated objectives. Conduct targeted searches to identify specific holding or spawning locations.* *Radio-tagging did provide a good description of fish movements for the few fish that did survive. However, the study is very much crippled by the variances. Radio-tagging goals were only achieved for four species in the Upper River and two species in the Middle and Lower River. Low survival in the months after tagging*	AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

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	further reduced tagging numbers. For example, in January, 2015, a total of 91 radio-tagged fish (out of 249 applied radio-tags) of all species were located in the Upper River and 24 radio-tagged fish (out of 179 applied radio-tags) located in the Middle and Lower River. Manual tracking and directed searches to identify habitat type of spawning or holding fish was not conducted. *Unfortunately, little information was presented on movement and holding patterns. Only the movements of selected Arctic Grayling and Longnose Sucker were presented in ISR 9.5 (2014) and no spawning locations were identified for any species. Detailed analysis of the current radio-tagging data should provide at least some general ideas on movement and distribution and direction for subsequent radio-tagging studies. Future radio-tagging activities need to include precise location and identification of habitat associated with holding and spawning activities.*	AEA has completed a detailed draft analysis of the radio-tagging study component for each target species (*2013-2015 Radiotelemetry Implementation Report*, Appendix 8). The TM contains a summary of tagging and tacking histories for each individual tagged and a description and analysis of seasonal movements, habitat use, and use of the reservoir inundation zone. The locations of tagged individuals during each season (foraging, overwintering and spawning) are depicted on maps and summarized. The TM also includes a short discussion comparing the 2013-2015 observations with relevant literature and on tagging goals. To repeat implementation of the radiotelemetry study would require two years at approximately $900,000 annually. The estimated cost of implementing this modification is $1,800,000.
USFWS_pp9.5-6_ph1	*Very little data have undergone analysis and none of the study objectives have been completed. Some elements of these studies remain incomplete, due to sampling goals not being met or some studies simply not being conducted. Other studies proved to be impractical or inconclusive and require reevaluation of study feasibility (PIT tagging, Upper River rotary trap sampling, and Upper River early life history studies). However these data, when analyses are completed, can provide a resource for determining what is feasible, determining the expected levels of accuracy in future sampling, and determining optimum allocation of sampling effort for future studies.*	See Section 2.6.1.1.2 below.

2.6.1.1. Responses to Comments on Study Completeness

2.6.1.1.1. Response to Comments Regarding Incomplete Study Components

NMFS (NMFS_pp9.5-2_ph2) and USFWS (USFWS_pp9.5-2_ph3) assert that many study components of Study 9.5 remain incomplete or not attempted at all. These include a mark-recapture study to estimate rotary trap efficiency that was not conducted; association of movement patterns in relation to water conditions (discharge, temperature, and turbidity) that was not summarized; collection of tissue samples for mercury and other baseline metals that was below goal (and only mercury concentrations were measured); accurate location of spawning grounds and capture of holding Humpback and Round Whitefish and Burbot to assess gonadal condition that was not done; collection of Dolly Varden and Humpback Whitefish otoliths was far under sample goals and no documentation of analysis of these otoliths was provided; and only opportunistic fish stranding and trapping data were collected and not analyzed.

AEA disagrees with the Services' characterization of study completeness, specifically, that certain study components were not attempted or were below goals. Rotary screw traps were operated under Objective 2 of Study 9.5 to help determine the timing of emigration by downstream migrating fish (RSP Section 9.5.4.4.10). Trap efficiency estimates were to be conducted in order to generate relative abundance estimates but only when catch exceeded 100 fish (Section 5.7.4 in Study 9.5 and 9.6 IP, March 1, 2013: *Final Susitna River Fish Distribution and Abundance Implementation Plan*). Field crews generally did not hold fish for more than 24 hours in traps because of increased mortality and concerns for predation and crowding and daily catches rarely met the target for efficiency testing. Unfortunately, the low daily catches were insufficient for generating meaningful Peterson mark-recapture estimates. At three Upper River trap sites only one trap catch exceeded 100 fish out of 254 trap days but that occurred on the final day of a trapping event so efficiency was not conducted. Since the daily catch did not meet the methods established in the Implementation Plan, the efficiency test results were not previously reported in the ISR or SIR. Despite lower catches, trap efficiency tests were conducted on nine occasions at the Oshetna River and twice at Kosina Creek in 2013 (Table 2.6.1-2). Because catch was less than 100 fish, tests were conducted with small sample sizes and results should be interpreted with caution.

Table 2.6.1-2. Rotary screw trap efficiency testing 2013-2014.

Number of Fish Released by Location (% Recaptured)		
Trapping Date	**Oshetna River**	**Kosina Creek**
2013-07-05	4 (0%)	
2013-07-24	21 (10%)	
2013-07-28	27 (4%)	
2013-08-02	12 (0%)	
2013-08-07		4 (25%)
2013-09-26	11 (0%)	12 (8%)
2014-06-09	33 (12%)	
2014-08-28	51 (4%)	
2014-09-02	29 (14%)	
2014-09-22	48 (2%)	
Total Release Events	9	2
Total # Fish Released	236	16

Documenting fish movement patterns in relation to water conditions was not an objective of Study 9.5 and trap catch was not sufficient to correlate with any environmental variables at any of the trapping sites. Even with low and variable trap efficiencies, the trap in the Upper River during both 2013 and 2014 provided important information about the timing of movement of fish out of natal tributaries and downstream in the mainstem Upper River, including data on the timing of downstream migrating juvenile Chinook Salmon. As stated in RSP Section 9.5.4.3.2 the trap data will be used in conjunction with biotelemetry to meet Objective 2 of Study 9.5.

The collection and analysis of tissue samples for metals and mercury is ongoing and will occur under future implementation of the study. It will be reported in the USR. The whereabouts of whitefish and Burbot during the spawning season are reported in the *2013-2015 Radiotelemetry Implementation Report* (Attachment 8). No winter studies occurred in the Upper River and no fish were handled during the spawning season for winter spawners and therefore gonadal condition was not done. Otoliths from Dolly Varden and Humpback Whitefish sacrificed for microchemistry analysis have not been analyzed and collection of large individuals, which are rare in the Upper River, is ongoing and future sampling efforts may be informed by 2013-2014 results.

Study 9.5 did not have an objective to identify stranding and trapping locations in support of the Instream Flow Model as no flow model has been proposed or developed for the Upper River.

2.6.1.1.2. Response to Comment on Status of Study Implementation

USFWS (USFWS_pp9.5-6_ph1) comments that very little data have undergone analysis and none of the study objectives have been completed. USFWS states that some elements of these studies remain incomplete, due to sampling goals not being met or some studies simply not being conducted. USFWS states that other studies proved to be impractical or inconclusive and require reevaluation of study feasibility (PIT tagging, Upper River rotary trap sampling and Upper River early life history studies). The USFWS comments that these data, when analyses are completed, can provide a resource for determining what is feasible, determining the expected levels of accuracy in future sampling, and determining optimum allocation of sampling effort for future studies.

AEA disagrees with USFWS's characterization that the level of preliminary analysis and reporting of data collected is insufficient for demonstrating progress towards meeting study objectives. Furthermore, AEA has made data collected publically available for review at http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.5-Fish_Dist_and_Abund_Upper_Susitna/. An immense amount of data has been collected to date by various study components under Study 9.5; initial reporting and analysis has focused on the efficacy of the sampling techniques and the level of sampling effort necessary to characterize fish distribution, abundance, and habitat associations in the Upper River. Ongoing data analysis and pilot testing of sampling approaches to improve the study and develop recommendations for further studies have been reported in a series of technical memoranda including: *Sampling Considerations for Study 9.5 Fish Distribution and Abundance in the Upper Susitna River TM* (Study 9.5 TM, March 20, 2014); *Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation TM* (Study 9.5 TM, September 17, 2014); *Protocol for Site-Specific Gear Type Selection* (Appendix 3 in Study 9.5 and 9.6 IP, November 14, 2014); *Evaluation of 2014 Study Modifications in the Black River TM* (Study 9.5 TM, December 17, 2014); the *Development of Relative Abundance and Fish Habitat Use Indices TM* (Attachment 7); and the *2013-2015 Radiotelemetry Implementation Report* (Attachment 8).

Some study components that require tissue collection and laboratory analysis are ongoing and will require a second year of study to complete. The collection of these specimens will be aided by the knowledge acquired during the first year of data collection. The Susitna River is one of the most thoroughly studied and well-documented glacial river systems in the world. With the modifications proposed and steps to complete Study 9.5 outlined in the ISR Part D, AEA asserts that one additional year of data collection will provide the necessary information for baseline characterization of fish resources to support impact analysis (see also Section 2.6.1.4 for additional discussion of impact analysis).

2.6.1.2. Responses to Comments Requesting Upstream Expansion of the Study Area

2.6.1.2.1. Response to Modification Request to Expand the Upper River Study Area Upstream of Inundation Zone

NMFS (Modification 1; NMFS_pp9.5-3_ph12) recommends that the sampling of fish distribution and abundance be modified to include the mainstem and tributaries upstream of the inundation zone. NMFS states that the approved Upper River FDA study was developed to document existing conditions within areas that would potentially be altered directly, indirectly, or cumulatively by the proposed Project. NMFS states that they now have good information proving salmon presence above the dam site which they did not have when the Study Plan was developed.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study

Plan. Specifically, NMFS has not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions. The data collected by AEA has not extended the Upper River distribution of Chinook Salmon beyond that used in the design of Study 9.5.

The Upper River Study Area included the spatial extent defined in the FERC Study Plan Determination and includes two major drainages that enter into the Susitna River above the reservoir inundation zone. The maximum pool elevation of the proposed reservoir, El. 2,050 feet MSL, would inundate to approximately PRM 232.5. To evaluate the upstream extent of Project effects, modeling has been proposed as a modification under study 6.5 at the head of the reservoir to evaluate fan development and barrier creation. The FDAUP study area extends to PRM 235.1 and includes 2.6 miles of mainstem habitat as well as Goose Creek (PRM 232.8) and the Oshetna (and Black) River (PRM 235.1) drainages. The study area includes all known anadromous salmon tributary streams; the upper extent of which is the Oshetna/Black Rivers.

The study area extent for tributary sampling includes the accessible portion of each selected tributary from the mainstem Susitna River to the 3,000 feet elevation contour. Under the proposed operations of the Project the reservoir pool would fluctuate between 1,850 feet elevation at lower pool and 2,050 feet elevation at full pool. The study area includes many river miles and 1,000 vertical feet of tributary above the reservoir inundation zone. The rationale to define the study area upper extent at the 3,000 feet elevation contour was based on the known upper extent of juvenile Chinook Salmon distribution (Buckwalter 2011). Based on sampling efforts to date this appears to be a reasonable approximation of the upper extent of Chinook Salmon distribution and study area boundary. The study area in the FERC-approved Study Plan allows for characterization of both areas within and upstream of the reservoir inundation zone. The Study 9.5 study area extent used for GRTS and transect site selection included: 15.6 river miles of tributary habitat within the reservoir inundation zone and 88.4 river miles upstream, and 45.4 river miles of mainstem habitat within the reservoir inundation zone and 2.6 miles upstream (Table 2.6.1-3 below). In addition, some activities including resident fish radio tracking and tagging did occur upstream of PRM 235.1 to follow fish movements between the study area and nearby Tyone River.

The current study area adequately covers the Project area that would be directly impacted by reservoir inundation and those tributaries that would be affected by partial inundation in their lower reaches as well the two tributary drainages, Goose Creek (PRM 232.8) and the Oshetna (and Black) River (PRM 235.1) upstream of but near the upper extent of the reservoir inundation zone. The Tyone River (PRM 247.3), Maclaren River (PRM 261.1), and Clearwater Creek (PRM 266.6) are not known anadromous salmon streams, would not be directly or physically affected and do not have a direct nexus with the Project.

Table 2.6.1-3. River Miles within and upstream of the proposed reservoir inundation zone at full pool in the FERC-approved Fish Distribution and Abundance Study area used for site selection and sampling.

Stream Name	PRM	River Miles Within Inundation Zone	River Miles Upstream of Inundation Zone
Susitna River Mainstem	187.1-235.1	45.4	2.6
Oshetna River	235.1	0	25.6
Black River	n/a	0	5.9
Goose Creek	232.8	0	10.1
Jay Creek	211	n/a Direct Sample	
Kosina Creek	209.1	3.5	15.6
Tsisi Creek	n/a	0	5.8
Unnamed Tributary	206.3	n/a Direct Sample	
Unnamed Tributary	204.5	n/a Direct Sample	
Unnamed Tributary	197.7	n/a Direct Sample	
Watana Creek	196.9	8.5	12.8
Watana Creek Tributary	n/a	0	8.3
Unnamed Tributary	194.8	3.7	4.3
Deadman Creek	189.4	n/a Direct Sample	
Tributary Total		**15.6**	**88.4**
Total		**61.1**	**91**

2.6.1.2.2. Response to Modification Request to Expand Study Area for Salmon Movements

NMFS (Modification 10; NMFS_pp9.5-10_ph7) recommends that sampling of fish distribution and abundance should be geographically expanded to include the mainstem and tributaries upstream of the inundation zone because adult salmon have been observed above the proposed reservoir (Study 9.7 ISR), tributaries above the reservoir could provide salmon spawning and rearing habitat and the proposed Project could influence fish passage into the Susitna River and tributaries above the reservoir. NMFS comments that the movement behavior of anadromous salmon above the proposed Project impoundment needs to be documented in order to evaluate potential Project related impacts on migration behavior. NMFS states that expanding the geographic zone will address Objective 2 (seasonal movements of juvenile salmonids) of this study.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification nor has NMFS demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

To clarify, Chinook Salmon are the only anadromous fish ever documented above Devils Canyon. Study 9.7 documented one radio-tagged adult Chinook Salmon that moved upstream of the

Oshetna River out of 1,577 tagged in the Middle River over a 3-year period. In addition, although this fish traveled extensively it did not move into any tributaries for a sufficient length of time to provide evidence of spawning or rearing upstream of PRM 235.1. While this one data point does indicate that individual salmon may explore upstream habitats, it provided no information to justify expanding studies for spawning and/or rearing Chinook Salmon in the reaches upstream of the area that would be inundated with a reservoir.

Estimated counts of adult Chinook Salmon through radio-tagging, nine years of aerial spawning surveys (1982-1985, 2003, 2011-2014), and sonar at Watana Dam indicate that very few individuals migrate upstream of the proposed dam site and that the primary spawning tributaries are Kosina Creek and the Oshetna/Black River. The study area for Study 9.5 as defined in the FERC Study Plan Determination contains the entire reservoir inundation zone (2,050 feet elevation), the same area for tributaries that would be partially inundated up to 3,000 feet elevation and includes Goose Creek, Oshetna River, and the Black River, all upstream of the reservoir inundation zone. See Section 2.6.1.2.1 for more information.

2.6.1.2.3. Response to Comments on the Presence of Coho Salmon in the Upper River

NMFS (NMFS_pp9.5-11_ph3) comments that adult salmon escapement studies (Study 9.7 ISR) have documented the movement of Chinook Salmon into the headwaters of the Susitna River. NMFS states that AEA contractors stated that large 2+ Chinook salmon have been captured in Upper River tributaries. NMFS asserts that since Chinook Salmon are known to have a one-year freshwater residency, these fish were more likely Coho Salmon.

AEA disagrees with the assertion that salmon have been misidentified in the Upper River. Contrary to NMFS assertion that Chinook Salmon are only known to have a one-year freshwater residency, a small portion of Chinook Salmon juveniles have been identified as rearing for two years in freshwater through cohort and scale analysis (Tobias and Willette 2010; Moulton 1997; Study 9.5 SIR, Section 6.1.3). The proportion of juvenile Chinook spending two years in freshwater is variable annually but averages somewhere around 2-5 percent. Of 2,608 adult Chinook Salmon examined for freshwater residency in the Northern District, General Sub-district of Cook Inlet, 1983-1991, primarily consisting of Susitna River origin fish, 0-3.9 percent of fish had two years of freshwater residency (Tobias and Willette 2010). Of 1,527 adult Chinook Salmon examined from the Northern District, Eastern Sub-district of Cook Inlet, 1986-1991, also primarily consisting of Susitna River origin fish, an annual average of 2.7 percent (range 0-6.7 percent) of fish had two years of freshwater residency (Tobias and Willette 2010). Of 17,018 adult Chinook Salmon examined from the Northern District, Upper Sub-district of Cook Inlet, 1986-1991, primarily consisting of Kenai River origin fish, an average of 1.5 percent (range 0-3.4 percent) of fish had two years of freshwater residency (Tobias and Willette 2010). Scale analysis of 206 juvenile Chinook Salmon collected in near-shore surface trawls in Cook Inlet near the mouth of the Susitna River found 6.8 percent 2 years old, the average length of age-2 fish was 93.3 mm (range 80-109 mm and average length of age-1 fish was 81.4 mm (range from 56-115mm) (Moulton 1997). During a downstream migrant study in which 56 scale samples were analyzed from the nearby Anchor River, 5.4 percent of Chinook Salmon were age 2 (110-115mm range), and Chinook Salmon up to 155 mm were collected but not aged (Anderson and Stillwater Sciences 2011).

During 2013-2014 licensing efforts, 742 samples of *genetically confirmed* juvenile Chinook Salmon with length measurements recorded were collected ranging from 37-174 mm in length. Consistent with other studies; 8.3 percent of fish genetically identified as Chinook Salmon were larger than 93 mm, and 2.9 percent were larger than 110 mm. It is reasonable to hypothesize that the larger juveniles were yearlings.

There is no evidence to date that suggests that Coho Salmon (or Chum, or Pink or Sockeye salmon) spawn above Impediment 1 of Devils Canyon, yet alone the Upper River. All of the juvenile salmon collected upstream of Impediment 1 that were genetically analyzed were verified as Chinook Salmon. To speculate that larger juveniles in the Upper River are Coho Salmon, in light of genetics results and scale aging from Cook Inlet purely based on the size of the individuals is inconsistent with existing data collected by AEA and others, does not warrant any merit, and is not supported by any citations or factual information. Stakeholder comments that Coho Salmon or Sockeye Salmon may occur in the Upper River or that the numbers of adult Chinook Salmon may be underestimated due to similar CPUE between the Middle and Upper River are unfounded as they do not consider the extensive existing dataset. All of the data collected in Upper Susitna River during 9 years of study conducted during the last 32 years, using multiple methods in various years, repeated methods across some years, concurrent sampling by varying methods, and targeting both juveniles and adults in some years point to the same conclusion. All existing data consistently confirm the presence of only Chinook Salmon above Devils Canyon, that they occur in very low numbers and within a limited distribution; see Section 2.6.7.3.1 for additional discussion about existing data and salmon in the Upper River.

Upstream of Impediment 1 in Devils Canyon, beyond the upper limit of distribution for juvenile Chum, Coho, Pink, and Sockeye salmon, 3.1 percent of juvenile Chinook Salmon were longer than 93 mm and 0.2 percent were longer than 100 mm. Although not aged from scales, the bimodal length-frequency distribution of juvenile Chinook Salmon collected in the Upper River in 2013 and 2014 suggests that two age classes may be present; i.e., a portion of the 2013 year class out-migrated in 2013 while other parr reared in the Upper River over the 2013-2014 winter and out-migrated as larger 1+ fish (Figure 2.6.1-1). The small numbers of fish less than 70 mm in 2014 may also be indicative of the year-to-year variability in passage conditions through Devils Canyon, spawning and/or juvenile survival for Upper River Chinook Salmon. This is consistent with adult fish estimates, where 2012 Upper River counts and the numbers of tagged fish moving into the Upper River were both greater than respective 2013 counts.

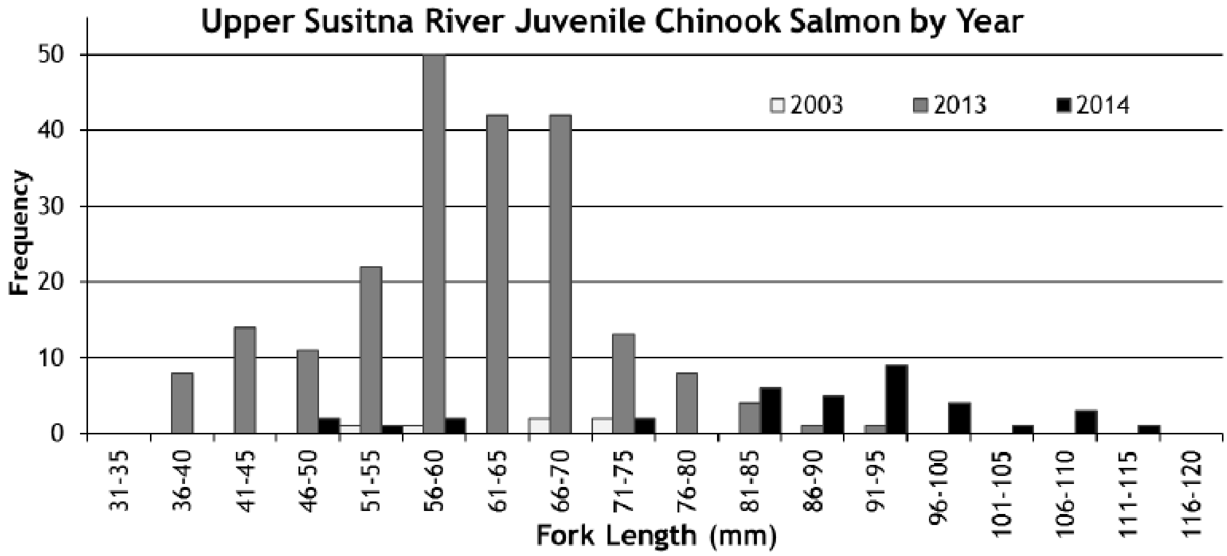


Figure 2.6.1-1. Juvenile Chinook Salmon length-frequency distribution by survey year in the Upper Susitna River, 2003-2014. Figure 5-1 from the Study 9.5 SIR.

2.6.1.3. Responses to Comments Requesting Additional Spring Sampling

2.6.1.3.1. Response to Modification Request Regarding Chinook Salmon Emergence

USFWS (Modification 3; USFWS_pp9.5-3_ph5) requests development of a complete and rigorous early life history sampling program that better integrates the intergravel monitoring component of the early life history studies and focuses on the location and timing of Chinook Salmon emergence. USFWS requests that this sampling program be integrated with the abundance and distribution sampling program to provide an understanding of the early spring distribution of fish species and life stages.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

The nexus between intergravel temperature monitoring and Project effects in the Upper River is unclear. Intergravel monitoring and emergence timing are of interest in the Middle River where the Project may alter streamflow and temperature; upstream of the Watana Dam location, spawning sites would be inundated by the reservoir or would be upstream of Project effects. Such an effort would be intensive and it is not clear how the information gathered would be used. As for emergence timing, in addition to studies under 8.5, there is a well-established body of literature for salmon species on the relationship between intergravel temperatures, embryonic development, incubation, survival, and emergence timing.

2.6.1.3.2. Response to Modification Request for Additional Spring FDA Sampling Event

NMFS (Modification 6; NMFS_pp9.5-8_ph2) recommends that spring sampling be conducted as proposed in the RSP for fish distribution and abundance in May or early June (in addition to the two summer and one fall sampling events) at all sampling locations. USFWS (USFWS_pp9.5-4_ph2) comments that a spring sampling program that is comparable to the summer and fall sampling program should be considered in the operational planning of a relative abundance sampling program. USFWS states that these data would help determine if resident fish overwinter in tributaries or the mainstem and would help identify the timing and water conditions of emerging Chinook Salmon, providing information on migration to rearing habitat. USFWS comments that the 2014 early life history sampling in the Middle River proved to be very systematic and effective, capturing over 18,000 juvenile salmon (Study 9.6 SIR) and suggests the design of this sampling program could provide a good model for the Upper River early life history sampling.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services' have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA agrees that it is important to gather additional information on the timing of juvenile Chinook Salmon movements from spawning to rearing areas and out of natal tributary streams. As proposed in the ISR Part D, AEA asserts the most effective approach to gather this information is to review the existing information and design a targeted salmon early life history sampling program initiated as soon as feasible following breakup and continue with downstream migrant trapping. A randomized study design comparable to the early summer, late summer, and fall sampling program would not be as effective in gathering the specific information sought, especially in the Upper River where so few Chinook Salmon occur and in limited areas.

In the RSP, AEA described the overall schedule for the sampling program in the Upper River as seasonal during the ice-free period with biweekly sampling immediately following ice-out in an attempt to capture juvenile Chinook Salmon during the out-migration. Recognizing the importance of the sampling in the spring, AEA then implemented the seasonal sampling schedule as described with targeted efforts immediately after ice-breakup focused on juvenile Chinook Salmon movements and downstream migrant trapping in known spawning tributaries. The highly focused spring effort allowed for targeted sampling in tributaries where Chinook Salmon were known historically and was then followed by seasonal sampling in early July, August, and mid-September to early October. While a spring sample at all of the fish distribution and abundance sampling locations would have added another seasonal sample, due to the difficulty of sampling mainstem areas during the flooding associated with breakup and snowmelt it would not have yielded a comparable seasonal event. Discharge at Gold Creek exceeded 30,000 cfs prior to the onset of summer on June 21, 2013 (Figure 2.6.1-2). Sampling was suspended for the high flow event in late August 2013 to collect consistent and comparable data. June is typically the highest discharge and most hydrologically variable month of the year. From 2001-2015 the average monthly discharge at Gold Creek was 17,100 cfs in May increasing to over 25,000 in June before dropping to 22,800 in July, 20,800 in August, and 15,000 in September. Average annual discharge in June varied from 16,600 to 37,600 from 2001-2015 and in 4 of the 15 years was greater than

31,000 cfs. AEA has implemented targeted salmon early life history sampling, downstream migrant trapping, and radio-tagging and tracking as the study components for implementation following ice breakup and typical spring/early flooding.

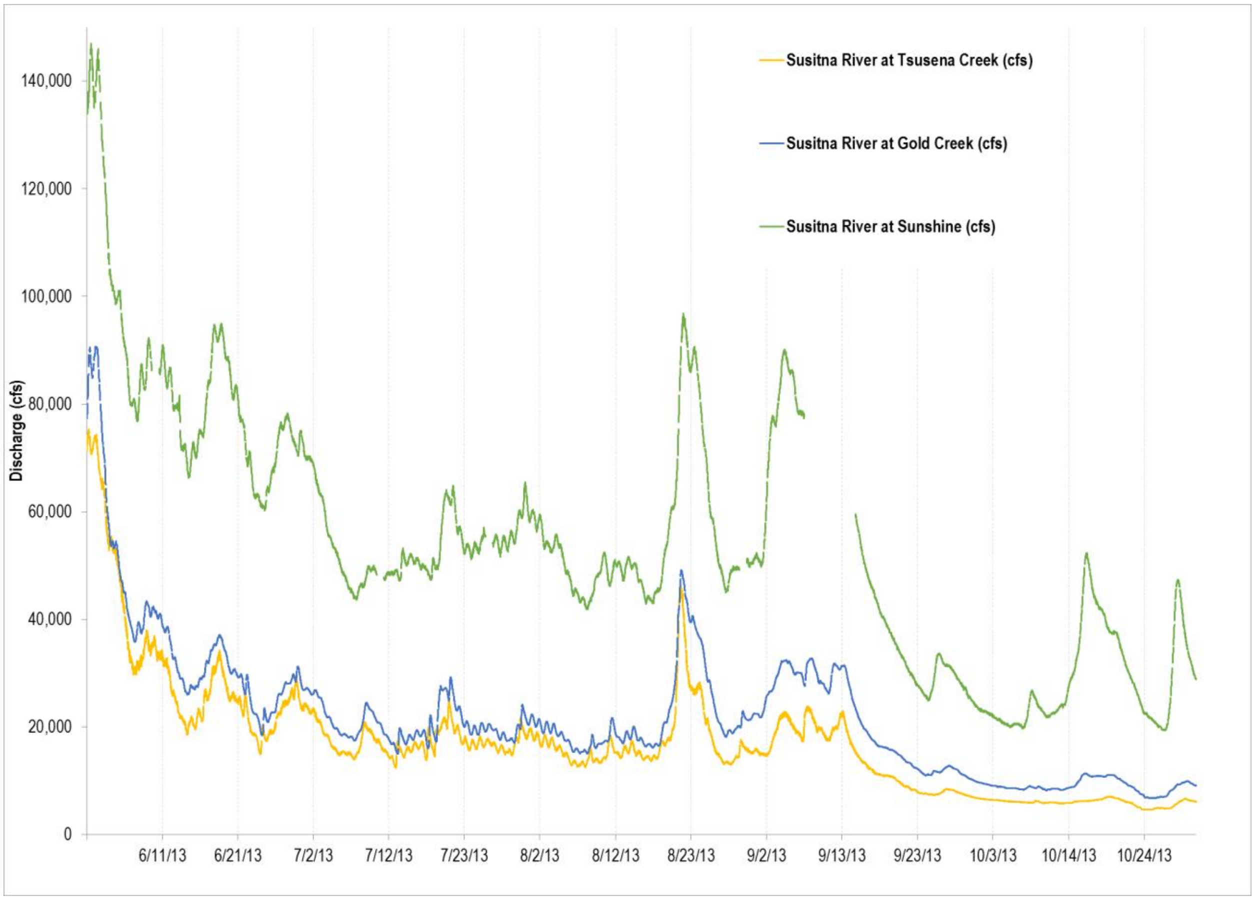


Figure 2.6.1-2. Discharge (cfs) at Tsusena Creek, Gold Creek, and Sunshine, 2013.

2.6.1.4. Response to Comments Regarding Baseline Data Collection and Impact Assessment

USFWS (USFWS_pp9.5-1_ph3) and NMFS (NMFS_pp9.5-1_ph3) comment that AEA must describe the basic process of how the results of the study will be used to estimate Project effects on fish populations, and provide statements about what is an acceptable level of accuracy and precision. The Services' comment that data collected in all sampling activities need to be made accessible and fully documented. Finally, the Services state that the data should be appropriately summarized and interpreted and statistical methods used in this process should be fully documented.

In response, Study 9.5 has made progress towards addressing the objectives as presented in Section 9.5.4.3 of the Study Plan. Impact analysis is not part of this baseline characterization of fish populations and will be addressed once baseline data collection is complete and potential Project impacts are defined. This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. Impact assessment in the Upper River will include an analysis of the quality and quantity of habitats affected by reservoir inundation as well as newly accessible habitat upstream of the inundation zone and fish use of those habitats. Impact assessment may also include an analysis of the potential effects of Watana Dam and Reservoir on the fish assemblage and how fish movements and the ability to carry out life history functions may be impacted by the Project. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impact assessment in the License Application, see Section 1.3.

A relational database of data collected during 2013-2014 sampling activities is publically available at http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.5-Fish_Dist_and_Abund_Upper_Susitna/. Reporting efforts to date have focused on the methodology of field data collection and the summarization of results at a level in order for FERC and licensing participants to evaluate AEA's progress in carrying out the Study Plan and the adequacy of data collection to meet the study objectives of the FERC-approved Study. AEA has described the methodology used, has summarized the data collected to date in the ISR, SIR, and several Technical Memoranda listed and described in Study 9.5 ISR Part D, Section 4.

2.6.1.5. Responses to Comments Regarding Integration of Relative Abundance Estimates from Multiple Gear Types

2.6.1.5.1. Response to Modification Request for Statistical Testing of Habitat Associations

NMFS (Modification 7; NMFS_pp9.5-9_ph4) recommends that the Study Plan be expanded to include a description of how the various data will be turned into quantitative estimates so that rigorous comparisons can be made across species, river habitat types and time. NMFS requests that the sampling plan be reevaluated so that there is a tight linkage between the sampling design and the estimates and statistical inferences that will be drawn from the data and that estimates be presented with appropriate measures of sampling error (confidence intervals or standard errors). NMFS recommends use of statistical tests to determine if differences in mean relative abundance measures are significantly different among habitat classifications at all classification levels one through three. ADF&G (ADNR_ADFG_pp13_ph2) also comment that across habitat comparisons were unrealistic for CPUE data collected with different gear types in different habitats.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA strongly disagrees with the proposed modification as rigorous, statistically significant comparisons were never a part of the Study Plan and are not necessary to meet study objectives. The FERC-approved Study was designed to provide a descriptive baseline characterization of fish distribution and relative abundance through hundreds of miles of habitat and was not set up to test specific hypothesis about the population estimates of fish in different habitats or across time. As clearly described in the Study Plan, Objective 1 of Study 9.5 requires a description of relative abundance and fish-habitat associations. While this objective can be met using fish counts and

CPUE estimated by gear type, AEA has further developed an index of fish habitat (See Attachment A: *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum*) documenting a statistically valid method to combine estimates of relative abundance collected using multiple gear types for a more comprehensive consideration of species-specific relative abundance and fish-habitat associations (Attachment 7). Standard errors of the Index values can be estimated and provided.

AEA's goal for fish distribution and abundance involves characterization of fish assemblages across more than 200 miles of river and tributary habitat. This necessitates sampling in a variety of diverse habitats for multiple species and life stages with multiple gear types. In the ISR AEA provided preliminary CPUE estimates by gear and habitat type from their Study 9.5 field efforts but assimilating data in this format is challenging. Thus, AEA developed a relative abundance statistic that combines CPUE across gear types to facilitate the comparison of relative abundance of species and lifestages as well as the entire fish assemblage across habitat types. It is important to note that development of the FUHI was not a requirement to meet the objective, nor was it required by the FERC-approved Study Plan, but was implemented by AEA to provide a synthesis of data collected by multiple gear types and help elucidate patterns in overall fish use of habitat types within geomorphic reaches. The purpose of the FUHI is to demonstrate a statistically valid approach to describing fish assemblages across the riverscape that can be used to qualify and evaluate potential project effects on different habitats or across seasons. In regards to sampling error, while we have not attempted to generate error estimates or conduct statistical tests at this point; however, the data have been collected in a way that will support future hypothesis testing and the FUHI supports tests of statistical significance. The relative abundance metrics and FUHI are amenable and sufficient for many comparisons that could be required in the effects analysis phase of the Project.

2.6.1.5.2. Response to Modification Request Regarding Use of Multiple Sampling Gear Types

USFWS (Modification 1; USFWS_pp9.5-2_ph4) requests that the efficiency of each sampling gear type be evaluated and compared so counts among sampling methods can be made comparable, interactions between sampling methods can be understood, and future sampling activities can be made more efficient.

NMFS (NMFS_pp9.5-10_ph2) comments that the ISR describes fish collection methods that varied in sampling area, sampling methods, and sampling effort. NMFS states that fish data were collected at one location or sampling date using electrofishing; a fyke net data during another sampling location; and minnow trap data at a third. Electrofishing time varied among sampling locations from seconds up to 20 minutes. NMFS states that units of metrics of relative abundance or community composition were different and not comparable among sites (i.e., catch/time/area, catch/trap/area, or catch/net/area). NMFS states that the data cannot be compared among sites and, therefore, the study goal of evaluating distribution and habitat association cannot be achieved.

ADF&G also comments that capture efficiency varies by species/life stage, habitat and gear type. ADF&G is also concerned that collecting CPUE using multiple gear types will make comparisons between habitat types (or species, sites or life stages) unrealistic, if each habitat type (or other factor) is sampled with different gear.

In response, AEA requests that FERC not adopt USFWS's proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" for the modification nor demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

Efficiencies of sampling gears vary by species, life stage, diet, and multiple interacting habitat conditions occurring when and where the gear is used; thus, AEA does not agree with the need for evaluating gear efficiency for estimating relative abundance. Gear efficiency would be variable across habitats and although it would add supplemental information about counts, it would not, in and of itself, provide additional information to support comparisons across habitats where efficiency varies. In addition, only comparing data in habitats where gear efficiency is similar would severely limit AEA's ability to characterize this complex riverscape and its fish assemblages.

AEA has addressed the need for use of different methods to effectively sample habitat that varied greatly with respect to parameters that affect capture/observation efficiency (See Study 9.5 and 9.6 IP Section 8 and Appendix 3, an updated Appendix 3 filed November 14, 2015, and Study 9.5 SIR, Section 4.3.1.1). As discussed in these documents, the most appropriate methods for documenting the diversity of species and life stages potentially present within each mesohabitat unit (pool, riffle, glide) were selected at the time of sampling. Many factors influence the effectiveness, suitability and selection of gear type including but not limited to: depth, velocity, substrate, snags, water clarity, water conductivity, and the presence of spawning salmonids. These environmental parameters changed geographically as well as over time. Since objective of the FERC-approved Study Plan was to characterize the fish present in all habitats and determine their relative abundance across habitats, this was the most effective approach. Still, the protocol included the use of Tier 1 preferred methods whenever feasible with reliance upon Tier 2 methods only when habitat conditions precluded the effectiveness of Tier 1 methods (Study 9.5 IP, Appendix 3, Table 1). Furthermore, this protocol was modified after 2013 data collection when the relative effectiveness of different sampling methods in the habitats selected for studies 9.5 and 9.6 could be evaluated and determined (Study 9.5 and 9.6 IP, March 1, 2013: *Final Susitna River Fish Distribution and Abundance Implementation Plan, Appendix 3: Protocol for Site-Specific Gear Type Selection; Version 5*).

At the conclusion of the 2013 field campaign, AEA reviewed CPUE and catch by gear type for each species and life stage and implemented minor adjustments to the Implementation Plan gear selection protocol in order to prioritize the use of gears that are efficient or catch unique species or life stages ((Study 9.5 and 9.6 IP, March 1, 2013: *Final Susitna River Fish Distribution and Abundance Implementation Plan, Appendix 3: Protocol for Site-Specific Gear Type Selection; Version 5*)). Although existing data could be used for broad conclusions on efficiency based on any consistent results observed, it is not appropriate data for a comprehensive study of gear efficiencies. Such a study would be very difficult, if not impossible, to conduct in this complex system.

It was not feasible in this study to apply one gear type to the varied macro and mesohabitats sampled. Observed differences in gear efficiencies that were related to differing habitat conditions would have invalidated relative abundance estimate if they were generated from only one or two gear types. AEA is submitting a *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7) that documents a method to combine estimates of relative abundance across gear types for a more comprehensive consideration of fish-habitat associations. Consistent with the FUHI, AEA has developed a protocol for generating combined CPUEs for individual fish species and life stages by habitat that will be presented in the USR. An example for juvenile Artic Grayling is provided in the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7).

There are various metrics that can be used as the effort denominator including, area, time, net/trap counts, trap densities, cast counts some of which are more appropriate than others for a given gear type. For analysis of relative abundance in the ISR and FUHI, AEA has used the most appropriate metric to standardize relative abundance. For example, because it may be difficult to quantify the effective sample area of a baited trap, and the sample area may be influenced by site specific conditions like depth, flow, and the distance to a neighboring trap; catch/trap was selected as the metric to standardize baited trap catch. For other metrics the best denominator of effort may be area-based or time-based. In the FUHI, catch for each gear is standardized, compared to the catch rates everywhere that particular gear was used, and then combined to determine how the habitat unit rates in comparison with others.

Streams sampled in the study area range from small unnamed tributaries <1 meter in width to the several hundred-meter wide Susitna River. As a general principle, to qualify as a unique mesohabitat unit, the unit must be longer than the wetted width. Therefore, a riffle mesohabitat unit in a small tributary may only be three meters long by two meters wide and a side channel site may be 500 meters long by 50 meters wide. The size of a feature obviously affects the level of effort that should be applied. Recognizing the value of a consistently applied level of effort, sampling effort per a given area was standardized in the protocol for gear selection used by field crews. Effort is recorded and then used to standardize catch as CPUE; this is generally accepted scientific practice. AEA then developed a statistical framework for combining gear types that is demonstrated in the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7). AEA asserts that to fulfill the 9.5 study objectives of characterizing fish distribution and abundance across a broad array of habitats, using the most effective gear for sampling each mesohabitat unit will best document the diversity and abundance of species and life stages present in the study area. The approach proposed in the FUHI then takes these catch-per-unit-effort data using the best gears and standardizes them and combines them to an index of fish relative abundance and fish habitat use.

2.6.1.5.3. Response to Modification Request Regarding Field Sampling Methods

NMFS (Modification 8; NMFS_pp9.5-9_ph6) recommends sampling a minimum of 20 baited minnow traps fished for 20 to 24 hours for every 200 meter of sampling unit length to document the seasonal distribution and relative abundance of juvenile Chinook and Coho Salmon. NMFS recommends that fyke nets and hoop traps, and beach seines be used to augment minnow trapping and electrofishing for fish distribution, but should not be used to derive estimates of relative abundance. NMFS states that the generally accepted scientific practice is to apply consistent methods and effort among sampling units (mainstem macrohabitats and tributary sampling reaches) to properly compare relative abundance by species and age class among habitat classification types. This supports testing for statistical differences in fish abundance or community composition among habitat types or trends in fish metrics due to differences in physical or chemical characteristics. NMFS considers this a critical step to meet the approved study objective. NMFS states that they found no record of a published scientific study where relative abundance using different sampling methods was compared among sampling sites (i.e., electrofishing at one site compared to fyke nets or minnow traps at another).

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan.

AEA implemented the sampling methodology proposed in the Implementation Plan in which the most effective gears targeting the suite of potential target species present were selected given the site conditions at the time of sampling and permitting restrictions. The Implementation Plan went into great detail about how and when various gears were to be employed and included a hierarchical guide to selecting the most appropriate gear for a given habitat type (*Study 9.5 and 9.6 IP, March 1, 2013: Final Susitna River Fish Distribution and Abundance Implementation Plan, Appendix 3: Protocol for Site-Specific Gear Type Selection; Version 5*). Under the gear selection protocol, minnow trapping was implemented with 1-2 traps/10 meters fished overnight for 20-24 hours. However, as described as a variance in the ISR Part A, Section 4.4.4.1, in 2013 the use of small helicopters to transport crews to and from sites affected the crews' ability to carry large numbers of traps. The high gradient nature of the Upper River tributary habitats and the use of multiple gear types in each habitat would have minimized the potential effects of a reduced density of minnow traps. Furthermore, for relative abundance estimates for the FUHI, AEA standardized minnow trapping CPUE as fish catch/trap/trap density at the sampling site. This standardization accounted for variability in minnow trap density in terms of the number of traps fished per site length (meters). In 2014, AEA implemented minnow trapping in the Upper River consistent with the protocol of 1 to 2 traps/10 meters.

AEA disagrees that minnow trapping should be used at all sites and habitats in an attempt to collect juvenile Chinook Salmon in the Upper River (the NMFS comment incorrectly refers to Coho Salmon in the Upper River). While this may work for a smaller project with a focus on sampling a specific type of habitat where minnow traps are effective, such as shallow, slow water runs or pools, using minnow traps in all the habitats to be sampled in this study would not be an effective approach because the effectiveness of the traps would vary from highly effective to virtually non-effective with changes in flow and fish species/lifestage composition of the habitat. If a researcher were to compare the catch between two sites with similar known fish densities, one where the habitat was deep, low velocity with cover, suitable for the application of minnow trapping, and another that was a fast, shallow, riffle with little cover, the results would give a very skewed perception of fish abundance (See Figure 2.6.1-3 for example of variability in sampled habitats). In addition, the comparison of minnow catch results among habitats would be misleading with regard to the distribution and abundance of fry and larger juveniles as well as larger bodied fish present in the habitat. Using traps baited with a seasonally available food source (eggs) may also elicit a seasonal response in feeding behavior and attraction to the trap and affect catch rates. While it may be statistically appropriate to compare minnow trapping data across these varied habitat and fish assemblages, the analysis would not be biologically meaningful in that catch would very likely misrepresent the actual fish assemblage present.

Instead of this approach where a particular gear is used in habitats where it is not effective or appropriate as the basis for determining fish use and value among habitats, AEA proposes to continue to use the most effective and appropriate gear type in each habitat unit. Minnow traps are most appropriate in slow velocity habitats with sufficient water depth to submerge the trap, which are rare in the Upper River. Therefore, crews should rarely select minnow traps in the Upper River and should instead select other techniques (primarily electrofishing) because it is more appropriate for making valid comparisons of fish abundance and value of habitats. Minnow traps are known to be selective for Chinook and Coho Salmon and Dolly Varden and size selective among those species. Minnow traps are not effective at collecting salmon fry less than 60 mm in length (Bryant 2000) and rarely catch individuals smaller than 50 mm (Figure 2.6.1-4). Instead, fyke nets, backpack electrofishing, seining and rotary screw traps should be employed to catch Chinook Salmon fry. The data from 2013 and 2014 also suggest that minnow traps are not effective at collecting large juvenile Chinook Salmon and that fyke nets, seining, and rotary screw traps are better gear types for collection of larger individuals (Figure 2.6.1-4).

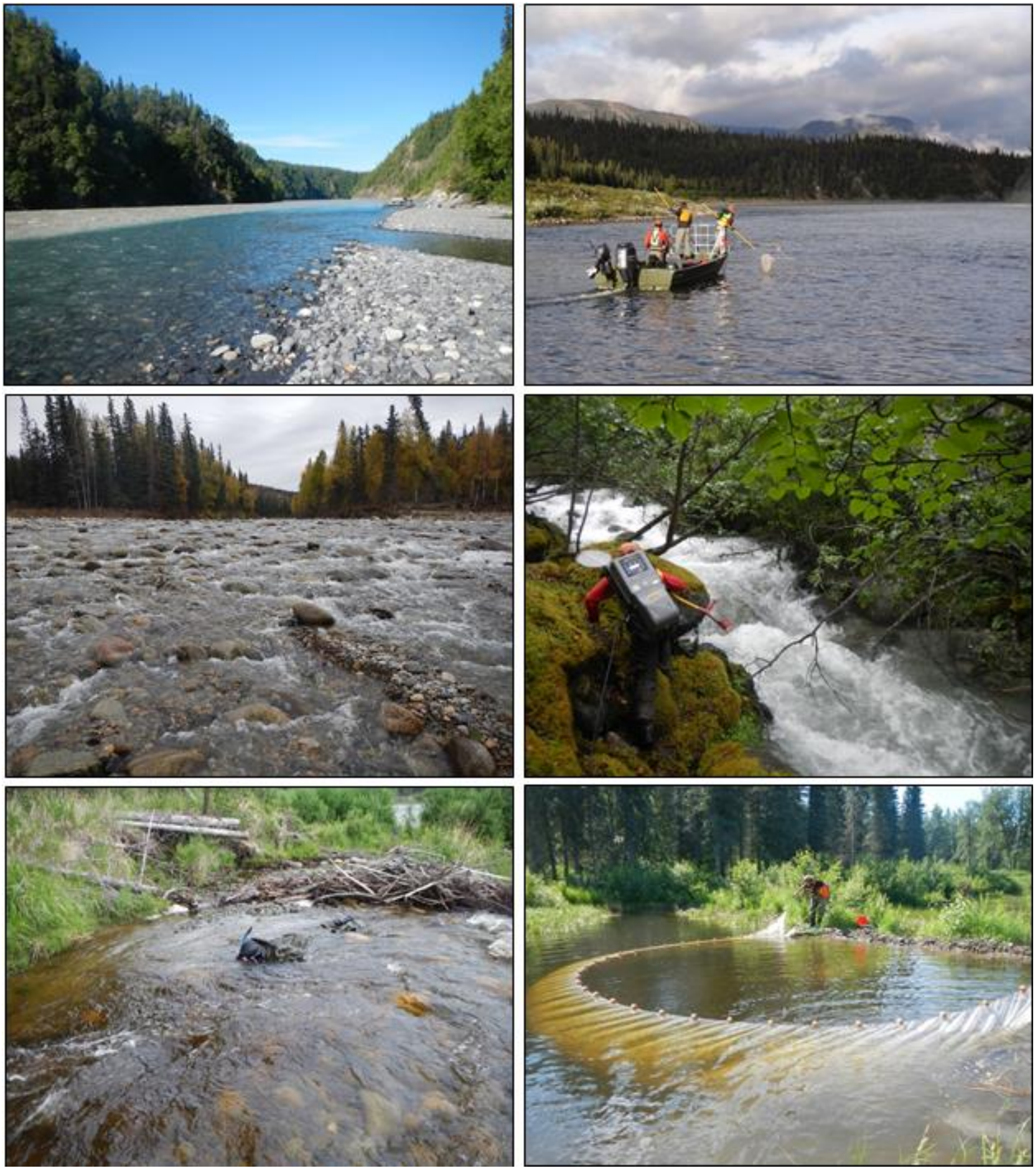
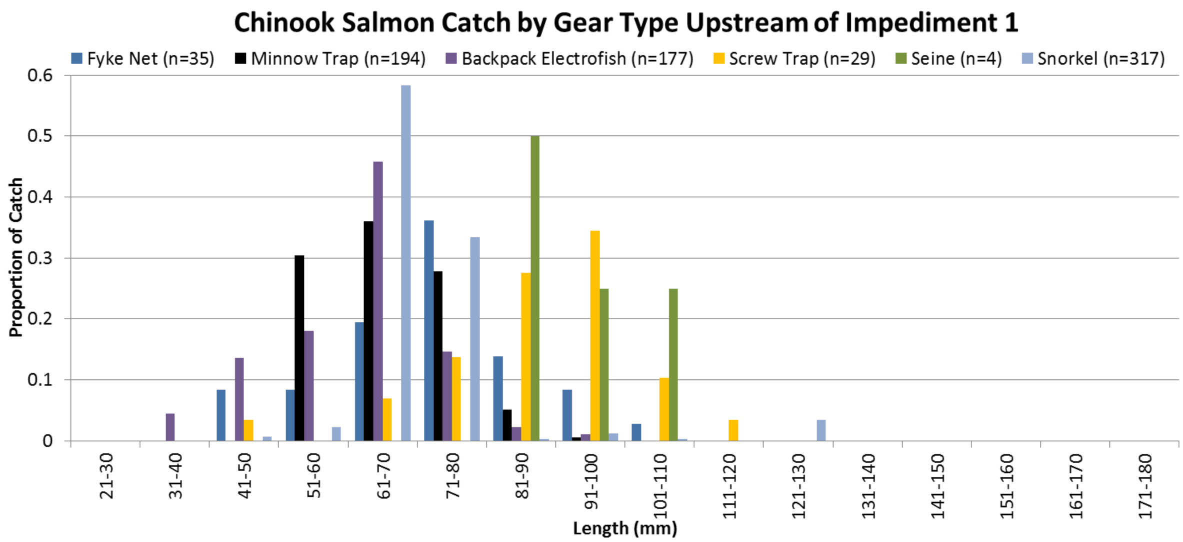


Figure 2.6.1-3. Examples of various habitat types encountered in the Susitna-Watana Fish Distribution and Abundance study area. Minnow trapping would not be an effective gear choice for sampling fish in the habitats shown in the middle two images.



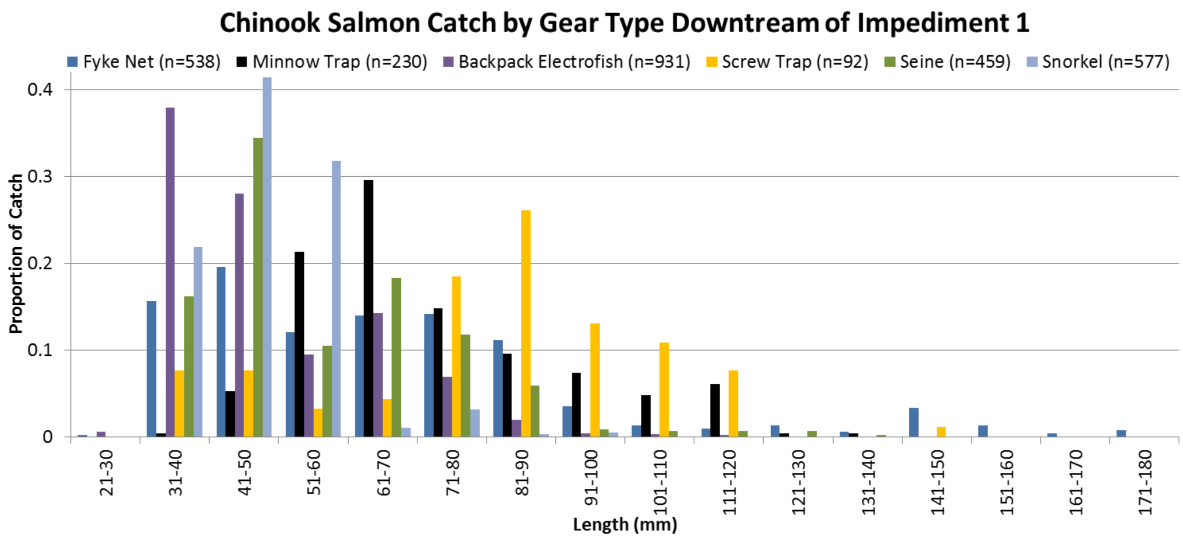


Figure 2.6.1-4. Length-frequency of Chinook Salmon upstream and downstream of Impediment 1.

2.6.1.6. Responses to Comments Regarding Sampling in Mainstem Macrohabitat Types

2.6.1.6.1. Response to Modification Request Regarding Site Selection

NMFS (Modification 2; NMFS_pp9.5-4_ph3) recommends that the fish distribution and habitat association sampling be modified to use the Proposed Study Plan and Revised Study Plan proposed site selection method. NMFS states that this method included using systematic-random selection of 10 or more replicate sampling units per macrohabitat. Finally, NMFS recommends again that in the Upper Susitna, three macrohabitats (main channel, split main, multiple split main) are treated as one and called simply “main channel”.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study

Plan. Specifically, NMFS have not established "good cause" for the modification or demonstrated the approved Study Pan has not been implemented.

The NMFS comment about selection of 10 or more replicate sampling units per habitat is incorrect. The Upper River was sampled using systematic random sampling of available habitats with 20 transect locations (not 30), as detailed in the FERC-approved Study Plan (see Final Susitna River Fish Distribution and Abundance Implementation Plan [IP], Section 5.4 filed March 1, 2013). Four of the selected transects were unsafe for sampling and were not sampled in 2013. At each transect, all available macrohabitat types within a 1 kilometer block were planned for sampling, which included 14 planned off-channel sampling sites. Logistical constraints and dry sampling units resulted in fewer units being sampled in 2013. Upon reviewing the 2013 sampling, AEA agreed that the number of side channel and off-channel macrohabitats was low using the transect-based method described in the IP. Accordingly, AEA proposed a modification to the FERC-approved Study Plan to address this in ISR Part C, Section 7.1.2.5 and in the *Proposed 2015 Modifications to Fish Distributions and Abundance Study Plan Implementation Technical Memorandum* filed on September 26, 2014. AEA's modification to the Study Plan was to expand sampling of off-channel habitats to ensure that better coverage would be achieved in the second year of study. AEA's proposed modification was implemented in the Upper River study area during the 2014 field season as a pilot test of the hybrid approach. The 2014 pilot effort included sampling all off channel habitat types as well as resampling a portion of main channel sites from 2013. The success of the proposed hybrid approach for increasing sampling in off-channel macrohabitats was evaluated and reported in Section 4.1.1.2 of the Study 9.5 SIR. During the evaluation, sampling took place at 35 macrohabitat locations including 6 or more replicates of off-channel and side channel habitats for upland sloughs, tributary mouths, clearwater plumes, side channels and side sloughs. There simply were not six backwaters present to sample in the Upper River and the three that were there were ephemeral (Study 9.5 SIR, Table 4.1.4). Consistent with NMFS recommendation, all main channel samples, including split and multiple split main channel units were combined into a single macrohabitat type (main channel) for analysis in the ISR and SIR, and AEA has proposed to continue to implement the combining of main channel types into one group for analysis. Implementation of AEA's proposed modification to the Study Plan has improved the sampling of multiple replicates and when implemented fully in the second year of study will allow AEA to fulfill study objectives for Study 9.5.

2.6.1.6.2. Response to Comment Regarding Additional Sampling

USFWS (USFWS_pp9.5-3_ph4-1) states that although the data collected during Upper River abundance sampling activities are incomplete, ambiguous, and limited, they may provide a basis for designing a sampling program that would provide levels of precision necessary to achieve study objectives. Accurate and verified mapping of the Upper River drainage also provides another source of information that improves sample design over earlier Study Plans. In this planning process, USFWS recommends that main channel, split main, and multiple split macrohabitats be classified as a single main channel macrohabitat and tributary mouth sampling be conducted as other macrohabitat sampling and not limited to clearwater plumes.

AEA disagrees with the USFWS characterization of Upper River sampling. In 2013, AEA used a transect-based approach to sample the Upper River mainstem, as described in the IP that resulted in few replicates of rare, off-channel habitat types. In 2014, AEA utilized available habitat mapping information and implemented a hybrid transect and GRTS sampling approach in the Upper River mainstem. AEA then evaluated the efficacy of the hybrid approach in the *Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation TM* filed September 17, 2014 and recommended that this approach be continued for future studies. This approach is consistent with this USFWS recommendation of grouping main channel types (single, split, multi-split) into a single macro habitat category and considers both tributary mouth and clearwater plume habitats as special habitat features selected using the GRTS approach similar to macrohabitat types. To date, tributary mouth and clearwater plume habitats have been classified and sampled as separate special habitat features (Level 4) consistent with the Implementation Plan and classification hierarchy established by Study 9.9, the Characterization and Mapping of Aquatic Habitats. This is consistent with the USFWS recommendation.

2.6.1.7. Responses to Comments Regarding Tributary Sampling

2.6.1.7.1. Response to Modification Request Regarding Tributary Sampling Lengths

NMFS (Modification 5; NMFS_pp9.5-6_ph4) recommends fish sampling occur throughout the entire tributary sampling units as required in the FERC study determination, and that sampling units include 25 percent of the tributary length as proposed. Sampling unit lengths are 200 meters, 400 meters, or 800 meters based on drainage area as described in the IP. NMFS describes AEA's proposed study modification (ISR Part C, Section 7.1.2.4) as unclear. NMFS (NMFS_pp9.5-7_ph3) states that the analysis presented in AEA's Black River Technical Memorandum does not support a reduction in tributary sampling area. NMFS states that the Technical Memorandum demonstrates that the subsampling conducted in 2013 is insufficient to meet study objectives; however, it does not evaluate whether targets proposed as a study modification, which are a reduction from sampling lengths in the FERC-approved Study Plan, are adequate to meet study objectives.

AEA requests that FERC not adopt this proposed Study Plan modification as NMFS has not demonstrated a need for their modification. In 2013 when implementing the Study Plan in the field it was determined that it would not be feasible to sample entire GRTS panels, a target of over 33,000 meters of tributary length, for three seasons with the allocated effort and budget for tributary sampling (~$1,800,000). In order to complete full GRTS panel sampling would have required an additional $3,600,000. While target lengths were not achievable, AEA would like to clarify that the RSP did indicate that the sample targets described for Chinook Salmon bearing streams were *up to* 15 percent and 25 percent of reach between the Susitna River and the 3,000 feet elevation contour that was accessible and suitable for sampling.

AEA disagrees that their proposed study modification for revised Upper River tributary sampling goals is "unclear" as the Services contend; the modification has been consistently described in detail as presented in Section 7.1.2.4 of the ISR Part C, and has been the focus of two technical memoranda (*Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation, filed September 17, 2014* and *Evaluation of 2014 Study Modification in the Black River, filed December 17, 2014*). During Study Plan development in 2012, there was a paucity of information on wetted stream widths for Upper River tributaries; this data gap was corrected during 2013 as initial fish and habitat surveys were completed, allowing AEA to employ a more standard approach for matching sample length to stream size. In the RSP and Implementation

Plan, AEA based target sample length and GRTS panel size on drainage basin size as a proxy for channel width. GRTS Panels were then subsampled in 2013. Although sub-sampling GRTS panels was a valid approach to maintain representativeness of samples across the stream length; it did not allow AEA to obtain as many replicate samples of rare habitat types to support rigorous evaluations of fish-habitat associations. To address the issue, AEA prepared and filed a TM (Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation Technical Memorandum; filed September 17, 2014) within which they proposed to adjust tributary sampling lengths based on other work conducted on streams in the region by ADF&G (Kirsch et al. 2014) as detailed in the 2015 Proposed Modification TM. Using a multiple of wetted channel widths for the basis of determining a minimum sample length is a generally accepted practice for study design

AEA also implemented a pilot study of their proposed approach in the Black River in 2014. Contrary to the Services assertion, AEA's modified approach offers a more rigorous sampling design than just selecting a certain percentage of stream length to be sampled as originally proposed in the RSP. Due to the high gradient nature of these Upper River tributaries, the majority of the main channel habitat is fast water, riffles and boulder riffles. By only using a target percent stream length to determine sampling area we would over sample these miles-long reaches of riffle habitat and likely would miss many of the slower water habitats that are not only relatively rare in these systems but also might be expected to better support fish rearing. With site-specific data in hand after 2013 field efforts, AEA was able to develop a refined approach that is: 1) based on relevant site-specific data about the habitats to be sampled; 2) consistent with the spatially balanced GRTS method and will build on the 2013 data set, 3) will increase sample size of all represented habitats, and 4) will be cost effective when trying to characterize the fish assemblages across hundreds of miles of riverine habitat. AEA's modified approach combines newly available site-specific information on wetted width and 2012 video imagery with 2013 GRTS design to derive attainable sampling lengths that are consistent with standard fisheries practice and enhance AEA's ability to collect data in underrepresented off-channel habitats in the high gradient tributary streams. The effectiveness of the modified tributary approach was then evaluated in terms of species distribution, species richness, relative fish abundance and the ability to evaluate fish-habitat associations in the Black River. As presented in the *Evaluation of 2014 Study Modification* TM the pilot effort not only increased the length of tributary samples as compared to 2013 but demonstrated sampling sufficiency in terms of an increased number of mesohabitats sampled, increased replicates of non-dominant habitats, increased species richness, and increased replicates for relative abundance estimates as compared to 2013 GRTS sub-sampling. These analyses demonstrated that AEA sampling in the Black River was effective for detecting and estimating relative abundance for both common and rare species and was effective for characterizing the fish assemblages in both dominant and rare habitat types.

AEA acknowledges that with their proposed modification, the length of tributaries to be sampled, would result in less length of tributary being sampled than if the FERC-approved Study Plan were followed explicitly, except for the Black River. However, AEA asserts that the expense required to sample these tributaries to this extent is unnecessary to meet study objectives and is not a more rigorous approach for characterizing fish assemblages in these tributaries. As presented in the 9.5 ISR, Section 5, and the 2015 Proposed Modification TM, Section 3.1, the 2013 subsampling was sufficient for documenting fish distribution and relative abundance for habitats sampled. However, after a review of 2013 data, AEA expressed their concern that the subsampling did not allow for incorporation of sufficient rare mesohabitat types to support documentation of fish abundance of all habitat types (Study 9.5 ISR Part C, Section 7.1.2.4 and the 2015 Proposed Modifications TM). AEA's proposed modification was designed to correct for this by implementing an approach that increases sampling proportional to stream width and increases the number of under-represented fish habitats (IP Section 3.1). The Evaluation of 2014 Study Modifications TM provides results that indicate that, if implemented, AEA's approach will be successful for meeting study objectives.

It is important to note that the modifications put forth by AEA were based on methods used by ADF&G (Kirsch et al. 2014) and incorporate sampling 40 wetted channel widths for wadeable streams, 120 channel widths for non-wadeable streams in basins with a watershed area of 100-300 km^2 (38.6 – 115.8 mi^2), and more than 140 channel widths in non-wadeable streams in larger drainage basins. AEA's proposed recommendation is much longer than the more commonly applied sample length of 20 (Fitzpatrick et al. 1998; USFS 2004) to 40 channel widths (Fritz et al. 2006; Kaufman and Robinson 1998; Maret and Ott 2004; Simonson et al. 1994, USEPA 2006) to characterize the fish assemblages and habitats in a stream reach.

A large volume of data on fish distribution and abundance has been collected in the Upper River by AEA from 2012-2014 and ADF&G from 2003 and 2011. AEA asserts that with one additional year of sampling using the study modifications proposed in the ISR Part C, Section 7.1.2.4 to build on the 2013 data set, data collection on fish distribution, relative abundance, and habitat associations will be sufficient to meet the study objectives of 9.5 and support impact analysis.

2.6.1.8. Responses to Comments Regarding Mainstem Boat Electrofishing

2.6.1.8.1. Response to Modification Request Regarding Mainstem Sampling Lengths

NMFS (Modification 4; NMFS_pp9.5-6_ph1) recommends sampling be conducted over the area described in the FERC study determination. All sampling units of side sloughs, upland sloughs and tributary mouths should be 200 meters long. Sampling within upland and side sloughs should begin at the confluence with the mainstem, include the mixing zone of turbid and clear water, when present, and extend upstream into the slough. For main channel and side channel sampling locations boat electrofishing and set or drift nets should effectively sample the entire 500-meter sampling unit. NMFS further recommends modifying this study to include subsampling units of 200 meters of shoreline using baited minnow traps and backpack electrofishing.

NMFS RSP comments (March 18, 2013) recommended that main channel and side channel habitats include sub-sample of nearshore habitat for juvenile species that may not be captured by boat electrofishing and gill drift netting due to shallow depths and nearshore cover. NMFS commented that they do not support what they interpreted as AEA proposed sampling of 200 meter lengths of main channel and side channel habitats if boat electrofishing or drift gill netting is not used. NMFS states that sampling smaller main channel and side channel habitats using minnow traps and backpack electrofishing will likely underestimate the distribution and abundance of grayling Dolly Varden, Whitefish, and Burbot whose probability of capture is lower when using these methods in the nearshore zone. Whereas, NMFS states that mainstem sampling using only boat electrofishing and drift nets will underestimate the distribution and abundance of juvenile salmon, they comment that consistently sampling 500 meter mainstem habitats by boat electrofishing and drift gill netting and a 200 meter sampling nearshore unit with backpacking electrofishing and minnow trapping will apply methods suitable for all target fish species at all sampling locations and comparable measures of fish abundance within and among macrohabitat types.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Several of NMFS comments were reiterations of comments they made on the RSP prior to the FERC Study Plan Determination and they express their disagreement that the FERC approved A Study Plan is adequate but they fail to show evidence to support their opinion.

First, AEA presented the variance for sampling unit lengths in 2013 in the 9.5 ISR Part A, Section 4.1.6.1.1. NMFS misinterpreted the sample length variance presented in Study 9.5 ISR Part A, Section 4.1.6.1.1 that states when boat electrofishing was not feasible, sampling units were shortened to either the complete mesohabitat unit or 200 meter (656 feet) per mesohabitat type per site, whichever was shorter. Specifically, NMFS states that AEA sampled 200 meters of nearshore habitat in main channel and side channel habitats only when 500 meter samples of boat electrofishing and drift gillnetting were not feasible and goes on to recommend nearshore sampling with minnow trapping and electrofishing. This is a mischaracterization of how sampling was proposed and implemented. Following the gear selection protocol, AEA did subsample 200 meters of nearshore habitat regardless of whether or not a 500-meter boat electrofishing or drift gill net sample was collected. Of the 301 main channel and side channel sampling events at GRTS and transect locations, on average 2.94 gears were used at each site (Table 2.6.1-4). A combination of nearshore and mid-channel techniques wasere used to document the range of fish species and life stage that could be present in the main channel (Table 2.6.1-4). The most common gear types employed were backpack electrofishing (in nearshore areas), boat electrofishing, minnow trapping (in nearshore areas), and seining (in nearshore areas) followed by hoop trapping and gill netting (Table 2.6.1-4). The most appropriate gear types targeting the diversity of species and life stages were applied at each site at the time of sampling following the protocol for gear type selection. Analysis of fish abundance is then standardized (CPUE) taking into about the amount of effort applied during each sampling event, a generally accepted scientific practice.

Table 2.6.1-4. Gear types used to sample main channel and side channel sites during 301 sampling events at GRTS and transect locations in the Lower, Middle, and Upper River, 2013-2014.

Gear Type	Events	% of Sites
Angling	2	1%
Boat Electrofish	206	68%
Fyke Net	26	9%
Gill Net	61	20%
Hoop Trap	82	27%
Minnow Trap	156	52%
Backpack Electrofish	242	80%
Seine	103	34%
Snorkel	4	1%
Trot Line	2	1%
Total Gear Events	884	

Regarding sampling within sloughs and tributary mouths, AEA's objective was to document fish distribution and abundance throughout the Project Area not just find fish where they may be most abundant. In 2013 only one slough and three tributary mouths were found in the vicinity of the transects. AEA field crews sampled 200 m of the slough, and both the mouth and associated clearwater plume for all three tributaries. To increase sample replicates of side channels and off-channel habitat features in 2014, the GRTS sampling procedure was added for site selection. The GRTS procedure is a spatially balanced approach for sampling across large landscapes and to achieve the spatial balance provided by this method, samples need to occur at the randomly selected GRTS panel locations. In contrast, if all sample sites were selected to begin at the confluence with the mainstem and continue upstream 200 meters they would be biased towards the species and life stages utilizing these areas and would not be representative of these habitat features overall. Still, in order to meet the intent of the FERC SPD, when slough habitats were sampled, slough confluence areas were inspected for mainstem backwatering and if present, these areas were sampled in addition to the 200m slough sample that may have occurred elsewhere within the slough. In addition, where tributary mouths had clearwater plumes associated with them, both the tributary mouth and up to 200m of the associated plume were sampled. These data are provided in the 9.5 SIR, Table 4.1-4.

2.6.1.8.2. Response to Modification Request Regarding Main and Side Channel Sampling

NMFS (Modification 9; NMFS_pp9.5-10_ph5) comments that FDA studies in the main and side channel should be modified to include methods in addition to boat electroshocking such as baited minnow traps and backpack electroshocking along the adjacent bank to capture juvenile salmon (Objective 1).

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study

Plan. Specifically, NMFS incorrectly interpreted AEA's implementation of the Study Plan specifically as approved by FERC and have not provided any justification to suggest otherwise.

It is not clear why NMFS is under the impression that near or bank-based sampling of main channel and side channels was not conducted. Sampling of main channel and side channel habitat included 200 meters of mid-channel and nearshore efforts as specific in the gear selection protocol (see Figure 2.6.1-5 below). The goal of sampling was to document all species and life stages potentially present at each site, including juvenile fish when present along river margins. See Section 2.6.1.8.1 for more detail on gears applied in main channel and side channel sites.

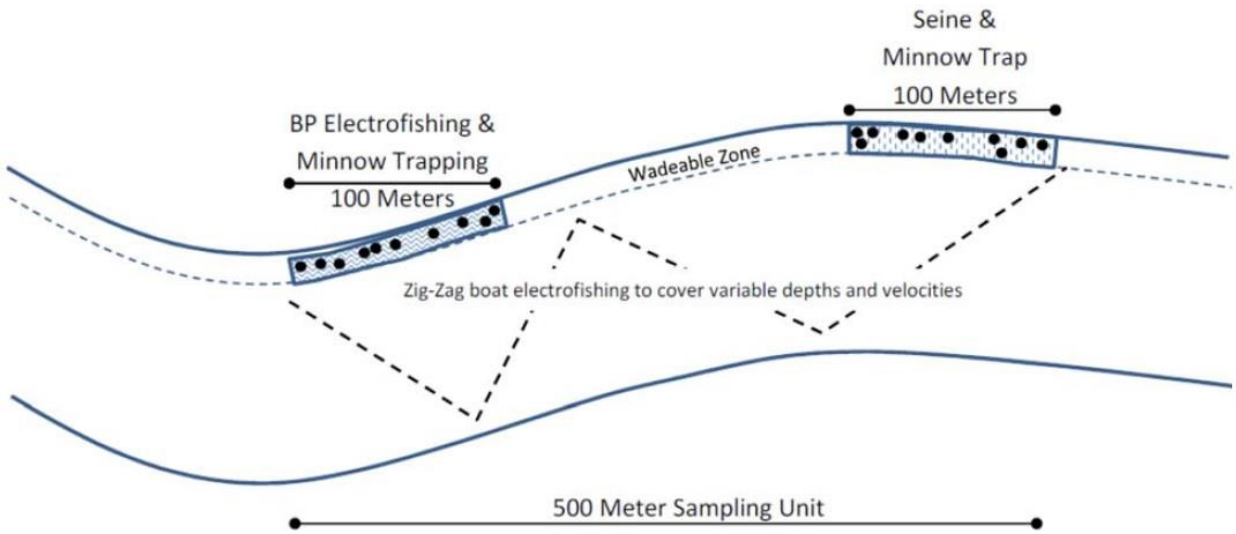


Figure 2.6.1-5. Figure 5 from Final Susitna River Fish Distribution and Abundance Implementation Plan, Appendix 3: Protocol for Site-Specific Gear Type Selection; Version 5 (Study 9.5 and 9.6 IP, March 1, 2013).

2.6.1.9. Response to Comments Regarding PIT Tagging

2.6.1.9.1. Response to Modification Request Regarding Future PIT Tagging

USFWS (Modification 5; USFWS_pp9.5-5_ph1) requests that AEA evaluate the effectiveness and value of the PIT tagging program. USFWS comments that the value of the 2013 and 2014 PIT tagging and detection program to describe fish movements is questionable. PIT array antennas were not installed in sequential spatial intervals at antenna sites, eliminating the ability to both discriminate upstream or downstream movement and assess the detection efficiency. USFWS states that very small numbers of tagged fish were captured outside the areas where they were tagged. No Chinook Salmon tagged in the Upper River were recaptured. USFWS states that interpretations of results from the few fish that are recaptured are problematic since tagging effort is not representatively distributed over habitat types or behavior characteristics.

USFWS comments that a detailed evaluation of the results of PIT tagging activities and discussion among involved researchers may provide insights into ways to improve and expand the existing sampling and tagging program, to redirect tagging objective to more attainable results (e.g., intensive study of a limited section of river), or to abandon the PIT tagging program and direct resources to other sampling activities.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

The general locations of PIT tag antennas were chosen to complement areas of intensive fish sampling (e.g., Focus Areas) during the Fish Distribution and Abundance Study such that the number of PIT tags deployed in the vicinity of each antenna, and the subsequent number of detections, could be maximized. As a result, targeted antenna locations were constrained to channel widths that approached or exceeded the functional limitations of PIT antenna technology. Where feasible, antennas were constructed to span the entire channel of the habitat feature. However, the electrical draw of such large individual antennas exceeded the amperage capacity of the PIT reader's multiplexer, preventing the deployment of multiple antennas from a single reader.

Duplicate antennas (each run off independent readers and power/charging stations) were tested at Whiskers Slough in early July 2013 in an attempt to discern directional movement and assess detection efficiency (ISR Part A, Section 4.5.3.1). However, considerable and inconsistent clock drift among each reader pair prevented accurate detection timestamps from which the sequence of upstream/downstream detection could be determined. To address this issue, in the fall of 2013, readers at Whiskers Slough and Slough 8A were connected to a new telemetry communications network and customized programming code was written to routinely correct each reader's clock. This approach was effective and replicated for the Slough 8A antenna location, although antennas at other locations had been removed for the season or destroyed by high flows or ice by this time.

In water bodies where channel width exceeded the functional limitations of PIT antenna technology or water velocity/depth rendered installation unsafe or infeasible, antennas were installed in either a portion of the channel or in an adjacent side channel to detect a subset of tagged fish movements. Because alternate routes of passage were available at these antenna locations, the standard method of evaluating detection efficiency was inappropriate; instead, read range and drift tests were relied upon to evaluate antenna performance.

Although the necessity of partial channel coverage reduced detection probability and constraints to deploying multiple antennas precluded determination of directionality, information regarding the movement of detected fish between a given antenna location and other antennas or recapture locations was still collected.

Although PIT tag antennas did not gather the quantity of detections in the Upper River compared to the Middle River some good information was documented. Of the 21 Arctic Grayling detected at the Oshetna antenna, most (62 percent) were only detected passing through the site on a single day; however, one individual (Tag # 183332001) used the area near the antenna extensively and was detected on 50 days between July 16 and September 15, 2013. A juvenile Round Whitefish (Tag # 226000553809) tagged in the Oshetna River in a riffle 80 meters downstream of the Oshetna antenna on September 12, 2013 was detected at the antenna on 15 days between September 16 and the end of monitoring on October 6, 2013.

Three PIT-tagged were fish documented moving between the Upper River and Middle River; two Artic Grayling and one Humpback Whitefish. A 200-mm long Arctic Grayling tagged on August 25, 2014 in side channel habitat at PRM 206.3 was later recaptured at PRM 184 in main channel habitat on September 15, 2014. A 330-mm long Arctic Grayling tagged in a side slough at PRM 173 on September 2, 2013, was later recaptured in the Oshetna River DMT (PRM 235.1) on June 30, 2014. The Humpback Whitefish was initially captured at the Oshetna River DMT (PRM 235.1) on June 21, 2013, and then recaptured at the Curry DMT on the mainstem Susitna River (PRM 123.9) on July 7, 2013. On August 3, 2013, it was last detected at the Whiskers Slough array (FA-104).

2.6.1.9.2. Response to Modification Request to Eliminate PIT Tagging

NMFS (Modification 13; NMFS_pp9.5-13_ph2) recommends assessing the migration of juvenile Chinook from Kosina Creek and Oshetna River into the Susitna downstream from the confluence through sampling once a month June through September in both the tributaries and directly downstream in the Susitna. NMFS recommends expanding the data collection using differences in the relative abundance of juvenile salmonids in tributaries over time, in addition to screw trap data, to determine movement patterns in place of PIT tagging.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification by demonstrating how sampling once a month would better evaluate fish movement nor have they demonstrated that the plan has not been implemented as provided by the approved Study Plan

In contrast to NMFS's comment, PIT tagging in the Upper River resulted in some very precise and interesting information about fish movement both confirming patterns evident from radio telemetry and documenting movement that otherwise would not have been documented. As described in 9.5 ISR Section 5.2.2.2.1, PIT tagging confirmed inter-tributary movement of both Arctic Grayling and Round Whitefish. In addition, the only documented downstream movement of a fish from the Upper River to the Middle River was a PIT-tagged Round Whitefish that traveled from the Oshetna River to Whiskers Slough, via Curry Station. The value of using individual PIT tags is enhanced when field efforts are repeated in consecutive seasons as they remain readable as fish survive and grow over time. As stated in the Fish Distribution and Abundance IP, Section 5.6, PIT tagging was proposed to provide additional information on localized fish movements, growth and survival across years. Evaluating its efficacy based on one field season in the Upper River is premature.

NMFS is correct that not all juvenile Chinook Salmon collected in the Upper River in 2013 were PIT tagged; however, they were incorrect in asserting that the RSP said all Chinook Salmon would be tagged. AEA implemented fish handling and tagging procedures as outlined in the Section 5.1 of the *Final Susitna River Fish Distribution and Abundance Implementation Plan* (Study 9.5 and 9.6 IP, March 1, 2013) including only tagging fish with fork length >60mm. Many of juvenile Chinook Salmon handled in the Upper River (104 of 216) did not meet the minimum size for PIT tagging. An additional 67 fish were between 61 and 69 mm FL and some individuals in this size range were not tagged based on fish condition at the discretion of the field crew. Juvenile Chinook Salmon were also used for multiple study objectives, including and importantly, as a source of genetics samples. To limit handling stress most individuals that were sampled for genetics (collected as fin clips during the early summer sampling event in 2013) were not PIT tagged including all 74 individuals collected by ADF&G under Study 9.14. It is also important to note that the number of fish cited by NMFS, 242, includes 30 individuals that were observed (snorkel or incidental) but not captured and could not be PIT tagged. NMFS correctly notes that none of the 22 juvenile Chinook Salmon PIT-tagged in 2013 were recaptured. This is to be expected as recapture rates tend to increase with the number of fish tagged. For rare species such as Chinook Salmon, the probability of detecting a tagged individual is low. In 2014 an additional 13 of 40 juvenile Chinook Salmon handled were PIT tagged and one fish was recaptured; however, the recapture occurred the day following tagging at the tagging location (Kosina Creek fyke nets) yielding little information.

While NMFS's comment about PIT array efficiency testing not being conducted as per the study plan is technically correct, AEA did implement an alternative approach to system testing as described in Study 9.5 ISR Part A, Section 4.5.4.1. The Implementation Plan proposed that the detection efficiency of PIT tag interrogation systems be determined using indirect methods as described by Connolly et al. (2008). This approach relies on the detection of fish at multiple locations (i.e., antennas located upstream and downstream) to identify missed detections of fish passing a given antenna. However, the limited availability of appropriate sites for antenna placement in 2013 precluded this approach because antenna sites could not be arranged in a longitudinal series; instead antennas were installed at a single site within a given tributary or slough. Detection efficiency of PIT antennas was reported as a variance (ISR Part A, Section 4.5.4.1) and a modified approach using an evaluation of read range over the antenna was implemented. Read range for both PIT tag sizes, combined with the antenna dimensions, water depth over the antenna (for a swim-over configuration), and wetted channel width was used to estimate the percentage of the channel's cross-sectional area in which a tag would be detected. This information was routinely recorded during site visits to download data. In addition, detection efficiency was evaluated in October 2013 by drifting neutrally buoyant test tags past an antenna and calculating the percentage of tags that were detected. Data on read range and neutrally buoyant tag tests were not used for any analysis in the ISR and are available upon request.

NMFS comments mischaracterize the release locations of PIT-tagged fish as being upstream of the rotary screw trap capture site and PIT tag interrogation system; PIT tagged fish were not transported around and released upstream of PIT tag antennas. They were released at the collection site and in the case of fish used in rotary screw trap efficiency testing they were released several hundred meters upstream. See the response to Comment USFWS_pp5_ph1 for more discussion on antenna testing and feasibility (Section 2.6.1.9.1).

An immense amount of effort has been applied to the Upper River from 2012 to 2014. AEA has documented that juvenile Chinook Salmon are rare and patchily distributed. In recent years, more than 600 unique locations have been sampled for fish and over 24,000 fish have been collected or observed (Table 2.6.1-5). AEA's study balances the need for targeted sampling to collect individuals near the spawning grounds where they are most likely to be collected and at the mouths of natal streams with the need for a rigorous sampling program to evaluate distribution across a varied riverscape in order to unbiasedly assess species distributions, evaluate relative abundance, and fish-habitat associations. NMFS states that AEA needs to "expand the sampling capacity" and collect more juvenile Chinook Salmon rather than expend effort on PIT tagging.

It is unclear how the proposed modification of sampling monthly in Kosina Creek and the Oshetna River and in the mainstem just below the tributaries is substantially different than the extensive sampling program completed by AEA during the first study year, when AEA sampled twice in June and then approximately monthly through September to be consistent with the FERC-approved Study Plan. In 2013, AEA conducted Early Life History Sampling in these tributaries as soon as feasible after ice out (9.5 ISR Section 4.6.2). Two events were conducted two weeks apart in June. Field crews sampled approximately 20 sites. Only 6 Chinook Salmon fry were collected near the documented 2012 spawning area in the Black River (9.5 ISR Section 5.3). This sample was too small to allow for tracking movement out of the tributary.

Collecting large sample sizes of a rare species is easier said than done, especially when uncertainty remains in regards to whether or not successful reproduction occurs every year. Preliminary genetics results have found a high degree of relatedness of samples from 2013 and 2014, including samples from GRTS sampling and out-migrant trapping. The relatedness of samples suggests these fish may come from the same small number of parents. It also suggests that sampling efforts were thorough where they were conducted. Finally, the cost of PIT tagging is a fraction of that required for additional field distribution and abundance sampling events; thus the NMFS modification would substantially increase cost of Study 9.5, see Table 2.6.1-1.

Table 2.6.1-5. Gear sampling effort and fish catch/observations in the Upper River study area by year, 2003-2015.

Year	# Sampling Events	# Sites Sampled	Fish Collected/ Observed	# Nights of Downstream Migrant Trapping	Total Downstream Migrating Trapping Catch	Total Observations	Juvenile Chinook Salmon Catch	# Resident Fish Radio-Tagged	# Radio Tag Detections
2003*	12	12	85	-	-	85	6		
2011*	14	14	327	-	-	327	-		
2012	177	177^	1,421	-	-	1,421	-		
2013	675	279^	11,601	94	1,157	12,758	280	93	217,533
2014	338	131^	7,946	158	1,639	9,585	42	155	2,931,568
2015									6,418
Total	**1,216**	**613**	**21,380**	**252**	**2,796**	**24,176**	**328**	**248**	**3,155,519**

Notes:

*ADF&G Fish Inventory Sites within the Upper River study area

^ Mesohabitat sampling units

2.6.1.10. Response to Comments Regarding Operation of Downstream Migrant Traps

2.6.1.10.1. Response to Modification Requests Regarding Downstream Migrant Trapping Schedule

USFWS (Modification 4; USFWS_pp9.5-4_ph3) requests that AEA continue and expand downstream migrant trap operations for two years and requests a modification to evaluate the ability of these traps to describe the timing of fish migrating past these sites.

NMFS (Modification 12; NMFS_pp9.5-12_ph6) recommends that rotary screw traps be placed in the main channel just downstream from the mouth of the Oshetna and Kosina Creeks to capture fish migrating from these tributaries and fish migrating downstream within the Susitna River mainstem. NMFS requests that the screw traps at the mouth of the Oshetna and Kosina Creeks be operated 7 days a week to document the movement of juvenile Chinook Salmon to mainstem rearing and overwintering habitats. NMFS requests that AEA conduct the population estimates and assess the efficiency of the migrant trap as described within the FERC-approved Study Plan.

NMFS (NMFS_pp9.5-12_ph3) comments that AEA test the efficiency of using a fyke net or screw traps and expresses concern with the use of fyke nets set for 20 to 24 hours at a time due to debris loading and not trap efficiency testing.

NMFS comments that AEA did not test the efficiency of the screw traps as required in the Study Plan Determination. NMFS requests that AEA conduct trap efficiency tests as described within the FERC-approved Study Plan for all screw traps. NMFS states that this information is necessary to evaluate the effectiveness of the study methodology at describing the movement patterns of target species and age classes.

AEA requests that FERC not adopt these proposed Study Plan modifications because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification by demonstrating how traps in the large mainstem Susitna River would be expected to perform better than tributary traps, nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan.

As proposed in the Implementation Plan, AEA implemented trapping in known Upper River Chinook Salmon tributaries (Kosina Creek and the Oshetna River) in 2013; however, a trap was not operated on the mainstem downstream of Kosina as recommended by FERC (April 1, 2013 SPD, pages B-133 and B-134) due to permitting restrictions. This was documented as a variance in the Study 9.5 ISR. In 2014, consistent with the FERC SPD recommendation (April 1, 2013 SPD, pages B-133 and B-134), AEA implemented trapping in both tributaries and the mainstem between Kosina Creek and the proposed dam site.

AEA disagrees that the Upper River traps have been unsuccessful in documenting movements of fish out of tributaries and within the mainstem itself even though catch of species that are rare in the Upper River, including Juvenile Chinook Salmon, have been low. A total of 40 individuals, accounting for 13 percent of the total catch of Juvenile Chinook Salmon in the Upper River in 2013-2014, are attributed to downstream trapping. In addition, AEA disagrees that moving traps from the tributaries to the mainstem will improve trap effectiveness. Based on the increased volume of the flow and challenges of operating a trap in a larger river, AEA expects that traps placed on the mainstem, downstream of known natal tributary streams, would be less efficient at collecting juvenile Chinook Salmon than tributary traps. These locations would have a much greater volume of water and traps would be sampling a smaller proportion of the total volume and more than likely collecting fewer fish. There are also additional challenges of operating the traps along the bank of the mainstem where water levels fluctuate considerably. AEA's proposed approach to sample at the mouths of the Oshetna River and Kosina Creek, along with fishing with fyke nets in the clearwater plume per AEA's modification to the Study Plan, is a better overall trapping strategy for gathering information on the rare species that originate in these tributaries than sampling only in the mainstem.

It is worth noting that for species that are more common in the Upper River, as evidenced by FDA sampling, trap catch was greater and patterns of movement were discernable indicating that the techniques were effective in meeting the objective. For example, 1,498 Arctic Grayling and 699 Longnose Sucker were collected during downstream migrant trapping in 2013-2014. In both study years, peak catch of juvenile Arctic Grayling occurred in mid-July while the catch of larger juvenile/adult and adult fish primarily occurred in mid-June and September through early October (Figure 2.6.1-6). The patterns of downstream movement exhibited by the catch of large fish are consistent with the post-spawn and pre-overwintering migrations documented by radio-tagged fish (Appendix B, *2013-2015 Radiotelemetry Implementation Report*).

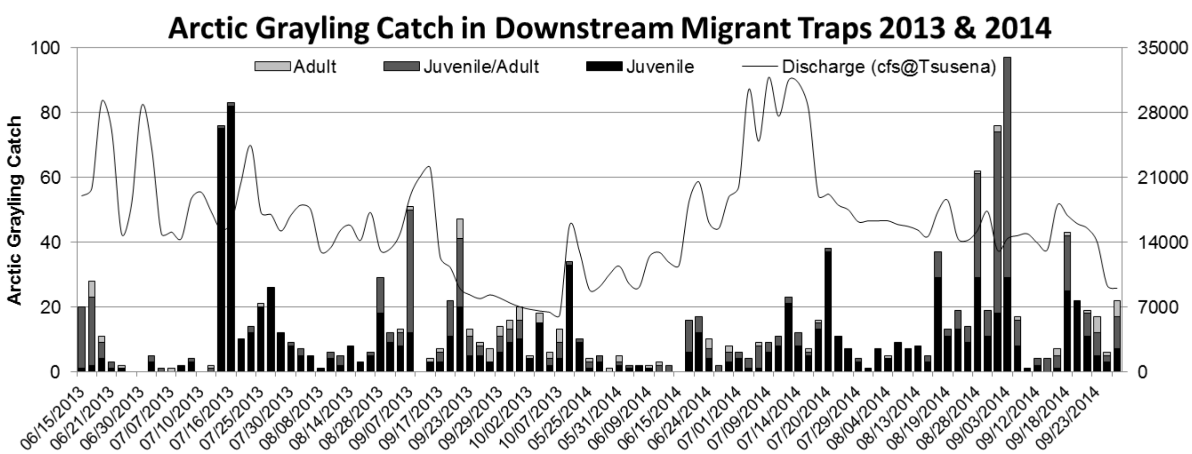


Figure 2.6.1-6. Artic Grayling catch in downstream migrant traps by life stage, 2013-2014.

It is a real possibility that catch at trapping locations in tributary mouth and clearwater plume habitats in the Upper River actually reflect the lower Chinook Salmon abundance in general (see combined relative abundance index in *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum*, Attachment 7). This notion is supported by the few locations where juvenile salmon have been found during field sampling in 2012, 2013 and 2014 as well as the preliminary findings of the Genetics Study (Study 9.14) that indicate the divergence evident in Upper River Chinook Salmon is consistent with representation by a few family groups. This preliminary finding will be further tested by conducting sibling analysis of the samples from Upper River Chinook Salmon.

For rare species, additional data sources (ELH, seasonal distribution and abundance sampling, radiotelemetry, etc.) may need to be synthesized to gain a more complete picture of movement patterns. When considering the 2013 and 2014 downstream migrant trapping program with the 2014 hybrid mainstem sampling, 38 of 52 juvenile Chinook Salmon collected in mainstem Upper Susitna River habitats (including tributary mouths) occurred in late-May through mid-July, within six to nine weeks of river breakup. Similar to the Middle River (see 9.6 ISR, Part A, Section 5.2.2; Schmidt et al. 1985), the primary outmigration period for juvenile Upper River Chinook Salmon appears to be May and June shortly after ice breakup. Collection numbers in mainstem habitats declined each month through the summer and into the fall; only two juvenile Chinook Salmon were collected in September and early October despite intensive sampling and downstream migrant trapping.

The additional year of trapping that AEA has proposed as a modification to the FERC-approved Study Plan (ISR Part D, Section 7.2) will add information on the timing of movements; however, rare species may remain poorly understood despite intensive sampling. AEA is agreeable to discussing alternatives and improvements to the downstream trapping program, however rare species, such as Chinook Salmon, likely will remain difficult to document. Trapping locations with the necessary depth and velocity criteria and safe access in the Upper River have been thoroughly scouted and are limited in number. The addition of sampling locations is preferred to expanding trap operations which is likely to result in additional days of low catch. AEA has demonstrated that fyke netting in Kosina Creek can effectively supplement rotary screw trapping efforts; however finding additional appropriate locations for long term fyke netting may also be challenging given high flows and high gradients characteristic of the Upper River.

The Services' provide recommendations for trap efficiency testing and indicate that efficiency testing was not conducted as described in the FERC-approved Study Plan. However, AEA did implement efficiency testing when sample sizes were sufficient. Trap efficiency testing as outlined in the Implementation Plan required a minimum sample size in order to make valid mark-recapture estimates. Catch was generally low in the Upper River and the minimum number of individuals was collected on only one occasion. See Section 2.6.1.1.1 for more discussion on efficiency testing.

NMFS mischaracterizes AEA's proposed modifications regarding trapping locations following the 2013 season. AEA never proposed moving the Oshetna trap. As described in Section 7.1 of the ISR Part D, AEA's proposed study modification was to replace the Kosina Creek trap with fyke netting near the mouth and move that trap (since it was ineffective) from Kosina to the mainstem Susitna River near the dam site, consistent with the FERC SPD (April 1, 2013, pages B-133 and B-134).

NMFS comment that fyke nets set overnight will not sample effectively because of debris loads is not applicable to Kosina Creek. Fyke nets in Kosina Creek did not typically have issues with debris, even in the fall. There is little in terms of vegetation in the Kosina basin as most of the basin is above the tree line.

Catch was low for juvenile Chinook Salmon because they are rare in the Upper River. Expanding the trapping schedule to seven days a week would likely result in more overall catch with low daily and weekly numbers that will not greatly increase information on the timing of salmon movements.

Resources are better used elsewhere, for example the AEA proposed modification of adding targeted salmon early life history sampling objective in the Upper River (ISR Part D, Section 7.1).

AEA has completed two years of downstream migrant trapping on the Oshetna River and Kosina Creek and one year on the mainstem downstream of the known spawning tributaries. In the ISR Part D, Section 7.2, AEA has proposed a modification to the FERC-approved Study Plan to add a third year of trapping in Kosina Creek and the Oshetna River and a second year of effort in the mainstem Susitna River. AEA is confident their approach will be successful in meeting study objectives.

2.6.1.10.2. Response to Modification Request Regarding Downstream Migrant Trap Locations

NMFS (Modification 11; NMFS_pp9.5-11_ph4) recommends a downstream migrant screw trap at the proposed dam location and an additional one at the reservoir head be installed and operated for a minimum of two years during the open water seasons as required in the FERC determination. NMFS comments that AEA did not install and operate a downstream migrant trap (screw trap) near the proposed dam location as required by the FERC-approved Study Plan and that understanding the species and timing of downstream migration is critical to assessing potential Project related impacts and evaluating passage alternatives. NMFS asserts that determining the migration pattern of salmonids and the environmental factors influencing migration is not likely to be accomplished during one or two years of study and therefore recommends at least 5 years of data collection.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established “good cause” for the modification nor demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA does not agree with the proposed modifications to trapping locations or schedule. NMFS does not acknowledge that AEA operated a downstream migrant trap on the mainstem upstream of the dam site at the most suitable location available for trap operation (RM 200) and was successful at capturing fish, including Chinook Salmon, and documenting movements. They do not discuss or demonstrate why this trap location and operation is not sufficient to meet study objectives. In addition, they provide no justification for the need to understand migration timing of fish from upstream of the proposed reservoir, an area where no salmon spawning has ever been documented. As discussed in Section 2.6.7.3.1, the successful completion of the fish passage feasibility analysis is not dependent upon this data.

In 2013, a downstream migrant trap was not installed near the dam site because of land access limitation and traps were fished in Kosina Creek and the Oshetna River, the two known Upper River Chinook Salmon spawning basins (Study 9.5 ISR Section 4.1.6.2). In 2014, AEA implemented downstream trapping on the Oshetna River, mouth of Kosina Creek, and the mainstem Susitna River at PRM 200, approximate thirteen river miles upstream of the dam site. After reconnaissance of mainstem sites using aerial videography and imagery, a short list of eight locations were visited on the ground to evaluate hydraulic conditions, depths, velocities, anchoring locations, vulnerability to collecting debris, landing zone, and staging/assembly area. The PRM

200 location was the most suitable location in proximity to the dam site. Trapping results from 2014 indicated that the trap performed reasonably well collecting 500 fish over the trapping period. The results of intensive research in the Upper River indicate that low numbers of juvenile and adult Chinook Salmon are present, there is interannual variation in abundance, and based on the information that has been collected, patterns of rearing and outmigration are similar to other segments of the river.

NMFS mischaracterizes AEA's proposed modifications regarding downstream migrant trap locations following the 2013 season. Contrary to NMFS's comment (NMFS_pp9.5-12_ph4), AEA never proposed moving the Oshetna trap. As described in Section 7.1 of the ISR Part D, AEA's proposed study modification was to replace the Kosina Creek trap with fyke netting near the mouth and move that trap (since it was ineffective) from Kosina to the mainstem Susitna River near the dam site, consistent with the FERC SPD (April 1, 2013, pages B-133 and B-134). NMFS comment that fyke nets set overnight will not sample effectively because of debris loads is not applicable to Kosina Creek. Fyke nets in Kosina creek did not typically have issues with debris, even in the fall. There is little in terms of vegetation in the Kosina basin as most of the basin is above the tree line. Catch sample sizes are small because juvenile Chinook Salmon are rare, expanding the trapping schedule to seven days a week would likely result in more overall catch with low daily and weekly numbers that will not greatly increase information on the timing of salmon movements. Resources are better used elsewhere, for example the AEA proposed modification of addition of the targeted salmon early life history sampling objective in the Upper River (ISR Part D, Section 7.1).

There has been no new or unique information to suggest a different life history strategy or out outmigration timing different from other river segments. It is difficult and expensive to conduct work in the remote areas of the Upper River. The study area as defined, and downstream migrant trapping locations used in 2014 and proposed as a modification by AEA in the ISR Part D, Section 7.1, are in the most effective locations with the best chances of collecting these rare fish and informing the study of fish passage on the timing of (1) the outmigration from natal tributary streams and (2) the outmigration in the mainstem near Watana Dam. There is not strong rationale for moving traps to the proposed locations where they more than likely will be less effective and catch fewer fish.

Regarding operating the downstream migrant traps 7 days a week to increase catch of salmon, AEA disagrees that this operational change is likely to be effective. Catch was low for juvenile Chinook Salmon because they are rare in the Upper River. Expanding the trapping schedule to seven days a week would likely result in more overall fish catch but low daily and weekly catch will continue and will not greatly increase information on the timing of salmon movements. Resources are better used elsewhere, for example the AEA proposed modification to add a targeted salmon early life history sampling objective in the Upper River (ISR Part D, Section 7.1).

2.6.1.10.3. Response to Comment Regarding Rotary Screw Trap Specifications

NMFS (NMFS_pp9.5-15_ph3) comments that the RSP, *Final Susitna River Fish Distribution and Abundance Implementation Plan* (Study 9.5 and 9.6 IP, March 1, 2013), and ISR do not state the mesh size of screw trap live boxes. Depending on mesh size emergent fry may not be retained in live boxes. NMFS requests that the study methodology clearly describe features of the screw trap. NMFS comments that mesh size used to construct live boxes should be < 2 mm or ~ 1/8 inch.

NMFS wants to ensure that juvenile salmon, grayling, and other resident fish that emerge from tributary spawning locations and migrate downstream to the Susitna River are retained within trap live boxes.

Rotary screw traps have a galvanized wire mesh debris drum from which water flows out of the live box. These traps are designed to collect salmon fry and have a mesh size smaller than 1/8-inch diameter (Figure 2.6.1-7). Rotary screw traps along with fyke netting (1/8-inch mesh) and backpack electrofishing are the best gear types for catching small juvenile Chinook Salmon (See Section 2.6.1.5.3). Data collected between 2013 and 2014 reveal that minnow trapping should not be used for the collection of newly emerged Chinook Salmon fry and fish less than 50 mm in length (See Section 2.6.1.5.3).

Figure 2.6.1-7. Photo of rotary screw trap used on the Susitna River with fine mesh debris drum.

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2.6.2. Study 9.6 – Study of Fish Distribution and Abundance in the Middle and Lower Susitna River

As established in the Study Plan[25] (RSP Section 9.6.1), the overall goal of this study is to characterize the current distributions, relative abundances, run timings, and life histories of all resident and non-salmon anadromous species encountered including, but not limited to Dolly Varden, Eulachon, Humpback Whitefish, Round Whitefish, Arctic Grayling, Northern Pike, Burbot, and Arctic Lamprey, as well as freshwater rearing life stages of anadromous salmonids (fry and juveniles) in the Middle and Lower Susitna River. Data collected as part of this study will be used to provide a baseline characterization of fish assemblages in the Susitna River, to identify and evaluate potential Project-induced effects on fish assemblages, and inform development of any necessary protection, mitigation, and enhancement measures.

The following seven specific objectives have been developed for this study and include multiple tasks.

- Objective 1: Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts) and fish habitat associations of juvenile anadromous salmonids, non-salmonid anadromous fishes and resident fishes.
- Objective 2: Describe seasonal movements of juvenile salmonids and selected fish species such as Rainbow Trout, Dolly Varden, Humpback Whitefish, Round Whitefish, Northern Pike, Arctic Lamprey, Arctic Grayling, and Burbot, with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem of the Susitna River.
    - Document the timing of downstream movement and catch using out-migrant traps.
    - Describe seasonal movements using biotelemetry (passive integrated transponder [PIT] and radio tags).

[25] The FERC-approved Revised Study Plan (RSP) Section 9.6 for the Fish Distribution and Abundance in the Middle and Lower Susitna River Study (FDAML) as modified by FERC's Study Plan Determination (Study 9.6 SPD, April 1, 2013) and *Final Susitna River Fish Distribution and Abundance Implementation Plan* (Study 9.5 and 9.6 IP, March 1, 2013) is collectively referred to as Study Plan Section 9.6.

- Objective 3: Describe early life history (ELH), timing, and movements of anadromous salmonids.
    - Describe emergence timing of salmonids.
    - Determine movement patterns and timing of juvenile salmonids from spawning to rearing habitats.
    - Determine juvenile salmonid diurnal behavior by season.
    - Collect baseline data to support the Stranding and Trapping Study.
- Objective 4: Document winter movements and timing and location of spawning for Burbot, Humpback Whitefish, and Round Whitefish.
- Objective 5: Document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type.
- Objective 6: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (Northern Pike).
- Objective 7: Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Fish Genetic Baseline Study (Study 9.14).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes fourteen modifications to Study Plan Section 9.6:

1. ELH sampling to take place every two weeks from ice breakup through the end of June;
2. adjust sample sites and include FA-113 (Slough 6A) and main channel habitat placed into single stratum;
3. relocate mainstem Curry Station RST to mainstem below Portage Creek (PRM 151.3-152.3);
4. relocate Montana Creek RST to mainstem in vicinity of Montana Creek;
5. relocate Indian River and Montana Creek PIT antennas closer to source of PIT tagged fish;
6. relocate radio tag receivers from Slough 21 to Powerline station and eliminate Slough 11 and Fog Creek stations;
7. continue to PIT tag fish at capture locations until 4,000 tags (1,000 tags x four PIT antennas) have been allocated per target species in the entire Middle/Lower River segments;
8. continue implementation of Winter Fish Studies as described in ISR Part C, Section 7.1.2.5;

9. continue with modified sample reach lengths for main channel habitat types (500 m (0.3 mi) for boat electrofishing and drift gillnetting, and 200 meters for other techniques;
10. continue to use single-pass sampling;
11. 25 fish, per species, per life stage, per gear will be weighed, measured for length and PIT tagged if appropriate;
12. continue to survey the same study sites used for 2013-2014 winter PIT tag arrays for future winter efforts;
13. collect additional tissue samples for genetic analysis and increase photo documentation of juvenile Chinook and Coho salmon; and
14. follow the gear specifications and descriptions of field application outlined in IP Appendix 3: *Protocol for Site-Specific Gear Type Selection; Version 5*.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, FERC staff and licensing participants submitted comments and proposed study modifications for Study 9.6. On June 22 and 23, 2016, AEA received comments on Study 9.6, including its proposed modifications outlined above from ADF&G, NMFS, and USFWS. Comments from the agencies included 36 study modifications, some of which overlapped between agencies, and numerous comments about study details. AEA's responses to the proposed modifications and comments can be found in Table 2.6.2-1 and below. For the narrative responses, AEA organized similar comments by topic to provide integrated responses and facilitate review.

AEA provides additional information in the following supplements to the Study 9.6 *2014-2015 Study Implementation Report* (November 9, 2015) that are filed with FERC as attachments to this document, *Response of the Alaska Energy Authority to Comments on the Initial Study Report*. The purpose of these Technical Memoranda is to provide licensing participants with detailed study status updates related to the FERC-approved Study Plan.

- *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7). This Fish Use Habitat Index (FUHI) TM demonstrates AEA's proposed approach to combining catch-per-unit-effort (CPUE) metrics for multiple gear types to evaluate relative abundance and habitat associations under Objective 1. Multiple gears were necessary to capture the diversity of fish species and life stages present in the study area in the most efficient and consistent manner to meet Objective 1.
- *2013-2015 Radiotelemetry Implementation Report.* This is a detailed analysis of the movement of radio-tagged resident fish in support of Objectives 2, 4 and 7 (Attachment 8). This fish movement TM uses data that was put through a rigorous quality control process to describe the whereabouts and home range size of fish during different seasons; the use of tributaries and the mainstem; use of the reservoir inundation zone/zone of hydrologic influence; and movements (including past the proposed Watana Dam location).

Table 2.6.2-1. Study 9.6 Comments and Responses.

Reference Number	Comment or Study Modfication Request	AEA's Response
ADNR_ADFG_pp13_ph3	*This study assessed current fish assemblages including spatial and temporal distribution, and relative abundance in the Susitna River downstream of the proposed Watana Dam. A variety of equipment and sampling techniques were used to collect information on fish distribution and abundance. Given the large project area, number of fish species and diversity of fish habitats, we believe AEA and their contracors have done a commendable job characterizing fish distribution and abundance in the Middle and Lower Susitna River.*	AEA appreciates ADF&G's constructive participation in the development of this study plan and review of study implementation within the context of the FERC ILP. AEA concurs.
ADNR_ADFG_pp13_ph4	*We acknowledge the difficulty AEA contractors have faced in the identification of juvenile Chinook and Coho salmon over this large area and variability in development timing. Combined with measures taken and the genetic sampling, we believe this issue has been appropriately addressed and will not affect interpretation of study results or the decision making process.*	AEA appreciates ADF&G's reviews and support for AEA's implementation of the FERC-approved Study Plan.
ADNR_ADFG_pp13_ph5	*We support AEA's modifications to collect additional tissue samples for genetic analysis, implement the Chinook and Coho salmon identification protocol, and to sub-sample fry and parr during winter and early spring sampling.*	AEA appreciates ADF&G's reviews and support for AEA's implementation of the FERC-approved Study Plan.
ADNR_ADFG_pp13_ph5a	*a. The table states that the number of divers for a reach = stream width/visibility. Using this formula, if the stream width is 25 feet and the visibility is 5 feet, the formula indicates that 5 divers would snorkel survey a 25 foot stream. Does this assume the diver has 5 feet of total visibility (2.5 feet either side)? The number of divers this formula generates seems to be excessive.*	The objective for the protocol for snorkeling is for observers to work upstream as a team and cover the entire stream width or as much area as possible. This decreases the chances that fish elude observations and minimizes double counting as snorkelers are close enough to see one another and communicate. The degree to which an entire stream or slough can be covered depends on width, velocity and water clarity. Snorkeling is typically only employed in very clear tributaries, clearwater plumes and upland sloughs. The average visibility for snorkelers to differentiate parr marks underwater during 2013-2014 snorkeling events in the Middle/Lower River was 2.1 meters (7 feet). Thus, one snorkeler could effectively cover a 14 foot wide habitat unit, two snorkelers could cover a 21 foot wide habitat unit, and three snorkelers could cover at 28 foot wide habitat. This was the preferred approach, a single pass, as outlined in FDA IP, Appendix 3: *Protocol for Site-Specific Gear Type* *Selection; Version 5* (November 14, 2014) and FDA IP Appendix 7: *Protocol for Snorkel Surveys* (March 1, 2013). In the case of

Reference Number	Comment or Study Modfication Request	AEA's Response
		extremely wide habitat units where it is not feasible to see from bank to bank, field crews either employed a zig-zag patter or surveyed a subunit of the stream channel. In high gradient streams upstream of Devils Canyon, for example Tsusena Creek and Kosina Creek, it is often only feasible for snorkelers to safely work the channel margins. This is taken into account when CPUE estimates are generated by summing the total effective area surveyed. The area surveyed was always estimated by multiplying the length of the unit by the visible corridor (or channel width if smaller).
ADNR_ADFG_pp13_ph5b	*b. Section 4.5.1 Emergence timing – document states that salmon redds were monitored on a monthly basis, but Table 2-1, Objective 3A, states that bi-weekly sampling was conducted. More frequent monitoring would provide AEA with more precise emergent timing information as addressed in 5.2, Objective 3, paragraph 3.*	Documenting emergence timing is a collaborative effort between fish distribution and abundance (Study 9.6), Instream Flow (Study 8.5), and Groundwater (Study 7.5). Under Study 8.5, surface and intergravel water temperatures and intergravel dissolved oxygen concentrations were continuously recorded during the salmon incubation period during the 2012-2013, 2013-2014, and 2014-2015 winters. Section 4.5.1 of the SIR should indicate that in addition to the continuous monitoring of incubation temperatures in redds, monthly fish sampling during the winter (February to April) and bi-weekly (every two weeks) sampling during salmon ELH (breakup to July 1) will be used to characterize emergence timing. While AEA agrees that more frequent monitoring would yield more precise field verification of emergence timing, the proposed scale of field sampling resolution in combination with the plethora of information on embryonic development and incubation rates at various temperatures and emergence studies from licensing efforts in the 1980s will be sufficient to characterize emergence timing.
ADNR_ADFG_pp14_ph5	*Table 4.1-2 Tributary Sampling Effort – The RSP states that the sample length criterion is 100 m or 20x the wetted channel width.* *a. The table states that Tsusena Creek is 30.7 m wide (wetted width) so the criterion requires that either 614 m (30.7 x 20) or 100 m be sampled per reach. 8 Sites were sampled for a total of 709 meters. So the mean sample length was 88.6 meters per site.* *b. The table state that Devils Creek wetted width is 21.2 meters. 6 sites were samples totaling 424 meters which averages 92.3 meters/site.* *c. Neither of the targets developed for the sampling lengths were achieved at these sites. If sampling efforts continue at some future*	The tributaries that ADF&G refers to are part of AEA's *direct sampling* approach. While 20x channel widths is a conventional approach to sampling and was used to determine the lengths of GRTS samples in narrow habitat units (20x wetted channel width or 200 meters, whichever is less), a direct sampling methodology was implemented on the nine tributary streams upstream of Devils Canyon Impediment 1 with minimal to moderate access and limited feasible sampling areas including Tsusena and Devils Creek (FDA IP, Section 5.2). While the sampling length is less than 20 channel widths, AEA feels an appropriate amount of effort was applied to these streams since they are upstream of the zone of hydrologic influence and would not be physically affected by the Project. The goal of sampling was to

Reference Number	Comment or Study Modfication Request	AEA's Response
	date, efforts should be made to ensure that minimum sample lengths are achieved.	distribute two days of sampling effort over the accessible study area in several locations that represented multiple mesohabitat types and off-channel habitats. In the Middle River downstream of the proposed dam site, efforts were focused in the lower reaches, immediately upstream of the tributary mouth, and below documented anadromous fish passage barriers. In the Upper River (Study 9.5), upstream of the proposed dam site, sampling efforts also took place upstream of fish barriers that would be inundated at full pool and accessible to fish from the reservoir.
NMFS_pp9.6-2_ph1	*The FDA study did not accurately document the distribution or habitat associations of juvenile salmon or resident fish due to problems with habitat classification, sampling site selection and subsampling, fish sampling methods, and fish identification. Further, the first year of sampling provided an opportunity to evaluate the appropriateness of the approved methods and their modifications. National Marine Fisheries Service (NMFS) recommends the following actions be taken to improve the methodology and increase the likelihood of meeting the approved study's goals and objective. We recommend: 1. Alaska Energy Authority (AEA) complete two years of studies implementing the methods as described within the FERC approved study plan with the modifications outlined below; and 2. Complete studies using consistent methods for selecting mainstem sampling locations and sampling fish.*	This recommendation is tied to NMFS's study modification proposals which are addressed below in the response to NMFS_pp9.6-4_ph2. AEA requests FERC not adopt these recommendations. While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan.
NMFS_pp9.6-4_ph2	*NMFS recommends a minimum of two additional years of data collection be completed to fully implement the approved methods with our requested modifications to improve the originally approved study plan. FDA studies in 2013 and 2014 were not conducted as provided for in the approved plan. Anomalous environmental conditions (fall storms and late breakup) in combination with low 2012 adult salmon returns will result in low numbers of juvenile salmon and influence studies designed to determine the distribution of these species and their habitat preferences. In addition, low salmon returns in combination with a 100 year storm event in 2012 likely resulted in low abundance of juvenile salmon in 2013 and the winter of 2014.*	While not proposed as a modification to the Study Plan, AEA requests that FERC not adopt this recommendation as it does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. The overarching goal of this study is to characterize the current distributions, relative abundances, run timings, and life histories of all resident and non-salmon anadromous species as well as freshwater rearing life stages of anadromous salmonids (fry and juveniles) in the Middle and Lower Susitna River. These data will support impact analysis in a Preliminary Licensing Proposal for a 50 year FERC license. The context for baseline conditions should keep this long time horizon and the dynamic nature of ecological processes in mind. AEA agrees that fall storms and late breakup in combination with low 2012 adult salmon returns likely resulted in low numbers of juvenile salmon. However, we disagree that these conditions won't

Reference Number	Comment or Study Modfication Request	AEA's Response
		provide valuable information on the distribution of fish species or their habitat associations, measures that are largely independent of population size. Although 2012 was a relatively low year, the escapement index from Susitna and Knik Arm streams for 2012 was similar to 2008 and 1994, and higher than 1981. See Section 2.6.3.1 for additional information putting the recent Chinook Salmon runs into a historical context. Distribution of salmon at the geomorphic reach scale was similar to previous studies, and unlikely to be influenced by flows or run size. Habitat associations were evaluated using relative abundance, which is also relatively insensitive to run size. AEA disagrees with NMFS recommendation to complete mainstem sampling using consistent methods for selecting mainstem sampling locations and sampling fish. AEA's sampling approach, consistent with the RSP and FDA IP is to consistently use the most effective gear types in each habitat type given conditions at the time of sampling and permit restrictions to target the diversity of species and life stages potentially present. Furthermore, mainstem sampling site selection has consistently followed a generalized random tessellation stratified sampling approach, a generally accepted scientific method for site selection for large-scale environmental surveys. Collection of two years of data (as specified in the existing Study Plan) will allow AEA to quantify any differences that may arise due to flow conditions or run size and evaluate the degree to which study objectives may have been influenced by conditions in 2013 and 2014 and whether any additional data will be required.
NMFS_pp9.6-5_ph1	*Field sampling in the first year of study (2013 and 2014) did not implement the approved studies and does not provide study results that address the project objectives or comparable data for subsequent years of study. Anomalous conditions including severe fall storms in 2012, late breakup in 2013 and poor 2012 salmon returns limited study implementation and will likely affect measures of fish abundance and distribution. Fish sampling was not applied to the total sampling units (200 to 500 m) as provided for in the approved study plan. Sampling units were selected at the macrohabitat level, but was conducted at the mesohabitat (riffle, run, pool) level and macrohabitat values cannot be estimated. Sampling was not conducted at the mouths of side sloughs and upland sloughs as provided for in the approved study plan. Tributary mouths were also not sampled as described in the*	As explained above in the response to NMFS_pp9.6-4_ph2 and below in response to comments on sampling at the macrohabitat level and within habitats (Section 2.6.2.4), comments on the integration of multiple gear types (Section 2.6.2.5), and comments on species identification (Section 2.6.2.1, and Comments NMFS_pp9.6-11_ph4, NMFS_pp9.6-28_ph1, and NMFS_pp9.6-37_ph3), AEA requests FERC not adopt these recommendations.

Reference Number	Comment or Study Modfication Request	AEA's Response
	approved plan. Comparisons of fish abundance among macrohabitat types or over time cannot be conducted due to different and non-comparable methods of gear types (i.e., fyke net versus electrofishing. There is also evidence that juvenile Chinook Salmon and other fish species were misidentified or unidentified to species.	
NMFS_pp9.6-5_ph3	*Modification 1: NMFS recommends spring sampling during May or early June at FDA sampling locations as described within the RSP and FDAIP (5.9(d)(1)). Spring sampling was not conducted as described in the RSP and the FDAIP to identify Middle and Lower River juvenile salmon rearing habitats.*	As explained below in Section 2.6.2.2.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $1,200,000-$3,500,000 annually.
NMFS_pp9.6-5_ph4a	*Macro- and mesohabitats were not correctly classified, resulting in fish data that cannot be accurately assigned to a representative habitat classification type.*	AEA disagrees with this comment for the reasons stated in responses to NMFS_pp9.6-6_ph7 and NMFS_pp9.6-6_ph8.
NMFS_pp9.6-5_ph4b	*A large number of juvenile salmon were speciated, and data presented within the Initial Study Report (ISR)(June, 2014) and to the Technical Working group supports the conclusion that juvenile Chinook, Coho, and Sockeye Salmon were misidentified.*	As explained below in Section 2.6.2.1.1, AEA disagrees with this comment.
NMFS_pp9.6-5_ph4c	*Different and incomparable fish sampling gear types were used at different locations and at different times that did not allow for comparisons to determine fish habitat associations. The distribution and temporal occurrence of juvenile salmon life stages is necessary to know when, where, and for which species and life stage habitat models developed through study 8.5 should be applied. Proposed operational scenarios would store spring flows within the reservoir, severely altering spring flows downstream. Understanding the spring fish distribution and habitat associations is necessary to evaluate project effects. Spring sampling will provide seasonal distribution of fish species by life stage and indicate overwintering locations. The spring sampling should be paired with the two summers and one fall sampling events.*	As explained below in Section 2.6.2.2.2, AEA disagrees with this comment.
NMFS_pp9.6-5_ph5	*Monthly sampling was not conducted at sampling sites as described in the proposed study plan and as summarized in the FERC study plan determination. AEA's RSP proposed year-round monthly sampling. The PSP page 7-13 states that electrofishing would occur monthly. The FDAIP (page 7) states that sampling will be conducted every other month during the months of May through October. The FERC*	AEA disagrees with NMFSs characterization of the FERC-approved Study Plan. See Section 2.6.2.2.2 below.

Reference Number	Comment or Study Modfication Request	AEA’s Response
	study plan determination states, “Generally, sampling would occur monthly at all sites for fish distribution and relative abundance surveys during the ice-free season. At focus areas, sampling would occur monthly year-round and biweekly after break-up through the first of July to characterize the movements of juvenile salmonids during critical transition periods from spawning to rearing habitats.” We recommended in March of 2013 that sampling within all sampling units occur once in early spring following breakup (May or early June), twice during the summer (July – August) and once in the fall, mid-September to early October. FERC supported the proposal for spring sampling, but stated that AEA was proposing to conduct biweekly ELH studies at all sampling locations. ELH sampling was not proposed for or conducted at all sampling locations; ELH sampling units were smaller; and ELH sampling methods were different than the FDA study. We do not believe that ELH sampling can replace spring FDA sampling. The approved sampling plan for ELH described biweekly spring sampling at six 40 m sampling units within focus areas near known spawning locations. FDA spring sampling was to be conducted within all focus areas and non-focus areas in sampling units of 200 m to 500 m depending on location selected using the Generalized Random Tesselation Stratified (GRTS) method. ELH sampling was to be conducted using fyke nets to replicate 1980s studies. FERC recommended two summer sampling events but did not adopt the spring or fall sampling schedule, or monthly sampling schedule proposed by AEA. The project currently has no spring FDA data for the Upper, Middle, or Lower River to identify whether juvenile or resident fish moved into or overwintered in tributaries or the mainstem.	
NMFS_pp9.6-6_ph5	*Modification 2: NMFS recommends the study plan be modified to classify Middle River macrohabitats as Level 3 macrohabitats. Sampling units should be selected, sampled, and reported as described within the FERC-approved study plan. Macrohabitat classification using the approved habitat classes needs to be completed, along with the field verification prior to additional site selection or field sampling (see comments on Study 9.9). Macrohabitats should include only those approved in the FERC study plan determination: main channel, side channel, split channel, multiple split channel, tributary mouth, side slough, and upland slough.*	As explained below in Section 2.6.2.4.2, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modfication Request	AEA's Response
NMFS_pp9.6-6_ph6	*Sampling locations in the Middle River did not include entire tributary mouths or the mouths of side sloughs and upland sloughs as defined within the FERC study plan determination. Macrohabitat sampling units were sub-sampled the 200 m or greater sampling units by flow type (level 4 mesohabitats).*	See Section 2.6.2.4.5 below. As explained below in the response to NMFS_pp9.6-6_ph7, AEA disagrees with NMFS's characterization of FDA macrohabitat sampling and results.
NMFS_pp9.6-6_ph7	*The RSP and FDAIP and FERC study plan determination proposed to select sampling units based on macrohabitat (Level 3) classification (i.e., main channel, split main channel, side channel, etc.). However field sampling, data analyses, and reporting within the ISR were conducted at the mesohabitat (Level 4) classification. This is a deviation from the approved study plan and does not comply with generally accepted scientific practices. The results cannot be used to test for differences among macrohabitats and do not meet the study objective.*	AEA disagrees with NMFS's characterization of FDA sampling and results. Macrohabitat samples are clusters of mesohabitat samples. Counts and CPUE for mesohabitat units are reported, as this is the basic result of individual samples. CPUE for macrohabitat sampling units is a weighted average of CPUE for mesohabitat sampling units within them, and these estimates can be used to compare fish use among macrohabitat types or among mesohabitat types within macrohabitats. AEA is providing the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (FUHI) (Attachment 7) to demonstrate methods for making these habitat comparisons.
NMFS_pp9.6-6_ph8	*The approved study plan called for randomly or systematically selected sampling units based on macrohabitat classification for mainstem and off-channel macrohabitats. Mesohabitat (level 4) classification in focus areas had not been completed prior to the 2013 sampling season. In order for sampling to be conducted at the mesohabitat level, the distribution of mesohabitats structured within macrohabitats must be identified prior to site selection. Fish sampling stratified by the distribution of these mesohabitats to generate relative abundance estimates for other strata: macrohabitats, focus areas, non-focus areas, or geomorphic reaches. In addition, without knowing the distribution of mesohabitats (level 4) within each macrohabitat (level 3) (e.g., percent pool, riffle, run backwater), and the sampling effort applied to each mesohabitat, it is not possible to know if samples were representative of the macrohabitat sampling unit. Therefore, the study objective cannot be met with FDA data as collected and reported in the ISR.*	AEA disagrees with NMFS's characterization of FDA sampling and results. The random sampling of macrohabitat units within macrohabitat features using GRTS guaranteed a representative sample of mesohabitat types within macrohabitat types. Sampling effort applied to each mesohabitat unit has been provided. CPUE can be estimated by mesohabitat type within macrohabitat types or combined across macrohabitat type strata using statistical methods for stratified cluster sampling. The *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (FUHI) (Attachment 7) illustrates how FDA sampling data supports evaluation of fish habitat associations among macrohabitat types.
NMFS_pp9.6-7_ph3	*Modification 3: NMFS recommends that tributary mouths be sampled as macrohabitat units at the confluence of tributaries with the Susitna River main channel and side channels. AEA sampled tributary mouths based on visual estimates of clear water plumes only. Tributary mouths should be selected and sampled as complete units. FERCs*	As explained below in Section 2.6.2.4.5, AEA requests that FERC not adopt this proposed Study Plan modification.

Reference Number	Comment or Study Modfication Request	AEA's Response
	study determination recommended that clearwater plumes be classified at level 4 and specified that tributary mouth sampling units to include the tributary mouth and 200 m downstream. This approved method was not used. AEA sampled clearwater plumes independent of the whether they were tributary mouths, based only on presence of clear water plumes. Entire tributary mouths should be sampled and not just the visible clearwater plume...Classifying clear water plumes based on visual observed clarity, and sampling at this mesohabitat level, excluded sampling downstream of tributary mouths where water turbidity could be much lower than the mainstem and provide better habitat quality, increased food resources, and yet not be visibly different from the mainstem…Therefore, we requested that FDA sampling occur within the tributary mouth and continue downstream for 200 m. FERC supported this recommendation in their April 1, 2013, Study Determination. We also recommended that invertebrate drift sampling (River Productivity 9.8) be conducted above and below tributary mouths to determine if these were locations of additional food resources. However, selecting sites as either tributary mouths or clearwater plumes resulted in site selection at the mesohabitat level and sampling was not conducted 200 m downstream from the tributary mouth... AEAs selection of clearwater plumes as a unique sampling unit disassociated this mesohabitat from the associated tributary. In some cases only the clearwater plume was sampled and in other cases the tributary mouth delta was sampled and not the tributary mouth habitat downstream... Tributary mouths should be sampled as complete and distinct macrohabitat units.	Assuming that all 47 tributary mouths and clearwater plumes in the Middle River are sampled seasonally, the estimated cost of implementing this modification is $800,000 annually.
NMFS_pp9.6-8_ph2	*Modification 4: NMFS recommends a study modification to clarify that mainstem sampling unit selection should be consistent with the selection and sampling of other mainstem level 3 macrohabitats. NMFS recommends that main, split main, and multiple split main channels be lumped into one macrohabitat. All three provide a turbid, fast-water, relatively deep environment. It is a safe assumption that temperature and DO are similar. Sub dividing them triples the number of sampling units needed. Once combined, they should follow the sampling procedures laid out in the RSP for main channel macrohabitat and, as requested, by study modification #6 and #7 in this document. To date AEA has said these main channel habitats were 3 separate macrohabitats, but they did not sample the 10*	As explained below in Section 2.6.2.4.3, AEA does not object to FERC's adoption this proposed Study Plan modification. This request is AEA's consistent with AEA's proposed Study Plan modifications and study implementation to date. As such, there is no additional cost for implementing this modification.

Reference Number	Comment or Study Modfication Request	AEA's Response
	replicates of each macrohabitat. With low to no replication the study cannot draw conclusions.	
NMFS_pp9.6-8_ph5	*Modification 5: NMFS recommends the study be modified to clarify that classification of sloughs needs to be based on deviations in the mainstem bank contours. We do not support the classification of the downstream extent of sloughs based on water clarity as implemented by AEA. Side sloughs and upland sloughs were not sampled from the beginning of the downstream mainstem confluence and extend a minimum of 200 m upstream as required by the study plan determination. Sloughs were reclassified as beginning with the presence of visibly clear water. The result of AEA's modification was to redefine sloughs and backwaters to make them separate rather than placing backwaters as a level 4 classification within macrohabitats as required by FERC in the study plan determination. The Initial Study Report for Study 9.6 states that "sloughs were differentiated from backwater habitat by clearwater." This change in classification eliminates the possibility of a level 4 backwater being contained within a level 3 slough (this was subsequently changed in the October 2015 line mapping in Study 9.9). The sampling scheme identified in the study plan determination would have provided data necessary to determine fish use the backwater mouths of off-channel habitats, which will be the most impacted by altered river stage height.*	As explained below in Section 2.6.2.4.1, AEA requests FERC not adopt this proposed Study Plan modification. Due to the reclassification of habitat followed by sampling. AEA estimates that costs to implement this modification request would range from $ 1,500,000 to 3,700,000 for Year 1 and $1,200,000 to $3,400,000 in Year 2. -.
NMFS_pp9.6-9_ph2	*Modification 6: NMFS recommends a study modification to require macrohabitat unit sampling, as described within the FERC study plan determination. These are 200 m sampling units or 20 x channel width of side sloughs, upland sloughs and tributary mouths. For sloughs, sampling should begin at the downstream mainstem confluence to include the mixing zone of turbid and clear water, when present, and extend upstream into the slough. For tributary mouths, sampling should include the portion of the tributary influenced by the mainstem (zone of hydraulic influence) and 200 m downstream whether or not a clearwater plume is visible. Boat electrofishing and set gillnets in main channels and side channels should effectively sample fish in the entire 500 m sampling unit. The FERC study determination clearly defined sampling unit lengths for the primary macrohabitats. FERC also defined the locations where sampling units should be selected in upland sloughs and side sloughs to capture the confluence of those*	As explained below in Section 2.6.2.4.4, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is ranges from $4,800,000 to $5,000,000 in the Middle and Lower River.

Reference Number	Comment or Study Modfication Request	AEA's Response
	habitat types with the mainstem and tributary mouths. This determination recognized that these are unique transitional habitats between main channel and off-channel habitats. AEA did not sample these areas nor sample entire sampling units as recommended by FERC, and therefore, did not implement the approved study plan. Decreasing the lengths of sampling units, results in underestimates of fish distribution and community diversity (AEA 2014).	
NMFS_pp9.6-9_ph5	*The ISR describes fish collection methods that varied in sampling unit, methodology and effort. This resulted in fish data from electrofishing at one location or date, fyke net data at another date and/or location and time, and minnow trap data at a third date and/or location and time. Electrofishing effort varied from seconds at one location or one sampling date to 10 to 20 minutes at another. Units of relative abundance or community composition were different and not comparable among sites (i.e., catch/time/unit, catch/trap/unit, or catch/net/unit). Consistent sampling methods must be used to meet study objectives.*	See Section 2.6.2.5.5 below.
NMFS_pp9.6-9_ph6	*Modification 7: NMFS recommends modifying the study plan to sample using different gear types in the following sequential order: FDA sampling should include a minimum of 20 baited minnow traps fished for 20 to 24 hours are used for every 200 m of sampling unit length to document the seasonal distribution and relative abundance of juvenile Chinook and Coho Salmon. •Following minnow trapping, backpack electrofishing should be used to obtain abundance estimates of salmon fry and resident fish species that are not effectively captured in minnow traps (Sockeye, Chum and Pink Salmon). •Fyke nets, hoop traps, and beach seines can be used to augment minnow trapping and backpack electrofishing, for fish distribution, but should not be used to derive estimates of relative abundance....Consistently sampling 500 m mainstem habitats by boat electrofishing and drift gill netting and a 200 m sampling nearshore unit with backpacking electrofishing and minnow trapping will apply methods suitable for all target fish species at all sampling locations and provide comparable measures of fish abundance within and among macrohabitat types. Baited minnow traps are an effective method for capturing juvenile Chinook and Coho Salmon (Appendix A). Multiple traps are necessary to obtain a consistent measure of relative abundance...Minnow trapping is not*	As explained below in Section 2.6.2.5.4, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification ranges from \$4,700,000 to \$5,000,000.

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	subject to the same restrictions by the ADFG collection permits which have restricted the use of electrofishing in the presence of adult salmon. Therefore this method can be consistently applied within all sampling units on all sampling dates, including winter. Following minnow trapping (after traps are pulled), the sampling unit should be sampled using backpack electrofishing...Consistent sampling effort should be applied for all sampling units so that relative abundance is not underestimated or overestimated due to excessive or insufficient effort, respectively. Fyke nets, hoop traps, drift nets and beach seines could be used for presence or absence (distribution) but should not be used as measures of relative abundance as these methods cannot be effectively fished in all sampling units. The application of these methods in this order will provide consistent and comparable measures of relative abundance among sites that can be used for statistical analyses used in generally accepted scientific practice.	
NMFS_pp9.6-11_ph2	*Modification 8: NMFS recommends the study be modified to include in reporting: of sampling locations, sample unit length and area, date, methods, effort by gear type (i.e., electrofishing time, number of seine hauls, number of minnow traps and hours fished, snorkel time, number of fyke nets and hours fished) by macrohabitat classification.*	As explained below, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. All data collection efforts that support analysis of the ISR (http://gis.suhydro.org/isr/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/) and SIR (http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/) were made available in a relational database as described in the FDA IP and FERC Study Plan Determination. These datasets include requested documentation of sampling location, date, habitat type, length, width, methods, effort, and catch. Field data were collected and entered in a database and checked for quality assurance/quality control in a consistent, rigorous, and well documented manner as described in great detail, including copies of draft field forms, in the FDA IP (Appendices 10-12).
NMFS_pp9.6-11_ph4	*Modification 9: NMFS recommends a study modification for tissue samples (belly swab with qtips) for genetic analyses be collected from 1 in 10 juvenile salmon to confirm species identification, pre-season field crew training in fish identification regarding juvenile salmon identification.*	As explained below in Section 2.6.2.1.2, AEA requests FERC not adopt this proposed Study Plan modification. Assuming that AEA collects and handles a similar number of juvenile salmon as 2013 (18,432), swab samples would take an extra hour at each site, cost $40 each to process, and would require additional data

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		analysis and reporting. The estimated cost of implementing this modification is $400,000-$500,000 annually.
NMFS_pp9.6-11_ph4	*Based on our review, juvenile salmon were not identified correctly by AEA field technicians. This conclusion is based on data presented in the ISR, ISR meetings, and through genetic analyses conducted by the ADFG. The habitat associations, age class information, and size frequency distribution of juvenile Chinook Salmon reported in the ISR are inconsistent with other regional studies (Appendix B). Juvenile Pink Salmon were generally absent from 2013 samples even though there were large numbers of returning adults in 2012 (e.g., Deshka River return of 79,000). At the September 23, 2013 TWG meeting AEA reported juvenile Sockeye Salmon as the primary species captured in the Montana Creek screw trap (261 sockeye through July 2013) (Figure 2). However, the ISR does not report any Sockeye Salmon in Montana Creek screw traps (ISR 9.6 Table 5.21 and Figure 5.2-4). Data presented at the TWG meetings were preliminary; however these inconsistencies along with misidentification of Chinook and Coho Salmon, and the large number of unidentified whitefish in the Upper River raise concerns regarding the accuracy of species identification. In response to comments by NMFS, the U.S. Fish and Wildlife Service (USFWS) and ADFG prior to and at the ISR meetings regarding inaccurate species identification, AEA developed a draft Chinook and Coho salmon identification protocol. Published protocol for identifying juvenile salmon and other fish species was submitted to FERC in Section 5.1.4 of the Susitna River FDAIP as a supplement to the RSPs (R2 Resource Consultants 2013). The new draft protocol does not propose any substantial changes to the procedures outlined in the FDAIP.*	AEA disagrees with the assessment that juvenile salmon were not identified correctly by AEA field technicians. AEA also disagrees with NMFS's assertion that "*other regional studies*" are inconsistent with the size and age distributions and habitat associations presented by AEA. A detailed response to this claim is presented in Section 2.6.2.1.4. In summary, although select regional studies conducted using only minnow trapping show a more limited size distribution and habitat associations, regional studies using more diverse gear types have very similar results to AEA's findings in 2013 and 2014. AEA also disagrees that "*juvenile Pink Salmon were largely absent from 2013 samples.*" Newly emerged Juvenile Pink Salmon were observed in late winter (April) 2013 (Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*). Pink Salmon were collected in lower numbers during the first ELH sampling event in early June, 2013 as most Pink Salmon fry had already emigrated with the late breakup at the end of May in 2013. Pink Salmon were also collected in downstream migrant traps in 2013 with peak catch occurring in mid-June shortly after traps were installed and outmigration concluded by the end of July. In 2014, Pink Salmon fry were not observed during winter studies but were observed during ELH sampling (n=266) in May and early June. The *Draft Chinook and Coho Salmon Identification Protocol* (Study 9.5 and 9.6 TM, November 26, 2014) represent several meaningful changes to the procedures outlined in the FDA IP (Study 9.5 and 9.6 IP, March 1, 2013: *Susitna River Fish Distribution and Abundance Implementation Plan*). The draft protocol increases staff training, including a voucher specimen library and a Susitna-specific identification guide. The protocol also implements standardized genetic and photographic subsampling with review and feedback for field crews. AEA proactively implemented steps between the 2013 and 2014 field seasons with demonstrated benefits and improvements in identification accuracy.
NMFS_pp9.6-12_ph3	***Modification 10:*** *NMFS recommends Lower River sampling units be selected based on macrohabitat classification for determining fish habitat associations. NMFS also recommends the study be modified to*	As explained below in Section 2.6.2.9.1, AEA requests that FERC not adopt this proposed Study Plan modification. Instead, AEA proposes to increase sampling of rare habitats in the Lower River using the

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	conduct macrohabitat sampling based on macrohabitat classification in a minimum of 10 tributary mouths, side sloughs, upland sloughs, side channels, and main channel habitats. Transect-based sampling was used in the Lower River and resulted in samples being collected in far proximity from mainstem or underrepresented off-channel habitats important for juvenile salmon. Sampling in side sloughs, tributary mouths, and upland sloughs should occur at the confluence with side channels or main channel as described in the FERC study plan determination. Lower River sampling units must adequately replicate available habitats to document the distribution of fish within the Susitna River and test for differences in relative abundance among river segments, geomorphic reaches, and macrohabitats. Our RSP comments recommended selecting sampling units based on macrohabitat classification and not using the transect approach. The FERC study plan in the Lower River for sampling unit selection in off-channel habitats was not implemented, limiting the utility of this information. Lower River sampling sites are displayed on maps in the ISR for Study 9.6. These maps show that sampling locations were not selected per the study plan. These habitats were sampled at transect locations instead in side sloughs and upland sloughs from their confluence with the mainstem and upstream 200 meters.	same method successfully implemented in the Upper River – a hybrid transect and GRTS approach. The estimated cost of implementing this modification is $800,000-$900,000.
NMFS_pp9.6-13_ph4	*Side slough, upland slough, tributary mouths, and side channel habitats were underrepresented in the sampling effort, with effort instead being allocated to additional habitat types, including tributaries, slough mouths, and "additional open water." There was no clear objective for how information from sampling these habitat types will be used. This must be determined in advance rather than gathering data not in accordance with the study plan, and then trying to determine after-the-fact how to interpret it. Four side channels, two upland sloughs, and three side sloughs were sampled to represent over 100 river miles (AEA Table 4.1-4), this is not adequate for a habitat based sampling plan and supports the need for NMFS request for a new study of Model Integration.*	AEA disagrees with this comment. Sampling in the Lower River was based on systematic random sampling of macrohabitat types in proximity to selected transect locations, as planned in the FERC-approved Study Plan. Off-channel habitats were sampled in proportion to their availability within wide proximity to transect locations. Off-channel habitats are relatively rare; for example slough habitat accounts for less than 0.4 percent of the habitat area mapped in the Lower River, and side channel habitat accounts for less than 1 percent of the habitat area. Out of the fish samples collected in the Lower River by AEA, 9 percent (4 out of 44) were in side channels and 11 percent (5 out of 44) were in sloughs.
NMFS_pp9.6-13_ph5	*Lower River site selection and sampling was not conducted as proposed. New information from the instream flow routing study (8.5), adult escapement study (9.7), and FDA study (9.6) indicate that the Lower River is likely important for the summer rearing and*	AEA disagrees that Lower River sampling was not conducted as proposed. Sampling in the Lower River was based on systematic random sampling of macrohabitat types in proximity to selected transect locations, as planned in the FERC-approved Study Plan

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	overwintering of juvenile salmon, and project effects are now known to extend to Lower River reaches. FDA sampling was not effective at identifying juvenile salmon and resident fish rearing and overwintering locations. For example only 179 juvenile Chinook Salmon, 413 juvenile Coho Salmon, and 751 juvenile Sockeye Salmon were captured over all sampling periods and all sampling locations in the Lower River (AEA Table 5.1-3; excluding tributary screw traps and tributary samples but including ELH and productivity sampling). Study results are not presented by macrohabitat; however, the low abundance of juvenile salmon is likely due to the under representation of offchannel side sloughs, upland sloughs, and tributary mouths and location of sampling units within these macrohabitats.	(Study 9.6 SPD, April 1, 2013, page B-154). . The sampling methods used did not under-represent off-channel habitat. Please see AEA's response to Comment NMFS_pp9.6-13_pp4 regarding the proportion of off-channel habitats sampled. Distributions of fish are spatially dispersed, and locating specific areas of high juvenile salmon abundance was not a study objective. AEA also disagrees that any new information has been provided to indicate that the Lower River is important for summer rearing and overwintering. In fact, sampling conducted by AEA, including targeted sampling by ADF&G, suggests that juvenile salmon are rare and patchily distributed in the Lower River mainstem and off-channel habitats.
NMFS_pp9.6-14_ph2	*Modification 11: NMFS recommends a study modification to address the relative importance of beaver ponds and complexes for juvenile salmon summer rearing and overwintering. Fish sampling should be conducted within 200 m sampling units within beaver ponds and in comparable macrohabitats without beaver ponds using 20 baited minnow traps set for at least 20 hours, spaced about 10 m apart during summer, at a minimum of 10 Middle River and 10 Lower River locations to test for differences in the relative abundance and size distribution of juvenile salmon in these habitats. . .. The FERC study plan determination also identified beaver ponds as one of the Middle and Lower River sampling strata; however, beaver ponds in the Lower River were not sampled. Therefore, the FDA study was not conducted as provided for in the approved study plan. We recommend ten randomly select Lower River beaver ponds for summer and winter FDA sampling. This study clarification is necessary to determine the juvenile salmon use of beaver pond habitats for summer rearing and overwintering. These habitats may be of special importance as the Lower River likely provides rearing and overwintering habitat for juveniles migrating from tributaries used by spawning Coho and Chinook Salmon. We recommend ten Middle River beaver ponds complexes be randomly selected for summer and winter FDA sampling. This modification or study clarification is necessary to ensure that these habitats and comparable habitats without beaver dam influence are sampled during summer and winter FDA studies.*	As explained below in Section 2.6.2.2.3, AEA requests FERC not adopt this proposed Study Plan modification. Because the proposed sampling methods are different than the FERC-approved Study Plan, he estimated cost of implementing this modification ranges from $650,000 to $1,000,000 depending on number of beaver sites.

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NMFS_pp9.6-15_ph2	*Modification 12:* *NMFS recommends a study modification to document the Middle and Lower River fish distribution, habitat association and abundance during the winter months (Appendix C). Pilot studies conducted in 2013 demonstrated that winter sampling is feasible. However, monthly sampling within focus areas was not conducted as described in the study plan. Winter FDA sampling conducted in 2014 was limited in scale and was only conducted within a few focus areas with little replication of Susitna River macrohabitats... ... Water depth and ice depth should be recorded at 20 locations within each sampling unit on each sampling date, even if sampling is not conducted due to insufficient water depth. Measures of water velocity, substrate size, woody debris, water temperature, dissolved oxygen and specific conductivity should be measured at all locations where fish traps are deployed. Backpack electrofishing, underwater video and fyke nets should be used to augment minnow trap estimates of fish distribution, where possible. The approved study plan stated that sampling would occur monthly in all Middle River Focus Areas. The FERC study plan determination stated that sampling would occur monthly in all Focus Areas and "winter sampling efforts would utilize the same sampling locations but would be less frequent, approximately monthly instead of bi-weekly and for winter would be dependent on safe access and sampling methods (due to ice cover)." . . . However, sampling has not been conducted monthly in all focus areas as described within the approved study plan. Therefore per 5.15(d)(1), the study was not conducted as provided in the approved study plan.*	As explained below in Section 2.6.2.10.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification ranges from $1,200,000 to $1,500,000 annually depending on the number of sites and kind and extent of logistic support.
NMFS_pp9.6-16_ph2	*Modification 13: NMFS recommends that the study plan be modified to include a description of how the various data will be turned into quantitative estimates so that rigorous comparisons can be made across species, river habitat types and sampling date. This modification would allow for direct comparison among the sampling design, estimates and statistical. This includes statistical tests to determine if differences in mean relative abundance measures are significantly different among habitat classifications at all classification levels 1 through 3, consistent with standard scientific practice. The approved study plan does not contain any section to describe the statistical analysis that will be applied to field data to address study objectives. This is not the accepted scientific practice, and results from*	As explained below in Section 2.6.2.5.3, AEA requests that FERC not adopt this proposed Study Plan modification. There is no additional cost for implementing this modification as AEA will used the relative abundance metrics they developed to conduct rigorous evaluation of potential impacts with the license application..

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	the first year of study raise questions as to whether this can be accomplished (Appendix A). For example, the available reports provide a comparison of differences among sites based on mean values or total counts without consideration for differences in sampling method or effort. This is not standard scientific practice.	
NMFS_pp9.6-16_ph3	*Modification 14: NMFS recommends a study modification to require juvenile salmon be identified to species. Fish should be identified to species. Individual species data should not be pooled with data from other species. In extreme circumstances of large sample size > ~500 of Sockeye and Chum are captured in a single fyke net or in an hour of screw trap operation, a minimum of 100 individuals or 25% of the total catch should be subsampled. Chinook Salmon are limited in their distribution and habitat requirements relative to Coho Salmon, and determining the distribution and habitat requirements of juvenile salmon species needed to describe the current environment and for evaluating potential project effects.*	As explained below in Section 2.6.2.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $100,000 due to increased time required for handling more fish.
NMFS_pp9.6-16_ph4	*The juvenile salmon species error reported by AEA based on genetic analyses is an underestimate (SIR). Genetic samples were not collected randomly from all juvenile Chinook and Coho Salmon and likely are biased based on the confidence of field personnel. AEA reports that 28% of the juvenile salmon identified as Chinook were Coho Salmon in 2013 for all studies, locations, and sampling dates). When we evaluated the size distribution of age-0 Chinook Salmon from AEA Middle River samples (Excel tables for 2013 condition index), error for Chinook Salmon was estimated at over 50%. AEA's SIR shows the size distribution of Susitna River Chinook Salmon that were identified genetically (Table B-4). This is consistent with the size distribution of Chinook Salmon captured by ARRI (Figure 3) and by ADFG in the 1980s (Appendix B), with 99% of age-0 Chinook < 100mm in fork length. However, well over 50% of the fish reported by AEA as Chinook Salmon collected in the Middle River in 2013 are over 100 mm in fork length and are therefore, more likely to be age-2 Coho Salmon (Figure 3).*	See Section 2.6.2.1.4 below.
NMFS_pp9.6-17_ph2	*Studies have shown that Coho Salmon are ubiquitous in their distribution and are found under a broad range of habitat characteristics whereas Chinook Salmon are restricted in their distribution and tend to have a narrower range of habitat requirements.*	The data AEA is collecting in accordance with the Study Plan will allow rigorous evaluation of these types of hypotheses about fish distribution and habitat associations in the Susitna River. Preliminary data does not support these generalizations.

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	Winter studies and studies conducted throughout the Mat-Su Basin indicate that Chinook Salmon are present only in a subset of the sites where Coho Salmon are found and relative abundance of Chinook is often lower than Coho Salmon (Davis et al. 2014, 2015a, 2015b, Miller et al. 2011, Davis et al. 2015c). AEA's SIR shows large differences in the water velocities where Chinook and Coho Salmon fry and juveniles were observed, with Coho Salmon in much slower and deeper waters. Murphy et al, (1989) found that Coho Salmon in the glacial Taku River occupied habitats with significantly slower currents than Chinook Salmon and that Chinook were "virtually absent (mean <1 fish/100m2) from beaver ponds and upland sloughs." Chinook Salmon are reportedly more temperature and oxygen sensitive and are most often found in fast-flowing, cold water habitats (Murphy et al. 1989; Quinn, 2005; Richter and Kolmes, 2005). Chinook and Coho Salmon distribution also varies over time. Chinook Salmon have a 5-7 year life cycle and most spawning occurs in tributaries. Their distribution in mainstem habitats will be limited in spring and early summer. Coho Salmon are likely to be broadly distributed during this same time period. Chinook Salmon abundance is likely to be higher near spawning tributaries as juveniles migrate from natal tributaries (Indian River and Portage Creek) to the mainstem Susitna River.	Study 9.6 did not collect water velocity measurements directly. Study 9.6 SIR, Appendix B (*Juvenile Chinook and Coho Salmon Identification Accuracy*) reported the habitat suitability criteria developed by the Instream Flow Study (Study 8.5) for water depth, velocity and temperature for Coho Salmon and Chinook Salmon; Chinook Salmon had a wider range of suitable conditions for all three parameters (Study 9.6 SIR, Appendix B, page 14) and the two species had considerable overlap in suitable habitat. This is consistent with preliminary evaluation of habitat associations. As reported in Appendix B of the SIR, juvenile Chinook and Coho salmon co-occurred in 87 percent of the habitat features where species identifications were verified.
NMFS_pp9.6-18_ph2	*Modification 15: NMFS recommends a study modification to require a mark-recapture study to measure the efficiency of the rotary screw traps. If conducted carefully and with adequate numbers of recaptures, results of this study could provide an estimate of the abundance of fish migrating past the rotary trap and trap efficiency, and address questions regarding the accuracy of results documenting juvenile salmon movement patterns from migrant traps (rotary screw traps) at the mouth of the Indian River and Montana Creek. Screw trap efficiency was not examined and the portion of juvenile salmon moving from tributaries to the mainstem for rearing and overwintering cannot be estimated. The PIT tag studies were largely ineffective and did not provide information on the proportion of juvenile Chinook or Coho Salmon from tributary spawning locations that moved to the mainstem for rearing and overwintering. Movement patterns of most resident fish were not identified due to the low number of radio tagged fish and the failure to track these fish as described within the approved study plan.*	AEA requests FERC not adopt this proposed Study Plan modification. See response to Comment USFWS _pp9.6-1_ph4 regarding rotary screw trap efficiency estimates (Section 2.6.2.11.). Estimating the proportional distribution of juvenile salmon emigrating from natal tributaries is not a study objective under Study 9.6 (RSP Section 9.6.1). AEA has demonstrated progress towards meeting study Objective 2 (fish movements) and has provided documentation that biotelemetry has been effective (Study 9.6 SIR, Section 4.4.4; Attachment 8: *2013-2015 Radiotelemetry Implementation Report*). Assuming trap operation 7 days per week for the same time period as 2013 and 2014, the estimated cost of implementing this modification is $700,000 per trap or $2,800,000 annually. .

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NMFS_pp9.6-18_ph3	*Modification 16: NMFS recommends a study modification to require downstream migrant traps (rotary screw traps) be deployed immediately following breakup and operated throughout the open water season to obtain two full years of migration data at four locations including the Indian River, mainstem near Curry, mainstem near Talkeetna Station and Montana Creek. Trap efficiency and abundance estimates should be conducted as described within the approved sampling plan. NMFS is recommending that the out-migrant screw traps in the Indian River and Montana Creek be operated 7 days a week to determine the proportion of tagged juvenile salmon migrating from these tributaries.*	As explained below in Section 2.6.2.7, AEA requests that FERC not adopt this proposed Study Plan modification. To increase the trapping schedule to seven days a week would increase the per-trap cost to approximately $700,000 annually. The estimated cost of implementing this modification is $2,800,000.
NMFS_pp9.6-19_ph2	*Modification 17: NMFS recommends modifying the study to require rotary screw traps be used to augment PIT tag recovery. The PIT tag antenna was not effective at recording tagged fish in Montana Creek and the Indian River due to the size of these stream systems. Therefore, the proportion of PIT tagged juvenile salmon exiting these tributaries, timing and age classes could not be determined. Screw traps will need to be operated seven days a week to efficiently capture PIT tagged fish.*	AEA requests FERC not adopt this proposed Study Plan modification. AEA disagrees with the need to operate traps every day to evaluate fish movements. The objective of downstream migrant trapping is document the timing of downstream movement and catch. AEA has demonstrated progress towards meeting study Objective 2 (fish movements and timing) and has provided documentation that PIT and radio biotelemetry have been effective (ISR Part A, Section 5.2-1; SIR Section 4.4.4; Attachment 8: *2013-2015 Radiotelemetry Implementation Report*). Under the ILP, AEA has an additional year of data collection in the Middle/Lower River to describe the seasonal movements of juvenile salmonids and selected resident fish species to meet study Objective 2. To increase the trapping schedule to seven days a week would increase the per-trap cost to approximately $700,000 annually. The estimated cost of implementing this modification is $2,800,000.
NMFS_pp9.6-19_ph3	*Modification 18: NMFS recommends a study modification to require anadromous salmon captured in migrant traps >45 mm fork length be measured to validate species identification and age class (i.e., age-0, or age 1+). Fish data should be reported by age class based on size frequency distributions or by fork length. Studies conducted were unable to provide descriptions of juvenile salmon age classes, growth, or condition among macrohabitat type. The RSP, FDAIP, and FERC study plan all differed in stated sample size for species age, length data. Sample sizes by species within each macrohabitat were insufficient to determine differences in age classes, lengths, condition, or growth by macrohabitat type. The age class designations used by*	AEA requests FERC not adopt this proposed Study Plan modification. An alevin/fry/parr/smolt life stage index for juvenile salmon allows for further documentation of physiological state that an individual is in and is ancillary data to a length and juvenile life stage designation. The FDA IP cites fish identification guides including Weiss 2003 and Pollard 1997 used by crews in the field that includes guidance on fry, parr, smolt determination. Additionally, a representative subsample of each life stage class of fish were also measured (fork length) and weighed. The use of a physiological index is subjective and therefore AEA did not assign rules regarding size and life stage such as that a

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	AEA (fry, parr, juvenile, and smolt) are subjective and do not contribute toward meeting study objectives. There is no clear distinction within the study methods to differentiate between salmon fry and parr, or parr and juveniles or juveniles and smolt.	55 mm fish had to be a fry or a parr, or that a 100 mm fish had to be a smolt. It was up to the observer to make the determination based on the morphology and coloration of the specimen. Growth rates in the Susitna River are highly variable, in some habitats overwintering juvenile salmonids less than 50 mm fork length have been observed in February (Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*, Figure 5.3.1-1; Davis and Davis 2015); the alevin/fry/parr/smolt index adds more information than length. The designation juvenile is a more general designation encompassing fry, parr, and smolt life stages. The size-at-life stage index used by field crews is found in the ISR Part A (Table 4.5-1). In some systems the proportion of fry, parr, and smolt present or emigrating can vary year to year. The use of a fry/parr/smolt index and measuring a subsample of the catch at a site is common practice in freshwater salmonid fisheries research, especially when handling large numbers of fish and the risk of handling stress is elevated. Assuming scale analysis used for aging juvenile fish and catch is similar to 2013-2014, the estimated cost of implementing this modification is $1,500,000.
NMFS_pp9.6-19_ph7	*Modification 20 [1 of 2]: NMFS recommends a study modification of the PIT tagging study to be conducted as required in the study plan determination, including evaluation of detection efficiency, and be modified such that the data can determine the movement patterns of juvenile salmon from spawning tributaries to the mainstem and off-channel habitats. The primary objective of the PIT tagging study and fish sampling with screw traps is to determine when juvenile salmon of different age classes and tagged resident fish migrate from spawning tributaries to the mainstem Susitna River. The PIT tagging study was not conducted as approved in the study plan determination. To do this antennas must be relocated from Slough 8A, Montana Creek and Indian River, and installing these antennas at the Whiskers Creek site to develop antenna arrays to document direction of movement. The screw traps in Montana Creek and Indian River should operate seven days a week to capture migrating tagged and untagged fish. Detection efficiency should be calculated for the antenna arrays. Increased sampling and tagging efforts of juvenile salmon should be conducted within Whiskers Creek, Indian River, and Montana Creek to determine the proportion of juvenile salmon from tributary spawning locations that*	As explained below in Section 2.6.2.6.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming multiple arrays per stream the estimated cost of implementing this modification is $640,000.

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	migrate to the mainstem Susitna River for rearing and overwintering. This modification will require the trapping and tagging 500 Chinook, 500 Coho, and 500 Sockeye Salmon that are >50 and < 80 mm fork length in each tributary during both summer and single fall sampling dates. The PIT tag study was not conducted as described in the approved sampling plan: antennae arrays were not installed such that upstream and downstream migration could be detected...Antennae arrays were not installed and detection efficiency was not estimated. PIT tag antennas in the Indian River and Montana Creek did not cover the entire channel.	
NMFS_pp9.6-21_ph2	*Modification 20 [2 of2]: NMFS recommends modifying the study plan to require untagged juvenile salmon captured in the screw traps are tagged be released downstream or used only to test trap efficiency. Otherwise results are biased by the movement patterns of fish already migrating.*	As explained below, AEA requests FERC not adopt this proposed Study Plan modification. NMFS modification appears to mischaracterize the release location of fish collected in downstream migrant traps in 2013 and 2014. In accordance with the FDA IP(Section 5.1), fish collected in rotary screw traps were released in calm water downstream, but in close proximity to the trap. The only fish released upstream of traps were marked (PIT tag or dyed) individuals used for efficiency testing (FDA IP, Section 5.7.4). Marked individuals used for efficiency tests were released 100-300 meters upstream of downstream migrant traps. Marked individuals are noted in the database from data collection forms for efficiency testing purposes and can be easily excluded from daily catches for other analyses. There is no estimated cost of this modification because it is already part of the FERC-approved Study Plan.
NMFS_pp9.6-21_ph3	*Modification 21: NMFS recommends expanding the geographic extent of fish sampling and PIT tagging to include Whiskers Creek, Montana Creek, and Indian River during the two summer and single fall FDA sampling events. A minimum of 500 Chinook, 500 Coho, and 500 sockeye should be tagged in each stream during each sampling event at each location. Sampling locations and methods within each tributary should be completed as provided in our RSP comments. Our RSP comments (summarized in the FERC study determination) were, "NMFS and FWS state that five 400-meter long fish sampling locations should be located in Indian River and stratified longitudinally from the PIT tag array site to the farthest upstream Alaska Railroad crossing. The agencies state that five 400-meter fish sampling locations should*	As explained in Section 2.6.2.9.2, AEA requests that FERC not adopt this proposed Study Plan modification. A directed PIT tagging program in Indian River, Whiskers Creek and Montana Creek to obtain the sample size targets specified by NMFS (however; not all species will be in each tributary) would take an estimated 36 days of additional effort and increased data management and reporting. The estimated cost of implementing this modification is $350,000 annually

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	be located in Montana Creek from the Parks Highway extending upstream to Yoder Road. The agencies request that five 200-meter long fish sampling locations should be established in Whiskers Creek at 1,000 meter intervals extending upstream from the Susitna River confluence. The agencies recommend that fish sampling be conducted in these locations using a combination of electrofishing and minnow trapping as described previously to capture juvenile coho and Chinook Salmon for PIT tagging." The purpose of this recommendation was to ensure that tags were applied to those fish under investigation. In order to determine the proportion of fish from spawning tributaries that migrate to the mainstem, it is necessary to tag these populations. Tagging fish from mainstem screw traps and FDA sampling locations did not, and will not, meet this objective.	
NMFS_pp9.6-21_ph5	*Modification 22: NMFS recommends a study modification for additional radio tagging. The radio tagging study should be modified to include (a) distribution of tagged fish equally among geomorphic reaches or proportional to the relative abundance of target fish species; (b) use aerial over flights to contrast with boat, foot, or snow machine tracking as described in the RSP; (c) additional fish should be captured during winter as proposed; and (d) status of recaptured fish ascertained. The radio tag study objectives were not met based on data presented in the ISR and subsequent 2013/2014 Winter Fish Study Technical Memorandum. Specifically, resident fish spawning, foraging, and overwintering locations and characteristics have not been identified. AEA proposed to place at least 30 radio tags within target fish species, to provide two years of data to represent the migration patterns of fish populations within the Middle and Lower River...A more uniform distribution of radio-tags released throughout the drainage would provide a more detailed assessment of migration from and into different river areas...The winter spawning locations and habitat characteristics of sites used by Burbot and whitefish were not identified…Tagging goals were not met for Humpback Whitefish during 2013...All Northern Pike captured were radio-tagged; all tagged Northern Pike were from Kroto Slough. The tagging effort did not meet tagging goals. Winter biotelemetry observations were mostly limited to monthly aerial surveys for radio tags...*	As explained below in Section 2.6.2.8.1, AEA requests that FERC not adopt this proposed Study Plan modification. It is not an objective of Study 9.6 to determine the proportion of fish from spawning tributaries that migrate to the mainstem or to conduct intensive sampling upstream of the zone of hydrologic influence of the Susitna-Watana project. To repeat implementation of the radiotelemetry study would require two years at approximately $900,000 annually. The estimated cost of implementing this modification is $1,800,000.

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NMFS_pp9.6-23_ph2	*Modification 23: NMFS recommends modifying the study plan to require ELH studies be conducted on all sampling dates at all Focus Areas as described in the RSP and add minnow traps and fyke nets with hoop traps in all sampling locations on all sampling dates. All traps, nets, and hoop traps should contain mesh sizes of 1/8 inch or less. The implementation of the ELH studies in 2013 did not achieve the study objectives. Determining emergence timing and habitats selected by emergent salmon was not accomplished. Few emergent salmon were captured, and data were not obtained on habitats selected by emergent and migrating sockeye salmon or other juvenile salmon species. The study did not identify the length of time fish < 50 mm were present or most abundant within the Middle River focus areas. Review of the ELH data (ISR9_6_FDAML_FishObservations-Excel) and results presented in the ISR indicate that selection of sampling locations, inconsistent sampling methods, and misidentification of juvenile salmon prevented the study from meeting the stated objectives. The number of focus areas sampled and frequency of sampling was less than proposed within the FERC approved study plan. Fish collection methods and sampling gear did not follow the approved plan and those selected in 2013 were not appropriate or effective for sampling newly emergent salmon fry. The differences in emergent fry abundance among sampling locations or over time could not be compared because different sampling methods were used in different sampling units and on different dates. The FERC approved study plan described bi-weekly sampling from ice out through July.*	As explained below in Section 2.6.2.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. Implementing this modification request would require sampling at 10 focus areas for three days each during four events. The estimated cost of implementing this modification is $900,000-$1, 000,000 annually.
NMFS_pp9.6-24_ph2	*NMFS opposes using electrofishing for emergent salmon studies. Electrofishing can cause fry to involuntarily emerge from the gravel and give erroneous results (Figure 4). We have observed salmon fry being pulled from the gravel by electrofishing. Fyke nets and hoop traps with the appropriate mesh size (1/8") should be used as provided in the approved plan. Minnow traps should be used to augment fyke nets and for the capture of emergent Coho Salmon and Chinook Salmon. This methodology will allow a comparison of catch among stations and sampling date to meet study objectives.*	As explained below in Section 2.6.2.3.2, AEA requests that FERC not adopt this proposed recommendation.
NMFS_pp9.6-25_ph2	*Modification 24: NMFS recommends a study modification adopting AEA's proposal to integrate emergence studies with proposed winter*	As explained below, AEA requests FERC not adopt this proposed Study Plan modification.

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	sampling at all Focus Areas prior to breakup, suspending sampling during breakup, and reinitiating sampling following breakup. Bi-weekly sampling should continue until July 1 or until 90% of emergent fry are greater than 50mm fork length. This Modification is further developed in Appendix C.	Emergence studies or emergence trapping are not proposed by AEA. Existing information on embryo development and emergence timing is available from the 1980s (Hoffman et al. 1983; Roth and Stratton 1985; Stratton 1986; Waangard and Burger 1983). The 2012-2103 and 2013-2104 Winter Studies were collaborative efforts involving Fish Distribution and Abundance in the Middle and Lower Susitna River (Study 9.6) Fish and Aquatics Instream Flow (Study 8.5), Groundwater (Study 7.5), and Ice Processes (Study 7.6). Much of the winter data collection was synoptic and can and will be integrated for impact analysis. In collaboration with intergravel temperature monitoring, monthly fish sampling in winter (February-April) and bi-weekly (every two weeks) salmon ELH sampling from breakup to July 1 will be used to inform and confirm juvenile salmon emergence timing and early growth. AEA has proposed to conduct this work at a subsample of Focus Areas that are representative of the Middle River, contain known spawning areas, a diversity of habitat types, and where work can be conducted safe manner to minimize risk. With the existing information, collaborative winter studies, salmon ELH sampling, and downstream migrant trapping, AEA is gathering the information necessary to meet study objectives for emergence timing, early growth, and movements. This modification request would require the design and implementation of an emergence studies program at ten Focus Areas. This would require monitoring of spawning locations and repeated visits to sample or check emergence traps. The estimated cost of implementing this modification is $1,000,000-$1,200,000 annually.
NMFS_pp9.6-25_ph3	*Modification 25: NMFS recommends a study modification to conduct ELH sampling in the Lower River. NMFS supports AEAs initiative to conduct ELH sampling to determine emergence timing and habitats used by emergent salmon. Sampling should occur proximal to known chum, sockeye, and Coho Salmon spawning locations. This sampling should not replace spring sampling as part of the FDA study. AEAs RSP and Implementation Plan did not propose ELH sampling within the Lower River. Flow routing studies have documented project effects extending into the Lower River, adult escapement studies have documented chum, Coho Salmon, and sockeye salmon spawning within the Lower River mainstem. Water quality studies have documented differences in water temperature and other water quality*	As explained below in Section 2.6.2.3.3, AEA does not object to this proposed Study Plan modification as described by AEA. AEA implemented ELH sampling in the Lower River in 2013 and AEA proposed another year of ELH in the Lower River as a study modification in the ISR Part D (Section 7.1). The estimated cost of implementing this modification is $600,000-$700,000 annually.

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	parameters in the Lower River compared to the Middle River. Therefore, ELH studies are warranted for this river segment. Limited sampling was conducted in the spring at some locations instead of conducting spring sampling as provided for within the approved study plan.	
NMFS_pp9.6-26_ph5	*Modification 26: NMFS recommends a study modification that clarifies that all fish captured as part of the FDA study be measured to fork length as proposed within the RSP. The first 100 of each species on each sampling date at each sampling location should be weighed to the nearest 0.1 gram. Differences in average lengths and weights over time and among habitats can be an indication of differences in habitat quality. Differences in lengths or weights over time and among locations can be analyzed relative to water quality parameters to determine those variables influencing the growth rates of resident fish and juvenile salmonids. Fork lengths are used to estimate age classes based on size frequency distributions. Length data will allow for comparisons among sampling locations, mesohabitats, macrohabitats, tributaries etc., and allow for calculation of growth as a change in length or weight over time. AEA did not implement the sampling plan regarding measuring fish lengths and weights as provided for in the approved study plan. Our study modification is intended to clarify the need to obtain fish lengths for all fish and fish weights, with an appropriate precision, on a subsample of fish by species, sampling date, and sampling site.*	As explained below, AEA requests that FERC not adopt this proposed Study Plan modification. AEA proposes to continue to implement the methods outlined in the FDA IP (Section 5.1.5), taking measurements (length and weight) of 25 individuals per species per life stage per site and not measuring 100 per species as proposed by NMFS. Taking measurements on a random sampling of 25 individuals per life stage will be more representative of the catch than simply 100 per species. It is also unnecessary and time prohibitive to collect measures on more than 25 individuals of a life stage; time and resources are better allocated elsewhere (e.g., sampling more sites or utilizing more gear types). AEA believes the subsampling approach is providing sufficient and representative documentation of fish size consistent with generally accepted scientific practices. Assuming that the processing of additional fish increases the amount of time required at each macrohabitat site by two hours, the estimated cost of implementing this modification is $450,000 annually.
NMFS_pp9.6-27_ph2	*Fish weights are reported to the nearest gram. Juvenile salmonids may only weigh from 1 to 3 grams. Documenting fish weights to the nearest gram does not provide the precision necessary to evaluate differences in condition factors among sampling locations and therefore application of the methods as in 2013 will not meet the study objective. AEA found a wide variation in fish condition factors. However, this is to be expected when weights are obtained to the nearest gram (i.e. 1,2,3) and at a minimum, weights to the nearest 0.1 should be documented. As most field scales are accurate to this level precision, this modification will require no additional cost or effort.*	AEA disagrees with NMFS's characterization of the data collection process. In the ISR Part D, AEA proposed to continue to measure the length and weight of a represented subsample of 25 individuals per species, per life stage (per site, sites are sampled at the mesohabitat level). Weighing and measuring a subsample of fish reduces excessive holding time and stress and is practical when large numbers of juvenile fish are collected. Collecting lengths on all fish collected is time prohibitive and would result in high mortality with large numbers of fish are caught , held, and handled. Weighing and measuring a subsample of fish is a standard practice in fisheries science. To date AEA has weighed small fish up to 200 grams to the nearest 0.1 grams using digital scales and to the nearest 1 gram for larger fish using spring scales. In most cases, weights are taken with calibrated digital

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		scales to the nearest 0.1 grams. Lengths and weights were collected from 14,992 individuals in 2013 (distribution and abundance sampling only; including winter, ELH, migrant trapping and river productivity samples: 25,459 fish measured 57 percent of catch; ISR Part A, Table 4.8-2) and 11,448 individuals in 2014 (winter, ELH, fish distribution and abundance sampling, and river productivity sampling; SIR, Table 4.7-2); this is approximately 52 percent and 33 percent of the fish that were caught in each study year. AEA's subsampling approach is providing sufficient and representative documentation of fish size consistent with generally accepted scientific practices. For reporting purposes applicable to fish weight, AEA has made data collected publically available including fish weights for fish weighing less than 200 grams to the nearest 0.1 grams for both the ISR and SIR at: http://gis.suhydro.org/isr/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/ (see condition factor file) and http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/
NMFS_pp9.6-26_ph8	*It is not clear what methods AEA applied in the field. We are unable to determine the actual number of fish that were measured on each sampling date, location, or by method. The ISR states that AEA randomly measured 25 fish per species and life stage, on each sampling date. It is unclear if fish were only measured during relative abundance surveys or if they were also measured during fish distribution surveys (ISR Part A, Section 4.4). This is considerably different than measuring all fish, or even 25 fish per species per life stage per site.*	In response, AEA refers the agency to the FDA IP (Section 5.1.1) which clearly states that measurements of length and weight will be collected on a random subsample of 25 individuals per species, life stage, and site. A site is the sampling unit for which data is being collected/recorded. For salmon ELH studies a site is a 40-meter-segment, for seasonal fish distribution and/or abundance sampling a site is a mesohabitat within macrohabitat, for downstream migrant trapping a site is a trapping location. Lengths and weights were gathered during all sampling components (i.e., winter sampling, ELH, downstream migrant trapping, and distribution and abundance sampling). Life stages are defined in SIR, Table 4.7-1. Excessive handling and holding fish for long periods of time can lead to stress and mortality. AEA's subsampling approach is providing sufficient and representative documentation of fish size consistent with generally accepted scientific practices.
NMFS_pp9.6-27_ph4	***Modification 27:*** *NMFS recommends modifying the approved study plan to require the development of a sampling method targeted toward the capture and tagging of northern pike.* *The distribution of invasive northern pike was not documented. Sampling was not conducted in locations likely to support northern*	As explained below, AEA requests FERC not adopt this proposed Study Plan modification as the NMFS has not demonstrated that AEA did not implement the FERC-approved Study Plan nor do they provide new information to support that the Study Plan as approved is no longer sufficient.

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	pike (due to transect-based site selection) and few northern pike were radio tagged. The objectives of the approved study will not be met with the approved study methodology. . . .The approved study plan relied on incidental capture and radio-tagging of northern pike during sampling events for the FDA study. However, sampling locations based on areas crossed by transects did not result in the selection of sampling locations that were likely to support northern pike. As a result, very few northern pike were captured or tagged. A total of five northern pike were radio-tagged in the Lower River, all captured in a tributary at the most downstream transect (Fish Creek), which drains into Kroto Slough and then into the Yentna River, near its confluence with the Susitna River. All other northern pike observations were made at the mouth of this tributary or in the receiving slough. The study objective is not likely to be met by implementing the same methods during the second year of study. In order to reach tagging goals and to assess distribution patterns, fish should be targeted in other streams identified by ADFG as problem areas, such as Trapper Creek, Rabideux Creek, Caswell Creek, or the Deshka River and additional Susitna River side channels and sloughs.	AEA does not support the addition of a sampling program specifically targeted at Northern Pike in the Lower River. The distribution of Northern Pike in the Susitna River has been extensively studied by ADF&G and is primarily limited to tributary and lake habitat (Ivey et al. 2009, Rutz 1999). AEA's sampling approach in the Lower and Middle River is adequate for characterizing fish distribution, relative abundance and habitat associations. The sampling design was focused on characterizing fish distributions, including Northern Pike in areas where the Project has potential effect and all habitat types present in the vicinity of the 1 km-wide transect were sampled. We have collected rare species where they are present and have not observed or collected Northern Pike in our samples, indicating that they are not associated with the mainstem of the Susitna River. AEA's findings are consistent with the literature documenting that they rear largely in Lower River tributaries. In the next year of study, targeted sampling may take place where Northern Pike of taggable size are known to occur within the study area in order to obtain radio-tagging targets; however, a new study component targeted at Northern Pike in Lower River tributaries is not within the scope of the fish distribution and abundance study and does not have a nexus with project effects. Assuming that 30 days of directed sampling are allocated to a Northern Pike sampling program, increased survey extent into tributaries habitat where Northern Pike are found and an increase in data management and reporting, the estimated cost of implementing this modification is $350,000-$400,000 annually.
NMFS_pp9.6-30_ph3	*For relatively accurate and precise estimates of relative abundance should have a good linear relationship between CPUE of different gears fishing on the same abundance. A poor linear relationship indicates an inaccurate or imprecise measure of abundance in one or both methods. Comparison of CPUE of Arctic grayling by backpack electrofishing and snorkeling (Figure 1, ISR 9.5 2014) results in a highly variable and somewhat ambiguous relationship between the two gears (Appendix C). This suggests poor sampling performance in one or both of the sampling techniques and, therefore, potential problems in the reported data.*	AEA disagrees with this comment. AEA had absolutely no expectation that CPUE with two gear types would be the same or related in a tight linear relationship. If they were, then the second gear type would be superfluous. Multiple gear types are explicitly used in order to ensure that fish species or life stages that are not susceptible to a particular gear are captured by a different gear type. This line of reasoning provides no evidence of poor sampling performance, but rather highlights the value of using multiple gears to accurately characterize fish distribution and abundance.
NMFS_pp9.6-31_ph1	*The calculation of CPUE is also problematic and examination of the results of these calculations indicates more substantial issues. Often,*	AEA disagrees with this comment. The Services repeatedly comment about a lack of precision in relative abundance estimates, equating

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	the same site is sampled by multiple gears over one or two days. For example, site TSI_01_04A was sampled by snorkel, backpack electrofishing, angling, and minnow traps over the same two day period in early summer. The estimates of relative abundance for each type of gear would likely depend on the number and order of sampling technique. Dispersal of fish from the survey by snorkel survey or electrofishing is likely to affect catches in minnow traps conducted the same day. Different sampling techniques measure different abundances. Electrofishing, angling, and snorkeling measure abundance of fish present within the duration of sampling (typically about 1 hour). Minnow trapping and other 24-hour sampling techniques determine abundances over a much longer duration and tend to target smaller and more mobile or migratory species and more crepuscular or nocturnal species.	these estimates with population estimates. This is not AEA's intent, as has been documented in the consultation record. During study development (PSP) AEA recommended two components for FDA sampling: one for distribution and a second to develop population estimates using multipass and depletion techniques. These methods were also discussed in TWG meetings where the Services requested omission of quantitative population estimates in favor of collecting relative abundance information at more sites. AEA moved forward with this change for FDA sampling based on the Study Plan Determination (Study 9.6 SPD, April 1, 2013). Still, the manner in which AEA collected the relative abundance data will allow for calculation of CPUE, and associated uncertainty estimates, by habitat type and season. AEA is submitting FUHI TM (Attachment 7) as an example of how relative abundance can be combined across fish sampling gears to provide comparisons of fish use of habitat types at the macrohabitat or mesohabitat levels.
NMFS_pp9.6-31_ph3	*The CPUE from different gear types is not comparable and cannot be combined to provide a more robust assessment of relative abundance in a given site. Electrofishing CPUE is calculated in fish per hour; seine and snorkel samples are fish per sampled area, and minnow traps, fyke nets and hoop nets are fish per unit of gear. Relative catches would be more comparable if they could be expressed as fish per square meter and relative abundances estimated by either summing or averaging individual gear catches, depending on sampling protocol…The influence of sampling gear selectivity and multiple sampling interactions on relative catch rates makes the quantitative estimate of differences in relative abundance between areas, habitats, gears, and possibly seasons quite challenging.*	AEA agrees that estimating differences in relative abundance between areas, habitats, gears, and seasons is challenging. However, as explained above in AEA's response to NMFS's comment NMFS_pp9.6-31_ph1, AEA disagrees that estimates are not comparable and have develop metrics of combined CPUEs that will allow AEA to compare fish assemblages across habitats and across seasons (Attachment 7)..
NMFS_pp9.6-32_ph2	*Some species of fish were found in virtually all sampling sites by at least one sampling techniques (all species combined across all sampling gears). However when individual species and individual gears are examined, fish of a single species were not found (ISR 9.5 2014 Appendix Table D14). For example, juvenile Chinook salmon, burbot, Dolly Varden, longnose sucker, and round whitefish were not found in 95%, 90%, 88%, 93%, and 88% of sites respectively. It is likely that confidence limits on catch and CPUE estimates would include zero for almost all areas and times sampled for these species,*	AEA disagrees that confidence limits on catch and CPUE estimates would include zero for almost all areas and times sampled for these species. Standard errors for CPUE for a single species/life stage within a single macrohabitat type within a single geomorphic reach may be relatively large, given the small sample sizes within this limited stratum. However, it is crucial to consider context for these broad statements. First, the total fish population size of a macrohabitat type is finite within each of these strata, so sample variances need to be corrected for this. Second, strata can be combined to achieve higher

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	and statistical differences or trends in abundance would be almost impossible to measure. Arctic grayling and sculpins were caught in more strata, resulting in more precise assessments of population distributions for these species. An approximation to the coefficient of variation for the Arctic grayling is 206%. N	sample sizes for comparing macrohabitat types. No specific statistical hypotheses have yet been planned to meet the study objectives. However, the existing data can be used to address statistical hypotheses in the Impact Analysis phase. Properly constructed confidence intervals including fish observations would not include zero, so the intent of this comment is unclear.
NMFS_pp9.6-32_ph3	*The distribution and relative abundance sampling was planned using either the GRTS or systematic sampling design protocol. The implementation of the Study Plan was carried out with few deviations from the plan. The major variance from the sample plan was the reduction in sampling sites. The highly variable nature of this type of sampling requires that a large number of sites be sampled. Analysis of CPUE remains incomplete and qualitative with presence or absence, total counts, and/or selected results from a single sampling event serving to support stated differences in abundance. The FDAIP stated: "Distribution results (i.e. fish observation locations) will be presented on maps. Relative abundance estimates (e.g., fish per unit area, CPUE) within the Lower and Upper River mainstem will be summarized by mainstem habitat type and gear type with appropriate statistical confidence intervals (emphasis added)" (IP 2014). Presence or absence of different species are displayed on maps, generally identifying Upper River fish distributions. Averages and confidence limits are not presented. Averages and estimates of sampling error will be difficult to calculate due to the study design and variability in counts. Subsampling within the GRTS selected sampling sites changes the probability of fish being in a sample, requiring weighting factors in the estimates of means and sampling error measures across transects. Many factors affect catches and CPUE estimates, including location, habitat type, sampling data, sampling technique, and implementation of the sampling procedures. The reported counts are highly variable and each type of sampling gear has its own biases, depending on the habitat type and size and behavior of target species. Quantitative comparisons are statistically challenging and should be performed with a great deal of caution and qualifications reported. However, some results can be supported with more elaborate data analysis and even qualitative data can be possibly compared using non-parametric statistical techniques or computer simulation. The study did qualitatively suggest which capture techniques are most*	Statistical confidence intervals have not yet been provided, as the SIR is an interim study report and the study is not completed. Statistical confidence intervals for CPUE with individual gear types can be provided in the USR but only become relevant if used for a comparative analysis or hypotheses test. Confidence intervals are not need to descriptively characterize the fish assemblage.

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	effective for each species. Paired comparisons of sampling techniques could also be used to determine the best tactics.	
NMFS_pp9.6-32_ph4	*Results discussed in habitat associations (section 5.1.3) could be an outcome of the susceptibility of different species to different sampling gear. This gear-species interaction could be evaluated by testing mesohabitat associations across all sampling techniques and across different macrohabitats by ranking mesohabitats by abundance for each sampling technique or for each habitat type. Estimates of confidence limits on the relative abundance estimates would determine if estimates by mesohabitat type are significantly different from zero.*	As indicated in the ISR Part A, Section 5.1.3, all data reported were preliminary and QAQC was not yet completed. AEA conducted preliminary analyses with this first year of preliminary data. Subsequent to the ISR, AEA has completed QAQC and data review and has developed methods to better calculate CPUE when using multiple gears to catch fish, AEA is submitting the FUHI TM (Attachment 7) to provide examples of how relative abundance can be combined across fish sampling gears to provide comparisons of fish use of habitat types at the macrohabitat or mesohabitat levels.
NMFS_pp9.6-34_ph4a	*Before any further sampling is done, gear effectiveness needs to be evaluated, and then only specific gears that do not conflict with each other (by harassing or dispersing fish before the next gear is used) should be used at each site.*	As explained below in Section 2.6.2.5.2, AEA disagrees with the comment.
NMFS_pp9.6-34_ph4b	*The Study Plan should be expanded to include a description of how the various data will be turned into quantitative estimates so that rigorous comparisons can be made across species, across river habitat types, and across time.*	As explained below in Section 2.6.2.5.3, AEA disagrees with this comment.
NMFS_pp9.6-34_ph4c	*The sampling plan should be reevaluated so that there is a tight linkage between the sampling design and the estimates and statistical inferences that will be drawn from the data.*	As explained below in Section 2.6.2.5.3, AEA disagree with this comment.
NMFS_pp9.6-34_ph4d	*Estimates should be presented with appropriate measures of sampling error (confidence intervals or standard errors).*	AEA disagrees with this comment for the ISR and SIR. See AEA's response to NMFS_pp9.6-31_ph1.
NMFS_pp9.6-37_ph3	*The habitat relationships of Chinook Salmon presented by AEA in the ISRs suggest that Chinook and Coho Salmon were misidentified. The ISR states that juvenile Chinook Salmon counts were highest in upland sloughs and these counts were highest in slow water beaver – complex mesohabitats. For example, based on a review of data provided, 51 Chinook salmon juveniles were captured in the beaver pond complex of Slough 6A (FA 115), and one Chinook salmon juvenile was captured in the backwater pool downstream from the beaver dam. High numbers of juvenile Chinook (292) also were reported for the Upland Slough beaver pond complex in the Indian River Focus Area (FA 141). These findings are inconsistent with*	AEA disagrees with this comment. NMFS has erroneously let habitat type influence species identification. For example, in the Upland Slough beaver complex in the Indian River Focus Area (FA-141), ten juvenile salmon have genetically confirmed species assignments; 8 were Chinook Salmon and 2 were Coho Salmon. Using habitat types to inform species identifications compromises the ability to evaluate fish habitat use and is not supported by AEA's data. Study 9.6 SIR, Appendix B (*Juvenile Chinook and Coho Salmon Identification Accuracy*) reported the habitat suitability criteria developed by the Instream Flow Study (Study 8.5) for water depth, velocity and temperature for Coho Salmon and Chinook Salmon; the

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	previous studies of juvenile Chinook salmon that generally document juvenile Chinook preference for habitats with high water velocities (with the exception of newly emergent fry) and dissolved oxygen, whereas, Coho Salmon have a greater tolerance for higher water temperature and low dissolved oxygen levels, and are most abundant in upland sloughs and beaver ponds.	two species had considerable overlap in suitable habitat. This is consistent with preliminary evaluation of habitat associations as presented in the SIR. As reported in SIR, Appendix B, juvenile Chinook and Coho salmon co-occurred in 87 percent of the habitat features where species identifications were verified. Furthermore, AEA's ISR data was preliminary and has been superseded by the SIR and its associated comprehensive database incorporating genetic samples (http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/).
NMFS_pp9.6-40_ph2	*Fork length data for fish identified as Chinook salmon are too large for a fish species that spends one year in fresh water and are inconsistent with juvenile Chinook lengths measured other studies in the Susitna River and other nearby locations.*	See Section 2.6.2.1.4 below.
NMFS_pp9.6-40_ph4	*The size distribution of Chinook salmon during the one year in freshwater are available from multiple sources. Previous studies conducted by ADFG (1983) in the Susitna River document a mean fork length range from ~ 50 to 70 mm (Figure 2). During June and July some age 1 Chinook are present with longer fork lengths, with a maximum of 125 reported by ADFG. Kirsch et al. (2014) also found the mean fork length of Chinook salmon to range between 50 and 60 mm. The size distribution of Chinook salmon within the Susitna River collected by ARRI as part of a study supported by the NMFS from October 2013 to February 2014 (Davis et al. 2013) is consistent with these values (Figure 3). This size range also is consistent with the fork lengths obtained from over 7,000 Chinook salmon captured by ARRI within the Susitna River drainage from 2007 through 2013 (Figure 3).*	See Section 2.6.2.1.4 below.
NMFS_pp9.6-47_ph1	*The objective of determining juvenile salmon overwintering habitat associations has not been accomplished due to problems with habitat classification and site selection, inconsistent sample collection methodology, low or no replicate sampling of macrohabitats, and absence of measures of habitat characteristics. Quantitative juvenile salmon overwintering data are only provided for 2 to 3 replicates of a subset of the Susitna River macrohabitats and no data are provided for the remaining macrohabitat classes. Data from these sites are not representative of the approximately 50 miles of Middle River and 100 Lower River miles of fish habitat. In addition, some macrohabitats are*	See Section 2.6.2.10.1 below.

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	misclassified and sampling sites in others are not representative due to dominant mesohabitat characteristics (e.g. in beaver ponds). Tributary mouths and main channel habitats were not sampled. Independent analyses show that differences in macrohabitat catch per unit effort (CPUE) for Chinook and Coho Salmon juveniles were not statistically significant among macrohabitats during February or March. No measures or descriptions of habitat characteristics are provided. The study has shown that juvenile Chinook, Coho Salmon, and sockeye salmon overwinter in off-channel Middle River habitats. However, due to inaccurate macrohabitat classification, the low number of replicates, and inconsistent sampling methods, this study is unable to determine if there are significant differences in juvenile salmon abundance among the 3 macrohabitats investigated. There is no information for two of the five Susitna River macrohabitats (main channel and tributary mouth) and no information on the habitat characteristics within or among those habitats investigated.	
NMFS_pp9.6-47_ph3	*The inability to meet radiotelemetry study objectives is the result of incomplete study implementation. The number of tagged fish at the start of winter was well below target levels of 30 fish within each river segment. Tagged fish were not tracked by snow machine or foot to determine their location at a scale that could be used to identify spawning or overwintering by macrohabitat or habitat characteristics. Therefore, timing of movement into the Susitna River for overwintering or out of the Susitna River for spawning is not known. There is no information on specific overwintering macrohabitat locations, or habitat characteristics selected by overwintering fish.*	AEA has completed a detailed draft *2013-2015 Radiotelemetry Implementation Report* (Attachment 8) that characterizes fish movements and habitat associations with mainstem non-confluence, tributary confluence, and tributary non-confluence habitat types during the foraging, overwintering, and spawning seasons. The resolution of detection from aerial observations was not fine enough resolution to assign detections to macrohabitat types and it was deemed unsafe to survey on the ground in the winter. The ILP is a two year study process. In the ISR Part D AEA indicates that an additional year of radio-tagging and tracking in the Middle and Lower River is necessary to meet study objectives. This comment appears to refer exclusively to the *2013-2014 Winter Fish Study Technical Memorandum* (Study 9.6 TM, September 14, 2014), updated tagging information was provided regarding radio tags-at-large in the SIR (SIR, Table 4.4-3). All fish tracking data information are available at http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/.
NMFS_pp9.6-48_ph2	*The detection of PIT-tagged resident fish and juvenile salmon documented juvenile Coho Salmon and Chinook salmon migrating from spawning tributaries (Indian River) and the Susitna River main channel to off-channel overwintering habitats. The study does not provide any additional information regarding juvenile salmon and*	AEA agrees that the study did not ddocument the proportion of tagged fish moving into and out of Focus Areas or determine if fish movement was associated with microhabitat variables such as velocity and depth. These questions are not objectives or even components of the study objective for Winter Studies under Study 9.6. Fish were PIT tagged

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	resident fish movement. The study did not report the total number of fish tagged within a macrohabitat or the detection efficiency of stationary antennas; therefore, the study was unable to document the portion of tagged fish moving into or out of a Focus Area. Because a single antenna was used one could not determine whether a fish moved across an antennae or only approached the antennae and if it crossed an array, whether the fish migrated outside of the macrohabitat or Focus Area. No data are provided on when fish were tagged or when fish were detected. The study is unable to determine if movements were associated with any habitat variables (i.e. change in velocity or water depth) or the timing of smolt movement. Similar problems are associated with the interpretation of the recaptured PIT-tagged fish. Only a small portion of the tagged fish were recaptured, which could be due to low probability of recapture of fish or due to a large portion of the fish migrating from the site. The fact that 50% of the recaptured fish occurred at the location where fish were tagged is not an indication of site fidelity due to low number of recaptures and differences in capture probability. Since sampling did not occur outside of the Focus Areas where they were tagged it is not possible that tagged fish would be recaptured elsewhere. Juvenile salmon growth rates were included as a winter study objective in order to provide a metric that could be used to evaluate differences in overwintering habitat quality. Due to the low number of recaptured PIT-tagged salmon, there were not enough replicates to test for differences in growth among the three macrohabitats investigated (side sloughs, upland sloughs, and side channels). Due to the low number of recaptured fish measured, growth of individual fish may not be representative of the fish population. Growth rates were variable over time and the time period that growth was measured for each tagged fish was inconsistent. Some of the differences in growth reflected differences due to when the fish were tagged and not differences among macrohabitats. Differences in growth, where present, also are not likely to be representative of the macrohabitat due to the low number of replicate macrohabitats (2 to 3) where growth was measured.	year round so movements between open-water and overwintering sites, within winter across and between Focus Areas and PIT arrays, and between winter and open-water are documented. The biotelemetry (PIT and radio tag) data indicated that movements are very limited during the winter and that site fidelity is high; these findings are consistent with the literature. Locating the same individuals time and time again in the same site in the same macrohabitat in winter is an indication of site fidelity. Tagging and recapture and detection are necessary for demonstrating progress towards study objectives; not a detailed analysis of individuals. Data on individual fish tagging and detection histories are provided in the SIR database (http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/). It is not clear what the comment regarding macrohabitat replication for condition factor and growth analysis intends. Fish from replicate macrohabitats were pooled; the sample size is the number of fish not the number of replicate macrohabitats. The macrohabitats sampled are from a stratified random sampling approach within Focus Areas, designed to be representative. Sufficient sample sizes of either PIT tag recaptures or examination of the length-frequency over time is necessary to look at growth; however some species and life stages are rare in the winter. In the ISR Part D, AEA proposed an additional year of data collection at the three Focus Areas to complete the study.
NMFS_pp9.6-49_ph1	*Only samples collected during February and March should be used to assess winter habitat associations of juvenile salmon and resident fish. Sampling was conducted in November, February, March, and April.*	See Section 2.6.2.10.2 below.

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	November sampling is prior to ice development and does not reflect winter conditions. The formation of ice significantly alters water depths and velocities among macrohabitats. Conditions are fairly stable from December following ice development through March. During April, breakup has started with an open mainstem channel which reduced stage height in off-channel habitats.	
NMFS_pp9.6-49_ph2	*Sampling site locations were not representative of the macrohabitats under investigation and contained very few replicates during the winter months. During February and March there was only one side channel habitat sampling site in FA 104 (WFS 104 154). This is inconsistent with the Technical Memorandum that states three replicates GRTS sites were selected for each macrohabitat types in each Focus Area. The FA 104 sampling locations, while identified in AEA Table 5.1-7 as a side channel is contradicted by side slough designation in AEA Figure 3.1. We support the side slough habitat classification based upon the review of aerial imagery. Therefore, no side channel habitats were sampled in FA-104. The two sites classified as side sloughs are misclassified and are located in the mouth of Whiskers Creek, downstream of where the Creek discharges into side slough habitat. ARRI sampled both of these locations during the winter of 2012/2013 and found significantly higher relative abundance of Chinook and Coho Salmon salmon within the side slough upstream of the tributary discharge point than downstream in the tributary mouth where AEA sampled (Davis et al. 2014). AEA also sampled further upstream within Whiskers Creek; however, as tributaries are not one of the Middle River macrohabitats under investigation, these sites do not address the study objective. For FA-104, therefore, only one side slough, two tributary mouth, and three upland slough sites were sampled representing one side slough and one upland slough that can be used to address the study objectives. The classification used in the current study reduces the likelihood of furthering our understanding of macrohabitats used by overwintering salmonids.*	These comments are regarding differences in opinion on habitat typing. Whiskers Slough downstream of Whiskers Creek is slough-dominated at habitat mapping flows and therefore has been classified as a side slough for all of AEA's studies. Not all Focus Areas have all three replicates of each habitat type, furthermore Table 4.3-1 and Figure 3-1 (Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*) display the GRTS and opportunistic sampling sites indicating a total of five upland slough sites, four side slough sites (one of which was a side channel (3B) and was later reclassified to side slough), and four sites within Whiskers Creek. Contrary to NMFS comment, tributaries are a macrohabitat within GRTS and are under investigation in the Middle River within the zone of hydrologic influence (see the FDA RSP or IP). Furthermore, AEA did opportunistically sample Whiskers Slough upstream of Whiskers Creek (WFS-104-OP3) where Davis et al. 2014 reported to have found high densities of juvenile salmon. However, this site was not used for CPUE reporting in the *2013-2014 Winter Fish Study Technical Memorandum* (Study 9.6 TM, September 14, 2014) due to the opportunistic nature of the sampling; AEAs objective to characterize fish abundance and habitat associations in a non-biased manner using GRTS which involved randomized site selection (not just selecting places known to have fish or suspected to have fish). With a randomized site design sometimes places contain lots of fish while others don't, but the point is that it is they are a much more accurate representation of available habitat than the non-random selection of sites that are subjectively considered representative (Davis et al. 2013; Davis et al. 2015; Davis and Davis 2015) and then used to compare among habitat types.
NMFS_pp9.6-50_ph2	*In FA 128, one side channel site was sampled with minnow traps in February and March (WFS- 128-64), and one additional side channel site was sampled by electrofishing in February (WO 119). The second*	The FDA studies, including the winter study, use mapped habitat classifications within Focus Areas to define GRTS panel populations from which sites are randomly selected. If the only upland sloughs in

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	side channel site crosses an island. These ephemeral channels should not be classified or sampled as representative of mainstem macrohabitats. The single island side channel site was not sampled in November. It is not known if fish were present at this location prior to ice development. Three side slough habitat sites were sampled by AEA in February and March, all representative of the same side slough. The sites were at the upstream end of the side slough within a beaver complex and outside of the Focus Area. These sites are representative of side sloughs; however, the associated beaver complex will ameliorate changes to water depth and velocity as the upstream end of the slough is breached during ice formation and mid-winter ice jams. Three upland slough sites were sampled in FA 128 during February and March. All three of these sites also are on a mid-channel island and one of the sites is superimposed by side channel habitat (see AEA Figure 3-2). Within FA 138, two side channel habitats units were sampled in February and March. Two upland slough units were sampled; however, one of these sites (Site 76) is more accurately classified as a side slough. The slough habitats sampled represent a single side slough, but also were within beaver complex mesohabitats. In summary, four side channel sites were sampled in February and three in March representing three distinct side channels, one of which was located on an island. Seven side slough sites were sampled in February and March representing three distinct side sloughs. Six of these sites were within beaver complex mesohabitats. Seven upland sloughs were sampled in February and March, representing four distinct upland sloughs, with three of the sloughs located on an island and with one of the sloughs more representative of a side slough than an upland slough.	FA-128 (Slough 8A) occur mid-channel then that is where the samples will fall. The GRTS panels for all of Slough 8A are included in the Focus Area for fish sampling as to not split this feature between Focus Area and non-Focus Area for fish sampling purposes. Again site selection is random and based on repeated open-water sampling locations as much as possible, however three side slough sites in slough 8A downstream of the beaver dam, including the slough mouth, were sampled opportunistically (Figure 3-2). Again, in the *2013-2014 Winter Fish Study Technical Memorandum* (Study 9.6 TM, September 14, 2014), habitat associations were only reported for sites selected through a random process. NMFS also indicates in comment NMFS_pp9.6-49_ph1 that November sampling during freeze should not be used for winter studies and then continually makes comparisons between November and other sampling events; this is confusing and inconsistent. See AEA response to NMFS_pp9.6-49_ph1 in Section 2.6.2.10.2.
NMFS_pp9.6-50_ph5	*Fish collection methods were not consistently applied at all sampling locations and sampling dates, results from different methods cannot be combined, and sampling unit lengths for each method and date are unknown. Minnow trap data are the only sampling method that was used on all sampling dates at most sampling sites. Therefore, minnow trap data are the only sampling method that can be used to test for differences in the relative abundance of juvenile Chinook and Coho Salmon salmon among sites during winter sampling (February and March). AEA Tables 5.1-1 through 5.1-12 show that in FA 104 during February and March, fyke nets and electrofishing were only used in*	AEA disagrees with this comment. The most effective and appropriate gears should be used at each site based on conditions at the time of sampling to best characterize the fish species and life stages that may be present. AEA proposes to use a combined gear approach, similar to that demonstrated in the FUHI TM (Attachment 7) to adjust for the selection of different sampling techniques used on different events. AEA believes that the data collected in 2013-2014 with the addition of a second year of data collection as proposed in the ISR Part D and supplemented with the 2012-2013 pilot study efforts, 1980s licensing efforts, winter habitat suitability criteria sampling under study 8.5, and

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	one macrohabitat type (excluding Whiskers Creek which is not a habitat under consideration). In FA 128 fyke nets were not used in February and at only one macrohabitat type in March, and electrofishing was used in three macrohabitat types in February and two macrohabitat types in March. Fyke nets were not used in FA 138 during February or March and electrofishing was used in two macrohabitats during both months. In addition, since fyke nets and electrofishing can only be used in open leads, results from these methods only represent a subset of available winter habitats. Therefore, there are not replicate sampling units using these methods to provide for comparisons among macrohabitat or over time.	synoptic Middle and Lower Susitna River winter fish sampling over the 2012-2013 winter (Davis et al. 2013), 2013-2014 winter (Davis et al. 2015), and 2014-2015 winter (Davis and Davis 2015) will provide the baseline documentation necessary for impact analysis. Winter sampling was designed as a descriptive study to collect data on baseline conditions. We did not identify specific hypothesis regarding fish populations that demanded a specific study design. Still, AEA disagrees that minnow trapping data are the only data suitable for future hypothesis testing. We have collected all fish data in as rigorous a fashion as possible to meet objectives and have developed tools to support analyses of potential Project impacts on fish.
NMFS_pp9.6-51_ph2	*AEA's analyses in section 5.1 of the Technical Memorandum provides a summary of the CPUE data from AEA Tables 5.1. The analysis does not test for differences among macrohabitats using comparable February and March data. For example, Chinook catch is reported as highest in tributary habitat. Fyke net catch is reported by AEA for FA 104 tributary habitat, but the report fails to mention that this method was not used in any of the other FA 104 macrohabitats or that high catch included a large number of emergent fry in April. Therefore it appears that high abundance in tributaries is due to the capture of large numbers of emergent fry with a collection method not used in other sampling locations. Using AEA's minnow trap data, in February average Chinook catch per unit trap (CPUT) was 0.11 in upland sloughs. 0.18 in side sloughs, and 0.00 in side channels; however, differences were not significant (ANOVA p = 0.48). There also was no differences in March Chinook CPUT among macrohabitats with means of 0.03, 0.00, and 0.02 for upland sloughs, side sloughs, and side channels, respectively. For Coho Salmon salmon juveniles average February CPUT was 0.63 in upland sloughs, 0.41 in side sloughs, and 0.66 in side channels, with no significant differences among macrohabitats (p = 0.83). If you exclude the low catch from FA 128 mid-island upland sloughs, average February Coho Salmon CPUT from upland sloughs is considerably higher at 4.26. No Coho Salmon were captured at the FA 128 island side channel site in February or March. March average Coho Salmon CPUT was 0.69 in upland sloughs, 0.25 in side sloughs, and 0.27 in side channels; however, averages were not significantly different (p = 0.45). If the island upland sloughs of FA 128 were excluded March Coho Salmon average CPUT*	AEA appreciates the Services' efforts demonstrating that at least some of the data collected by AEA is suitable for statistical analysis. It is also nice to see that NMFS has been able to use data to describe differences in fish habitats sampled, such as the example of high versus low CPUT of upland slough habitats provided by NMFS. However, it was not a goal of our data collection to demonstrate significant differences among habitats, but rather to collect data that is effective at describing the fish in these habitats. Basing a conclusion about the value of habitat types from the removal or addition of sites and manipulating results from a randomized study design is not a sound scientific approach to testing for differences between lateral and mid-channel slough habitat quality. The same mid-channel upland sloughs excluded from analysis yielded overwintering juvenile salmon during the 2012-2013 winter. AEA's abundance data has found that during the open-water period mid-island slough habitats such as the one at PRM 130 can be important rearing areas. The distinction between lateral and mid-channel slough is not a part of the FERC approved habitat mapping protocol or study design.

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	would have been considerable higher at 5.51 in upland slough macrohabitats. Therefore, including mid-island upland sloughs resulted in no significant differences, while excluding these sites resulted in Coho Salmon CPUT significantly higher in upland slough macrohabitats (p<0.05). This analysis indicates that mid or cross-island habitats are biologically distinct and should have a unique classification, and suggest that Coho Salmon are more abundant in upland sloughs during winter.	
NMFS_pp9.6-51_ph4	*Habitats under investigation do not have associated descriptions. Habitat variables (water depth, velocity, cover, ice thickness, wood debris, substrate type, dissolved oxygen, pH, and specific conductivity) should be measured to evaluate important characteristics for overwintering salmon. This is particularly important if the IFS is unable to capture enough fish to develop habitat suitability curves (HSC) or accurately model water depths and velocities in Focus Areas.*	Winter studies are a collaborative effort between FDA, HSC and other study participants. FDA does not collect information on microhabitat variables as it is not a study objective. FDA does collect basic water quality and habitat information; see Figure 2.6.2-11 below for an example field data form. Results of winter IFS studies were reported in the *2013-2014 Instream Flow Winter Studies Technical Memorandum* (Study 8.5 TM, September 17, 2014).
NMFS_pp9.6-51_ph5	*The radio tagging study was not implemented as provided for in the approved plan and there are not enough tagged fish to come to any conclusions regarding juvenile salmon and resident fish winter movements or habitat use during the winter months. Tagged fish were not tracked to specific locations, the area describing fish locations were very large, and there is no information on the habitat characteristics selected during winter by tagged fish. Therefore, the study does not provide the information necessary to evaluate or mitigate for potential project effects. The technical memorandum exaggerates the number of tagged fish tracked during winter. Due to the low number of tagged fish it is not clear what portion of the population is represented. For example, Section 5.2.1.1.1 states that 10 tagged Arctic grayling were released upstream from Devils Canyon and 6 below; however, the TM does not report that, per AEA Table 4.5-1, of the 10 tagged Arctic grayling only 6 were active by January 1 and only 3 by January 15. Similarly, of the 6 tagged Arctic grayling below Devils Canyon only 4 tagged fish were present by December 1. The movements of 4 Arctic grayling cannot be expected to be representative of the Middle River Arctic grayling population. Information on the movement of Upper River Arctic grayling described in the TM is not supported by information in the cited table (AEA Table 4.5-8), that shows the locations of approximately 11 Upper River Arctic*	As explained above in response to NMFS's comment NMFS_pp9.6-47_ph3, AEA disagrees with the characterization of radio-tagging study implementation.

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	grayling and not the 31 referenced in the report. The locations of the Arctic grayling in the Tyone River are not shown in the referenced table. The TM fails to describe two Arctic grayling that were released near Kosina Creek and were later located below Devils Canyon near Lane Creek, and apparently migrated back upstream (AEA Table 4.5-8).	
NMFS_pp9.6-53_ph3	*The documentation of juvenile salmon migrating from the main channel and a tributary to offchannel habitats to overwinter is the only information gained from the detection of PIT-tagged resident fish and juvenile salmon. The standard scientific practice for PIT-tagging studies is to determine the portion of tagged fish moving from one location to another corrected by the ability to detect tags either as they approach or pass a stationary antennae or are detected by a hand held antenna (Bramblett et al. 2002). The study does not clearly state when fish were tagged and if detections only reflected fish tagged during winter or fish tagged at on any previous date. The text of the Technical Memorandum does not describe any analyses conducted to determine winter site fidelity or the timing of smolt outmigration, or if movements were associated with any other environmental variable, in particular, rising stage height during ice formation.*	AEA disagrees with the comment, analysis of environmental variables with fish movement or catch data is not necessary in this point of the ILP to demonstrate progress towards meeting study objectives and will be completed for the USR once all data collection is complete and potential Project impacts are understood and specific analyses that address impacts are developed. Determining portions of fish moving from one location to another is not a component of Objective 2 and the study is not designed to do this especially in sloughs with and entrance and an exit. Objective 2 is to characterize the timing and movements which have been demonstrated through PIT array detections, in-hand recaptures, ELH, and downstream migrant trapping.
NMFS_pp9.6-54_ph1	*Since the number of fish tagged within a Focus Area is not provided, the probability of recapture is unknown, and sampling only occurred in Focus Areas, then the fact that more than half of the recaptures occurring within the same Focus Area where they were tagged does not provide any useful information. Knowledge of when fish were recaptured relative to tagging is also necessary to determine site fidelity. The only information provided within the TM is that fish were recaptured over 7 days after tagging. However, as sampling took place monthly, it is unclear what this means. Did sampling occur more often, than monthly within a Focus Area or did sampling within a Focus Area extend over a 7-day period and fish moved from a sampling site at one end of a Focus Area to the other end of the Focus Area during the sampling period?*	The number of tagged fish by tagging location and date as well as recapture and detection information is available at: http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/.. The TM clearly states that that a minimum time interval of 7 days between recapture events was used for fish to qualify for growth analysis (Section 4.7.2 in Study 9.6 TM, September 14, 2014*: 2013-2014 Winter Fish Study Technical Memorandum Winter TM*).
NMFS_pp9.6-54_ph3	*The study does not clearly state when fish were tagged or if the detections reported were only for fish tagged during winter. For example, AEA table 4.6-1 reports that 2 rainbow trout were tagged but that there were 12 detections at an array. This could mean that the two*	This requested level of detailed analysis is not necessary to demonstrate progress towards study objectives. Tagging and detection histories are available with associated latitude and longitude in the relational database. The number of tagged fish by tagging

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	tagged rainbow trout were detected multiple times. However AEA section 5.2.7.2 states that the 12 fish detected were tagged between August 28 and September 21, so the report also tracks fish tagged during fall sampling. Therefore, it is not clear how many rainbow trout were tagged (2, 12, or some other number) and how many of these tagged fish were relocated. The report states that 9 rainbow trout were detected at the array that were tagged in Whiskers Creek or the classified side slough habitat within the mouth of Whiskers Creek. We don't know the number of tagged rainbow trout within Whiskers Creek at the onset of the Winter Study or where within Whiskers Creek these fish were tagged. Therefore, we cannot identify the portion of rainbow trout in Whiskers Creek that migrated to the mainstem habitats to overwinter.	location and date as well as recapture and detection information is available at: http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/ .
NMFS_pp9.6-55_ph2	*The TM identifies emergence timing based on the presence of target fish less than 40 mm occurring in monthly samples. These results reveal the presence of fry beginning as early as February, with a maximum number in April sampling. The TM does not provide results by sampling method or by sampling location. Electrofishing, which causes involuntary muscle contraction, can result in early emergence and result in erroneous results. Electrofishing results should be analyzed independently from and compared to fyke net results.*	The timing of emergence described in AEA's TM (Study 9.6 TM, September 14, 2014*: 2013-2014 Winter Fish Study Technical Memorandum Winter TM)* is similar to that documented in the 1980s. AEA disagrees that electrofishing is drawing large numbers of pre-emergent salmon fry from salmon redds and should be discontinued during salmon ELH studies. For a more detailed response, please see AEA's response to NMFS's Comment NMFS_pp9.6-24_ph2. Differences between AEA's and ARRI's winter data can be explained by the size selectivity of wire minnow traps used by ARRI. For more information, the number of fish collected by gear type and their sizes are available at: http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/.
NMFS_pp9.6-55_ph3	*The presence of emergent salmon is an indication of spawning location. However, the study does not identify where emergent fish were captured. For example, the presence of emergent Chinook or Coho Salmon salmon within FA 128 or FA 138 could indicate spawning in off-channel habitats or early migration from known spawning streams. If Coho Salmon or Chinook fry are migrating during April, these newly emergent fish must be considered in fish passage barrier studies (Study 9.12). Alternatively, emergent Chinook and Coho Salmon salmon captured in Whiskers Creek would be an indication of spawning within this tributary, and support the need to extend the adult escapement study into the lower Middle River (see the Services RSP comments). If Chinook and Coho Salmon fry were*	It is not a study objective to undertake a spatial analysis of fry emergence locations. The number of newly emerged fry as well as their locations are available in the database supporting the SIR at: http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/.

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	captured in Whiskers Creek side channel or side sloughs, this would suggest that either spawning was occurring in these locations, or emergent fry were migrating to these locations and the presence of Chinook and Coho Salmon fry in off-channel habitats would need to be considered in any analyses of project effects and for the development of mitigation options. To evaluate project effects HSC curves would need to be developed for this life stage.	
NMFS_pp9.6-55_ph5	*The level of effort directed toward determining juvenile salmon growth rates was insufficient. The number of recaptured PIT-tagged salmon was insufficient to allow for statistical comparisons of growth among macrohabitats. The low number of fish makes it less likely that the growth rates measured are representative of the species or macrohabitat (2 to 3 for Chinook salmon, 7 to 28 for Coho Salmon salmon per AEA Figure 5.2.4-1). The low number of replicate macrohabitats sampled makes it unlikely that the growth rates measured are representative of the macrohabitats sampled (2 or 3 for 3 of the 5 macrohabitats). Differences in growth based on date of tagging reduce the probability of detecting differences among species or macrohabitats.*	The macrohabitats sampled are from a stratified random sampling approach within Focus Areas, designed to be representative. A small sample size may increase risk that samples do not capture full range of variation of the data, but does not indicate whether samples are or are not representative of the large population. Sufficient sample sizes of either PIT tag recaptures or examination of the length-frequency over time is necessary to look at growth; however some species and life stage are rare in the winter. In the ISR Part D (Section 8) AEA proposed an additional year of data collection at the three Focus Areas to complete the study.
NMFS_pp9.6-56_ph1	*Habitat characteristics were not measured at sampling locations; therefore, differences in growth among macrohabitats and as a function of habitat characteristics potentially influenced by project operations cannot be evaluated. Therefore, this study did not provide the information necessary to evaluate project effects or to develop effective mitigation options.*	The measurement of microhabitat variables (velocity, substrate, depth, etc.) as a function of growth are not an objective of the FDA study. Other parameters are recorded as described in the field form (Figure 2.6.2-10 below).
USFWS_pp9.6-1_ph2	*First, AEA must describe the basic process of how the results of the study will be used to estimate Project effects on fish populations, and provide statements about what is an acceptable level of accuracy and precision. Second, data collected in all sampling activities need to be made accessible and fully documented. And third, the data should be appropriately summarized and interpreted and statistical methods used in this process should be fully documented.*	See Section 2.6.2.11.1 below regarding data availability and statistical approach.
USFWS_pp9.6-1_ph4	*Many study components of Study 9.6 remain incomplete or not attempted at all. These include a mark-recapture study to estimate rotary trap efficiency that was not conducted; association of movement patterns in relation to water conditions (discharge, temperature, and*	See Section 2.6.2.11.2 below regarding study progress.

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	turbidity) that was not summarized; diurnal behavior is poorly documented and only studies in the winter months of February, March, and April; accurate location of spawning grounds and capture of holding Humpback and Round Whitefish and Burbot to assess gonadal condition that was not done; and only opportunistic fish stranding and trapping data were collected and not analyzed.	
USFWS_pp9.6-2_ph2	*Modification 1: The efficiency of each sampling gear type should be evaluated and compared so counts among sampling methods can be made comparable, interactions between sampling methods can be understood, and future sampling activities can be made more efficient. If such comparisons prove to be difficult or highly variable, then sampling gear should limited to the most effective gear types and deployment of this gear remain consistent. The use of multiple sampling methods to measure fish abundance and distribution across a diversity of habitat types remains problematic. Different sampling gears have resulted in different, non-comparable measures of abundance. The effect of one sampling method on abundance estimates obtained in subsequent sampling activities is unknown. The same sampling gear-type is not used consistently (e.g. different electrofishing times or different densities of minnow traps). The use of block nets seems to be inconsistent. The generally accepted scientific practice is to apply consistent methods and effort among sampling units to properly compare relative abundance by species and age class among habitat classification types. Studies 9.5 and 9.6 have collected a vast amount of abundance data. USFWS recommends that these data be evaluated to identify the most efficient and repeatable sampling protocol and this protocol remain consistent for all abundance measurements.*	As explained below in Section 2.6.2.5.2, AEA requests that FERC not adopt these proposed Study Plan modifications. This precise nature of this modification if unclear. AEA has interpreted this as a desktop analysis of existing data and continuation of sampling with some undetermined method changes. Thus, AEA has estimated the cost of the desk top analysis at $75,000 and assumes no additional cost for the next year of study implementation.
USFWS_pp9.6-2_ph5	*Modification 2: Develop a complete operational plan for relative abundance sampling that adheres to the statistical methodology used to designate sampling sites and provides estimates with acceptable precision. Implement this plan with no variances. The number of sites sampled in 2013 was deemed to be inadequate, with a number of tributaries and Middle River mainstem sites being inaccessible or reclassified to other habitat types. In the Middle River, 162 of 207 sites were sampled. Off-channel sites were poorly sampled in the Lower River with only 4 side channel, 2 upland slough, and 3 side slough*	As explained below in Section 2.6.2.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing a new study for fish distribution and abundance with seasonal sampling at 207 locations is $4,800,000-$5,000,000 annually.

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	habitats sampled in 2013. Classification of habitat type and sample design was inconsistent between Middle and Lower River studies. The intention of the 2014 abundance and distribution sampling was to return to the unsampled 2013 sample sites and complete the first year of sampling for the Middle River. No abundance and distribution sampling was conducted in the Lower River.	
USFWS_pp9.6-2_ph7	*Although the data collected during Upper River abundance sampling activities are incomplete, ambiguous, and limited, they may provide a basis for designing a sampling program that would provide levels of precision necessary to achieve study objectives. Accurate and verified mapping of the Middle and Lower River drainages also provides another source of information that improves sample design over earlier study plans. In this planning process, USFWS recommends that main channel, split main, and multiple split macrohabitats be classified as a single main channel macrohabitat and tributary mouth sampling should be conducted as other macrohabitat sampling and not be limited to clearwater plumes.*	AEA disagrees that designing a new sampling program in the Upper River of Middle and Lower River is necessary.This comment from USFWS refers initially to data collection in the Upper River under Study 9.5. In 2013 AEA used a transect-based approach to sample the Upper River mainstem. Although the main channel habitat features were adequately represented by the transect approach, it resulted infew replicates of rare, off-channel habitat types. In 2014 AEA utilized available habitat mapping information and implemented a hybrid transect and GRTS sampling approach in the Upper River mainstem. AEA then evaluated the efficacy of the hybrid approach and recommended that this approach be continued for future studies. This approach for lumping of habitat types is consistent with the Services' recommendations to group main channel types (single, split, multi-split) into a single macrohabitat category and considers both tributary mouth and clearwater plume habitats as special habitat features selected using the GRTS approach similar to macrohabitat types. To date, tributary mouth and clearwater plume habitats have been classified and sampled as separate special habitat features (Level 4) consistent with the FDA IP and classification hierarchy established by Study 9.9, the Characterization and Mapping of Aquatic Habitats. This is consistent with the USFWS recommendation.
USFWS_pp9.6-3_ph1a	*Sampling should also occur at the mouths of side sloughs and upland sloughs. Classification of sloughs should be based on stream bank morphology and not clarity of water.*	See Section 2.6.2.4.1 and Section 2.6.2.4.5 below.
USFWS_pp9.6-3_ph1b	*Early life history sampling should be extended to sampling sites identified for summer and fall abundance and distribution sampling in the spring, immediately after ice breakup, to understand fish distribution during this potentially critical time of year (see Modification 3).*	AEA would like to clarify that the salmon ELH (ELH) sampling objective has an important distinction from the seasonal GRTS sampling for fish distribution and abundance. ELH involves non-random site selection with focused sampling effort at known spawning and rearing locations in select Focus Areas. This targeted effort allows for the collection of large numbers of salmon fry shortly after emergence and large numbers of parr and smolt phase juvenile salmon as they disperse

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		between habitats or begin outmigration. See response to USFWS_pp9.6-3_ph5 (Section 2.6.2.2.2) for a discussion on the timing of sampling.
USFWS_pp9.6-3_ph1c	*Scale aging for juvenile salmon is a proven method for allocating fish to different age groups and should be employed for these fish. Scale aging, fin ray aging, or other simple and non-destructive means to age other species of fish should be investigated.*	AEA agrees that scale aging is a reliable technique for allocating fish to age groups as demonstrated by Study 9.7, River Productivity. Under Objective 5 AEA is to document the seasonal age class structure, growth, and condition of juvenile anadromous and resident fish by habitat type. Because of the variability in growth rates within the Susitna basin and between habitat types; AEA proposed in the ISR Part D to use size (life stage) instead of age to characterize habitat association of juvenile salmonids and resident fish. AEA has documented at least two year classes of juvenile Chinook Salmon in the Upper River with fish reaching 114 mm in length. The bimodal length-frequency distribution of juvenile Chinook Salmon collected in 2013 and 2014 suggests that two age classes may be present, i.e., a portion of 2013 year class out-migrated in 2013 while other parr reared in the Upper River over the 2013-14 winter and out-migrated as larger 1+ fish. It is not clear how the additional information on fish age would be used as opposed to length or smoltifcation index as currently proposed. If deemed appropriate to collect scales from juvenile Chinook Salmon in the Middle and Lower River for aging purposes, a subsampling approach should be employed specifically targeted at the size range of specimens of interest.
USFWS_pp9.6-3_ph1d	*Fish should be weighed to the nearest 0.1 gm and lengths measured for all captured fish.*	In the ISR Part D, AEA proposed to continue to measure the length and weight of a represented subsample of 25 individuals per species, per life stage. Weighing and measuring a subsample of fish reduces excessive holding time and stress and is practical when large numbers of juvenile fish are collected. Collecting lengths on all fish collected is time prohibitive and would result in high mortality with large numbers of fish are caught , held, and handled. Weighing and measuring a subsample of fish is a standard practice in fisheries science. To date AEA has weighed small fish up to 200 grams to the nearest 0.1 grams using digital scales and to the nearest 1 gram for larger fish using spring scales. In most cases, weights are taken with calibrated digital scales to the nearest 0.1 grams. Lengths and weights were collected from 14,922 individuals in the Middle and Lower River in 2013 and 11,448 individuals in 2014 (ISR Part A, Table 4.8-2; SIR, Table 4.7-2).

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		AEA believes the subsampling approach is providing sufficient and representative documentation of fish size consistent with generally accepted scientific practices.
USFWS_pp9.6-3_ph3	*Modification 3: Continue the development of a complete and rigorous early life history sampling program that better integrates the intergravel monitoring component of the early life history studies. This sampling program should also be integrated with the distribution and abundance (FDA) sampling program to provide an understanding of the early spring distribution of fish species and life stages. Include a modification to species identification that better identifies and estimates the salmon species composition of emergent and rearing juvenile salmon (see Modification 4). Sampling was conducted before ice breakup and in early and late June in 2013 and in three sampling periods from May 19 through June 25 in 2014. About two thousand juvenile salmon were counted in 2013 and over 18,000 juvenile salmon counted in 2014. The Intergravel Monitoring component of the Early Life History studies was not incorporated into emergence and migration of juvenile salmon. In fact, it appears that the winter intergravel monitoring in spring of 2013 was terminated in April, 2013, just prior to the ELH sampling in May and June. Intergravel monitoring in 2014 seemed to be directed more towards fish distribution in the winter studies, not emergence of salmon in April and May. Because sampling was limited to select sites, these sites were located only in the Middle River in 2014, transect lengths were smaller than abundance and distribution sampling, and sampling gear was limited to fyke nets, early life history samples are not comparable to the more extensive summer and fall sampling of both mainstem and tributary habitats. The overwintering distribution and movements between tributary and mainstem habitats remains poorly understood.*	See response above to NMFS_pp9.6-25_ph2, (NMFS Modification 24) and as explained below in Section 2.6.2.2.1, AEA requests that FERC not adopt this proposed Study Plan modification. This modification request would require the design and implementation of an emergence studies program at ten Focus Areas. This would require monitoring of spawning locations and repeated visits to sample or check emergence traps. The estimated cost of implementing this modification is $1,200,000 to $3,500,000 annually depending on the number of sites.
USFWS_pp9.6-3_ph5	*(Modification 3 Continued) A spring sampling program that is comparable to the summer and fall sampling program should be considered in the operational planning of a relative abundance sampling program (Modification 2). The 2014 early life history sampling in the Middle River proved to be very systematic and effective, capturing over 18,000 juvenile salmon (SIR 9.6 2015). The design of this sampling program could provide a good model for extending early life history sampling to Lower River sites.*	See Section 2.6.2.3.3 below.

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USFWS_pp9.6-4_ph2	*Modification 4: Develop a protocol for accurately and correctly identifying all juvenile salmon to species. If numbers of individual fish preclude genetically identifying each specimen, then implement a sampling program that provides acceptable estimates of species composition of samples. Accuracy in species identification needs to be improved. In 2013, 28% of Coho Salmon were misidentified as Chinook Salmon (SIR 9.6, 2015). Based on length frequencies of juveniles identified as Chinook Salmon, this level of misidentification may be much greater. Species misidentified also occurred between other species of salmon. Modification in species identification protocol in 2014 substantially improved identification of Chinook and Coho salmon in FDA samples. However, over 80% of the salmon captured in Early Life History studies were designated as mixed Chum/Sockeye salmon or as mixed salmon. High or unknown error rates in identifying salmon to species or allocating a group of juvenile salmon to a mixed species category is unacceptable. Genetic identification should be conducted on as many individuals as possible to estimate rates of misidentification for all species of juvenile salmon. Subsampling early life history catches would provide a more specific species allocation of catches. Mixed-species designation drastically limits any potential usefulness of the resulting data, and should be avoided.*	As explained below in Section 2.6.2.1.1, AEA requests that FERC not adopt this proposed Study Plan modification As AEA has proposed a modification similar to this, there would be no additional cost for this modification.
USFWS_pp9.6-4_ph5	*Modification 5: Continue and expand downstream migrant trap operations for two years. Evaluate the ability of these traps to describe the timing of fish migrating past these sites. Rotary screw traps were operated at four sites in 2013 and no traps were operated in the Middle and Lower River in 2014. The four traps were more successful in capturing downstream migrating fish than Upper River traps, especially for juvenile salmon. The traps average annual catch was 2,884 fish, of which 66% were juvenile salmon. Problems did occur with debris loads and flood events, resulting in several sampling periods where traps were not operational. Juvenile salmon were caught immediately on installation of all four traps, indicating that downstream migration of juveniles was already underway in mid-June, and timing statistics do not include early downstream migrants. The rotary screw traps in the Middle River did perform well in documenting the downstream migration of fish in summer and fall. Understanding the magnitude and timing of downstream migration from tributaries to mainstem habitats and from in-river to marine environments is*	As explained below in Section 2.6.2.7.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of this modification is $700,000 per trap per year for $2,800,000 total.

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	important for assessing potential Project related impacts. Modifications to trap operations which could improve trap performance include expanding operations to seven days a week, assessing the efficiency of traps, beginning trap operations earlier in the season, relocating traps to waters more favorable to trap operations, and the use of alternative capture methods.	
USFWS_pp9.6-4_ph8	*Modification 6: Evaluate the effectiveness and value of the PIT tagging program. The value of the 2013 and 2014 PIT tagging and detection program to describe fish movements is questionable. PIT array antennas were not installed in sequential spatial intervals at antenna sites, eliminating the ability to both discriminate upstream or downstream movement and assess the detection efficiency. Very small numbers of tagged fish were captured outside the areas where they were tagged. Interpretation of results from the few fish that are recaptured are problematic since tagging effort is not representatively distributed over habitat types or behavior characteristics. A detailed evaluation of the results of PIT tagging activities and discussion among involved researchers may provide insights into ways to improve and expand the existing sampling and tagging program, to redirect tagging objective to more attainable results (e.g., intensive study of a limited section of river), or to abandon the PIT tagging program and direct resources to other sampling activities.*	As explained below in Section 2.6.2.6.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming that planning efforts take approximately $60,000 and potential expansion of the PIT tagging program includes expansion of sampling or monitoring efforts, the estimated cost of implementing this modification is $300,000-$1,000,000.
USFWS_pp9.6-5_ph3	*Modification 7: Continue the planning and implementation of radio-tagging studies. Evaluate results from the two years of tagging and almost three years of locating tagged fish and assess if tagging goals are appropriate and achieve stated objectives. Conduct targeted searches to identify specific holding or spawning locations. Radio-tagging provided a good description of fish movements for the few fish that did survive. However, the study is very much crippled by the variances. . . . Future radio-tagging activities need to include precise location and identification of habitat associated with holding and spawning activities. Radio-tagging efforts should be allocated proportionally throughout the Susitna River drainage to study the movements of all populations of resident fish.*	AEA does not object to FERC adopting this proposed Study Plan modification. This modification appears to be consistent with the FERC approved Study Pan so no cost was estimated. See Section 2.6.2.8.1 for additional discussion of radio tagging.
USFWS_pp9.6-6_ph1	*Modification 8: Develop an operational plan for winter sampling that increases the geographic range and diversity of habitats sampled and includes measuring physical attributes of the sites. The ad hoc*	As explained below in Section 2.6.2.11.3, AEA requests that FERC not adopt this proposed Study Plan modification.

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	selection of sample site during winter sampling (e.g., selecting open water areas) and the small range in sampled area of the river (37 river miles of Middle River habitat, compared to 200 total river miles) limits the ability to make interpretations of or draw conclusions from winter sampling results. For example, warmer water may create open leads which are easier to sample, and may also be more attractive to juvenile salmonids. The use of video for sampling should be limited or paired with other sampling methods since 85% of observed fish were either undifferentiated salmon or unidentified species. Four species of emergent fry salmon were captured in the March and April of 2014 sampling periods, but no Pink Salmon were recovered in any winter samples. Juvenile Pink Salmon were also scarce in 2013 samples. Pink Salmon fry were found in 2014 Early Life History studies. The scarcity of Pink Salmon fry in many of the samples should be of concern and a subject for directed sampling efforts.	In their study modification request, USFWS did not provide specifics on the scope of geographic range or habitats to be sampled during the winter, making costing difficult. Assuming that 200 river miles need to be sampled with a level of effort similar to the open-water period, the estimated cost of implementing this modification is $3,600,000-$4,000,000 annually.
USFWS_pp9.6-6_ph3	*Modification 9: Develop a more complete sampling and radio-tagging program for Northern Pike populations. Tagging of Northern Pike was limited to 5 radio-tags being applied in the same general location (Yentna-Deshka zone). Four of these tags were still active in 2014 and two still active in 2015. There was no focused effort to census waters outside of the abundance and distribution study area or to present results other than to state that the radio-tagged fish remained within one river mile of the tagging location in 2013. Far more effort and resources need to be allocated to this part of the study in order to meet the objective. The sampling plan should identify sampling locations and methods that can target Northern Pike populations. Radio-tagging goals need to be developed that adequately describe the movement of these fish. Studies from the Sport Fish Division of Alaska Department of Fish and Game and possibly other agencies should be referenced to obtain a better understanding of the abundance, distribution, and movement of this fish species.*	As explained below in Section 2.6.2.8.2, AEA requests that FERC not adopt this proposed Study Plan modification. The request for radio-tagging additional Northern Pike does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification. Assuming that 30 days of directed sampling are allocated to a Northern Pike sampling program and an increased in data management and reporting, the estimated cost of implementing this modification is $250,000-$300,000 annually.
USFWS_pp9.6-6_ph6	*In summary, an ambitious set of objectives and accompanying studies were proposed in support of Studies 9.6 generating vast amounts of data, which are extensive in both quantity and complexity. Very little data have undergone analysis and none of the study objectives have been completed. Some elements of these studies remain incomplete, due to sampling goals not being met or some studies simply not being*	AEA disagrees with the licensing participant's characterization that the level of preliminary analysis and reporting of data collected is insufficient for demonstrating progress towards meeting study objectives. Furthermore, AEA has made data collected publically available for review at: http://gis.suhydro.org/isr/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/.

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	conducted. Other studies proved to be impractical or inconclusive and require reevaluation of study feasibility (PIT tagging and Northern Pike studies). However these data, when analyses are completed, can provide a resource for determining what is feasible, determining the expected levels of accuracy in future sampling, and determining optimum allocation of sampling effort for future studies.	An immense amount of data has been collected to date by various study components under Study 9.6; initial reporting and analysis has focused on the efficacy of the sampling techniques and the level of sampling effort necessary to characterize fish distribution, abundance, and habitat associations in the Middle and Lower River. Ongoing data analysis and pilot testing of sampling approaches to improve the study and develop recommendations for further studies have been reported in series of TMs including: *2013-2014 Winter Fish Study Technical Memorandum* (Study 9.6 TM, September 14, 2014), *Protocol for Site-Specific Gear Type Selection; Version 5* (FDA IP, Appendix 3, November 14, 2014), the *Draft Chinook and Coho Salmon Identification Protocol (Study 9.5 and 9.6 TM, November 26, 2014)*, the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7), and the *2013-2015 Radiotelemetry Implementation Report* (Attachment 8). Some study components that require tissue collection and laboratory analysis are ongoing and will require a second year of study to complete. The collection of these specimens will be aided by the knowledge acquired during the first year of data collection. The Susitna River is one of, if not the most thoroughly studied and well documented glacial river systems in the world. With the modifications proposed and steps to complete Study 9.6 outlined in the ISR Part D, AEA asserts that one additional year of data collection will provide the necessary information for baseline characterization of fish resources to support impact analysis in a License Application

2.6.2.1. Responses to Comments Regarding Species Identification

2.6.2.1.1. Response to Modification Request Pertaining to the Accuracy of Species Identification

NMFS asserts that a large number of juvenile salmon were speciated, and data presented within the ISR and to the Technical Workgroup supports the conclusion that juvenile Chinook, Coho, and Sockeye Salmon were misidentified (NMFS_pp9.6-5_ph4b; NMFS_pp9.6-5_ph1).

USFWS requests (USFWS_pp9.6-4_ph2, Modification 4) that AEA develop a protocol for accurately and correctly identifying all juvenile salmon to species. USFWS states that if numbers of individual fish preclude genetically identifying each specimen, then AEA should implement a sampling program that provides acceptable estimates of species composition of samples.

USFWS also states (USFWS_pp9.6-4_ph2, Modification 4) that genetic identification should be conducted on as many individuals as possible to estimate rates of misidentification for all species of juvenile salmon, and that subsampling ELH catches would provide a more specific species allocation of catches. USFWS asserts that mixed-species designation drastically limits any potential usefulness of the resulting data, and should be avoided.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

During the 2013 study year of the Susitna-Watana Hydro Fish Distribution and Abundance Studies, sampling occurred along over 200 miles of the Susitna River including many salmon-bearing tributaries. As in other larger glacial river systems in Alaska, Chinook and Coho salmon in the Susitna River exhibit a wide variety of phenotypic variation and can appear very different among reaches, rearing habitats (e.g., turbid mainstem vs. tannic upland slough), and stages of smoltification. There is little data available regarding the accuracy of field identification of juvenile salmonids as most field biologists do not collect voucher specimen or samples with which they could verify field identifications and/or estimate a rate of error associated with their field identification, yet differentiating between these two species in some Alaska rivers can be challenging. This issue has been noted both historically in the Taku River (Meehan and Vania 1961) and, more recently, in the Copper River (Phil Joy, ADF&G, personal communication, October, 2014) and in the Susitna River where genetic verification documented that AEA field crews, including some Chinook salmon experts, incorrectly identified Coho Salmon when collecting Chinook Salmon genetic samples in 2013.

In light of this, AEA proposed measures to improve field identification and estimate the species identification accuracy rate for juvenile salmon (Study 9.5 and 9.6 TM, November 26, 2014: *Draft Chinook and Coho Salmon Identification Protocol*). Some measures included in the plan were implemented in the 2014 field season including: expanded field training in difficult habitats, the collection of voucher specimens for meristic analysis, quality control of photographs of field specimens, and genetic verification (SIR, Appendix B: *Juvenile Chinook and Coho Salmon Identification Accuracy*). The protocol also includes the development of a Susitna River specific identification guide to juvenile salmonids to be prepared prior to the next study year. AEA anticipates by implementing the full protocol identification, accuracy will be improved for all juvenile salmon species and quantified for Chinook and Coho salmon.

As reported in the SIR, during ELH sampling, large pulses of newly emerged salmon fry were frequently collected during sampling in particular with fyke nets. In 2014, in order to manage large volumes of fish while minimizing impacts and returning them to the stream in a safe and timely manner, Chum and Sockeye salmon fry were grouped together. To differentiate between the emergent fry and early parr of these two species in the field when they co-occurred would have required holding these fragile life stages in buckets for extended periods while handling every fish and it is unnecessary to document habitats protective of ELH stages of salmon. In addition to the large pulses of newly emerged fry resulting in nearly 10,000 mixed group Chum/Sockeye salmon, 5,400 new emerged salmon fry were documented visually during ELH sampling (VOG, visual on ground). The individuals were not collected or handled but are listed as incidental observation, contributing the large number of mixed grouped salmon. The mixed grouping of Chum-Sockeye was reported as a variance in the SIR, Section 4.5.5, because it did not follow the FDA IP protocol for fish handling and documentation in an effort to minimize the mortality of large numbers of fish.

2.6.2.1.2. Response to Modification Request for Collection of Genetic Tissue Samples in One out of Ten Fish for Species Identification

NMFS recommends a study modification (Modification 9) for tissue samples (belly swab with qtips) for genetic analyses be collected from 1 in 10 juvenile salmon to confirm species identification, pre-season field crew training in fish identification regarding juvenile salmon identification (NMFS_pp9.6-11_ph4).

AEA requests FERC not adopt this proposed Study Plan modification as AEA has proposed a protocol to improve and quantify the accuracy of species identification for juvenile Chinook and Coho salmon (Study 9.5 and 9.6 TM, November 26, 2014: *Draft Chinook and Coho Salmon Identification Protocol*). The protocol specifies the recommendations made by NMFS: increased field training of Project staff at various macrohabitat locations including those areas identified as difficult to discern between the two species. The protocol also includes the collection of genetic samples for verification, vouchers specimens for training and meristics, and photograph quality control. A power analysis will be completed with available data prior to the next study season to estimate the appropriate sample size for genetic samples collected with the omni-swab technique. This is a more rigorous approach than sampling 1 in 10 individuals for genetic analysis. AEA does not propose to collect additional genetic samples from other juvenile salmon species.

2.6.2.1.3. Response to Modification Request for Juvenile Salmon Identification

NMFS recommends a study modification (Modification 14) to require juvenile salmon be identified to species (NMFS_pp9.6-16_ph3). NMFS states that individual species data should not be pooled with data from other species. In extreme circumstances of large sample size (> ~500 of Sockeye and Chum are captured in a single fyke net or in an hour of screw trap operation), a minimum of 100 individuals or 25 percent of the total catch should be subsampled. NMFS asserts that Chinook Salmon are limited in their distribution and habitat requirements relative to Coho

Salmon, and determining the distribution and habitat requirements of juvenile salmon species are needed to describe the current environment and for evaluating potential Project effects.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

Fish collected under studies 9.5 and 9.6 are identified to the lowest possible taxonomic level in the field. Some techniques are observational including snorkeling, underwater video, sonar, and incidental visual observations from the ground (VOG), boat (VOB), or helicopter/air (VOH). Observational techniques tend to have a higher degree of uncertainty and higher proportion of individuals assigned to higher taxa groupings. In rare circumstances such as large catches of fragile fry, fish were quickly assigned to lower possible taxa grouping and released to minimize mortality. This was reported as a variance (ISR Part D, Section 6.2). For 2013 ELH and FDA sampling downstream of Devils Canyon, because of some degree of uncertainty with field identification of Chinook Salmon, some individuals were assigned to a combined Chinook/Coho salmon taxa grouping. A protocol to improve speciation between these two species has been proposed (Study 9.5 and 9.6 TM, November 26, 2014: *Draft Chinook and Coho Salmon Identification Protocol*) and partially implemented in 2014 (Study 9.6 SIR, Appendix B: *Juvenile Chinook and Coho Salmon Identification Accuracy*) demonstrating it was successful. Following the protocol, if a large catch of salmon fry occurs and cannot be easily and quickly differentiated, representative vouchers specimens of undifferentiated individuals may be collected for meristics and photographs taken and reviewed by senior staff. AEA has reported a variance associated identifying fish to the lowest possible taxonomic level and has proposed reasonable measures to improve species identification in the field for the next year of study. AEA does not believe that the combined taxa groupings from 2013 or 2014 produce an inability to meet study objectives or conduct impact analysis.

2.6.2.1.4. Response to Comments Regarding AEA’s Genetic Species Verification Analysis.

NMFS states (NMFS-pp9.6-16_ph4) that the juvenile salmon species error reported by AEA based on genetic analyses is an underestimate (SIR). According to NMFS, genetic samples were not collected randomly from all juvenile Chinook and Coho Salmon and likely are biased based on the confidence of field personnel. NMFS states that AEA reports that 28 percent of the juvenile salmon identified as Chinook were Coho Salmon in 2013 for all studies, locations, and sampling dates. According to NMFS, when they evaluated the size distribution of age-0 Chinook Salmon from AEA Middle River samples, error for Chinook Salmon was estimated at over 50 percent. NMFS states that AEA’s SIR shows the size distribution of Susitna River Chinook Salmon that were identified genetically.

NMFS asserts that this is inconsistent with the size distribution of Chinook Salmon captured by the Aquatic Restoration and Research Institute (ARRI) (see Figure 2.6.2-1) and by ADF&G in the 1980s, with 99 percent of age-0 Chinook less than 100mm in fork length. NMFS comments that well over 50 percent of the fish reported by AEA as Chinook Salmon collected in the Middle River in 2013 are over 100 mm in fork length and are therefore, more likely to be age-2 Coho Salmon.

NMFS also comments (NMFS_pp9.6-40_ph2) that fork length data for fish identified as Chinook salmon are too large for a fish species that spend one year in fresh water and are inconsistent with juvenile Chinook lengths measured in other studies in the Susitna River and other nearby locations.

NMFS also comments that the size distribution of Chinook salmon during the one year in freshwater are available from multiple sources. NMFS states that previous studies conducted by ADF&G (1983) in the Susitna River document a mean fork length range from ~ 50 to 70 mm (NMFS_pp9.6-40_ph4), and that during June and July, some age-1 Chinook are present with longer fork lengths, with a maximum of 125 reported by ADF&G. NMFS notes that Kirsch et al. (2014) also found the mean fork length of Chinook salmon to range between 50 and 60 mm. NMFS comments that the size distribution of Chinook salmon within the Susitna River collected by ARRI as part of a study supported by the NMFS from October 2013 to February 2014 (Davis et al. 2013) is consistent with these values. NMFS comments that this size range is also consistent with the fork lengths obtained from over 7,000 Chinook salmon captured by ARRI within the Susitna River drainage from 2007 through 2013 (see Figure 2.6.2-1).

In response to these comments, AEA has recognized that higher than desirable error rates occurred in 2013 and appreciates the comment from NMFS regarding fish identification. The 72 percent accuracy rate reported by AEA for 2013 was for the entire study area. Accuracy by geomorphic reach is reported in the SIR (Table B-3 in Appendix B: *Juvenile Chinook and Coho Salmon Identification Accuracy*) and ranged from 33 percent to 100 percent; however, samples sizes are low for some reaches. Overall, accuracy of Chinook Salmon identification for the Middle/Lower River downstream of Devils Canyon 2013-2014 was estimated at 72 percent.

AEA disagrees that field identification error rates reported in the SIR (Appendix B) are a gross underestimate. In many instances, field staff collected genetic samples from specimens they (made a species determination on the field but) found challenging to identify in the field, which would lead to an overestimate of error. While genetic samples were not collected randomly, they are fairly representative and were collected from 66 locations for Study 9.6.

NMFS comments on species identification accuracy are based on length-frequency comparisons with a synoptic data collection using only minnow traps. NMFS states that the size distribution of Chinook Salmon identified genetically (Figure B-4 in SIR, Appendix B and Figure 2.6.2-2 below) is similar to fish collection by ARRI (Figure 2.6.2-1).

AEA disagrees with this characterization. AEA has identified discrepancies between ARRI's size distribution and that of genetically confirmed Chinook Salmon from fish distribution and abundance studies. The restricted size distribution of Chinook Salmon in ARRI's data may be due to size selectivity associated with minnow trapping or species identification errors. ARRI's data set does not contain any Chinook Salmon over 100 mm in length and very few fish over 80 mm. Similarly, ARRI's data do not contain juvenile Chinook Salmon less than 50 mm fork length. In the AEA data set of genetically verified Chinook Salmon, over 5 percent of genetically verified Chinook Salmon were $\geq$100 mm fork length with fish up to 174 mm fork length documented. In the AEA genetically confirmed Chinook Salmon dataset, 6 percent of the samples are from fish 50 mm fork length or smaller.

Comparison of juvenile Chinook Salmon sizes among sampling gears using AEA's dataset demonstrates the size selectivity of various gear types (Figure 2.6.2-3). Minnow trapping is size selective for Chinook Salmon 50-80 mm fork length and collects both fewer small and fewer large juvenile Chinook Salmon than other methods. Because of the gear bias introduced with only using a single gear, it is not appropriate to make comparisons between the datasets as a whole and make generalized statements about "error" rates. Fyke netting and rotary screw traps tend to catch larger juvenile Chinook Salmon than minnow trapping, while electrofishing and seining are better techniques for collection fish less than 50 mm fork length (Figure 2.6.2-3). This illustrates the advantage of using a diverse sampling approach with multiple gear types to characterize all phases (fry, parr, and smolt) and ages of juvenile Chinook Salmon life history.

It is more appropriate to compare only Chinook Salmon captured using minnow traps in both datasets. The highest proportion of juvenile Chinook Salmon were between 55-75 mm in both data sets. However, AEA still captured both smaller and larger genetically verified Chinook Salmon in minnow traps. Approximately 3 percent of Chinook Salmon in the AEA data set are smaller than those collected by ARRI (less than 50 mm) and six percent are larger (>100 mm). The smaller individuals collected by AEA may be attributable to the fine mesh fabric minnow traps used by AEA during salmon ELH sampling. The differences in larger individuals among the data sets, is unknown but could reflect a species identification bias if ARRI used size and/or habitat to identifying larger juveniles. AEA genetic analysis of juvenile Coho and Chinook salmon has confirmed that juveniles of both species rearing in freshwater to sizes greater than 100mm but also that they may occupy similar habitats (Table B-5 in SIR, Appendix B).

Additionally, it is important to note that AEA's data on the size (and age) distribution of juvenile Chinook Salmon is consistent with data collected from Alaska's commercial fishery (Tobias and Willette 2010 and from trawl surveys conducted near the mouth of the Susitna River (Moulton 1997). This scale analysis of Susitna River adult Chinook Salmon captured in the commercial fishery has identified a two-year freshwater life history for this population as well as other from Cook Inlet rivers. The proportion of juvenile Chinook rearing two years in freshwater is variable annually but averages somewhere between 2-5 percent. Of 2,608 Chinook Salmon examined for freshwater residency in the Northern District, General Sub-district of Cook Inlet, (1983-1991) primarily consisting of Susitna River origin fish, 0-3.9 percent of fish had two years of freshwater residency (Tobias and Willette 2010). Of 1,527 Chinook Salmon examined from the Northern District, Eastern Sub-district of Cook Inlet (1986-1991) also primarily consisting of Susitna River origin fish, an annual average of 2.7 percent (range 0-6.7 percent) of fish had two years of freshwater residency (Tobias and Willette 2010). Of 17,018 Chinook Salmon examined from the Northern District, Upper Sub-district of Cook Inlet, 1986-1991, primarily consisting of Kenai River origin fish, an average of 1.5 percent (range 0-3.4 percent) of fish had two years of freshwater residency (Tobias and Willette 2010).

Similar to the fishery data are the results of the scale analysis of genetically verified Chinook Salmon from the Susitna River Productivity Study (Figure 2.6.2-4) and analysis of 206 juvenile Chinook Salmon collected in near-shore surface trawls in Cook Inlet near the mouth of the Susitna River, as well as other studies of downstream migrants throughout Cook Inlet. Moulton (1997) found 6.8 percent 2 years old; average length of age-2 fish was 93.3 mm (range 80-109 mm and average length of age-1 fish was 81.4 mm (range from 56-115 mm). During a downstream migrant study in which 56 scale samples were analyzed from the Anchor River, 5.4 percent of Chinook

Salmon were age 2 (110-115 mm range), Chinook Salmon up to 155mm were collected but not aged (Anderson 2011). Similar to AEA's observations on the Susitna, Nemeth et al. 2009 used minnow traps, rotary screw traps, fyke nets, video, and weirs to collect 3,237 juvenile Chinook Salmon in the Chuit River (Upper Cook Inlet) ranging in size from 31-231 mm fork length and juveniles with two years of freshwater residency in the 100-140 mm size range are evident (Figure 2.6.2-5).

During 2013-2014 licensing efforts, 742 samples of genetically confirmed juvenile Chinook Salmon with length measurements recorded were collected ranging from 37-174 mm in length. The mean fork length of genetically confirmed Chinook Salmon was 71.7 mm and mean fork of all juvenile Chinook Salmon in the updated database is 61.3 mm (http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/). Consistent with other studies, 8.3 percent of fish genetically identified Chinook Salmon were larger than 93 mm, and 2.9 percent were larger than 110 mm (Figure 2.6.2-1). In summary, AEA's Chinook Salmon length-frequency data set (including the SIR database updated with genetics results) and documentation of a two-year freshwater life history for around five percent of juvenile Chinook Salmon is consistent with the literature we reviewed, but inconsistent with ARRI's minnow trapping data set. Because our data set is supported with genetics and similar to other research using multiple gear types on Cook Inlet Rivers, AEA maintains that NMFS's comment mischaracterizes the quality of the data.

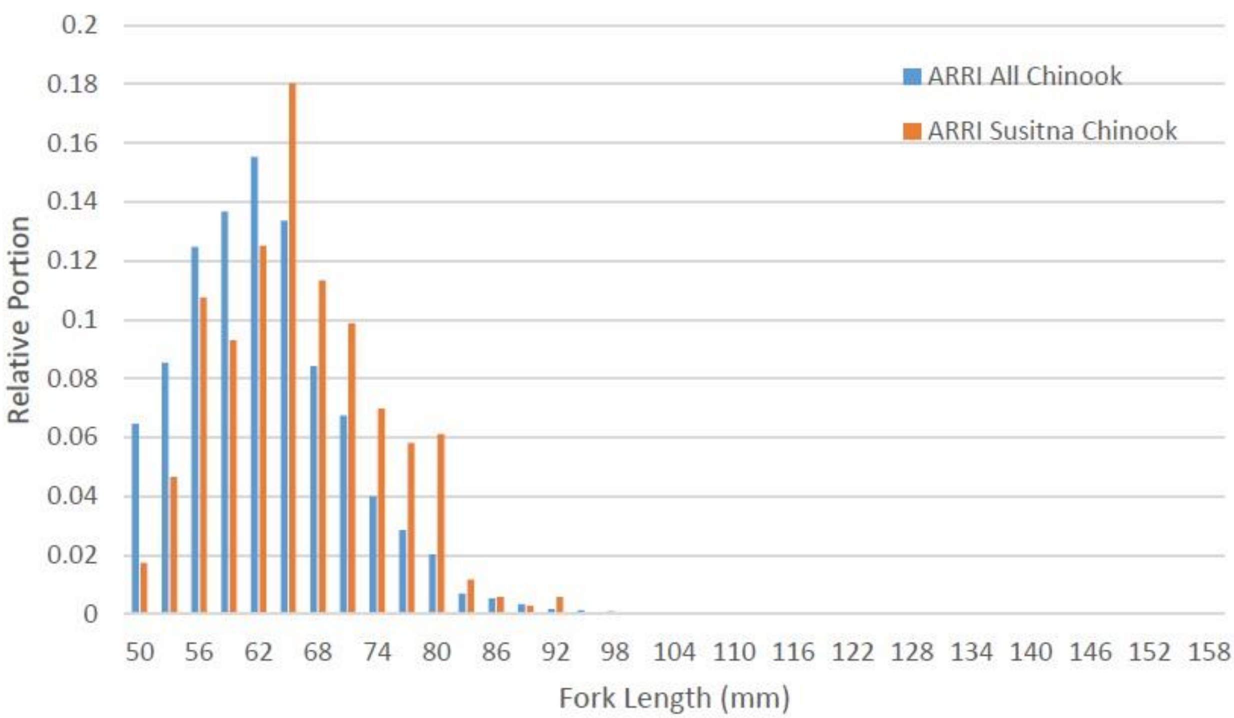


Figure 2.6.2-1. Aquatic Restoration & Research Institute (ARRI) Middle Susitna River Chinook Salmon lengths from NMFS June 22, 2016 ISR Comments, Figure B3 in Appendix B.

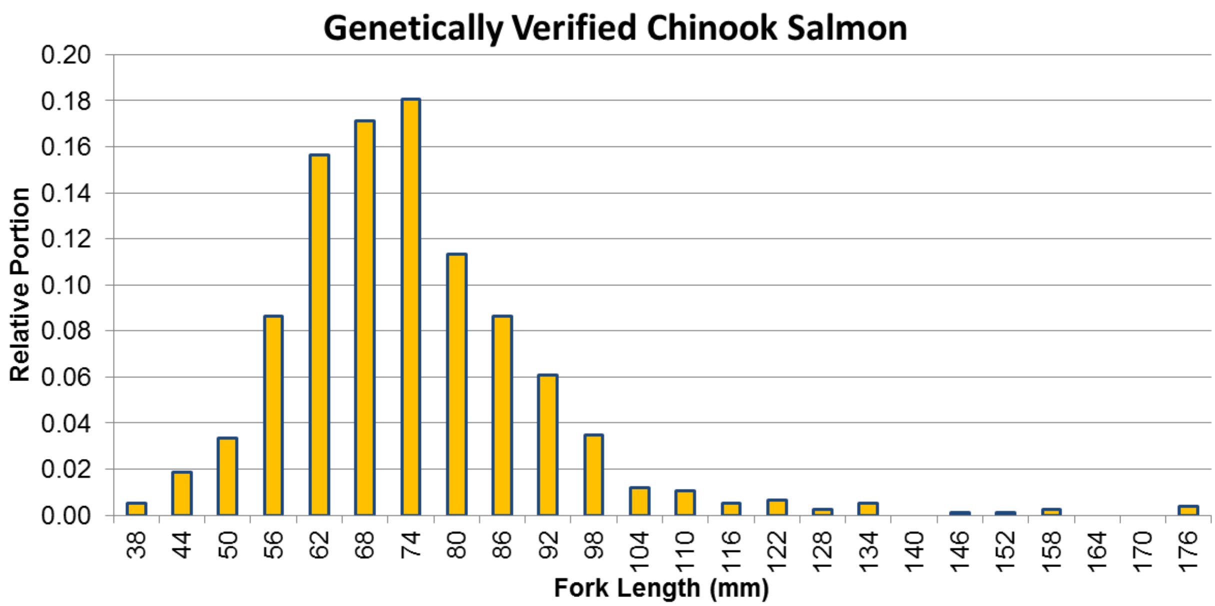
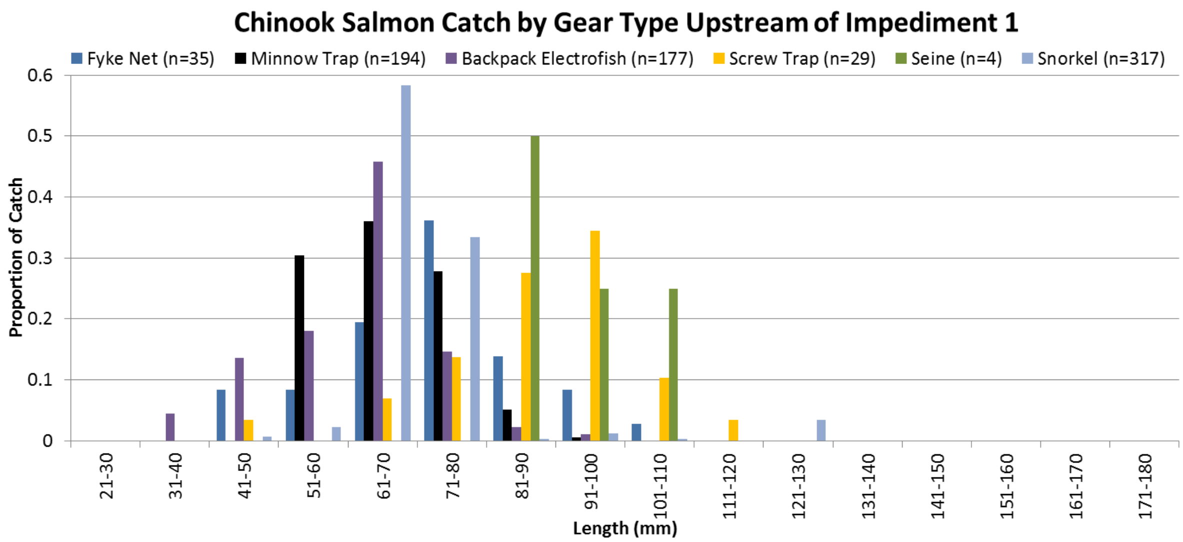


Figure 2.6.2-2. Genetically verified Chinook Salmon from the Susitna River (n=742) collected using multiple gear types, AEA 2013-2014.



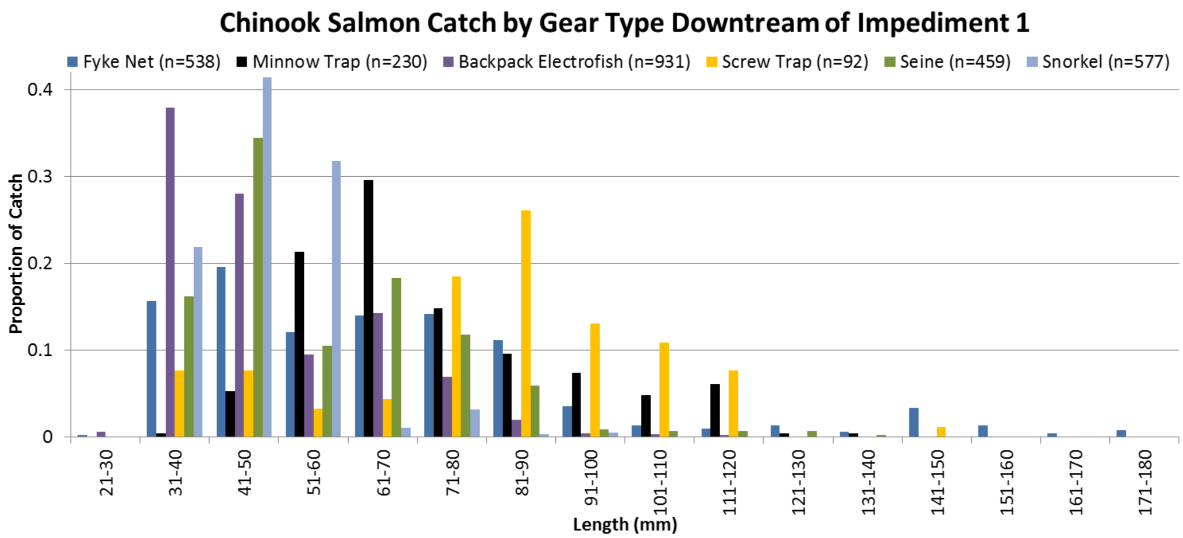


Figure 2.6.2-3. Size-selectivity of juvenile Chinook Salmon upstream and downstream of impediment 1 for various gear types, downstream of impediment 1, lengths are from genetically confirmed fish and 2014 sampling with a 97 percent field identification accuracy rate.

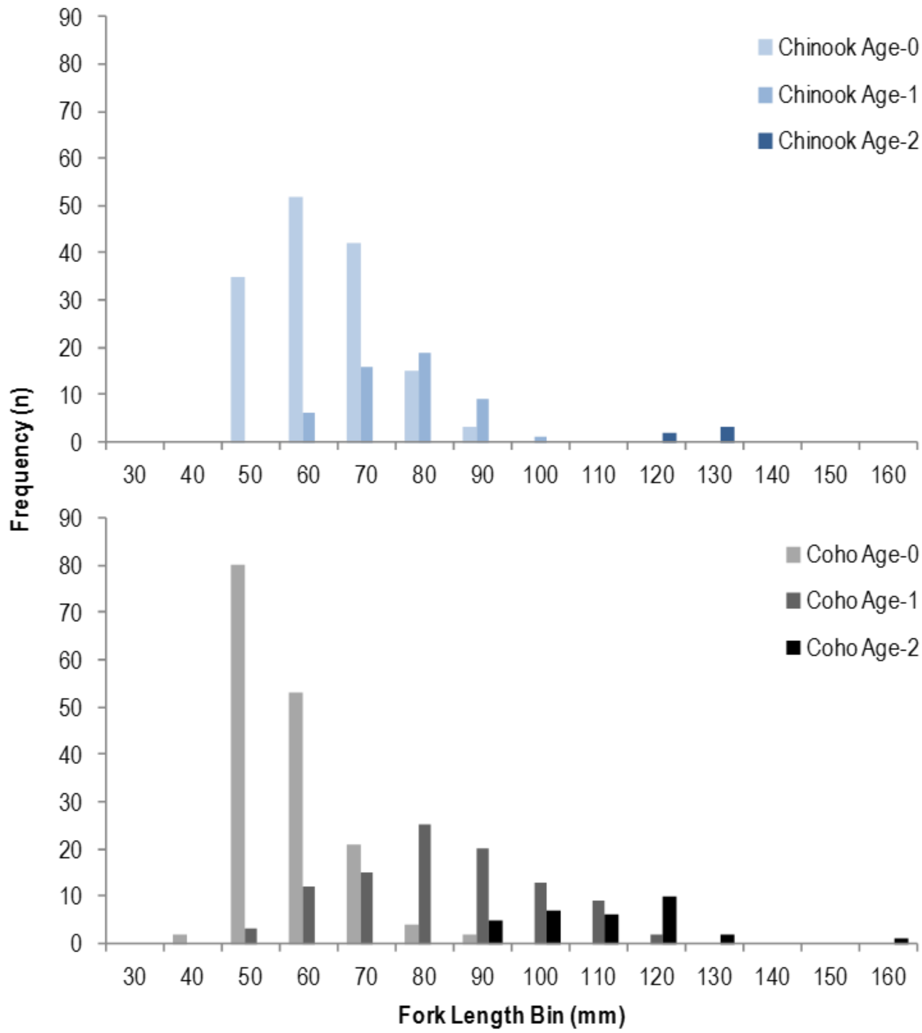


Figure 2.6.2-4. Age at length of genetically-verified Chinook and Coho salmon based on scale analysis (Data Source: Study 9.8 SIR; Figure 5.4-5 and Figure 5.4-6).

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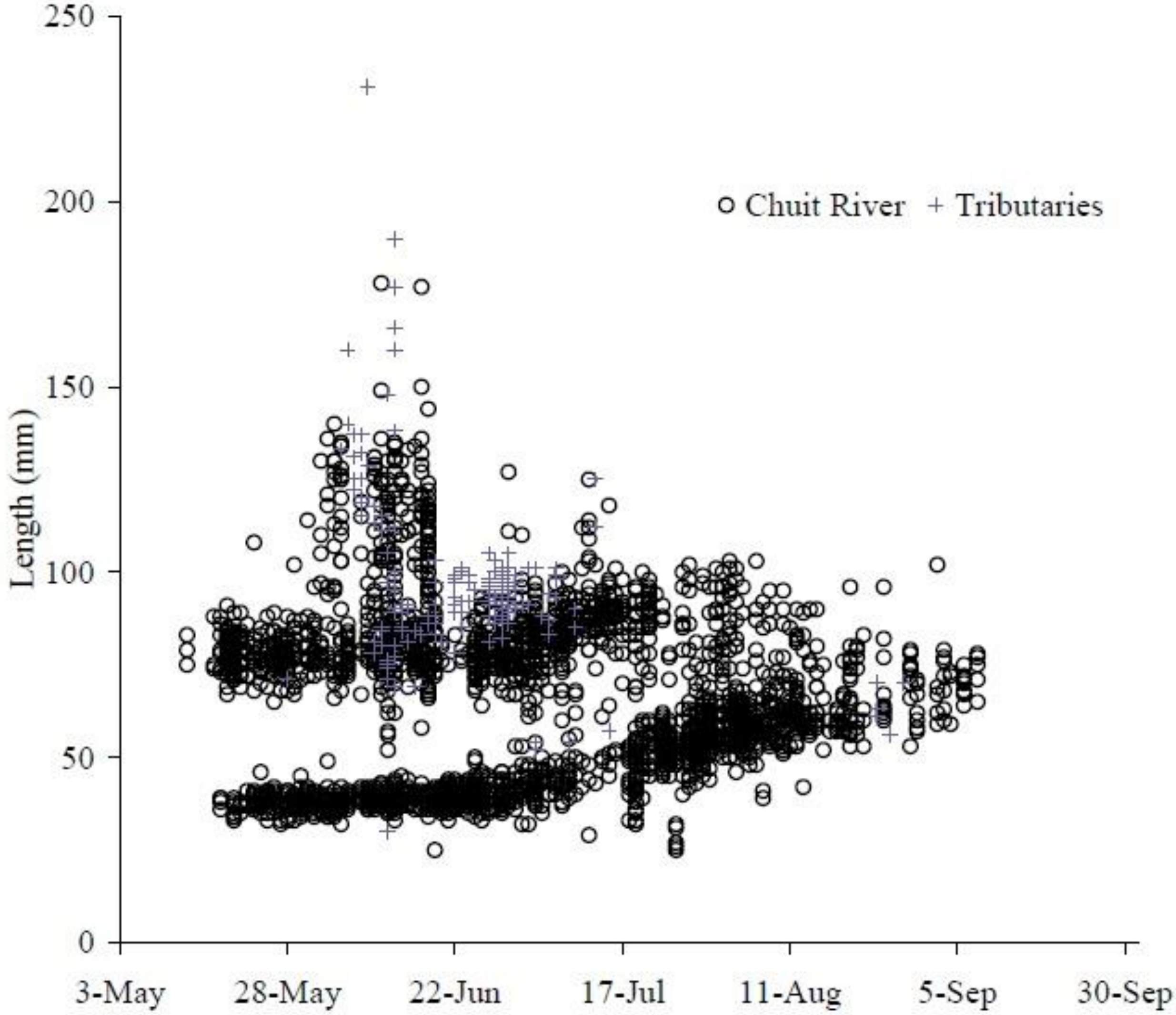

Figure 2.6.2-5. Juvenile Chinook Salmon lengths (fork length) by date observed, Chuit River. Data are from minnow traps, fyke nets, rotary screw traps and weirs. Figure adapted from Nemeth et al. 2009.

2.6.2.2. Responses to Comments Regarding Increased Sampling Efforts in the Middle River

2.6.2.2.1. Response to Modification Request to Integrate Intergravel Monitoring with Early Spring Fish Sampling Efforts

USFWS requests (USFWS_pp9.6-3_ph3, Modification 3) that AEA continue the development of a complete and rigorous ELH sampling program that better integrates the intergravel monitoring component of the ELH studies. USFWS states that the intergravel monitoring sampling program should also be integrated with the FDA sampling program to provide an understanding of the early spring distribution of fish species and life stages.

In support of this modification, USFWS comments that sampling was conducted before ice breakup and in early and late June in 2013 and in three sampling periods from May 19 through June 25 in 2014; about two thousand juvenile salmon were counted in 2013 and over 18,000 juvenile salmon counted in 2014. USFWS also states that the Intergravel Monitoring component of the ELH studies was not incorporated into emergence and migration of juvenile salmon. USFWS comments that in fact, it appears that the winter intergravel monitoring in spring of 2013 was terminated in April, 2013, just prior to the ELH sampling in May and June.

USFWS asserts that intergravel monitoring in 2014 seemed to be directed more towards fish distribution in the winter studies, not emergence of salmon in April and May. USFWS also comments that because sampling was limited to select sites located only in the Middle River in 2014, transect lengths were smaller than abundance and distribution sampling, and sampling gear was limited to fyke nets, ELH samples are not comparable to the more extensive summer and fall sampling of both mainstem and tributary habitats. USFWS concludes that the overwintering distribution and movements between tributary and mainstem habitats remains poorly understood.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

Task A of Objective 3, describing the emergence timing of salmonids, is supported by field data collection during winter studies and ELH as well as the intergravel monitoring study. While the intergravel monitoring study is an objective of Study 8.5, not Study 9.6, it is interrelated and along with winter and ELH fish sampling will help inform and refine estimates of emergence timing. In the spring of 2013 a subset of dataloggers were removed prior to ice-breakup to minimize equipment loss; however, others were left installed (Table 4-1 in Study 8.5 SIR, Appendix A: *2014 Instream Flow Winter Studies*). Intergravel monitoring continued during the 2013-2014 and 2014-2015 incubation seasons. AEA is confident that the three complementary data sets, along with existing literature on incubation rates, will be sufficient to describe the emergence timing of salmon fry.

ELH sampling was targeted, often yielding large catches of juvenile salmon and occurred in smaller sampling locations than seasonal FDA samplings. Measures of relative abundance as measured by CPUE are comparable between ELH events and FDA sampling; however, site selection is random vs non-random and habitat associations cannot be compared. ELH sampling in 2014 was not limited to fyke netting; it also included backpack electrofishing and seining (SIR, Section 4.5.2). To collect data that was more comparable between sites and sampling events ELH gear types were streamlined in 2014. After review of 2013 ELH catch and size/life stage, minnow trapping and snorkeling were dropped from ELH methods for 2014 (Table 2.6.2-2). Minnow trapping was dropped because of concerns about size selectivity against very small and very large juvenile salmon (Freeman 2003; Magnus et al. 2006) and reduced efficiency catching juvenile salmon less than 60 mm (Bryant 2000) that proved to be valid based on AEA's 2013 and 2014 data (Figure 2.6.2-3). For example, the size of Chinook Salmon in minnow traps ranged from 36 mm to 119 mm whereas other gears collected Chinook Salmon juveniles at sizes as small as 25 mm and as large as 170 mm. Snorkeling was also eliminated as a technique because it was not often used during the period shortly after breakup when stream flows and turbidity were high.

Table 2.6.2-2. Sampling events using various gear types during salmon early life history (ELH) sampling in Middle River Focus Areas 2013 and 2014.

Year	Fyke Net	Backpack Electrofish	Minnow Trap	Seine	Snorkel
2013	20	24	40	3	5
2014	56	47	0	6	0
Total Events	76	71	40	9	5

2.6.2.2.2. Response to Modification Request for an Expanded Spring Sampling Program

NMFS recommends (Modification 1; NMFS_pp9.6-5_ph3) spring sampling during May or early June at FDA sampling locations as described within the RSP and FDA IP (5.9(d)(1)). NMFS states that spring sampling was not conducted as described in the RSP and the FDA IP to identify Middle and Lower River juvenile salmon rearing habitats.

In support of the modification, NMFS comments that distribution and temporal occurrence of juvenile salmon life stages is necessary to know when, where, and for which species and life stage habitat models developed through the Instream Flow Study 8.5 should be applied. NMFS comments that proposed operational scenarios would store spring flows within the reservoir (NMFS_pp9.6-5_ph4c), and that understanding the spring fish distribution and habitat associations is necessary to evaluate Project effects. NMFS comments that spring sampling would provide seasonal distribution of fish species by life stage and indicate overwintering locations, and recommends spring sampling be paired with the two summers and one fall sampling events.

NMFS also states that monthly sampling was not conducted at sampling sites as described in the Study Plan or as summarized in the FERC Study Plan Determination (NMFS_pp9.6-5_ph5). NMFS comments that AEA's RSP proposed year-round monthly sampling, the PSP page 7-13 states that electrofishing would occur monthly, and that the FDA IP (page 7) states that sampling will be conducted every other month during the months of May through October. NMFS notes that the FERC Study Plan Determination states, "*Generally, sampling would occur monthly at all sites for fish distribution and relative abundance surveys during the ice-free season. At focus areas, sampling would occur monthly year-round and biweekly after break-up through the first of*

July to characterize the movements of juvenile salmonids during critical transition periods from spawning to rearing habitats." NMFS also comments that they recommended in March of 2013 that sampling within all sampling units occur once in early spring following breakup (May or early June), twice during the summer (July-August) and once in the fall, mid-September to early October.

The USFWS also comments (USFWS_pp9.6-3_ph5 under Modification 3) that a spring sampling program that is comparable to the summer and fall sampling program should be considered in the operational planning of a relative abundance sampling program (USFWS_pp9.6-2_ph5 under Modification 2).

In response to the NMFS Modification 1, AEA requests FERC not adopt this proposed Study Plan modification as NMFS fails to accurately demonstrate that the FERC-approved Study Plan was not implemented and has not provided any additional or new information that indicates why the approved Study is not sufficient. AEA also disagrees with the USFWS comment.

In the RSP, AEA described the overall schedule for the sampling program in the Middle River as seasonal during the ice-free period with biweekly sampling immediately following ice-out in an attempt to capture juvenile salmon during the out-migration. Recognizing the importance of the sampling in the spring, AEA then implemented the seasonal sampling schedule as described with targeted efforts immediately after ice-breakup focused on juvenile salmon. The highly focused spring effort allowed for targeted sampling near known spawning and rearing areas and was then followed by seasonal sampling in Early July, August, and mid-September to early October. Spring on the Susitna River is a dynamic period that includes the ice-breakup process followed by snowmelt and freshet flooding. While a spring sample at all of the fish distribution and abundance sampling locations would have added another seasonal sample, it would not have yielded a comparable seasonal event due to the difficulty of sampling mainstem areas during the flooding associated with breakup and snowmelt. Gear catch efficiencies could be greatly reduced sampling at high water leading to low CPUE in some habitats and potentially erroneous results. Discharge at Gold Creek exceeded 30,000 cfs prior to the onset of summer on June 21st in 2013 (Figure 2.6.2-6). Similarly, sampling was suspended for the high flow event in late August 2013 to collect consistent and comparable data. June is typically the highest discharge and most variable month of the year. From 200 to 2015 the average monthly discharge at Gold Creek was 17,100 cfs in May increasing to over 25,000 in June before dropping to 22,800 in July, 20,800 in August, and 15,000 in September. Average annual discharge in June varied from 16,600 to 37,600 from 2001-2015 and in 4 of the 15 years was greater than 31,000 cfs. AEA has implemented targeted salmon ELH sampling, downstream migrant trapping, and radio-tagging and tracking as the study components for implementation following ice breakup and typical spring/early flooding.

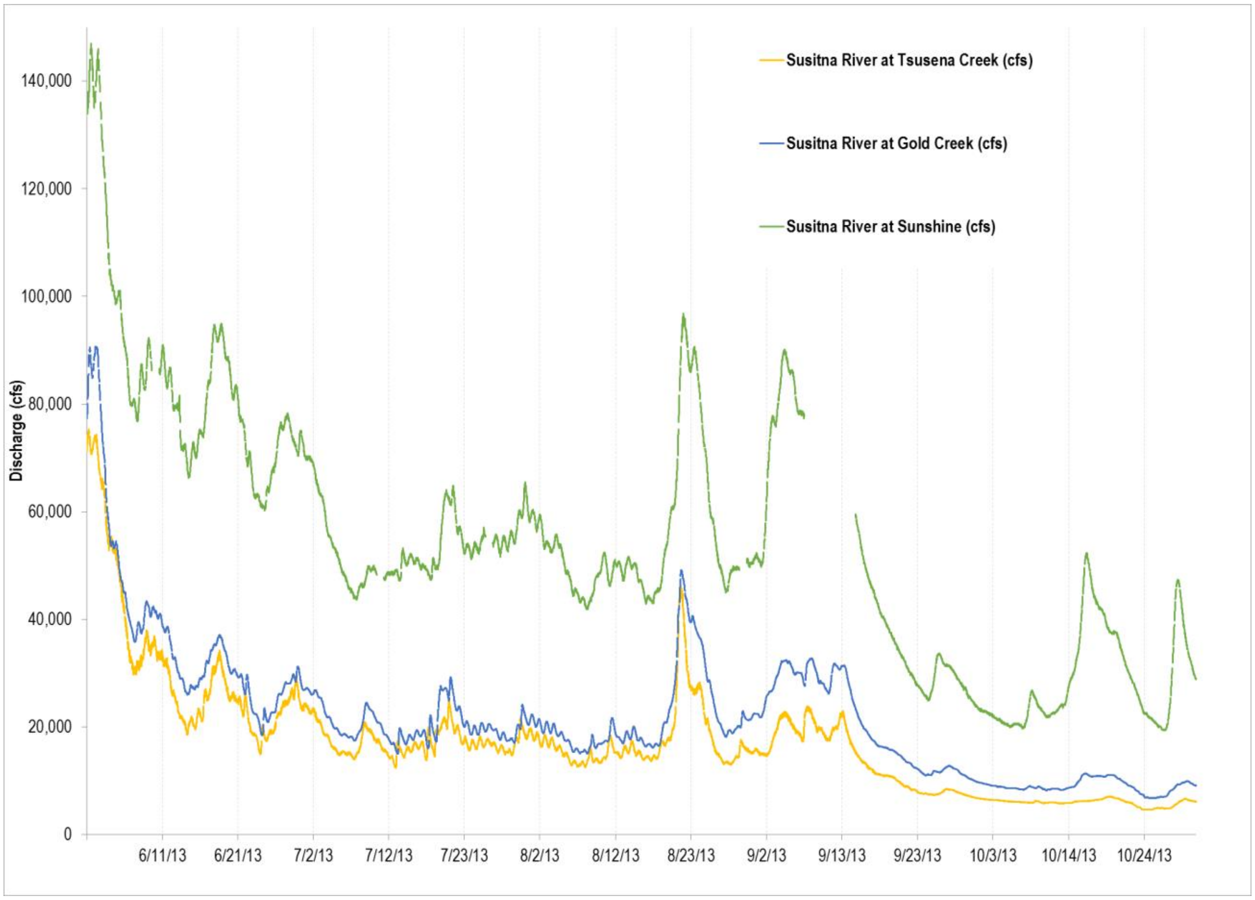

Figure 2.6.2-6. Discharge (cfs) at Tsusena Creek, Gold Creek, and Sunshine, 2013.

2.6.2.2.3. Response to Modification Request for Additional Sampling in Beaver Ponds and Complexes Specific to Juvenile Salmon

NMFS recommends a study modification (Modification 11; NMFS_pp9.6-14_ph2) to address the relative importance of beaver ponds and complexes for juvenile salmon summer rearing and overwintering. NMFS recommends that fish sampling be conducted within 200-meter sampling units within beaver ponds and in comparable macrohabitats without beaver ponds using 20 baited minnow traps set for at least 20 hours, spaced about 10 meters apart during summer, at a minimum of ten Middle River and ten Lower River locations to test for differences in the relative abundance and size distribution of juvenile salmon in these habitats. NMFS comments that this information will be used to evaluate the relative effects of Project operations on the development and establishment of beaver ponds, and Project operations that may affect fish access to beaver ponds and pond complexes. NMFS comments that this study modification does not require any additional effort; rather, it ensures that during the second and subsequent years of study, sampling occurs within sampling locations with and without beaver influence in the Middle and Lower River during summer and winter. NMFS states beaver ponds in the Lower River were not sampled. NMFS recommends that ten Lower River beaver ponds be randomly selected for summer and winter FDA sampling.

AEA requests FERC not adopt this proposed Study Plan modification. AEA has extensively sampled beaver complexes as part of FDA sampling. Although FERC's SPD recommendations changed beaver complexes from a Level 3 macrohabitat to a Level 4 mesohabitat, AEA sampled beaver complexes when present in all sampling locations. GRTS sampling in the Middle River included at least 23 beaver complexes and Lower River transect sampling included beaver complex habitats at Transects 56.1 and 63.5. The FDA IP provided for sampling side sloughs and upland sloughs with and without beaver complexes based on the remote line mapping. However, beaver complexes are dynamic features that both removed by floods and ice scour and added by ongoing beaver activity. Similarly, beaver activity included active dams, bank beaver activity and inactive dams that provided a continuum of beaver influence on fish habitat. The degree of influence of each of these features also varied depending on the location of beaver activity within each slough. Beaver activity near the confluence could impact fish movement whereas activity further upstream could affect physical and biological attributes like temperature and productivity. The complete absence of beaver influence within an entire macrohabitat was rare during on-the-ground surveys of off-channel areas. Thus AEA has moved the assessment of beaver influence to the mesohabitat scale and reported on fish use of beaver complexes at the mesohabitat scale within both upland slough sand side sloughs. These data place fish use of beaver complexes in the context of fish use of slough habitats. The data being collected will readily support evaluation fish use of beaver complexes.

AEA is concerned about the NMFS's requests to sample slough macrohabitats only beginning at the slough mouth and beaver pond mesohabitats in a targeted, non-random manner that may or may not be representative of fish use of slough macrohabitats on the landscape scale. AEA believes the GRTS approach outlined in FERC-approved Study Plan in which sloughs are systematically segmented into 200-meter-long panels and randomly selected for sampling is the preferred and scientifically accepted method for characterizing fish distribution and abundance for large-scale environmental surveys.

NMFS requests that minnow traps be used as the singular method for evaluating fish use of beaver complexes. Minnow traps are known to be selective for Chinook and Coho Salmon and Dolly Varden and size selective among those species. Minnow traps are not effective at collecting salmon fry less than 60 mm in length (Bryant 2000) and rarely catch individuals smaller than 50 mm (Figure 2.6.2-3). Instead, fyke nets, backpack electrofishing, and seining should also be employed to catch salmon fry when possible. Data from 2013 and 2014 also suggest that minnow traps are not effective at collecting large juvenile Chinook Salmon and that fyke nets and seining are better gear types for collection of larger individuals (Figure 2.6.2-3).

NMFS states that this study modification does not require any additional effort. However, it would require AEA to redesign the study based on a new and ongoing complete Lower River and Middle River mapping mesohabitat effort to identify beaver ponds for random selection for sampling. Based on AEA's experience, habitat mapping would need to be an ongoing effort as beaver ponds are ephemeral features and are continually being breached and rebuilt in the Susitna River. This is not practical and will not provide additional data to assess potential Project impacts.

2.6.2.3. Responses to Comments Regarding Salmon Early Life History Sampling

2.6.2.3.1. Response to Modification Request Regarding Early Life History Sampling Methods

NMFS recommends modifying the Study Plan (Modification 23; NMFS_pp9.6-23_ph2) to require ELH studies be conducted on all sampling dates at all Focus Areas as described in the RSP and add minnow traps and fyke nets with hoop traps in all sampling locations on all sampling dates, such that all traps, nets, and hoop traps should contain mesh sizes of 1/8 inch or less.

In support of this proposed modification, NMFS asserts that the implementation of the ELH studies in 2013 did not achieve the study objectives, and that determining emergence timing and habitats selected by emergent salmon was not accomplished. NMFS notes that few emergent salmon were captured, and data were not obtained on habitats selected by emergent and migrating Sockeye Salmon or other juvenile salmon species. NMFS also states the study did not identify the length of time fish < 50 mm were present or most abundant within the Middle River Focus Areas. NMFS comments that the number of Focus Areas sampled and frequency of sampling was less than proposed within the FERC-approved Study Plan, that fish collection methods and sampling gear did not follow the approved Plan, and those selected in 2013 were not appropriate or effective for sampling newly emergent salmon fry. NMFS asserts that the differences in emergent fry abundance among sampling locations or over time could not be compared because different sampling methods were used in different sampling units and on different dates.

NMFS also comments that different sampling methods were applied at the same sampling site on different dates and different sampling units within the same Focus Area. NMFS states that many of the methods used are ineffective at capturing emergent salmon and in particular, emergent Sockeye and Chum Salmon. NMFS comments that mesh size for fyke nets and seines used was 0.25 inches which salmon fry < 45 mm can pass through. NMFS notes that minnow traps were the only method used at other sampling units within each Focus Area during both June sampling events, and since minnow traps are "*not effective at capturing Sockeye, Chum, or Pink Salmon,*" and also had 0.25-inch mesh, it is unclear if emergent salmon of these species were present in these sampling units or not.

In response to this modification request and comments, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the study has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA disagrees with the NMFS's assertion that the Study was not implemented consistent with the FERC-approved Study Plan. In regards to salmon ELH sampling, the FERC SPD recommendation (April 1, 2013, B-166) states:

> *AEA proposes early life history studies that would take place in five select focus areas where movements between spawning and early life stage rearing habitats are anticipated based on results of historic and recent studies. During bi-weekly fish distribution sampling, sites for sampling would include three designated 40-meter long sampling units immediately downstream of a documented Chinook, chum, or*

coho salmon spawning area (these may be tributary mouths or side sloughs at some focus area locations) and three 40-meter long rearing habitat sampling units. Rearing habitat sampling units would be generally stratified in side slough habitat to include upper slough, middle slough, and slough mouth areas where appropriate. Electrofishing, seining, fyke nets, and minnow traps would be the primary methods for collecting salmon during the early life stage. Snorkeling may also be used where appropriate. Stranding assessment and winter sampling efforts would utilize the same sampling locations but would be less frequent, approximately monthly instead of biweekly and for winter would be dependent on safe access and sampling methods (due to ice cover).

AEA's proposed approach is consistent with scientifically accepted practices (section 5.9(b)(6)) and is a reasonable initial level of effort to address the study objectives (section 5.9(b)(7)).

No modifications to the Study Plan are recommended.

In 2013 and 2014, six Focus Areas were sampled for ELH, greater than the five required in the FERC-approved Study Plan. Each Focus Area contained the planned number of sample locations, three rearing and three spawning. Sampling frequency met the bi-weekly sampling schedule proposed from breakup to July 1, and went beyond the approved schedule to include a pre-breakup sampling event at three Focus Areas in 2013.

In 2013, ice breakup occurred May 25-29 (Study 7.6 ISR), and to take advantage of this late break-up AEA initiated ELH sampling in April. In 2013, bi-weekly sampling occurred April 29-May 2, June 4-June 15 and June 20-29. In 2014, ice breakup occurred May 5-8 (Study 7.6 TM, September 17, 2014: *Detailed Ice Observations October 2013 – May 2014 Technical Memorandum*), and sampling took place May 19-May 26, June 2-June 9, and June 18-June 25.

Additionally, NMFS's comments mischaracterize the mesh sizes and openings of seines and minnow traps used for salmon ELH sampling. The general specifications for sampling gear used for all FDA sampling were presented in FDA IP Section 8, seines mesh sizes varied from 0.125 to 1 inch (Section 8.9) and both fabric (0.125-inch) and wire mesh (0.25-inch) minnow traps were deployed. Small mesh seines were used for most sampling; however, on occasion a 0.25-inch seine was selected to target larger fish in higher velocity areas where a 0.125-inch mesh net would not have been effective. Only fabric minnow traps (0.125-inch nylon mesh) were used for salmon ELH sampling. After reviewing catch data, minnow traps were found to be size and species selective missing the smallest and largest fish present. Other techniques collected a broader size distribution, more species, and were more versatile; thus, minnow traps were not used for ELH sampling in 2014 and were dropped from a tier 1 technique to tier 2 for all sampling purposes. The actual size of fyke nets used in the field for ELH was different than that reported in the FDA IP (Section 8.7). The FDA IP indicates that either 0.25- or 0.33-inch mesh fyke nets would be used for fish sampling. However, during spring 2013 after the FDA IP was prepared, AEA ordered custom-made fyke nets with 0.125-inch mesh specifically for ELH sampling. These custom nets were used in the spring for all sampling in the Middle and Lower River; however, due to a limited supply of smaller meshed nets, 0.25-inch mesh nets were used in the Upper River, where the addition of ELH sampling was a variance (Table 2.6.2-3). In summary, 0.125-inch mesh gear was used for 97 percent of net and trap samples in the Middle/Lower River and 86 percent of all net and trap ELH samples. Large numbers of salmon fry, parr, and smolts were effectively collected during 2013 and 2014 ELH and AEA has demonstrated progress towards meeting study objectives.

Based on 2013 sampling, AEA streamlined the ELH sampling techniques to fyke netting, electrofishing, and seining, and adjusted sampling locations. AEA disagrees that minnow traps and hoop traps should be used for salmon ELH sampling. Furthermore, AEA recognizes the importance of ELH data collection and has proposed a third year of ELH sampling in Middle River Focus Areas (ISR Part D Section 7 and Section 8).

Table 2.6.2-3. Gear specifications for nets and traps used for salmon early life history (ELH) sampling events, 2013-2014.

Hydro Segment	Year	Fyke Net		Seine		Minnow Trap	
		0.125-in.	0.25-in.	0.125-in.	0.25-in.	0.125-in. Fabric	0.25-in. Wire
Middle River	2014	56	-	5	1	-	-
Middle River	2013	10	-	3	-	10	-
Lower River	2013	-	-	-	2	8	-
Upper River	2013	-	12	-	-	-	-
Total		66	12	8	3	18	0

Regarding NMFS's assertion that ELH study objectives were not met for emergence timing and movements between habitats, AEA presented data collected in 2013 in Study 9.6 ISR Section 5.3 and data collected in 2014 in Study 9.6 SIR Section 5.2. In 2014 alone, the ELH field team captured more than 20,200 juvenile salmon (Study 9.6 SIR Table 5.2-1) all of which were associated with specific habitats. In addition, Section 4.5.1 reports on the redd monitoring that occurred in collaboration with Study 8.5 and Section 4.5.2 reports on the biweekly sampling that occurred in the same areas. While AEA has not been able to determine the precise timing of emergence of these salmon in the field, first sightings of newly emergent alevin of sacfry have been documented because of the coordination between Winter and ELH sampling. In addition, the temperature data collected in the redds is being done so as to facilitate a modeling exercise for determining emergence timing as presented in RSP Section 9.6.4.3.3.

2.6.2.3.2. Response to Comments Regarding Electrofishing for Emergent Salmon

NMFS states that it opposes using electrofishing for emergent salmon studies because electrofishing can cause fry to involuntarily emerge from the gravel and give erroneous results. NMFS have observed salmon fry being pulled from the gravel by electrofishing (NMFS_pp9.6-24_ph2). NMFS asserts that fyke nets and hoop traps with the appropriate mesh size (1/8 inch) should be used as provided in the approved plan, and that minnow traps should be used to augment fyke nets and for the capture of emergent Coho Salmon and Chinook Salmon. NMFS believes this methodology will allow a comparison of catch among stations and sampling date to meet study objectives.

AEA disagrees that electrofishing is drawing large numbers of pre-emergent salmon fry from salmon redds, that electrofishing is inappropriate, and that it be discontinued during salmon ELH studies. Electrofishing is a commonly used and scientifically valid method for sampling juvenile fishes. Furthermore, electrofishing has been demonstrated to be inefficient at sampling fish within interstitial spaces (Roni and Fayram 1998, Peterson et al. 2004). AEA would appreciate citations for studies documenting galvanotaxis of pre-emergent salmon fry and alevin from spawning gravels.

The study design for salmon ELH study specifically designated sampling locations immediately downstream of documented spawning areas (spawning) or in the lower reaches of spawning tributaries and in locations with rearing potential (rearing) (FDA IP, Section 5.5). The intention of site selection downstream of spawning areas is to reduce the impact associated with walking on redds and electrofishing around redds. Crews were instructed not to electrofish near salmon redds and spawning gravels. Newly emerged salmon fry often seek cover in cobbles immediately downstream of spawning areas during the day and may be drawn out by electrofishing. Very few alevin were collected during sampling in 2014 when large numbers of juvenile salmon were collected, indicating large numbers of pre-emergent salmon are not being drawn from spawning gravels and giving erroneous results (Table 2.6.2-4). NMFS refers to a figure (NMFS_pp9.6-23_ph1) that reveals the gear bias and size selectivity of electrofishing and fyke netting. Both methods collect juvenile salmon over 30 mm in length; however, fyke netting is more effective than electrofishing at collecting larger juveniles (hence the relative proportion of the catch of smaller juveniles is lower) and is better suited for use in rearing locations than electrofishing (Figure 2.6.2-3). Neither technique appears to be collecting large numbers of pre-emergent alevin or fry less than 30 mm FL.

Table 2.6.2-4. Collection of fry and alevin at a percent of all juvenile salmon collected or observed during winter and salmon early life history (ELH) sampling 2013-2014.

Collection Method	Juvenile Salmon Catch	% fry	% alevin
Backpack Electrofish	7,565	91.7%	1.1%
Fyke Net	7,236	76.0%	0.1%
Visual Observation (incidental)	5,821	91.9%	0.1%
Minnow Trap	1,341	4.5%	0.3%
Seine	903	90.3%	0.0%
Dip Net (incidental)	350	20.3%	0.3%
Snorkel	245	71.4%	0.0%
Total	23,461	80.6%	0.4%

2.6.2.3.3. Response to Modification Requests to Extend Early Life History Sampling to Lower River Sites

NMFS recommends (Modification 25; NMFS_pp9.6-25_ph3) conducting ELH sampling in the Lower River. USFWS comments (USFWS_pp9.6-3_ph5, under Modification 3) that the 2014 ELH sampling in the Middle River proved to be very systematic and effective, capturing over

18,000 juvenile salmon (SIR), and recommends the design of this sampling program could provide a good model for extending ELH sampling to Lower River sites.

AEA does not object to FERC's adoption of some elements of this modification, consistent with AEA's proposed modification to expand ELH sampling. AEA implemented ELH sampling in the Lower River in 2013 and as described in the ISR Part D Section 8, AEA has proposed to implement a second study year of salmon ELH studies in the Lower River and the Middle River upstream of Devils Canyon and a third year of data collection in the six Middle River Focus Areas previously sampled. AEA appreciates the Services' support for AEA's proposed modification to extend ELH sampling; however, the study design for this extended ELH study applies several modifications to the previous study.

ELH site selection and gear selection for the Lower River and Middle River above Devils Canyon will be based on a review of existing fish collection data with the goal of improving the catch and documentation of juvenile salmon as was done for Middle River Focus Areas in 2014. Site selection during the planning phase for the second year of sampling in the Lower River and Middle River upstream of Devils Canyon and a third year of sampling in Middle River Focus Areas will utilize specific spawning location information from Studies 9.7 and 8.5 and juvenile salmon catch from 2013-2014 winter, ELH and seasonal fish distribution and abundance sampling under Study 9.6 to select rearing locations.

AEA does not propose a sampling event during spring flooding and snowmelt. Although the high water following breakup is important cue for fish migrations, sampling the river while flooding would be difficult and not provide data that would be comparable to the other sampling seasons, particularly for main channel and side channel macrohabitats.

2.6.2.4. Response to Comments Regarding Macrohabitat Classifications and Sampling Within Habitats

2.6.2.4.1. Response to Modification Request for Reclassification of Sloughs based on Mainstem Bank Contours

The NMFS recommends a modification (Modification 5; NMFS_pp9.6-8_ph5) to classify sloughs based on deviations in bank contours and not water clarity. While they did not propose a modification, the USFWS commented similarly that classification of sloughs should be based on stream bank morphology and not clarity of water (USFWS_pp9.6-3_ph1a).

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification as AEA is already classifying sloughs based on bank contours and water clarity, as described in more detail in Section 2.6.5.2.1.1.

AEA recognizes that slough confluence areas may be important habitat features for fish. Backwater habitats at slough mouths have always been classified as Level 4 mesohabitats. In the ISR, these mesohabitats were classified as part of main channel macrohabitats (e.g., main channel, split main channel, side channel). However, in the SIR and associated database backwater mesohabitats were reported as Level 4 mesohabitats within off-channel Level 3 macrohabitats (e.g., tributaries, side sloughs and upland sloughs). This is consistent with the Services' comments and no further modification is necessary.

AEA also recognized that backwater habitats were important features. They were the focus of sampling during the ELH field effort and were included as a category for GRTS site selection. In addition, backwater habitats were treated as a special mesohabitat type. Furthermore, in an attempt to meet the intention of the FERC April 1 SPD while maintaining the balanced GRTS approach, AEA's study team collected additional information on backwater features, even if they were not selected as a backwater GRTS sample. The mouths of upland slough and side sloughs selected by GRTS were inspected for mainstem backwatering, and if present, the backwatered portion was sampled as an additional replicate. AEA feels that sampling under the GRTS program has adequately sampled the downstream end of sloughs while preserving the random study design for the best characterization of overall fish use of upland slough and side slough features. In total, 26 Middle River slough mouth locations were sampled 2013-2014; 10 as backwaters, 9 of 30 side sloughs samples were initiated at the downstream end, and 7 of 36 upland sloughs samples were initiated at the downstream end.

2.6.2.4.2. Response to Modification Request to Reclassify Middle River Macrohabitats

NMFS recommended a study modification (Modification 2; NMFS_pp9.6-6_ph5) to require the study to be conducted with Middle River macrohabitats classified as Level 3 macrohabitats using only those habitats approved in the FERC Study Plan Determination: main channel, side channel, split channel, multiple split channel, tributary mouth, side slough, and upland slough. They also commented that sampling locations in the Middle River did not include entire tributary mouths or the mouths of side sloughs and upland sloughs as defined within the FERC Study Plan Determination. They commented that while the RSP, FDA IP, and FERC Study Plan Determination (April 1, 2013) proposed to select sampling units based on macrohabitat (Level 3) classification (i.e., main channel, split main channel, side channel, etc.), field sampling, data analyses, and reporting within the ISR were conducted at the mesohabitat (Level 4) classification.

AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan.

The intent of this study modification is not clear; AEA used macrohabitat classifications to select FDA sampling sites in accordance with the Study Plan. NMFS's comments on the accuracy of macrohabitat classifications are addressed in responses to comments on Study 9.9. As for limiting FDA selections to macrohabitat types, this would eliminate sampling of clearwater plumes and backwaters, which would be in clear contradiction to previous requests, other comments on the ISR, and FERC's recommendation to give these habitats special consideration. The inclusion of split main channel and multiple split main channel macrohabitat classifications is also in contradiction with NMFS's request to combine these classifications (NMFS_pp9.6-8_ph2; see Section 2.6.2.4.3 below). AEA has sampled all macrohabitat types listed by NMFS along with tributary habitat, clearwater plumes and backwaters.

2.6.2.4.3. Response to Modification Request to Combine Main, Split Main and Multi-split Main into One Macrohabitat

NMFS recommends a study modification (Modification 4; NMFS_pp9.6-8_ph2) to clarify that mainstem sampling unit selection should be consistent with the selection and sampling of other mainstem Level 3 macrohabitats. They also recommend that main, split main and multi-split main channels be lumped into one macrohabitat.

AEA asserts that the requested approach is consistent with AEA's proposed Study Plan modifications and study implementation to date. The FERC SPD (April 1, 2013, p. B-154) recommended that AEA sample mainstem habitats using separate strata for main channel, split main channel and multi-split main channels. However, based on licensing participants' recommendations during the Study Plan development and ongoing discussions in the Fish and Aquatic TWG meetings regarding the potential to extend an unbalanced effort in these habitats, these three channel forms were sampled as a single strata designated as main channel. This variance, reported in ISR Part A (Section 4.1.7.2) is an AEA proposed modification for future study efforts in ISR Part D (Section 7.1).

2.6.2.4.4. Response to Modification Request to Require Macrohabitat Unit Sampling

NMFS recommends a study modification (Modification 6; NMFS_pp9.6-9_ph2) to require macrohabitat unit sampling, as described within the FERC Study Plan Determination. NMFS defines these as 200-m sampling units or 20x channel width of side sloughs, upland sloughs and tributary mouths. For sloughs, NMFS states sampling should begin at the downstream mainstem confluence to include the mixing zone of turbid and clear water, when present, and extend upstream into the slough. For tributary mouths, sampling should include the portion of the tributary influenced by the mainstem (zone of hydraulic influence) and 200 meters downstream whether or not a clearwater plume is visible. NMFS recommends that boat electrofishing and set gillnets in main channels and side channels should effectively sample fish in the entire 500-meter sampling unit.

NMFS states that the FERC Study Plan Determination clearly defined sampling unit lengths for the primary macrohabitats, and that FERC also defined the locations where sampling units should be selected in upland sloughs and side sloughs to capture the confluence of those habitat types with the mainstem and tributary mouths. NMFS comments that this determination recognized that these are unique transitional habitats between main channel and off-channel habitats, but asserts that AEA did not sample these areas nor sample entire sampling units as recommended by FERC, and therefore, did not implement the approved Study Plan. NMFS comments that decreasing the lengths of sampling units results in underestimates of fish distribution and community diversity.

In addition, USFWS recommends that sampling should also occur at the mouths of side sloughs and upland sloughs (USFWS_pp9.6-3_ph1a).

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification and the proposed modification is inconsistent with the GRTS sampling approach outlined in the approved Study Plan.

Macrohabitat classifications for fish distribution and abundance sampling were based on habitat classification (Study 9.9) at a reference flow, approximately 16,000-19,000 cfs at Gold Creek. Habitat classification took into account morphology, vegetation, and water clarity when classifying sloughs and side channel features. Seasonal fish sampling occurred at a range of flows above, within, and below the reference flows for habitat classification, therefore, water clarity, and gear type selection varied field conditions at the time of sampling.

The GRTS sampling methodology was proposed for Study 9.6 and supported in the FERC Study Plan Determination. The FERC SPD (April 1, 2013) also recommended that slough sampling begin at the downstream end of the slough (B-152). The GRTS sampling approach then randomly selected panels for sampling from the population as to be representative of the habitat type. Selection of the downstream-most panel within each slough does not fit the randomized sampling design. If fish use and abundance is different near the downstream connection with the mainstem Susitna River, non-random sampling would bias and complicate the interpretation of fish use and abundance within slough habitats generally. The objective of the study is to characterize fish distribution, abundance and use of habitats in both poor and good quality habitats.

AEA recognizes that slough confluence areas may be important habitat features for fish. These areas were the focus of sampling during salmon ELH sampling and were included as a category for GRTS site selection. Sloughs and backwater habitats were also designated as a special mesohabitat type. Furthermore, and in an attempt to meet the intention of the FERC April 1 SPD, additional information was collected on backwater features. Even if they were not already selected as a backwater GRTS sample, the mouths of upland slough and side sloughs selected by GRTS were inspected for mainstem backwatering, and if present, the backwatered portion was sampled as an additional replicate. Sampling under the GRTS program has adequately sampled the downstream end of sloughs while preserving the random study design for the best characterization of overall fish use of upland slough and side slough features. In total, 26 Middle River slough mouth locations were sampled 2013-2014; 10 as backwaters, 9 of 30 side slough samples were initiated at the downstream end, and 7 of 36 upland slough samples were initiated at the downstream end.

2.6.2.4.5. Response to Modification Request Regarding Sampling the Mouths of Tributaries and Sloughs

NMFS states (NMFS_pp9.6-6_ph6) that sampling locations in the Middle River did not include entire tributary mouths or the mouths of side sloughs and upland sloughs as defined within the FERC Study Plan Determination.

NMFS also recommends (Modification 3; NMFS_pp9.6-7_ph3) that tributary mouths be sampled as macrohabitat units at the confluence of tributaries with the Susitna River main channel and side channels. NMFS comments that FERC's Study Plan Determination recommended that clearwater plumes be classified at Level 4 and specified that tributary mouth sampling units include the tributary mouth and 200 meters downstream regardless of the presence of clear water. They comment that this approved method was not used, and AEA sampled clearwater plumes independent of whether they were tributary mouths, based only on presence of clear water.

NMFS states that visual estimates of water clarity are not a good substitute for differences in turbidity, and that classifying clearwater plumes based on visual observed clarity, and sampling at this mesohabitat level, excluded sampling downstream of tributary mouths where water turbidity could be much lower than the mainstem and provide better habitat quality, increased food resources, and yet not be visibly different from the mainstem. NMFS asserts that AEA's selection of clearwater plumes as a unique sampling unit disassociated this mesohabitat from the associated tributary.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan

AEA also disagrees with NMFS's comments about tributary mouth sampling which likely stems from alternative definitions of tributary mouths being applied. Section 4.1.1.1 of the Study 9.9 SCR describes how tributary mouths were delineated, as the length of the wetted area of the tributary that extended from the vegetation line out to the edge of the gravel bank. In some of the larger tributaries, the mouth habitat was extended inland beyond the vegetation line based on visible habitat breaks between the tributary channel and the alluvial gravel areas at the mouth. In some smaller tributaries no mouth existed, for example when the flow went subsurface before reaching the Susitna River.

Study 9.9 ISR Part A, Table 4.1.1 and Table 9.9-4 of the Study Plan both provided the same definition for clearwater plume and in the phrase "a pronounced area of clearwater in contrast to the turbid water of the main channel". This was the only definition ever provided by Study 9.9 for this habitat type and by definition this feature was determined by a noticeable difference in turbidity from the main channel flow. This definition was consistently applied by AEA during 2013 and 2014 field efforts.

During the study planning process, it was determined that tributary mouth and clearwater plumes are unique features, consistent with 1980s. Therefore, consistent with the overall study design, tributary mouth and clearwater plumes were considered unique strata for the selection of sampling units. AEA sampled tributary habitat, tributary mouths, and clearwater plumes as three different units of selection within each geomorphic reach. Collectively, these data can be combined for analysis purposes into any desired tributary mouth definition. Sampling in this way differentiates fish use of habitats with very different physical attributes.

AEA did not follow FERC's recommendation to sample 200 meters downstream of tributaries regardless of tributary size and plume length. Instead, AEA sampled the entire clearwater plume up to 200 meters. Depending on the season, clearwater plume samples ranged from 14 to 200 meters in the Middle River. In early summer, 50 percent of clearwater plume samples selected by GRTS were 200 meters long, although only 39 percent of late summer samples were that long and 57 percent of fall samples were 200 meters.

Using a standard length for plume sampling regardless of tributary and plume size could obscure patterns of fish use by combining clear tributary influenced plume habitats with turbid mainstem habitats. All catch data are reported as catch-per-effort to facilitate comparison of fish use among differently sized plume habitats. Preliminary analysis of habitat associations using combined measures of relative abundance showed relatively high use of tributary mouths by both juvenile salmon and the entire fish assemblage, with clearwater plumes intermediate between tributary mouth habitats and mainstem macrohabitats (see Attachment 7: *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum*). Expanding the classification of clearwater plumes to include a fixed length downstream independent of tributary size encompassing a range of turbidity values would only further obscure patterns of fish use. Sampling these features independently does not prevent the data being pooled for analysis.

Again related to the GRTS protocol, AEA did not follow FERC's recommendation to initiate slough sampling at the confluence with the mainstem Susitna River. The GRTS sampling procedure was used for site selection and is based on randomization of sampling locations to provide for an unbiased sampling design that is spatially balanced across the landscape. In contrast, if all sample sites were selected to begin at the confluence with the mainstem and continue upstream 200 m they would be biased towards the species and life stages utilizing these areas and would not be representative of these habitat features overall. As a compromise with agency desires to gather additional information in these areas, and because of the difficultly of identifying backwaters during remote line mapping, slough confluence areas were inspected for mainstem backwatering when slough habitats were sampled, and all backwaters were sampled.

2.6.2.5. Response to Comments Regarding Integration of Multiple Gear Types

2.6.2.5.1. Response to Modification Request to Develop a Complete Operational Plan for Relative Abundance Sampling

USFWS requests (Modification 2; USFWS_pp9.6-2_ph5) that AEA develop a complete operational plan for relative abundance sampling that adheres to the statistical methodology used to designate sampling sites and provides estimates with acceptable precision, and to implement this plan with no variances. USFWS states the number of sites sampled in 2013 was deemed to be inadequate, with a number of tributaries and Middle River mainstem sites being inaccessible or reclassified to other habitat types. USFWS comments that in the Middle River, 162 of 207 sites were sampled, but that off-channel sites were poorly sampled in the Lower River, with only 4 side channel, 2 upland slough, and 3 side slough habitats sampled in 2013. USFWS asserts that classification of habitat type and sample design was inconsistent between Middle and Lower River studies. USFWS states that the intention of the 2014 abundance and distribution sampling was to return to the unsampled 2013 sample sites and complete the first year of sampling for the Middle River, and that no abundance and distribution sampling was conducted in the Lower River.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" for the modification or demonstrated the study has not been implemented as provided by the approved Study Plan.

The combined samples from 2013 and 2014 in the Middle and Lower River comprise a complete first year of sampling with 226 sites sampled (Table 2.6.2-5 and Table 2.6.2-6). Off-channel habitats in the Lower River were sampled in proportion to their availability within proximity to transect locations. Habitat mapping of the Lower River was not amenable to site selection based on the GRTS approach used in the Middle River. Off-channel habitats were relatively rare; slough habitat accounted for less than 0.4 percent and side channel habitat accounted for less than 1 percent of the habitat area mapped by Study 6.5. Out of the samples collected in the Lower River by AEA, 9 percent (4 out of 44) were in side channels and 11 percent (5 out of 44) were in sloughs (Table 2.6.2-6).

AEA is submitting the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (Attachment 7) documenting a method to combine estimates of relative abundance across gear types for a more comprehensive summary of fish-habitat association data.

Table 2.6.2-5. Habitat types and number of sites sampled for distribution and relative abundance sampling in the Middle River, 2013 and 2014 (SIR, Table 4.1-3).

Focus Stratum	Habitat Stratum	Geomorphic Reach												Total	
		MR-1		MR-2		MR-5		MR-6		MR-7[d]		MR-8			
		Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled	Targeted	Sampled
	Main Channel	3	2	3	3	2[e]	2 (1[g])	3	1	3	1	3	3		
	Split Main Channel[f]		1						1		1			17	17
	Multi-Split Main Channel[f]								1		1				
	Side Channel	2[e]	2	3	3			3	3	3	3	3	3	14	14
	Side Slough			3	3			3[b]	1[b]			3	3	12	12
	Side Slough Beaver Complex							3	5[c]						
Focus Areas	Upland Slough			3	0[a] (3)			3	3	3[b]	1[b]	3[b]		18	18
	Upland Slough Beaver Complex							3	3	3[d]	5[c]		3[c]		
	Backwater				1			1	1	2	2 (1[g])			3	4
	Tributary			1	0[a] (1)	1	0[a] (1)	2	2 (1[g])	3[d]	3 (2[g])	1	1	8	8
	Tributary Mouth			1	1	1	0[a] (1)	2	2	1[d]	1			5	5
	Clearwater Plume				1	1	1 (1[g])	1	1		1			2	4
	Subtotal Focus Areas	5	5	14	16	5	5	24	24	18	19	13	13	79	82
	Main Channel	3	3	3	1 (1)	3	2	3	3	3	1	3	2		
	Split Main Channel[f]				1		1				2		1	18	18
	Multi-Split Main Channel[f]														
	Side Channel	1[e]	1	3	3			3	3	3	3	3	3	13	13
	Side Slough			3	3	3	3	3	3	3	3	3	3	18	18
Non Focus Areas	Side Slough Beaver Complex									3	3				
	Upland Slough			3	0[a] (3)			3	2[a] (1)	3	1[b]	3	3	18	18
	Upland Slough Beaver Complex							3	3	3	5[c]				
	Backwater			1	1			3	3	1	1	1	1	6	6
	Tributary			3	0[a] (3)			3	2[a] (1)	3	3 (1[g])			9	9
	Tributary Mouth			3	2 (1)	1	0[a](1)	3	3	2[d]	2			9	9
	Clearwater Plume			3	3 (1)		(1)	3	2 (1)	1	1			7	9
	Subtotal Non-Focus Areas	4	4	22	23	7	8	27	27	25	25	13	13	98	100
Total number of sampling sites		9	9	36	39	12	13	51	51	43	44	26	26	177	182

Notes:

a site not accessible in 2013 to sample CIRI Lands or Alaska Railroad Corporation.

b Sloughs w/o Beaver Complexes were found upon visitation to support beaver activity and were reclassified.

c Sloughs with Beaver Complexes were added due to observed beaver activity in classified Upland Sloughs or Side Sloughs w/o Beaver Complexes.

d number of target sites per strata modified from IP Table 5.3-1 with inclusion of FA-113 (Slough 6A) in MR-7, May 2013.

e number of target sites modified from IP Table 5.3-1 due to sample unit length increases.

f this strata combined into Main Channel for sites selection purposes.

g Site re-sampled in 2014 due to partial sample in 2013 (land access).

() sites in parenthesis were sampled in 2014.

Table 2.6.2-6. Habitat types sampled for fish distribution in the Lower River by transect and reach in 2013 (ISR Part A, Table 4.1-4).

Geomorphic Reach	Transect PRM	Sample Type	Habitat Type										
			Main Channel	Side Channel Complex	Bar Island Complex	Side Channel	Upland Slough	Side Slough	Slough Mouth	Tributary	Tributary Mouth	Additional Open-water	Total
LR1	100.3	Abundance	1	1				1	1	1	1		6
LR1	92.9	Distribution		1	1	1				1	1		5
LR2	85.6	Distribution	1	1									2
LR2	78.2	Distribution	1			1							2
LR2	70.8	Abundance	1	1						1	1		4
LR3	63.5	Abundance		1	1		1		1	1	1		6
LR3	56.1	Distribution			1	1				1	1	1	5
LR3	48.8	Distribution	1	1									2
LR4	41.4	Distribution	1	1			1	1	1			1	6
LR4	34.0	Abundance	1			1		1		1	1	1	6
Total Abundance			3	3	1	1	1	2	2	4	4	1	22
Total Distribution			4	4	2	3	1	1	1	2	2	2	22
Total Sites Lower River			7	7	3	4	2	3	3	6	6	3	44
Estimated in Implementation Plan			10	10	10	6	4	0		2		2	44

2.6.2.5.2. Response to Modification Request Regarding the Evaluation of Gear Efficiency

USFWS requests (Modification 1; USFWS_pp9.6-2_ph2) that the efficiency of each sampling gear type be evaluated and compared so counts among sampling methods can be made comparable, interactions between sampling methods can be understood, and future sampling activities can be made more efficient. If such comparisons prove to be difficult or highly variable, USFWS suggests sampling gear be limited to the most effective gear types and deployment of this gear remain consistent. USFWS asserts that the use of multiple sampling methods to measure fish abundance and distribution across a diversity of habitat types remains problematic, and that different sampling gears have resulted in different, non-comparable measures of abundance. USFWS states that the effect of one sampling method on abundance estimates obtained in subsequent sampling activities is unknown, the same sampling gear-type is not used consistently (e.g., different electrofishing times or different densities of minnow traps), and the use of block nets seems to be inconsistent.

USFWS comments that the generally accepted scientific practice is to apply consistent methods and effort among sampling units to properly compare relative abundance by species and age class among habitat classification types. While Studies 9.5 and 9.6 have collected a vast amount of abundance data, USFWS recommends that these data be evaluated to identify the most efficient and repeatable sampling protocol and that protocol remain consistent for all abundance measurements.

NMFS also requests (NMFS_pp9.6-34_ph4a) that before any further sampling is done, gear effectiveness be evaluated, and then suggests that only specific gears that do not conflict with each other (by harassing or dispersing fish before the next gear is used) be used at each site.

In response, AEA requests that FERC not adopt these proposed Study Plan modifications because these requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modifications nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan.

AEA does not agree about the utility of evaluating gear efficiency for estimating relative abundance. Efficiencies of sampling gears vary by species, life stage, diet, and habitat conditions. Certainly efficiency cannot be assumed to be a constant gear-specific parameter. USFWS comments on the RSP that "*catchability for all standard gear types can vary greatly among different habitat types*" and that "*results based on CPUE would not directly reflect habitat quality because of the biases of gear among habitat types*" also reflect this understanding that applying uniform methods and effort across diverse habitats is not the generally accepted scientific practice to "*properly compare relative abundance*" (USFWS 2012).

AEA is less concerned about gear efficiency than overall sampling effectiveness. Depletion methods could be implemented at approximately one half of the number of sampling locations and very precise estimates could be developed to test statistical hypotheses that would miss entire life stages and species, and therefore would not be as effective at describing the complex fish assemblages found in the Susitna basin.

Instead, AEA has developed an index whereby data collected using multiple gear types can be combined to estimate the relative abundance of fish by habitat type. This proposed method is described in the technical memorandum *Development of Relative Abundance and Fish Habitat Use Indices* (FUHI) that has been filed with these responses to comments as Attachment 7.

AEA has addressed the need for use of different methods to effectively sample habitat that varied greatly with respect to parameters that affect capture/observation efficiency (FDA IP, Section 8: Field Techniques; updated FDA IP Appendix 3 filed November 14, 2015: *Protocol for Site-Specific Gear Type Selection; Version 5*; Study 9.5 SIR, Section 4.3.1.1: Field Methods). As discussed in these documents, the most appropriate methods for documenting the diversity of species and life stages potentially present within each mesohabitat unit (pool, riffle, and glide) were selected at the time of sampling. Many factors influence the effectiveness, suitability and selection of gear type including but not limited to: depth, velocity, substrate, snags, water clarity, water conductivity, and the presence of spawning salmonids. These environmental parameters changed geographically as well as over time within each site. Since AEA's objective was to characterize the fish present in all habitats and determine the relative abundance of them across habitats, this was the most effective approach. Still, the protocol included the use of Tier 1 preferred methods whenever feasible with reliance upon Tier 2 methods only when habitat conditions precluded the effectiveness of Tier 1 methods (FDA IP, Appendix 3, Table 1). Furthermore, this protocol was modified after 2013 data collection when the relative effectiveness of different sampling methods in the habitats selected for studies 9.5 and 9.6 could be evaluated and determined (FDA IP, Appendix 3, November 14, 2014: *Protocol for Site-Specific Gear Type Selection; Version 5*).

At the conclusion of the 2013 field season, AEA reviewed CPUE and catch by gear type for each species and life stage and implemented minor adjustments to the FDA IP gear selection protocol in order to prioritize the use of gears that were efficient or caught unique species or life stages (FDA IP, Appendix 3). Although existing data could be used for broad conclusions on efficiency based on any consistent results observed, it is not appropriate data for a comprehensive study of gear efficiencies. Such a study would be very difficult, if not impossible, to conduct in this complex system.

Unfortunately, it was not feasible in this study to apply one gear type to the varied macro and mesohabitats sampled and differences in gear efficiencies related to differing habitat conditions invalidate relative abundance estimates estimated with only one or two gear types. The FUHI TM (Attachment 7) documents a method to combine estimates of relative abundance across gear types for a more comprehensive consideration of fish-habitat associations. Consistent with the FUHI, AEA has developed a protocol for generating combined CPUEs for individual fish species by habitat, an example using juvenile Arctic Grayling is provided.

There are various metrics that can be used as the effort denominator including, area, time, net/trap counts, trap densities, and cast counts some of which are more appropriate than others for a given gear type. For analysis of relative abundance in the ISR and FUHI TM, AEA has used the most appropriate metric to standardize relative abundance for each gear type. For example, catch per trap was selected as the metric to standardize baited trap catch because it may be difficult to quantify the effective sample area of a baited trap, and the sample area may be influenced by site specific conditions like depth, flow, and the distance to a neighboring trap. For other metrics the best denominator of effort was area-based or time-based. In the FUHI, catch for each gear is standardized, compared to the catch rates everywhere that particular gear was used, and then combined across gears to determine how the habitat unit rates in comparison with others.

Streams sampled in the study area range from small unnamed tributaries less than 1 meter in width to the several-hundred-meter-wide Susitna River. As a general principle, to qualify as a unique mesohabitat unit, the unit must have been longer than the wetted width. Therefore, a riffle mesohabitat unit in a small tributary may have only been three meters long by two meters wide and a side channel site may have been 500 meters long by 50 meters wide. The size of a feature obviously affects the level of effort that should be applied. Recognizing the value of a consistently applied level of effort, sampling effort per a given area was standardized in the protocol for gear selection used by field crews. Effort was recorded and then used to standardize catch as CPUE; this is generally accepted scientific practice. AEA then developed a statistical framework for combining gear types that is demonstrated in the FUHI TM. AEA asserts that using the most effective gear for sampling each mesohabitat unit will best document the diversity and abundance of species and life stages present in the study area to fulfill the Study 9.6 study objectives of characterizing fish distribution and abundance across a broad array of habitats. The approach proposed in the FUHI TM then takes these catch-per-unit-effort data using the best gears and standardizes and combines them into an index of fish relative abundance and habitat use.

2.6.2.5.3. Response to Modification Request Relating to the Description of Data Analyses

NMFS recommends that the Study Plan be modified (Modification 13) to include a description of how the various data will be turned into quantitative estimates so that rigorous comparisons can be made across species, river habitat types and sampling date. This modification would allow for direct comparison among the sampling design, estimates and includes statistical tests to determine if differences in mean relative abundance measures are significantly different among habitat classifications at all classification levels 1 through 3, consistent with standard scientific practice. NMFS asserts that the approved Study Plan does not contain any section to describe the statistical analysis that will be applied to field data to address study objectives (NMFS_pp9.6-16_ph2). NMFS further states this is not the accepted scientific practice, and results from the first year of study raise questions as to whether this can be accomplished (NMFS June 22, 2016 ISR Comments, Appendix A). NMFS presents an example, commenting that the available reports provide a comparison of differences among sites based on mean values or total counts without consideration for differences in sampling method or effort, counter to standard scientific practice.

NMFS additionally recommends the sampling plan should be reevaluated so that there is a tight linkage between the sampling design and the estimates and statistical inferences that will be drawn from the data.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan.

AEA disagrees strongly with the proposed modification as rigorous, statistically significant comparisons were never a part of the Study Plan and not necessary to meet study objectives.

AEA's study was designed to provide a descriptive baseline characterization of fish distribution and relative abundance through hundreds of miles of habitat and was not set up to test specific hypothesis about the population estimates of fish in different habitats or across time. As clearly described in the Study Plan, Objective #1 of Study 9.5 requires a description of relative abundance and fish-habitat associations. While this objective can be met using fish counts and CPUE estimated by gear type, AEA has further developed an index of fish habitat as described in the *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (FUHI), documenting a statistically valid method to combine estimates of relative abundance collected using multiple gear types for a more comprehensive consideration of fish-habitat associations. Standard errors can be estimated and provided to the index.

Of note, the development of the FUHI was not a requirement to meet the Study objective, nor was it required by the FERC-approved Study Plan, but was implemented by AEA to synthesize data collected by multiple gear types and help elucidate patterns in overall fish use of habitat types within geomorphic reaches. Measures of variability and tests of statistical significance would require focused quantitative objectives about fish use which have not been developed at this time. However, the data that have been collected are amenable and sufficient for many comparisons that could be required in the effects analysis phase of the Project.

2.6.2.5.4. Response to Modification Request Regarding Using Different Gear in a Specific Sequential Order

NMFS recommends modifying the Study Plan (Modification 7; NMFS_pp9.6-9_ph6) to sample with different gear types in the following sequential order: include a minimum of 20 baited minnow traps fished for 20 to 24 hours used for every 200 meters of sampling unit length to document the seasonal distribution and relative abundance of juvenile Chinook and Coho Salmon. Following minnow trapping, backpack electrofishing is recommended to obtain abundance estimates of salmon fry and resident fish species that are not effectively captured in minnow traps (Sockeye, Chum, and Pink Salmon). Then use of fyke nets, hoop traps, and beach seines can be used to augment minnow trapping and backpack electrofishing, for fish distribution, but not to derive estimates of relative abundance.

NMFS notes that their RSP comments recommended that a sub-sample of nearshore habitat of main channel and side channels be sampled for juvenile species that may escape boat electrofishing and drift gill nets due to shallow depths and nearshore cover. . NMFS opposes AEA's proposed modification to sample 200 meter lengths of main channel and side channel habitats if boat electrofishing or drift gill netting is not used because they state it will result in different sampling methods being applied to different sampling units, which does not allow for accurate testing of differences in fish abundance among main channel and side channel sampling units or with off-channel habitats absent an accurate conversion factor. NMFS comments that sampling smaller main channel and side channel habitats using minnow traps and backpack electrofishing will likely underestimate the distribution and abundance of grayling, Dolly Varden, whitefish (spp.), and Burbot, whose probability of capture is lower when using these methods in the nearshore zone. NMFS also comments that mainstem sampling using only boat electrofishing and drift nets will underestimate the distribution and abundance of juvenile salmon. NMFS asserts that consistently sampling 500-meter mainstem habitats by boat electrofishing and drift gill netting and a 200-meter sampling nearshore unit with backpacking electrofishing and minnow trapping will apply methods suitable for all target fish species at all sampling locations and provide comparable measures of fish abundance within and among macrohabitat types.

NMFS further explains that baited minnow traps are an effective method for capturing juvenile Chinook and Coho Salmon and that multiple traps are necessary to obtain a consistent measure of relative abundance. NMFS comments that minnow trapping is not disruptive and should not affect the catchability of other sampling methods, and is not subject to the same restrictions by the ADF&G collection permits which have restricted the use of electrofishing in the presence of adult salmon. Therefore, NMFS states this method can be consistently applied within all sampling units on all sampling dates, including winter. NMFS also directs the type and order of gear that should be applied.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the study has not been implemented as provided by the approved Study Plan.

This modification request addresses three primary issues: gear selection, gear order and effort. AEA has responded to general comments about gear selection in Section 2.6.2.5.

It seems NMFS misinterpreted the sample length variance presented in Study 9.6 ISR Part A, Section 4.4.4.1, inferring that it applied to application of multiple methods at a mainstem site only when boat electrofishing was not used. Specifically, NMFS states that AEA sampled 200 meters of nearshore habitat in main channel and side channel habitats only when 500-meter samples of boat electrofishing and drift gillnetting were not feasible and goes on to recommend nearshore sampling with minnow trapping and electrofishing. This is a mischaracterization of how sampling was implemented. Following the gear selection protocol, AEA did subsample 200 meters of nearshore habitat regardless of whether or not a 500-meter boat electrofishing or drift gill net sample was collected (Figure 2.6.2-7). Of the 301 main channel and side channel sampling events at GRTS and transect locations, on average 2.94 gears were used at each site (Table 2.6.2-7). A combination of nearshore and mid-channel techniques were used to document the range of fish species and life stage that could be present in the main channel (Table 2.6.2-7). The most common gear types employed were backpack electrofishing (in nearshore areas), boat electrofishing, minnow trapping (in nearshore areas), and seining (in nearshore areas) followed by hoop trapping and gill netting (Table 2.6.2-7). The most appropriate gear types targeting the diversity of species and life stages were applied at each site at the time of sampling following the protocol for gear type selection.

Table 2.6.2-7. Gear types used to sample main channel and side channel sites during 301 sampling events at GRTS and transect locations in the Lower, Middle and Upper River, 2013-2014.

Gear Type	Events	% of Sites
Angling	2	1%
Boat Electrofish	206	68%
Fyke Net	26	9%
Gill Net	61	20%
Hoop Trap	82	27%

Minnow Trap	156	52%
Backpack Electrofish	242	80%
Seine	103	34%
Snorkel	4	1%
Trot Line	2	1%
Total Gear Events	884	

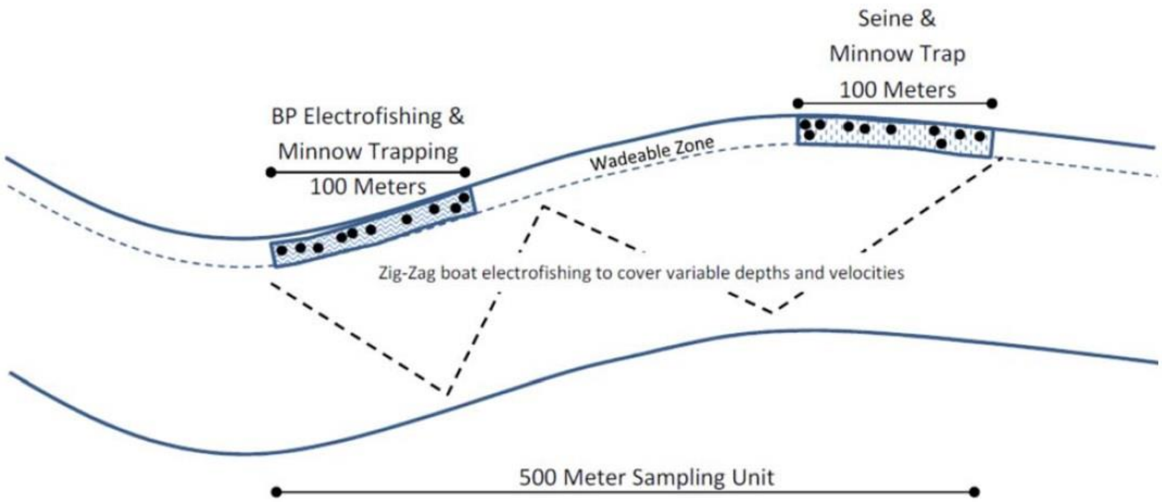

Figure 2.6.2-7. Figure 5 from Susitna River Fish Distribution and Abundance Implementation Plan: Appendix 3. *Protocol for Site-Specific Gear Type Selection; Version 5* (November 14, 2014).

AEA disagrees that the proposal to limit relative abundance estimates to catch from minnow traps and backpack electrofishing would follow generally accepted scientific practice. Although limiting gear types would make relative abundance calculations more simple computationally, the variable efficiency of those gear types across the diverse habitats of the Susitna River would prevent those estimates from being comparable. For example, if AEA adopted this modification and backpack electrofished in turbid riffles with low visibility and low conductivity, CPUE estimates could be statistically compared to CPUE estimates from clear water glides with moderate conductivity, but that analysis would not be an accurate reflection of any differences in fish assemblages. In this case, numerical precision and computational ease should not be confused with accuracy. AEA maintains that the most accurate description of relative abundance will be generated by using the most effective gears in each habitat type, as described in detail in the *Protocol for Site-Specific Gear Type Selection; Version 5* (FDA IP, Appendix 3, November 14, 2014).

AEA has responded to the request for consistent effort among sites in the response to Comment NMFS_pp9.6-9_ph5 in Section 2.6.2.5.5 below.

As for gear order, AEA has responded to concerns about this issue raised by Comment NMFS_pp9.6-34_ph4 (See Section 2.6.2.5.2). Appendix 3 of the FDA IP describes the standardized order in which gear types were applied. The protocol seeks to minimize the interaction among gears by using visual methods first, followed by active sampling and ending with passive overnight techniques. This approach is supported by Poesch (2014). AEA disagrees with the assertion that using minnow traps is not disruptive and should not affect the catchability of other sampling methods; the use of bait draws fish into the sampling unit and trap placement and retrieval is highly disruptive.

2.6.2.5.5. Response to Comments Regarding the Use of Different Collection Methods

NMFS comments that the ISR describes fish collection methods that varied in sampling unit, methodology and effort, resulting in fish data from electrofishing at one location or date, fyke net data at another date and/or location and time, and minnow trap data at a third date and/or location and time (NMFS_pp9.6-9_ph5). NMFS also notes that electrofishing effort varied from seconds at one location or one sampling date to 10 to 20 minutes at another. NMFS states that units of relative abundance or community composition were different and were not comparable among sites (i.e., catch/time/unit, catch/trap/unit, or catch/net/unit). NMFS asserts that consistent sampling methods must be used to meet study objectives.

Unfortunately, it was not feasible in this study to effectively apply one gear type to the varied macro and mesohabitats sample. Differences in gear efficiencies that were related to differing habitat conditions invalidate relative abundance estimates estimated with only one or two gear types. In *Development of Relative Abundance and Fish Habitat Use Indices Technical Memorandum* (FUHI) (Attachment 7), AEA documents a method to combine estimates of relative abundance across gear types for a more comprehensive consideration of fish-habitat associations. Consistent with the FUHI, AEA has developed a protocol for generating combined CPUEs for individual fish species by habitat that will be presented in the USR. An example using one year of data collection for juvenile Arctic Grayling is provided.

There are various metrics that can be used as the effort denominator including, area, time, net/trap counts, trap densities, cast counts some of which are more appropriate than others for a given gear type. For analysis of relative abundance in the ISR and FUHI TM, AEA has used the most appropriate metric to standardize relative abundance. For example, because it may be difficult to quantify the effective sample area of a baited trap, and the sample area may be influenced by site specific conditions like depth, flow, and the distance to a neighboring trap; catch/trap was selected as the metric to standardize baited trap catch. For other metrics the best denominator of effort may have been area-based or time-based. In the FUHI approach, catch for each gear was standardized, compared to the catch rates everywhere that a particular gear was used, and then combined to determine how the habitat unit rated in comparison with others.

Streams sampled in the study area ranged from small unnamed tributaries less than 1 meter in width to the several-hundred-meter-wide Susitna River. As a general principle, to qualify as a unique mesohabitat unit, the unit must have been longer than the wetted width. Therefore, a riffle mesohabitat unit in a small tributary may have only been three meters long by two meters wide and a side channel site may have been 500 meters long by 50 meters wide. The size of a feature obviously affects the level of effort that should be applied. Recognizing the value of a consistently applied level of effort, sampling effort per a given area was standardized in the protocol for gear selection used by field crews. Effort was recorded and then used to standardize catch as CPUE;

the generally accepted scientific practice. AEA then developed a statistical framework for combining gear types that is demonstrated in the FUHI TM. AEA asserts that using the most effective gear for sampling each mesohabitat unit will best document the diversity and abundance of species and life stages present in the study area to fulfill the Study 9.6 objectives of characterizing fish distribution and abundance across a broad array of habitats. The approach proposed in the FUHI TM then takes these catch-per-unit-effort data using the best gears and standardizes and combines them into an index of fish relative abundance and fish habitat use.

2.6.2.6. Responses to Modification Requests Regarding PIT Tagging

2.6.2.6.1. Response to Modification Requests for Improvements to the PIT Tagging Study

NMFS recommends a study modification (Modification 20; NMFS_pp9.6-19_ph7) of the PIT tagging study to be conducted as required in the Study Plan Determination, including evaluation of detection efficiency, and be modified such that the data can determine the movement patterns of juvenile salmon from spawning tributaries to the mainstem and off-channel habitats. NMFS comments that the primary objective of the PIT tagging study and fish sampling with screw traps is to determine when juvenile salmon of different age classes and tagged resident fish migrate from spawning tributaries to the mainstem Susitna River, but further asserts that the PIT tagging study was not conducted as approved in the Study Plan Determination. NMFS states that to do this, antennas must be relocated from Slough 8A, Montana Creek and Indian River, and installed at the Whiskers Creek site to develop antenna arrays to document direction of movement. NMFS also requests that screw traps in Montana Creek and Indian River operate seven days a week to capture migrating tagged and untagged fish. NMFS states that detection efficiency should be calculated for the antenna arrays, and that increased sampling and tagging efforts of juvenile salmon should be conducted within Whiskers Creek, Indian River, and Montana Creek to determine the proportion of juvenile salmon from tributary spawning locations that migrate to the mainstem Susitna River for rearing and overwintering. This modification would require the trapping and tagging 500 Chinook, 500 Coho, and 500 Sockeye Salmon that are between 50 and 80 mm fork length in each tributary during both summer and the single fall sampling dates.

USFWS requests (Modification 6; USFWS_pp9.6-4_ph8) that AEA evaluate the effectiveness and value of the PIT tagging program. USFWS asserts that the value of the 2013 and 2014 PIT tagging and detection program to describe fish movements is questionable. USFWS notes that PIT array antennas were not installed in sequential spatial intervals at antenna sites, eliminating the ability to both discriminate upstream or downstream movement and assess the detection efficiency. USFWS comments that very small numbers of tagged fish were captured outside the areas where they were tagged, and that the interpretation of results from the few fish that are recaptured is problematic since tagging effort is not representatively distributed over habitat types or behavior characteristics. USFWS concludes that a detailed evaluation of the results of PIT tagging activities and discussion among involved researchers may provide insights into ways to improve and expand the existing sampling and tagging program, to redirect the tagging objective to more attainable results (e.g., intensive study of a limited section of river), or to abandon the PIT tagging program and direct resources to other sampling activities.

In response, AEA requests that FERC not adopt these proposed Study Plan modifications because these requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan.

The general locations of PIT tag antennas were chosen to complement areas of intensive fish sampling (e.g., Focus Areas) during the Fish Distribution and Abundance Study such that the number of PIT tags deployed in the vicinity of each antenna, and the subsequent number of detections, could be maximized. As a result, targeted antenna locations were constrained to channel widths that approached or exceeded the functional limitations of PIT antenna technology. Where feasible, antennas were constructed to span the entire channel of the habitat feature. However, the electrical draw of such large individual antennas exceeded the amperage capacity of the PIT reader's multiplexer, preventing the deployment of multiple antennas from a single reader.

Duplicate antennas (each run off independent readers and power/charging stations) were tested at Whiskers Slough in early July 2013 in an attempt to discern directional movement and assess detection efficiency. However, considerable and inconsistent clock drift among each reader pair prevented accurate detection timestamps from which the sequence of upstream/downstream detection could be determined. To address this issue, in the fall of 2013, readers at Whiskers Slough and Slough 8A were connected to a new telemetry communications network and customized programming code was written to routinely correct each reader's clock. This approach was effective and replicated for the Slough 8A antenna location, although antennas at other locations had been removed for the season or destroyed by high flows or ice by that time.

In water bodies where channel width exceeded the functional limitations of PIT antenna technology or water velocity/depth rendered installation unsafe or infeasible, antennas were installed in either a portion of the channel or in an adjacent side channel to detect a subset of tagged fish movements. Because alternate routes of passage were available at these antenna locations, the standard method of evaluating detection efficiency was inappropriate; instead, read range and drift tests were relied upon to evaluate antenna performance.

Although the necessity of partial channel coverage reduced detection probability and constraints to deploying multiple antennas precluded determination of directionality, information regarding the movement of detected fish between a given antenna location and other antennas or recapture locations was still collected.

As proposed in the FDA IP (Section 5.6.8), PIT tagging of fish occurred opportunistically with other sampling activities including downstream migrant trapping, winter sampling, ELH sampling and seasonal FDA sampling. Since the tagging location and habitat are documented and the detection location and habitat are documented this does not make interpretation of the results problematic as suggested by the USFWS. Many fish were detected near where they were tagged; this demonstrates that some fish have site fidelity and use a limited home range and also is a product of spatial autocorrelation of where tagging occurred. The proximity of tagging to detection location does not detract from the information gathered or make it difficult to interpret. In fact, it may provide very meaningful results such as the duration that an individual inhabited a slough, a record of its daily movements, and the timing of outmigration or dispersal.

Despite the challenges in collecting information on directionality, and issues with maintaining antennas during high flow events, AEA considers the information gathered by PIT antennas in the Middle River useful. Overall, of the 7,252 fish PIT-tagged in the Middle and Lower River, 764 individuals (10 percent) were detected at antennas in the Middle/Lower River providing information on movement and 428 (5 percent) were recaptured providing information on movement and growth. As an example of information gathered a summary of Coho Salmon movement and growth follows.

Of the 3,425 juvenile Coho Salmon implanted with PIT tags in 2013 and 2014, 585 were subsequently relocated by recapture or detected at stationary PIT antenna arrays. Some fish were recaptured twice (n=27) or three times (n=3) while 150 fish were detected at one or more PIT tag arrays on multiple dates; 18 fish were both recaptured and detected. The subsequent location of these fish relative to their implant locations are depicted in Table 2.6.2-8. For fish initially tagged during the open-water season, the majority (92 percent) of relocations also occurred during this period, while 8 percent were observed later during winter. Although most relocations (70 percent) were within the same Focus Area or PRM in which the fish was tagged, 30 percent were at a different Focus Area/PRM located downstream; no fish were found at a Focus Area/PRM located upstream of where they were tagged. Likewise, there was no evidence of any tagged Coho Salmon juveniles moving into a tributary from the Susitna River or between tributaries. Most frequently, the relocation of fish outside of their tagging location occurred in side slough habitat located downstream. Fish tagged during winter were subsequently observed exclusively in the Focus Area/PRM in which they were tagged, regardless of whether they were relocated during the winter or ensuing open-water period.

Seven percent (n=251) of PIT tagged Coho Salmon were subsequently recaptured, although only six percent (n=202) of recaptures occurred after the eight-day minimum period deemed appropriate for analyzing growth rates. All of these fish were located in the Middle River, and the duration between tagging and recapture ranged from 12 to 334 days (mean=87 days). The mean specific growth rate (SGR) was 0.15 (percent growth/day) overall. Compared to other species, the number of Coho Salmon recaptures was large enough to offer some evaluation of growth rates across different locations (Table 2.6.2-9) and habitat types (Figure 2.6.2-8). Mean SGR was slightly less for fish initially tagged in Reach MR-8 (mean=0.10) compared to proximal upstream reaches, MR-7 (mean=0.16) and MR-6 (mean=0.17; Table 2.6.2-9). No strong trends were discernible in SGR as a function of habitat type, although more than half of juvenile Coho Salmon tagged in side slough and tributary habitat had SGRs in excess of 0.15, whereas half of those tagged in upland slough habitat had SGRs less than 0.09 (Figure 2.6.2-8).

Table 2.6.2-8. Movement among habitats and season by PIT tagged juvenile Coho Salmon detected or recaptured during study efforts in 2013 and 2014. Light shading indicates a shared Focus Area/Project River Mile, while darker shading indicates a shared macrohabitat.

Tagging Location			Detection/Recapture Location[2]																								
	Season[1]		Open-water																								
	Focus Area/PRM		81		104				106.9	113			115		118	123.9	128		138		141				143.9	144	
		Macrohabitat	Trib. Array	Trib. DMT	Side Slough	Side Slough	Upland Slough	Whiskers Cr.	MS DMT	Gash Cr.	Side Slough	Upland Slough	Unnamed	Upland Slough	Side Channel	MS DMT	Side Slough	Side Slough	Side Slough	Upland Slough	Trib. Array	Trib. DMT	Trib. Mouth	Upland Slough	Upland Slough	Side Slough	Upland Slough
Open-water	81	Montana Creek	1																								
		Tributary DMT	13	4																							
	104	Side Slough				21																					
		Upland Slough				16	4																				
		Whiskers Creek				41		1																			
	106.9	MS DMT			1	34			3																		
	113	Gash Creek								3																	
		Side Slough					1				1																
		Upland Slough				4						2															
	115	Unnamed 115.4				1					1		23														
		Upland Slough				8								33													
	118	Side Channel													1												
	123.9	MS DMT				61								5		3											
	128	Side Slough				1											1	9									
	138	Side Slough																	1								
	141	Indian River				1												2			3						
		Tributary DMT			1	30			3			1		3		5		5			71	9	1				
		Upland Slough																						40			
	143.9	Upland Slough																							15		
	144	Side Slough																								1	
		Upland Slough																									2
Winter	104	Side Slough						1																			
		Upland Slough																									
		Whiskers Creek																									
	113	Side Slough									4																
	128	Side Channel																									
		Side Slough																									
		Upland Slough																									
	138	Side Slough																									
		Upland Slough																		1							
	141	Upland Slough																						3			
	144	Side Slough																									2
		Upland Slough																								2	2

Tagging Location			Detection/Recapture Location[2]										
	Season[1]		Winter										
	Focus Area/PRM		104				128			138		141	144
		Macrohabitat	Side Slough	Side Slough	Upland Slough	Whiskers Cr.	Side Slough	Side Slough	Upland Slough	Side Slough	Upland Slough	Upland Slough	Upland Slough
Open-water	81	Montana Creek											
		Tributary DMT											
	104	Side Slough		1									
		Upland Slough	1		10								
		Whiskers Creek		2		1							
	106.9	MS DMT		2	1								
	113	Gash Creek											
		Side Slough											
		Upland Slough		3									
	115	Unnamed 115.4	1	1									
		Upland Slough		1									
	118	Side Channel											
	123.9	MS DMT		1									
	128	Side Slough					3	1					
	138	Side Slough								1			
	141	Indian River									1		
		Tributary DMT		2	2		1	2			1		
		Upland Slough										2	
	143.9	Upland Slough											
	144	Side Slough											
		Upland Slough											1
Winter	104	Side Slough	7	13	1								
		Upland Slough	5	3	18								
		Whiskers Creek		6		2							
	113	Side Slough											
	128	Side Channel						1					
		Side Slough						1					
		Upland Slough							1				
	138	Side Slough								11			
		Upland Slough									3		
	141	Upland Slough											
	144	Side Slough											
		Upland Slough											

Notes:

1 For the purposes of this analysis, the open-water season is the months of June through October while the winter season is November through May.

2 Values include fish that may have been detected or recaptured in multiple habitat types.

Table 2.6.2-9. Summary statistics for specific growth rates of juvenile Coho Salmon in the Middle River, during 2013-2014. Only fish with a minimum of eight days duration between recapture events were used for growth assessment. Site information reflects tagging event.

River Segment	Reach	Stream Name	ISR Habitat Channel Category	ISR Macro Habitat	Mean SGR (% length/d)	Min SGR (% length/d)	Max SGR (% length/d)	N
Middle	MR-6	Indian River	Trib	Tributary DMT	0.20	-0.01	0.70	9
			TRIB-MC	Indian River	0.11	0.11	0.11	1
		Susitna River	MC	MS DMT	0.17	0.06	0.27	4
			OCH	Side Slough	0.18	-0.23	1.04	18
				Upland Slough	0.16	-0.14	0.86	66
		Total			0.17	-0.23	1.04	98
	MR-7	Gash Creek	TRIB-MC	Gash Creek	0.26	0.16	0.34	3
		Susitna River	OCH	Side Slough	0.53	0.35	0.63	6
				Upland Slough	0.06	-0.27	0.66	32
		Unnamed 115.4	TRIB-MC	Unnamed 115.4	0.20	-0.25	0.54	22
		Total			0.16	-0.27	0.66	63
	MR-8	Susitna River	MC	MS DMT	0.34	0.34	0.34	1
			OCH	Side Slough	0.13	0.00	0.42	5
				Upland Slough	0.10	-0.09	0.44	31
		Whiskers Creek	TRIB-MC	Whiskers Creek	0.04	-0.27	0.37	4
		Total			0.10	-0.27	0.44	41
	Total				0.15	-0.27	1.04	202

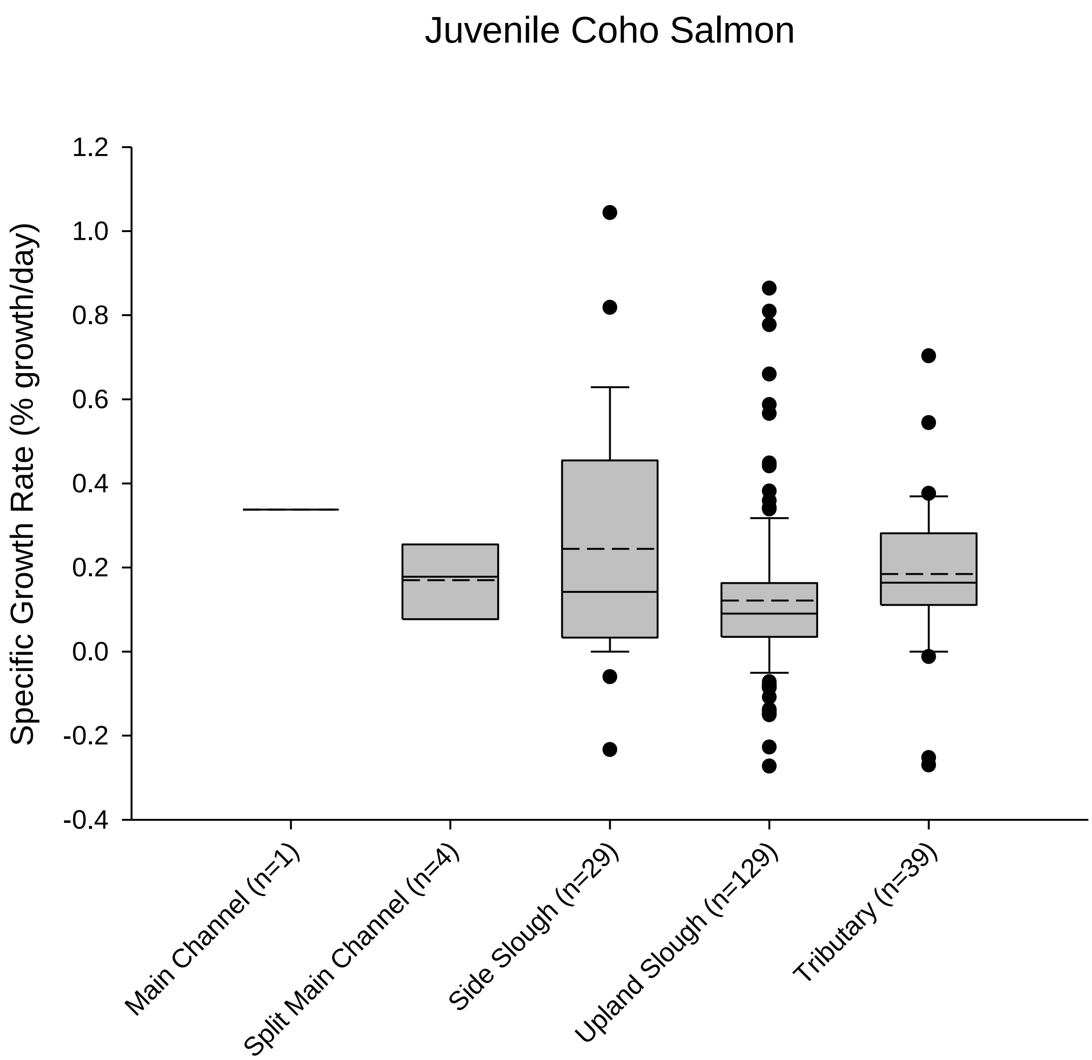

Figure 2.6.2-8. Box plot (median, 25-75%, and 10-90%) of specific growth rates of juvenile Coho Salmon recaptured during 2013 and 2014, by habitat type of initial tagging event. Mean is dashed line.

2.6.2.7. Response to Modification Requests to Continue and Expand Downstream Migrant Trap Operations for Two Years

USFWS requests (Modification 5; USFWS _pp9.6-4_ph5) that AEA continue and expand downstream migrant trap operations for two years, and evaluate the ability of these traps to describe the timing of fish migrating past these sites. USFWS states that modifications to trap operations which could improve trap performance include expanding operations to seven days a week, assessing the efficiency of traps, beginning trap operations earlier in the season, relocating traps to waters more favorable to trap operations, and the use of alternative capture methods.

In addition, NMFS also recommends a study modification (Modification 16; NMFS_pp9.6-18_ph3) to require downstream migrant traps (rotary screw traps) to be deployed immediately following breakup and operated throughout the open-water season to obtain two full years of migration data at four locations including the Indian River, mainstem near Curry, mainstem near

Talkeetna Station and Montana Creek, and to evaluate trap efficiency and abundance estimates as described within the approved sampling plan. NMFS recommends that the out-migrant screw traps in the Indian River and Montana Creek be operated 7 days a week to determine the proportion of tagged juvenile salmon migrating from these tributaries.

In response, AEA requests that FERC not adopt these proposed Study Plan modifications because the requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the study has not been implemented as provided by the approved Study Plan.

Downstream migrant traps cannot be installed and operated before the ice break-up process is complete. In 2013, downstream migrant trapping began as soon as feasible after ice-out. Break-up activity was concentrated between May 25 and May 29 and ice continued to float down river during the first week of June (Figure 2.6.2-9). Traps were transported and installed on site. Trap operation in the Middle River began on June 8, 2013 at Curry Station. Juvenile salmon were collected as soon as trap operations began. The collection of downstream migrating juvenile salmon when traps were installed immediately after ice-breakup was not unexpected. It is well documented that juvenile salmon outmigration co-occurs with the onset of warming water temperatures and ice break-up (FERC 1984; Hartman et al. 1967; Martin et al. 1987; Burgner 1991; Reist et al. 2006). AEA will continue to deploy traps as soon as possible after break-up. To do so before break-up would result in a high risk of damage to, or loss of, traps.

Figure 2.6.2-9. Ice jams at Whiskers Slough (PRM 105.4) May 25, 2013. (From Ice Processes Study 7.6 ISR Part A, Figure 5.1.2-4). Downstream migrant traps were installed as soon as feasible after breakup in 2013.

Consistent with the USFWS Modification 5, after reviewing the 2013 catch, AEA proposed to modify the location of two downstream migrant traps in the ISR Part C. AEA proposes to move the rotary screw trap located on the mainstem Susitna at Curry Station to the mainstem Susitna below Portage Creek between PRM 151.3-152.3 (ISR Part C, Section 7.1.2.3). AEA plans to move the Montana Creek rotary screw trap to a suitable location in the mainstem Lower Susitna River in the vicinity of Montana Creek (ISR Part C, Section 7.1.2.3). The proposed improvements to trap locations and the installation and operation of downstream migration traps for one more study year will result in data collection to meet Study Objective 2(a).

Operating traps seven days a week would result in increased overall catch but would not lead to a significantly better understanding of the timing of outmigration and movements. Resources are better used for other study components during the open-water period including ELH sampling, fish distribution and abundance sampling, and fish tagging and monitoring through biotelemetry.

2.6.2.8. Responses to Modification Requests Regarding Radiotelemetry

2.6.2.8.1. Response to Modification Request to Conduct Additional Radio Tagging

USFWS requests (Modification 7; USFWS_pp9.6-5_ph3) that AEA continue the planning and implementation of radio-tagging studies, by evaluating results from the two years of tagging and almost three years of locating tagged fish and assessing if tagging goals are appropriate and achieve stated objectives. USFWS requests that AEA conduct targeted searches to identify specific holding or spawning locations.

USFWS states that radio-tagging provided a good description of fish movements for the few fish that did survive; however, USFWS asserts that the study is very much crippled by the variances. USFWS comments that the release of radio-tagged fish was not distributed throughout the Susitna River drainage and that manual tracking and directed searches to identify habitat type of spawning or holding fish was not conducted.

USFWS comments that detailed analysis of the current radio-tagging data should provide at least some general ideas on movement and distribution and direction for subsequent radio-tagging studies. USFWS states that future radio-tagging activities need to include precise location and identification of habitat associated with holding and spawning activities, and that radio-tagging efforts should be allocated proportionally throughout the Susitna River drainage to study the movements of all populations of resident fish.

NMFS also recommends a study modification (Modification 22; NMFS_pp9.6-21_ph5) for AEA to conduct additional radio-tagging. NMFS specifies that the radio-tagging study should be modified to include (a) distribution of tagged fish equally among geomorphic reaches or proportional to the relative abundance of target fish species; (b) use of aerial over flights to contrast with boat, foot, or snow machine tracking as described in the RSP; (c) additional fish captured during winter as proposed; and (d) status of recaptured fish ascertained.

NMFS asserts that the radio tag study objectives were not met based on data presented in the ISR and subsequent *2013-2014 Winter Fish Study Technical Memorandum* (Study 9.6 TM, September 14, 2014), specifically, resident fish spawning, foraging, and overwintering locations and characteristics had not been identified. NMFS notes that the distribution of radio tags released throughout the drainage was not uniform, and doing so would provide a more detailed assessment of migration from and into different river areas. NMFS also comments that 2013 tagging goals were not met for Dolly Varden, Burbot, Artic Grayling, Longnose Suckers, Humpback Whitefish, Round Whitefish, and Northern Pike. NMFS states that winter biotelemetry observations were mostly limited to monthly aerial surveys for radio tags, and that because the fixed receivers at

Whiskers Creek, Indian River, Devils Island and Kosina Creek are only operational above -4°F, there was likely little winter data collected between aerial surveys.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan.

Resident fish foraging, overwintering and spawning locations are described in the *2013-2015 Radiotelemetry Implementation Report* (Attachment 8). AEA agrees that not all tagging goals were met in year one in the Middle River and asserts the radiotelemetry study is ongoing and additional tagging will occur in the next year of study. The FDA IP, Section 5.8 clearly describes the tradeoffs between tag size, pulse frequency, and battery life. The operating life of tags ranged from 180-901 days depending on the size of the fish tagged. AEA did not propose that two years of data would be collected on each tagged individual. In several instances, radio- tagging was done opportunistically when large fish were collected at fishwheels, downstream migrant traps or by FDA study crews sampling tributary mouths and clearwater plumes. The FERC-approved Study Plan describes the allocation of tags between the Upper and Middle and Lower river segments but does not specify geomorphic reaches. Although a concerted effort was made to distribute tags around the study area, resident fish of taggable size were not commonly collected everywhere and tagging occurred where these fish were most abundant. In addition, AEA crews implemented directed efforts to increase tag numbers for species that were rare in collections. In their comment, NMFS cites overall catch statistics for various species alluding to the abundance of target species; however, very few of these individuals are of taggable size. The overall allocation of tags was well distributed throughout the study area (Table 2.6.2-10). Twenty-seven Arctic Grayling and five Burbot were radio-tagged in MR-1 and MR-2 (Table 2.6.2-10).

The locations of fish during the spawning season are reported in the *2013-2015 Radio Telemetry Implementation Report* (Attachment 8). Some species had sufficient numbers of tagged fish surviving into the spawning season to provide good documentation while others did not. It is not a generally acceptable scientific practice to surgically implant radio tags in fish just prior to spawning. The FERC-recommended approach targets fish when they will potentially be at a phase of their life history (pre-spawning development) when they are more energetically taxed (as a result of limited food availability during the winter months) and potentially more sensitive to the stresses associated with handling. AEA reported the timing of tagging as a variance in the ISR and SIR, as well as justification for implementing the variance.

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Table 2.6.2-10. Capture locations for radio-tagged fish 2013-2014.

Hydro Segment	Tagging Location	Tributary Mouth	Arctic Grayling	Burbot	Dolly Varden	Humpback Whitefish	Lake Trout	Longnose Sucker	Northern Pike	Rainbow Trout	Round Whitefish	Grand Total
Lower River	Fish Creek (Kroto) TRM 1.9			1								1
	Fish Creek (Kroto) TRM 3.3								5			5
	Montana Creek TRM 2.3									6		6
	Talkeetna River TRM 5.9				3			3		1	1	8
	Talkeetna River TRM 6.3				3					7		10
	Susitna River PRM 33.8			1								1
	Susitna River PRM 33.9			2								2
	Susitna River PRM 80.9	Tributary Mouth		2						7		9
	Lower River Total		0	6	6	0	0	3	5	21	1	42
Middle River	Susitna River PRM 107			2		2		9				13
	Susitna River PRM 113.8	Tributary Mouth						2				2
	Susitna River PRM 117.5	Tributary Mouth						1				1
	Susitna River PRM 124.2		11	1	2	3		5		9	12	43
	Susitna River PRM 134.3	Tributary Mouth	2							6	6	14
	Susitna River PRM 142	Tributary Mouth	1		1			3		7	1	13
	Susitna River PRM 142.3	Tributary Mouth						4		1	1	6
	Susitna River PRM 152.3	Tributary Mouth	1			2		1				4
	Middle River DS of DC Total		**15**	**3**	**3**	**7**	**0**	**25**	**0**	**23**	**20**	**96**
	Susitna River PRM 175		1									1
	Susitna River PRM 179.4	Tributary Mouth	10									10
	Susitna River PRM 183.8			1								1
	Susitna River PRM 185.2			1								1
	Susitna River PRM 186.8			3								3
	Tsusena Creek TRM 0.1	Tributary Mouth	16									16
	Middle/Lower US of DC		**27**	**5**								**32**
	Middle River Total		**42**	**8**	**3**	**7**	**0**	**25**	**0**	**23**	**20**	**128**
Upper River	Clearwater Creek TRM 0.9		2									2
	Goose Creek TRM 0.1	Tributary Mouth	6								1	7
	Goose Creek TRM 0.3		2									2
	Kosina Creek TRM 0.1	Tributary Mouth	29									29
	Oshetna River TRM 18.3		2									2
	Oshetna River TRM 21.7		6									6
	Sally Lake						1					1
	Susitna River PRM 187.7		1									1
	Susitna River PRM 189.5	Tributary Mouth	22									22
	Susitna River PRM 192.7	Tributary Mouth		2				1				3
	Susitna River PRM 194.3			1								1
	Susitna River PRM 194.8	Tributary Mouth	2									2
	Susitna River PRM 196.4		3	2				3			1	9
	Susitna River PRM 198.1							1			2	3
	Susitna River PRM 198.9	Tributary Mouth	1	1				5			10	17
	Susitna River PRM 201.4										2	2
	Susitna River PRM 203.5		7	5				2			2	16
	Susitna River PRM 206.7		5	3				8			14	30
	Susitna River PRM 208.3		3									3
	Susitna River PRM 210.3			4								4
	Susitna River PRM 211	Tributary Mouth	2	2								4
	Susitna River PRM 211.1	Tributary Mouth		1								1
	Susitna River PRM 213.6							1			1	2
	Susitna River PRM 215.2	Tributary Mouth		1								1
	Susitna River PRM 227.1		2									2
	Susitna River PRM 232.4	Tributary Mouth		2								2
	Susitna River PRM 247	Tributary Mouth						4				4
	Susitna River PRM 247.3	Tributary Mouth		5				6			2	13
	Tsisi Lake 1						11					11
	Tyone River TRM 0.4							5				5
	Watana Creek TRM 0.1	Tributary Mouth	16	11				8			6	41
	Upper River		**111**	**40**			**12**	**44**			**41**	**248**
Grand Total			**153**	**54**	**9**	**7**	**12**	**72**	**5**	**44**	**62**	**418**

2.6.2.8.2. Response to Modification Request to Develop a Sampling and Radio-Tagging Program for Northern Pike

USFWS requests (Modification 9; USFWS_pp9.6-6_ph3) that AEA develop a more complete sampling and radio-tagging program for Northern Pike populations. USFWS notes that there was no focused effort to census waters outside of the abundance and distribution study area or to present results other than to state that the radio-tagged fish remained within one river mile of the tagging location in 2013. USFWS comments that far more effort and resources need to be allocated to this part of the study in order to meet the objective. USFWS asserts that the sampling plan should identify sampling locations and methods that can target Northern Pike populations, and radio-tagging goals need to be developed that adequately describe the movement of these fish. USFWS comments that studies from the Sport Fish Division of Alaska Department of Fish and Game and possibly other agencies should be referenced to obtain a better understanding of the abundance, distribution, and movement of this fish species.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan.

Northern Pike were tagged within the known distribution range for the species in the Susitna River study area. Tagging occurred during the foraging period and in the section of the river where Northern Pike were expected to be present. All detections of Northern Pike were within the known distribution range for the species. Telemetry results indicated no presence of Northern Pike in the Upper or Middle River.

While no Northern Pike were radio-tagged in the Upper River, the study objectives were met for that portion of the drainage as it is representative of existing conditions and the current fish assemblage present. Northern Pike have not been detected in the Upper River during this study nor in a number of other studies. Due to the small number of individuals tagged in the Lower River, limited information could be gathered for this species from this study. To complete the study AEA plans another year of radio tagging and tracking efforts (ISR Part D) in the study area with the goal of allocating a total of 30 radio tags to Northern Pike in the Middle/Lower River. Targeted sampling may be necessary in the Lower River in order to reach tagging goals. AEA does not plan on collecting Northern Pike outside of the study area for tagging as there is no nexus with the Project. Furthermore, data gathered from Northern Pike studies conducted by Sport Fish Division of ADF&G in the Lower River will be incorporated into describing this species' distribution and movements.

Historically, within the Susitna River, Northern Pike have been documented in Lower River tributaries as far upstream as the Deshka River (PRM 44.9). The suspected distribution extends to tributaries up to the Three Rivers (Ivey 2009). There is little information specific to the Susitna River regarding northern pike spawning, juvenile emergence, or juvenile rearing. Telemetry studies suggest that adult northern pike do not migrate significant distances within the Susitna Basin; a 1996 study found that over the course of one year, only one out of 18 radio-tagged northern pike moved a distance greater than 10 km and many moved less than 1 km (Rutz 1999).

Northern Pike fish distribution and abundance sampling and radio tracking in 2013-2014 confirmed that distribution of Northern Pike in the study area is limited to Fish Creek, Kroto Slough and the Yentna River Confluence. The FDA IP Section 5.8.1 indicated that tagging would take place opportunistically with coordinated fish collection efforts in the study area.

Details of the movements of radio tagged Northern Pike 2013-2014 can be found in the *2013-2015 Radio Telemetry Implementation Report* (Attachment 8). It is important to note that AEA has reviewed the extensive previous studies on Northern Pike and will incorporate that information into the License Application along with data from Study 9.6.

In 2013, a total of five Northern Pike were radio-tagged in the Lower River downstream of Devils Canyon. All five Northern Pike were captured and tagged 3.3 river miles up Fish Creek, a tributary to Kroto Slough in the Lower River (PRM 34.1). Northern Pike tagged in the Lower River with one or more live detections following the release day (n=4) were tracked for 144 to 439 days with a median 235 days. One fish was not detected alive following release. No fish were detected at fixed stations. Four tagged fish (100 percent) were located on aerial surveys. The number of aerial surveys in which tags were detected ranged from 1 to 28 with a median of 5 surveys. Northern Pike with active tags were tracked over a 15-month period (August 2013 to October 2014).

All four Northern Pike remained in the Lower River downstream of the Three Rivers Confluence (PRM 102.4) for the monitoring duration. Total distance traveled for Northern Pike with active tags with one or more detections following release (n=4) ranged from 1.9 to 30.4 river miles, the median distance was 6 river miles. The home range size for most Northern Pike was small. Linear home range span for fish tracked 60 days or more (n=4) ranged from 0.9 to 30.4 miles with a median of 1.7 miles. The majority of fish utilized a 2-3 mile reach of Fish Creek during the foraging, overwintering and spawning seasons. Tagged fish tended to be near the confluence of Fish Creek with Kroto Slough in August and September, however, samples sizes were low and no seasonal directional movements were observed. One fish (Tag 9152) made an extensive upstream movement more than 25 miles up the Yentna River prior to being caught and reported in the sport fishery.

All four Northern Pike (100 percent) used tributary habitat exclusively during the monitoring period. Three fish used one tributary and one fish used two tributaries. The most frequently used tributaries were Fish Creek (4 fish) and the Yentna River (1 fish). Of the four fish that used tributaries, 3 (75 percent) were detected only in the lower two miles (TRM 0.0-2.0), and one fish (25 percent) was detected 10 or more miles upstream in Fish Creek. Fish Creek and the Yentna River accounted for 95 percent and 5 percent of all aerial survey detections during the monitoring period respectively. All four tagged Northern Pike (100 percent) re-located on at least one aerial survey were found outside of the ZHI on all surveys. Tagged fish exclusively used tributary reaches in the Lower River that are not within the ZHI of the Project.

2.6.2.9. Responses to Modification Request Regarding Expanding the Geographic Extent of Sampling

2.6.2.9.1. Response to Modification Request to Conduct Macrohabitat-based Sampling in the Lower River

NMFS recommends (Modification 10; NMFS_pp9.6-12_ph3) Lower River sampling units be selected based on macrohabitat classification for determining fish habitat associations. NMFS also recommends the study be modified to conduct macrohabitat sampling based on macrohabitat classification in a minimum of 10 tributary mouths, side sloughs, upland sloughs, side channels, and main channel habitats.

NMFS states that transect-based sampling was used in the Lower River and resulted in samples being collected in far proximity from mainstem or underrepresented off-channel habitats important for juvenile salmon. NMFS comments that sampling in side sloughs, tributary mouths, and upland sloughs should occur at the confluence with side channels or main channel as described in the FERC Study Plan Determination, and that Lower River sampling units must adequately replicate available habitats to document the distribution of fish within the Susitna River and test for differences in relative abundance among river segments, geomorphic reaches, and macrohabitats. NMFS also comments that their RSP comments recommended selecting sampling units based on macrohabitat classification and not using the transect approach.

NMFS asserts that the FERC Study Plan in the Lower River for sampling unit selection in off-channel habitats was not implemented, limiting the utility of this information. NMFS also states that the Lower River sampling sites displayed on maps in the Study 9.6 ISR show that sampling locations were not selected per the Study Plan; these habitats were sampled at transect locations instead in side sloughs and upland sloughs from their confluence with the mainstem and upstream 200 meters.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan. However, AEA does propose to modify the Study Plan to increase sampling of rare habitats in the Lower River, described herein.

This modification request repeats the initial study request and was addressed during the Study Plan Determination (Study 9.6 SPD, April 1, 2013, p. B-154). FDA sampling in the Lower River was based on systematic random sampling of macrohabitat types in proximity to selected transect locations, as planned in the FERC-approved Study Plan. Off-channel habitats were sampled in a higher proportion than their availability within wide proximity to transect locations, however, these habitats were rare. Random sampling makes evaluating habitat associations with rare habitats difficult.

AEA proposes to increase sampling of rare habitats in the Lower River using the same method proposed for the Upper River – a hybrid transect and GRTS approach. Transect sampling will be continued for the relatively abundant main channel habitat types. In order to increase sampling in rare habitat types that may be important for fish, AEA proposes to take advantage of geomorphic mapping to implement a GRTS sampling approach for rare, off-channel habitat types including upland sloughs, side sloughs, tributaries, and additional open-water. Backwater habitats would be sampled when present at slough mouths; tributary mouths and clearwater plumes would be sampled when present at tributary confluences.

Considering updated simulation results from the Open-water Flow Routing Model (OWFRM) in the Lower River, AEA proposes to increase Lower River sampling within Geomorphic Reaches LR-1 to LR-4, where stage changes are predicted upstream of the confluence with the Yentna River. AEA proposes to sample 6 replicates of each off-channel macrohabitat type (4) present within each geomorphic reach (4) during each sampling event (3). Sampling six replicates is consistent with NMFS's previous study request; NMFS does not provide justification for increasing the minimum sample size from their original request for 6 replicates to this request for 10 replicates of all habitat types.

AEA's proposed hybrid sampling approach will maintain the integrity of the data collected in 2013. It will minimize the risk of selecting sites impossible to sample by providing a list of oversample sites to draw upon. It will also increase both the types of habitat as well as the overall area of habitat sampled in the Lower River, and thereby improve AEA's ability to characterize fish-habitat associations in the Lower Susitna River.

This fish sampling effort will be paired with ground-based habitat characterization following the protocol described in Study 9.9. Pairing these two study efforts will maximize the information gathered during field efforts in remote locations over a large study area.

2.6.2.9.2. Response to Modification Request for Expanding Fish Sampling and PIT Tagging into Whiskers Creek, Montana Creek, and the Indian River

NMFS recommends (Modification 21; NMFS_pp9.6-21_ph3) expanding the geographic extent of fish sampling and PIT tagging to include Whiskers Creek, Montana Creek, and Indian River during the two summer and single fall FDA sampling events. NMFS requests that a minimum of 500 Chinook, 500 Coho, and 500 Sockeye be tagged in each stream during each sampling event at each location. NMFS requests that sampling locations and methods within each tributary be completed as provided in their RSP comments. NMFS's RSP comments (summarized in the FERC Study Plan Determination, April 1, 2013) were, "*NMFS and FWS state that five 400-meter long fish sampling locations should be located in Indian River and stratified longitudinally from the PIT tag array site to the farthest upstream Alaska Railroad crossing. The agencies state that five 400-meter fish sampling locations should be located in Montana Creek from the Parks Highway extending upstream to Yoder Road. The agencies request that five 200-meter long fish sampling locations should be established in Whiskers Creek at 1,000 meter intervals extending upstream from the Susitna River confluence. The agencies recommend that fish sampling be conducted in these locations using a combination of electrofishing and minnow trapping as described previously to capture juvenile coho and Chinook Salmon for PIT tagging.*" NMFS comments that the purpose of this recommendation was to ensure that tags were applied to those fish under investigation, stating that it is necessary to tag these populations in order to determine the proportion of fish from spawning tributaries that migrate to the mainstem. NMFS comments that tagging fish from mainstem screw traps and FDA sampling locations did not, and will not, meet this Study objective.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan.

It is not an objective of Study 9.6 to determine the proportion of fish from spawning tributaries that migrate to the mainstem or to conduct intensive sampling upstream of the zone of hydrologic influence of the Susitna-Watana Project. While the tagging of juvenile fish in tributaries would provide information about the dispersal and mainstem rearing locations of fish from particular tributaries, it is not an objective of the study. It is not clear to AEA, and NMFS does not articulate, how the timing of outmigration from these three creeks may be related to potential Project effects. Furthermore, information on downstream movements is already being collected through salmon ELH sampling, downstream migrant trap operation and biotelemetry. A total of 1,001 of 7,525 (14 percent) PIT tagged fish in the Middle/Lower River have been detected at arrays or re-captured and many thousands of juvenile salmon have been collected in downstream migrant traps and during salmon ELH sampling demonstrating that the approach proposed in the Study Plan is effective. AEA has recommended adjustments to rotary screw trap locations (ISR Part D); moving the Curry trap downstream of Portage Creek and the Montana Creek trap to the Lower River mainstem to gain a better understanding of juvenile salmon outmigration within areas potentially affected by the Project.

2.6.2.10. Response to Modification Requests Regarding Winter Fish Studies

2.6.2.10.1. Response to Modification Request to Conduct Winter Fish Sampling in the Middle and Lower River

NMFS recommends a study modification (Modification 12; NMFS_pp9.6-15_ph2) to document the Middle and Lower River fish distribution, habitat association and abundance during the winter months. NMFS comments that the approved Study Plan stated that sampling would occur monthly in all Middle River Focus Areas and that the FERC Study Plan Determination stated that sampling would occur monthly in all Focus Areas and "*winter sampling efforts would utilize the same sampling locations but would be less frequent, approximately monthly instead of bi-weekly and for winter would be dependent on safe access and sampling methods (due to ice cover).*" NMFS states that despite a pilot study in 2013 and 2014 demonstrating that winter sampling is feasible, sampling has not been conducted monthly in all Focus Areas as described within the approved Study Plan. Therefore, NMFS contends that the study was not conducted as provided in the approved Study Plan.

NMFS also comments (NMFS_pp9.6-47_ph1) that the objective of determining juvenile salmon overwintering habitat associations has not been accomplished due to problems with habitat classification and site selection, inconsistent sample collection methodology, low or no replicate sampling of macrohabitats, and absence of measures of habitat characteristics. NMFS also states that there is no information for two of the five Susitna River macrohabitats (main channel and tributary mouth) and no information on the habitat characteristics within or among those habitats investigated.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan.

AEA agrees that the 2012-2013 winter field season consisted of a pilot study to test sampling techniques and develop sampling recommendations (Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*). However, AEA disagrees with NMFS's claims that the study was not implemented per the approved Study Plan and that the SPD indicated that AEA should sample monthly at all Focus Areas. The summary of the AEA 2013 pilot study as summarized on page B-149 of the April 1 SPD indicated that AEA would conduct the pilot study in the Whiskers Slough FA, determine logistics, safety and suitable methods, and make recommendations for future winter sampling efforts. On page B-165 of the April 1 SPD, FERC's Discussion and Staff Recommendation on Winter Sampling indicated that AEA's phased approach was reasonable, sampling methods were consistent with scientific practices, and no modifications were recommended. The quotation NMFS includes from the SPD was taken from the FERC Discussion and Staff Recommendation regarding AEA's proposed early life history studies (April 1 SPD pg B-166) and the context of that statement pertains to the relationship between winter and early life history sampling. It is important to note that the end of FERC's statement is that sampling "for winter would be dependent on safe access and sampling methods (due to ice cover)."

Based on the pilot study, it was evident that winter studies pose significant risks and hazards to field researchers and that a collaborative study approach among resource disciplines with study efforts concentrated in a handful of already well-studied Focus Areas with good accessibility would be integral to a successful and safe winter campaign. It was also found to be challenging to find flowing water under the ice in the main channel and side channels except for open-water leads which should be avoided and study efforts would need to be focused on off-channel areas to minimize risk. Furthermore, winter ice conditions were found to be extremely dynamic, on some sampling occasions a site may have 3 feet of ice with 2 feet of water underneath and on another occasion it may be frozen to the substrate. For these reasons it was not feasible to implement an entirely systematic random sampling program in the 50 miles of mainstem river downstream of Devils Canyon similar to the open-water period.

Subsequent to the 2013 pilot effort, AEA recommended expanding the winter sampling program (Study 9.6 ISR Part A, Appendix C, Section 6.1.1). As presented in Appendix C, AEAs' recommendations included:1) conducting interdisciplinary field trips to maximize safety and minimize logistical concerns, 2) concentrating the effort in three Focus Areas [FA-104 (Whiskers Slough), FA-128 (Slough 8A), and FA-138 (Gold Creek)], and 3) monthly sampling with the timing dependent upon safe and practical transportation conditions. The approach implemented in 2013-2014, to the extent practical based on ice conditions, used the same stratified macrohabitat locations randomly selected using the GRTS method for the fish distribution and abundance sampling conducted during the open-water period in 2013. Each sampling event included sampling in three replicate sites of each off-channel macrohabitat type present within each of the three Focus Areas. When open-water GRTS did not have appropriate conditions for sampling, spatially random oversample sites were evaluated and sampled. To supplement GRTS sampling, opportunistic sampling took place at particular features of interest inside and outside of Focus Areas and at main channel sites that could be safely accessed and sampled. For consistency with all study efforts, macrohabitat classification for winter used classifications from the habitat mapping efforts (Study 9.9); although notes on observations regarding connectivity and flow were recorded during winter, the lowest discharge period of the year.

Data collected in 2013-2014 were representative of habitats inside of the three Focus Areas. The selection of these Focus Areas was a collaborative effort among many stakeholders. NMFS indicates that tributary mouth and main channel sampling did not take place. The mouths of small to medium sized tributaries including Skull and Gold creeks were found to not have flowing water (or water was subsurface) in winter (Skull Creek contained a few inches of frazil ice/water in one pocket under the ice in February 2014 in which a video camera was deployed), Whiskers Creek and Whiskers Slough near their confluence were intensively sampled but Whiskers Creek lacks a mouth as defined geomorphically, FA-138 (Gold Creek) does not contain a tributary, and the mouth of Indian River was sampled opportunistically between February and April 2014 (Table 4.3-1 in Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*). Because of potentially hazardous conditions, main channel sites were not proposed for winter sampling, yet opportunistic main channel sampling took place at two locations in 2013 and three locations in 2014 (Table 4.3-1 in Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*).

Habitat characteristics were measured in the field in accordance with the variables proposed in the FDA IP (Figure 2.6.2-10) but not have been a focus of reporting and analysis as analysis of fish abundance or presence by habitat variables is not a study objective. See example winter data field form from the FDA IP for variables collected during winter studies (Figure 2.6.2-10).

Even more extreme than during the open-water period, winter conditions were variable and as such, the most effective or appropriate gear to use at a site varied. For example, when open-water was present the preferred techniques were electrofishing and fyke netting, depth permitting. However, on the next sampling event the same site may have been completely frozen over and required under ice minnow trapping and underwater video. AEA asserts that the most effective and appropriate gears should be used at each site based on conditions at the time of sampling to best characterize the fish species and life stages that may be present. AEA proposes to use a combined gear approach, similar to that demonstrated in the FUHI TM (Attachment 7), to adjust for the selection of different sampling techniques on different events. AEA believes that the data collected in 2013-2014 with the addition of a second year of data collection as proposed in the ISR Part D and supplemented with the 2012-2013 pilot study efforts, 1980s licensing efforts, winter habitat suitability criteria sampling under Study 8.5, and synoptic Middle and Lower Susitna River winter fish sampling over the 2012-2013 winter (Davis et al. 2013), 2013-2014 winter (Davis et al. 2015), and 2014-2015 winter (Davis and Davis 2015) will provide the baseline documentation necessary for impact analysis in a License Application.

AEA SuWa FDA Study — Winter Fish Sampling — Pg ___ of ___

Form A1 - WS

Event Information

Site ID:		Start Date:		End Date:
Weather:		Air Temp (ºC):	Crew:	
Site Arrival Time:			Site Departure Time:	
DS Coords (WGS84): N		W	DS Coord Description:	
GPS Unit:	GPS Date:	GPS Wpt:		
US Coords (WGS84): N		W	US Coord Description:	
GPS Unit:	GPS Date:	GPS Wpt:		

Stream Habitat Classification

MS Hab Category (L3):	MC	OCH	NA (i.e., TRIB)		Trib Channel Type:		Single (1)		Split (2)
MC Hab Type (L3):	MC	Split MC	Mult Split MC	SC	NA		Complex (≥3)		NA
OCH Type (L3):	Side Slough	Upland Slough		NA	Trib Mesohab Type (L4):		Falls		Chute
MC/OCH Mesohab Type (L4):	Rapid[1]	Riffle	Run	Glide	Cascade		Rapid		Boulder Riffle
[1] Applies to MC only. [2] Applies to OCH only.	Pool		Beaver Complex[2]	NA	Riffle	Run	Glide	Pool	Alcove
MC/OCH Spcl Mesohab Type (L4):	Trib Mouth	Trib Plume		None	Beaver Pond		Percol'n Chan		NA
MC/OCH/Trib Pool Subtype:	Str Scour	Lat Scour			Plunge Pool		BW Pool		NA
Habitat Classification Comments:									

Site Information

Site Length (m):	Representative Site Width (including areas under ice; m):			
Water Temp (ºC):	Amb Cond (µS/cm):	Turbidity (NTU):	DO (mg/L):	DO (%):
Site Event Comments:				

Habitat & Ice Conditions

Open Wat Avg Dep (m):	Open Wat Max Dep (m):		Ice Cover (to nearest 10%):
Obs Ice Thickness (m):	Min _______	Avg _______	Max _______
Obs Under Ice Wat Depth (m):	Min _______	Avg _______	Max _______
Habitat & Ice Conditions Comments:			

Site Photos

Camera ID	*Photo #*	*Photo Description (e.g., photo orientation - US/DS, LB/RB)*

Time Zone _____

QC1 Init Date ___________
Data Entry Init Date ___________
QC2 Init Date ___________

Figure 2.6.2-10. Example of the winter fish studies field form.

2.6.2.10.2. Response to Comment Regarding Validity of November and April Winter Samples

NMFS asserts that only samples collected during February and March should be used to assess winter habitat associations of juvenile salmon and resident fish (NMFS_pp9.6-49_ph1). NMFS states that November sampling is prior to ice development and does not reflect winter conditions, due to the fact that the formation of ice significantly alters water depths and velocities among macrohabitats. NMFS comments that conditions are fairly stable from December following ice development through March, but during April, breakup has started with an open mainstem channel which reduced stage height in off-channel habitats.

AEA disagrees that data collection from November 2013 and April 2013 and 2014 should not be used for winter studies. Consistent with the Study Plan and AEA recommendations developed following the pilot study, sampling took place monthly from February to April in 2013 and 2014. In 2013, a November cold snap with sustained temperatures below 10°F led to a rapid freeze of both off-channel habitats (Figure 2.6.2-11) and much of the main channel and water temperatures were below 1°C in the main channel indicating winter conditions (Figure 2.6.2-12). The November 2013 sample was an abbreviated add-on sampling event to collect information during low flow freeze-up process in early winter 2013. AEA reported the November sampled as a variance in the ISR Part D; however, this variance strengthens our ability to describe the winter season during a freeze up period when not much work has been conducted. In an unrelated study on the same section of the Susitna River, Davis et al. 2013, used fish collections from October and November when main channel temperatures averaged 5.4° to compare with mid-winter sampling. In addition, April is indeed still winter on the Susitna River as the river is completely frozen over and the mainstem temperatures remain less than 0-1°C (Figure 2.6.2-12). April is a very interesting and critical part of winter to study as the photoperiod and productivity increase and large number of salmon fry begin to emerge.

Figure 2.6.2-11. Winter conditions on November 17, 2013 at Slough 11 (left) and the main channel (right).

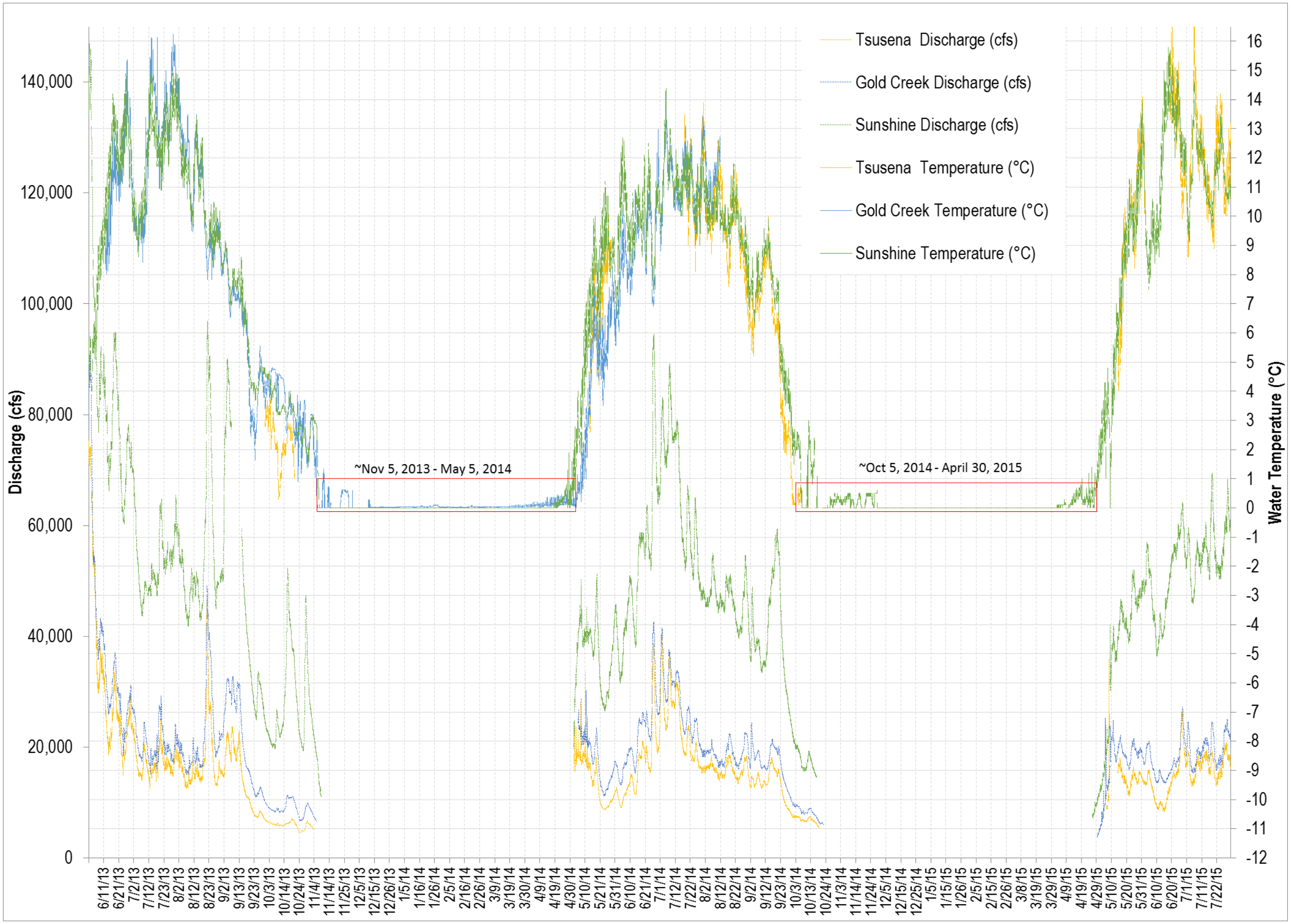

Figure 2.6.2-12. Streamflow and temperature used to characterize the winter season for radiotelemetry analysis.

2.6.2.11. Responses to Other USFWS Comments

2.6.2.11.1. Response to Comment Regarding the Study Data Use, Analyses, and Documentation

USWFS states that: 1) AEA must describe the basic process of how the results of the study will be used to estimate Project effects on fish populations, and provide statements about what is an acceptable level of accuracy and precision; 2) the data collected in all sampling activities need to be made accessible and fully documented; and 3) the data should be appropriately summarized and interpreted and statistical methods used in this process should be fully documented (USFWS_pp9.6-1_ph2).

In response, AEA asserts that Study 9.6 addresses the objectives as presented in Section 9.6.1 of the Revised Study Plan. Impact analysis is not part of this baseline characterization of fish populations and will be addressed once baseline data collection is complete and potential Project impacts are defined. This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impact assessment in a License Application, please see Section 1.3.

A relational database of data collected during 2013-2014 sampling activities is publically available at http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.6-Fish_Dist_and_Abund_Mid_Lower_Susitna/. Reporting efforts to date have focused on the methodology of field data collection and the summarization of results at a high level in order for the FERC and stakeholders to evaluate the adequacy of data collection to meet study objectives in the Study Plan. AEA has described the methodology used, has summarized the data collected to date in the ISR, SIR, and several TMs listed and described in Study 9.6 ISR Part D, Section 4.

2.6.2.11.2. Response to Comment Regarding Incomplete Study Components

USFWS states that many study components of Study 9.6 remain incomplete or not attempted at all (USFWS_pp9.6-1_ph4). USFWS describes these as including a mark-recapture study to estimate rotary trap efficiency that was not conducted; association of movement patterns in relation to water conditions (discharge, temperature, and turbidity) that was not summarized; documentation of diurnal behavior beyond the winter months of February, March, and April; accurate location of spawning grounds, capture of Humpback and Round Whitefish and Burbot to assess gonadal condition and analysis of opportunistic fish stranding and trapping data.

AEA maintains that the study components referred to by USFWS are not integral to meeting study objectives specific to Study 9.6 or demonstrating progress towards meeting objectives and were not reported in the ISR or SIR.

Rotary screw traps were operated under Objective 2 of Study 9.6 to help determine the timing of emigration by downstream migrating fish (RSP Section 9.6.4.4.10). Trap efficiency estimates were to be conducted in order to generate relative abundance estimates, but only when catch exceeded 100 fish (FDA IP, Section 5.7.4). Field crews generally did not hold fish for more than

24 hours in traps because of increased mortality and concerns for predation and crowding and daily catches rarely met the target for efficiency testing. Unfortunately, the low daily catches were insufficient for generating meaningful Peterson mark-recapture estimates. In the Middle River (2013), non-adult salmon catches exceeding 100 fish occurred on of 9 of 47 trapping days at Indian River, six of 42 trapping days at Talkeetna Station, five of 40 trapping days at Montana Creek, and one of 42 trapping days at Curry Station. Of the 21 days with catch exceeding the target for efficiency testing, 12 occasions fell at the end of a trapping session when testing was not applicable. During periods of higher water temperatures, fry were stressed and were not held and dyed for efficiency testing. In the Middle and Lower River (2013) efficiency testing was conducted on 11 occasions at Indian River, 10 occasions on Montana Creek, 5 occasions at Talkeetna Station, and 0 occasions at Curry Station (Table 2.6.2-11). Often the number of fish that were healthy and available for efficiency trails was less than 100 and results should be interpreted with caution.

Table 2.6.2-11. Rotary screw trap efficiency testing, 2013-2014.

Number of Fish Released by Location (percent recaptured)			
Trapping Date	**Indian River**	**Montana Creek**	**Talkeetna Station**
2013-07-05	66 (15%)	102 (6%)	27 (0%)
2013-07-09		24 (13%)	10 (0%)
2013-07-14	36 (0%)		
2013-07-19	22 (4%)	44 (18%)	
2013-07-24	37 (0%)	16 (0%)	
2013-07-28	15 (0%)		
2013-07-30		10 (0%)	
2013-08-02	79 (8%)		
2013-08-04		32 (9%)	
2013-08-07	50 (18%)		
2013-08-09		24 (4%)	11 (0%)
2013-08-17	62 (6%)		
2013-08-19		6 (0%)	8 (0%)
2013-09-16	66 (5%)		
2013-09-18		27 (33%)	19 (5%)
2013-09-21	20 (10%)		
2013-09-23		14 (14%)	
2013-09-26	74 (3%)		
Total Release Events	**11**	**10**	**5**
Total # fish released	**527**	**299**	**75**

Movement patterns in relation to water conditions is not an objective of Study 9.6 but screw trap catch can be analyzed in relation to water conditions in the future. Information on the diurnal behavior of juvenile salmon was collected at PIT interrogation stations and during day/night stratified sonar monitoring, trapping, and electrofishing during winter studies described in the

Winter TMs for studies 9.6 and 8.5 (Study 9.6 TM, September 14, 2014: *2013-2014 Winter Fish Study Technical Memorandum*; Study 8.5 TM, September 17, 2014: *2013-2014 Instream Flow Winter Studies Technical Memorandum*). The locations of Humpback Whitefish and Burbot during the spawning season are reported in the *2013-2015 Radiotelemetry Implementation Report* (Attachment 8). Very few adult winter spawning fish were collected during winter studies, the gonadal condition was checked for the few fish collected and they were all in post-spawn condition. Habitats vulnerable to fish stranding and trapping at the time of sampling were identified and characterized as isolated pools (Level 5 habitat hierarchy, pool subtypes); no further analysis of these features under Study 9.6 has been completed to date. The role of Study 9.6 is to collect baseline data to support the stranding and trapping objective of Study 8.5. In the ISR Part D, Study 8.5 indicated that following agency recommendations, limited stranding and trapping data is being collected; this has been reported as a variance as follows:

> *The Study Plan indicated that field surveys would be conducted at potential stranding and trapping areas on an opportunistic basis following up to three flow reduction events during 2013 (RSP Section 8.5.4.5.1.2.2). During a May 17, 2013 Technical Team meeting, participants indicated that site-specific stranding and trapping studies should be a low priority. Because the Project does not yet exist, the effects of Project-induced flow fluctuations cannot be directly studied in the Susitna River. Some opportunistic observations of potential stranding and trapping areas were recorded during substrate classification surveys conducted during falling river stage conditions in September 2013, but the observations did not follow robust survey protocols. Although specific stranding and trapping surveys were not conducted in 2013, this change is not expected to adversely impact achieving Project objectives. As discussed and documented during the May 17, 2013 TWG meeting, ramping criteria developed in Washington State (Hunter, M.A. 1992. Hydropower flow fluctuations and salmonids: a review of the biological effects, mechanical causes, and options for mitigation. Washington Department of Fisheries, Technical Report No. 119) will be proposed as fallback criteria during Project effects analyses.*

2.6.2.11.3. Response to Modification Request to Develop a Plan to Increase Winter Sampling

USFWS requests (Modification 8; USFWS_pp9.6-6_ph1) that AEA develop an operational plan for winter sampling that increases the geographic range and diversity of habitats sampled and includes measuring physical attributes of the sites. USFWS states that the ad hoc selection of sample sites during winter sampling (e.g., selecting open-water areas) and the small range in sampled area of the river (37 river miles of Middle River habitat, compared to 200 total river miles) limits AEA's ability to make interpretations of or draw conclusions from winter sampling results. For example, warmer water may create open leads which are easier to sample, and may also be more attractive to juvenile salmonids. USFWS states that the use of video for sampling should be limited or paired with other sampling methods since 85 percent of observed fish were either undifferentiated salmon or unidentified species. USFWS comments that four species of emergent fry salmon were captured in the March and April of 2014 sampling periods, but no Pink Salmon were recovered in any winter samples. USFWS also notes that juvenile Pink Salmon were also scarce in 2013 samples, but Pink Salmon fry were found in 2014 ELH studies. USFWS asserts that the scarcity of Pink Salmon fry in many of the samples should be of concern and a subject for directed sampling efforts.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established “good cause” for the modification or nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan.

To clarify, correlating fish use with microhabitat variables such as velocity, depth and substrate is an objective of synoptic winter data collection under Study 8.5, and is not a study objective of fish distribution and abundance sampling under Study 9.6. AEA contends that winter sampling, although limited due to the constraints of sampling and safely working on ice covered rivers in the winter, resulted in the collection of fish abundance and habitat association data representative of the winter study area, the Middle River downstream of Devils Canyon.

Winter sampling in 2014 was not just ad-hoc as suggested by USFWS, and site selection followed recommendations put forth in the winter sampling TM (Study 9.6 TM, September 14 2014: *2013-2014 Winter Fish Study Technical Memorandum*). Winter sampling used a GRTS based approach to re-sample as many open-water season FDA sites as possible with additional winter oversample locations to reach three replicates of each habitat type in each Focus Area. This preserved the GRTS spatial random design; however, AEA also supplemented sampling with opportunistic (ad-hoc) sites at specific locations of interest (areas with groundwater upwelling, confluence areas, deep pools in side sloughs, and areas on the mainstem that could be safely accessed). The randomized site selection results in both open-water and ice-covered sites; however, when sites were frozen solid to the substrate it necessitated sampling at GRTS oversample locations.

Newly emerged juvenile Pink Salmon (n=3) were observed in late winter (April) 2013 (2014 Study 9.6 TM, September 14 2014: *2013-2014 Winter Fish Study Technical Memorandum*) but were not observed during winter studies in 2014 (Study 9.6 SIR). Pink Salmon were collected in lower numbers during the first ELH sampling event in early June 2013 as most Pink Salmon fry had already emigrated with the late breakup at the end of May in 2013. Pink Salmon were also collected in downstream migrant traps in 2013 with peak catch occurring in mid-June shortly after traps were installed and outmigration concluded by the end of July. In 2014, Pink Salmon fry were not observed during winter studies but were observed in good numbers during ELH sampling (n=266) in May and early June.

The aim of winter sampling is to use two or more techniques to sample each site. Underwater video sampling is always paired with other techniques whenever feasible. AEA asserts that the most effective and appropriate gears should be used at each site based on conditions at the time of sampling to best characterize the fish species and life stages that may be present. AEA proposes to use a combined gear approach, similar to that demonstrated in the FUHI TM (Attachment 7) to adjust for the selection of different sampling techniques used on different events. AEA maintains that the data collected in 2013-2014 with the addition of a second year of data collection as proposed in the ISR Part D and supplemented with the 2012-2013 pilot study efforts, 1980s licensing efforts, winter habitat suitability criteria sampling under study 8.5, and ARRI’s synoptic Middle and Lower Susitna River winter fish sampling over the 2012-2013 winter (Davis et al.

2013), 2013-2014 winter (Davis et al. 2015), and 2014-2015 winter (Davis and Davis 2015) will provide the baseline documentation necessary for impact analyses.

2.6.2.12. References Cited

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2.6.3. Study 9.7 – Salmon Escapement Study

As established in the Study Plan[26] (RSP Section 9.7.1), the primary goal of the study is to characterize the current distribution, abundance, habitat use, and migratory behavior of all species of adult anadromous salmon across mainstem river habitats and select tributaries above the Three Rivers Confluence (i.e., confluence of the Susitna, Chulitna, and Talkeetna rivers). Sufficient information of this nature has been collected for several species elsewhere in the Susitna watershed. However, for Chinook and Coho salmon, additional information would aid in assessing the potential impacts of the Project. Therefore, a second goal of this study is to estimate the distribution, abundance, and migratory behavior of adult Chinook Salmon throughout the entire Susitna River drainage, and the Coho Salmon distribution and abundance in the Susitna River above the confluence of the Yentna River.

The specific objectives of the Salmon Escapement Study, as described in the RSP (Section 9.7.1), are:

- Capture, radio-tag, and track adults of five species of Pacific salmon in the Middle and Upper Susitna River in proportion to their abundance. Capture and tag Chinook, Coho and Pink salmon in the Lower Susitna River.
- Characterize the migration behavior and spawning locations of radio-tagged fish in the Lower, Middle, and Upper Susitna River.
- Characterize adult salmon migration behavior and timing within and above Devils Canyon.

[26] The FERC-approved Revised Study Plan (RSP) Section 9.7 for the Salmon Escapement Study (ESCAPE) as modified by FERC's Study Plan Determination (Study 9.7 SPD, February 1, 2013) is referred to as Study Plan Section 9.7.

- If shown to be an effective sampling method, and where feasible, use sonar to aid in documenting salmon spawning locations in turbid water in 2013 and 2014.
- Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon.
- Generate counts of adult Chinook Salmon spawning in the Susitna River and its tributaries to estimate the proportions of fish with tags for populations in the watershed.
- Collect tissue samples to support the Fish Genetic Baseline Study (Section 9.14).
- Estimate the system-wide Chinook Salmon escapement to the entire Susitna River, the Coho Salmon escapement to the Susitna River above the its confluence with the Yentna River, and the distribution of Chinook, Coho, and Pink salmon among tributaries of the Susitna River (upstream of Yentna River confluence) in 2013 and 2014.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes no modifications to Study Plan Section 9.7. The FERC-approved Study Plan was conducted in 2013 and 2014, building upon the first year of study initiated by AEA in 2012. The data gathered has met the eight study objectives and AEA considers the approved Study Plan complete.

Comments on the ISR and ISR meeting were filed, in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, by FERC staff, NMFS and USFWS. In addition to general comments, NMFS and USFWS submitted four and two study modification proposals, respectively. FERC requested clarification and additional information on the sonar in the Lower River. AEA's responses to the comments can be found in Table 2.6.3-1 with further detail below. NMFS organized their modification requests by study objectives. AEA organized its responses in a similar manner below, citing the Study Objectives as indicated in the FERC-approved Study Plan.

Table 2.6.3-1. Study 9.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA5_ph2	*1. Sections 5.1.4.3 and 5.1.4.4 of the ISR state that the Middle Fork Chulitna River and Talachulitna River sonar data for year 2013 were in the process of being analyzed; however, these data were not provided in later reports (i.e., ISR Part D, September 30th Tech Memo, or the SCR). Please include the 2013 data for both locations in the USR.*	Although not discussed in the Study 9.7 SCR, the variance regarding the Chulitna and Talachulitna weirs and Chulitna sonar were presented in the Study 9.7 ISR Part D, Sections 6.1 and 6.2. In addition, the difficulty with the Talachulitna sonar data was presented in Study 9.7 ISR Part C Section 7.1.2.6.1. A summary of these variances follows. During the winter of 2012-2013 planning was underway to operate floating weirs on the middle fork (MF) of the Chulitna River in the Susitna drainage and on the Talachulitna River in the Yentna drainage. In the spring of 2013, sites on both rivers were evaluated for the feasibility of weir installation. After a thorough evaluation of possible sites, it was determined that water velocities and large cobble substrate would preclude operation of floating weirs at both locations. As an alternative, ARIS sonar units were deployed on the MF of the Chulitna River

Reference Number	Comment or Study Modification Request	AEA's Response
		and on the Talachulitna to count migrating salmon at each site. Sonar units were operated on the MF of the Chulitna River from June 20 through July 29, 2013, and on the Talachulitna River from May 16 through September 4, 2013. Subsequent to the field season, data collected from the MF of the Chulitna River was reviewed and edited. Sonar aiming difficulties and bottom contours where fish could migrate past the sonar unit undetected, led to concerns about the accuracy of the data. Hence the data was not used in calculating abundance estimates for 2013 (ISR Part A Section 5.1.4.3). Data collected on the Talachulitna River was also ambiguous due to lack of suitable boat accessible sites to operate sonar, salmon milling behavior near the transducer and aiming complications. As a result, sonar data collected from the Talachulitna River was impracticable for calculating 2013 abundance estimates (ISR Part A Section 5.1.4.4.). Because of the absence of sonar data from the MF of the Chulitna River, abundance estimates were calculated using only data collected at the Deshka River and Montana Creek weir sites. For the Yentna River drainage, abundance estimates were not calculated because of unreliable sonar data from the Talachulitna River. However Chinook Salmon spawner distribution data were gathered from radio tags deployed from the Yentna River mile six.
FERC_ppA5_ph3	*2. Table H-1 in Appendix H of the SCR states, "These data are preliminary, and additional aerial spawner surveys are planned for August (these data will be added to the table later)." Please explain whether you intend to report these data in the USR or if you intend to revise the SCR to incorporate these data, and if so, when.*	All 2014 aerial surveys in the Indian River are included in the final version of Table H-1 published in the SCR. The caption language "These data are preliminary, and additional aerial spawner surveys are planned for August (these data will be added to the table later)." was left over from a working draft and should have been deleted from the final publication. Table H-1 of the SCR documents the results of surveys conducted on August 1, 3, 6, 9, 12, 15, 18, and 19, 2014.
NMFS_pp9.7-1_ph3	*The Salmon Escapement Study was conducted during a period of very low Chinook Salmon abundance thus resulting estimates of Chinook Salmon escapement cannot and should not be considered as even approximately representative of the number of salmon moving upstream.*	As explained below in Section 2.6.3.1, AEA disagrees.
USFWS_pp9.7-1_ph2	*The escapement study was conducted during years of low abundance and years with age-class distribution shifted to younger age classes. As age class is strongly related to size, and size may be related to a fish's ability to pass to the upper reaches of the Susitna River and breed, the*	As explained below in Section 2.6.3.1, AEA disagrees.

Reference Number	Comment or Study Modification Request	AEA's Response
	observed numbers of radio-tags probably fails to represent the spatial distribution and magnitude of large-sized Chinook Salmon that spawn in the very upper reaches of the Susitna River, past Devils Canyon, in a typical year. This study should not be considered adequate to reliably characterize the overall spatial distribution, size distribution, and magnitude of Chinook Salmon escapement in a typical year.	
NMFS_pp9.7-3_ph1	*Modification 1-1: NMFS recommends that spawning ground surveys be conducted to obtain size distribution for comparisons with tagged fish and identify any size tag sampling selection bias from fish wheel sampling and to obtain more accurate assessments of mark rates and escapement as provided for in the approved plan.*	As explained below in Section 2.6.3.2.1, AEA requests that FERC not adopt this proposed Study Plan modification. The cost of this modification is difficult to obtain because details about the extent of the field data collection effort or an effective fish sample size were not provided. If AEA assumes a sample size of 100 adults of each species at each of the five fishwheel sites as a sample size to achieve and an adult capture or carcass recovery efficiency of 25 percent and includes tagging. The estimated cost of this modification is $7,000,000 for an additional year.
NMFS_pp9.7-4_ph2	*Modification 2-1: For future requested tagging NMFS recommends that AEA conduct ground surveys of Lower and Middle River salmon spawning surveys to pinpoint spawning locations to macro- and mesohabitats and characterize quality of spawning habitat, including the physical and chemical habitat characteristics of those habitats. Surveys should be directed toward tag locations from previous years of study that were assigned main-stem spawning locations and surveys should be conducted at least weekly to document peak spawning activity.*	As explained below in Section 2.6.3.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. The implementation of Modification 1-1 and 1-2 have significant overlap. Given the uncertainty of successfully documenting spawning salmon in the turbid waters of the Susitna River, AEA has estimated cost of this modification to be approximately $200,000 more than Modification 1-1, for a total of $7,200,000.
USFWS_pp9.7-2_ph3	*Modification 1: There should be some additional radio tagging in the middle river and with tags tracked to specific spawning locations.*	As explained below in Section 2.6.3.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. The cost of implementing this modification is difficult to estimate due to a lack of detail. The estimated cost is assumed to be the same as and duplicative with NMFS Modification 1-1 and NMFS Modification 2-1 (i.e., $7,000,000-$7,200,000).
NMFS_pp9.7-4_ph3	*The RSP stated that when helicopter and fixed-wing surveys located adult salmon, boat and ground surveys would be conducted weekly to pinpoint fish locations within 10 meters. Instead, locations of tagged fish were monitored by fixed-station radio receivers at specific locations in the Lower, Middle, and Upper River; the number of receivers was fewer than proposed.*	AEA disagrees with the implication that locations of tagged fish were only monitored by fixed-station receivers. As described in SCR Section 4.2.2 likely spawning and holding locations were identified during helicopter surveys. See Section 2.6.3.3.1 for discussions on the boat and ground surveys conducted to confirm spawning and holding as well as the number of fixed receivers proposed versus installed.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.7-4_ph4	*The RSP for Study 9.7 states that results would be used to evaluate potential fish passage barriers. A large number of beaver dams were located in middle river side channel and off-channel habitats. Water depths within sloughs may also result in passage barriers. The timing and distribution of adult salmon at the mesohabitat scale is necessary to evaluate those beaver dams or water depths that were barriers to adult salmon migration. The information on spawning locations of adult salmon are necessary to identify locations where habitat characteristics can be measured to develop and validate habitat models for spawning salmon (Study 8.5). Therefore, due to inadequate spawning surveys, Objective 2 has not been met.*	NMFS mischaracterizes Objective 2 for Study 9.7 by indicating that part of this objective is to evaluate potential fish barriers. The behaviors intended to be address by this Objective are described in RSP Section 9.7.4.2 and there is no discussion of fish passage barriers. Thus, AEA disagrees with NMFS comment that spawning survey were inadequate and Objective 2 was not met. It was noted in RSP Section 9.7.7, Relationship with Other Studies, that "*Study 9.7 will provide useful output information to other studies, including general information on salmon distribution and access to habitat, which will be used by the Fish Passage Barriers Study (Study 9.12) and the Aquatic Resources Access Study [sic](Study 9.13)*." This statement remains valid and the data collected locating fish in mainstem, side-channel and slough habitat, is both consistent with the RSP Section 9.7.4.2.2 and sufficient to inform Fish Barriers above distribution and access to these habitats.
NMFS_pp9.7-5_ph1	*The proposed intent of aerial survey was to direct ground surveys to track salmon to specific spawning locations and characterize spawning preference to the macrohabitat level.*	AEA disagrees with this comment. RSP Section 9.7.4.2.2 states that "*Aerial surveys of the mainstem Susitna from RM 22 to Kosina Creek will be conducted by helicopter to allow relatively accurate positioning of tagged fish, to locate spawning areas, and to make visual counts of fish in clear water areas, all with respect to mainstem habitat types*." In addition, RSP Section 9.7.4.2 clearly states the approach of assigning final destinations for salmon in main channel, slough, side channel and tributary habitats. To further clarify RSP Section 9.7.4.2.6 describes the use of boat and/or ground surveys to provide data to the habitat suitability sampling team. Boat surveys were conducted and discussed in Study 9.7 ISR Section 5.2.4 and Study 9.7 SCR Section 4.2.3.
NMFS_pp9.7-6_ph1	*Objective 3:* *Under Objective 8 NMFS recommends additional tagging above Indian River but below Devils Canyon, as required in the study plan, to adequately quantify the number, size, and distribution of Chinook Salmon migrating into the Upper River.*	See Section 2.6.3.4.1 below.
NMFS_pp9.7-1_ph5	*An important variance from the FERC-ordered study is that salmon were not captured and tagged at a location upstream from Portage Creek and below Devils Canyon. NMFS continues to recommend that this part of the study plan be fully implemented in order to adequately understand the number, timing, and characterization of Chinook Salmon that migrate into Devils Canyon and beyond the proposed dam site.*	See Section 2.6.3.4.1 below.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.7-6_ph2	*Objective 4:* *Modification 4-1: NMFS recommends that AEA work with the Technical Working Groups (TWGs) to develop and propose additional methods to FERC to use to locate and document Pacific Salmon spawning in turbid waters at sites classified as main-stem spawning locations in previous tagging studies.*	As explained below in Section 2.6.3.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. The cost of this planning modification could cost $75,000. This does not include field work because no field methods or study area have been proposed. Coarse estimates for additional field work to locate salmon spawning such as the methods proposed by NMFS would range from $250,000 to over $1,000,000 depending on the number of species, sampling sites and methods employed.
NMFS_pp9.7-6_ph6	*Objective 5: Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon NMFS is not recommending any study modifications under this objective. However, we do not agree with the presentation or interpretation of data collection efforts.*	See Section 2.6.3.6.1 below.
NMFS_pp9.7-7_ph1	*Objective 5:* *To document lower middle river Coho Salmon spawning locations, additional tagging of Coho Salmon at Talkeetna Station should be conducted along with foot surveys to verify spawning locations.*	See Section 2.6.3.6.2. See AEA's response to USFWS_pp9.7-2_ph3 for AEA's cost estimate associated with this recommendation.
NMFS_pp9.7-7_ph3	*Objective 5:* *AEA needs to discuss the differences between Middle River tributary Coho Salmon spawning between current studies compared with studies conducted in the 1980s. In current studies, Coho Salmon tagged in the Middle River at Curry spawned in Upper River tributaries (Indian River and Portage Creek). In the 1980s, fish were tagged at Talkeetna Station in the lower Middle River, and the majority of spawning was documented as occurring in Whiskers Creek, Chase Creek, and Gash Creek (far downstream of the current tagging site at Curry). These lower Middle River tributaries likely continue to be important for Coho Salmon spawning; however, their use is underestimated due to the upstream tagging location at Curry. The SCR provides a number of tables to document roaming: fish that were tagged at Curry but ultimately spawned downstream as support of tagging fish at Curry instead of Talkeetna Station (tagging site used in the 1980s at PRM ~106). However, AEA did not attempt to determine the distribution of salmon into the Yentna River drainage or the Deshka River from tagging locations 22 miles upstream. Thus, current studies are not precise enough to confirm spawning areas in the lower middle river.*	See Section 2.6.3.6.1 below.
NMFS_pp9.7-7_ph4	*Objective 6:* *NMFS does not recommend any study modifications*	See Section 2.6.3.7.1 below.

Reference Number	Comment or Study Modification Request	AEA's Response
	directed toward achieving this objective. However, we do not agree that the applied methods provide an accurate assessment of salmon escapement into tributaries and these estimates should not be relied on for assessment of current conditions or used to predict the effects of project operations on spawning habitat.	
NMFS_pp9.7-8_ph3	*Objective 7 was carried out by collecting tissue samples from captured adult salmon. Because this objective was intended to support the Fish Genetics Study and analyses completed by the Alaska Department of Fish and Game, the results are provided in a different section of the completion report. If a weir is constructed in the Oshetna River and Kosina Creek to enumerate Chinook Salmon escapement and allow for recapture of tagged fish, the opportunity exists for additional samples to be collected for the genetics study.*	Under Modification 8-1 NMFS requested operation of three fish weirs in the Upper River. AEA requests that FERC not adopt NMFS Modification Request 8-1 (NMFS_pp9.7-8_ph4 below). In addition to the estimated cost of $7,500,000 to implement Modification 8-1, this request could add another $200,000 depending on the numbers of fish analyzed and the type of analysis completed.
NMFS_pp9.7-8_ph4	*Modification 8-1: NMFS recommends that an additional year of study be conducted with fish capture and tagging occurring in the Lower Middle River near the historic Talkeetna Station and at a second location upstream from Indian River but below Devils Canyon. We recommend an a priori statistical analysis be conducted to determine the number of additional tagged fish required to yield sufficient identification of spawning habitat locations in the lower Middle River site (Coho Salmon, Sockeye Salmon, Chum Salmon and Chinook Salmon). We also recommend that all Chinook Salmon be tagged at the site below Devils Canyon. Tracking tagged fish should be conducted following the methods specified in the FERC-ordered study plan. NMFS recommends that weirs be installed and maintained on main-stem Susitna at or upstream of the head of the proposed reservoir, at Kosina Creek and the Oshetna Rivers to recapture tagged fish and for additional genetic sampling.*	As explained below in Section 2.6.3.8.1, AEA requests that FERC not adopt this proposed Study Plan modification. Based on the cost of implementing the FERC-approved Study Plan and tagging ALL Chinook Salmon capture at 2 Middle River sites, the estimated cost of this modification is $7,500,000.
USFWS_pp9.7-2_ph5	*Modification 2: Develop a complete operational plan for an additional year of radio tagging and tag recoveries. Implement this plan with no variances.*	As explained below in Section 2.6.3.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of this planning effort is $50,000. No field data collection efforts were included in this modification; however additional tagging is the objective of the proposed plan. As such the estimated range of cost for additional tagging would be $7,000,000-$7,500,000. This cost would be duplicative with NMFS Modifications 1-1 and/or 8-1.

2.6.3.1. Response to Comment Regarding the Study Being Conducted During a Period of Low Chinook Salmon Abundance

NMFS (NMFS_pp9.7-1_ph3) and USFWS (USFWS_pp9.7-1_ph2) comment that the study was conducted during a period of low Chinook Salmon abundance thus resulting estimates of Chinook Salmon escapement are not representative of the number of salmon moving upstream. The USFWS further contends that the escapement study was conducted during years with age-class distribution shifted to younger age classes. As age class is strongly related to size, and size may be related to a fish's ability to pass to the upper reaches of the Susitna River and breed, the observed numbers of radio tags probably fails to represent the spatial distribution and magnitude of large-sized Chinook Salmon that spawn in the very upper reaches of the Susitna River, past Devils Canyon, in a typical year. The Services assert that this study should not be considered adequate to reliably characterize the overall spatial distribution, size distribution, and magnitude of Chinook Salmon escapement in a typical year.

AEA disagrees with these comments. Normal annual variation in Chinook Salmon abundance and size distribution did not prevent this study from meeting its objectives. Representative numbers were tagged and tagging goals were met for this species (Objective 1). Migration and spawning locations of radio-tagged fish were characterized (Objective 2). Migration behavior and timing within and above Devils Canyon were described (Objective 3). Proportions of Chinook Salmon spawning in different areas were estimated (Objective 6). Large numbers of Chinook were sampled for genetic analysis (Objective 7). System-wide escapement of Chinook Salmon was estimated (Objective 8). Comparisons of current and historical data (Objective 5) provided comparable results.

Salmon abundance typically varies in annual and longer-term patterns in response to normal variation in freshwater and marine environmental conditions. From 2007-2014, Susitna Chinook Salmon runs were below average based on long term escapement aerial index surveys conducted by ADF&G since 1979 (Figure 2.6.3-1). Similar patterns were documented for Chinook Salmon throughout much of Alaska. While abundance of Chinook Salmon using the upper Susitna and tributaries can be expected to vary along with system-wide abundance, there is no evidence to suggest that the proportion of Upper Susitna fish in the total run will vary. Thus, a primary objective of this study was effectively achieved. The fact that a number of Chinook were documented in the upper basin alleviates concern that a low incidence of occurrence might be overlooked during a period of scarcity. Furthermore, during these low abundance years, 2012-2014, aerial survey documented a broader distribution of Chinook Salmon in tributaries within and upstream of Devils Canyon as compared to 1983-1985 which were moderate abundance years (Table 2.6.3-2). This documentation of more spawning tributaries is further support that AEA's surveys adequately captured the distribution of Chinook Salmon, in spite of the occurrence of low abundance years.

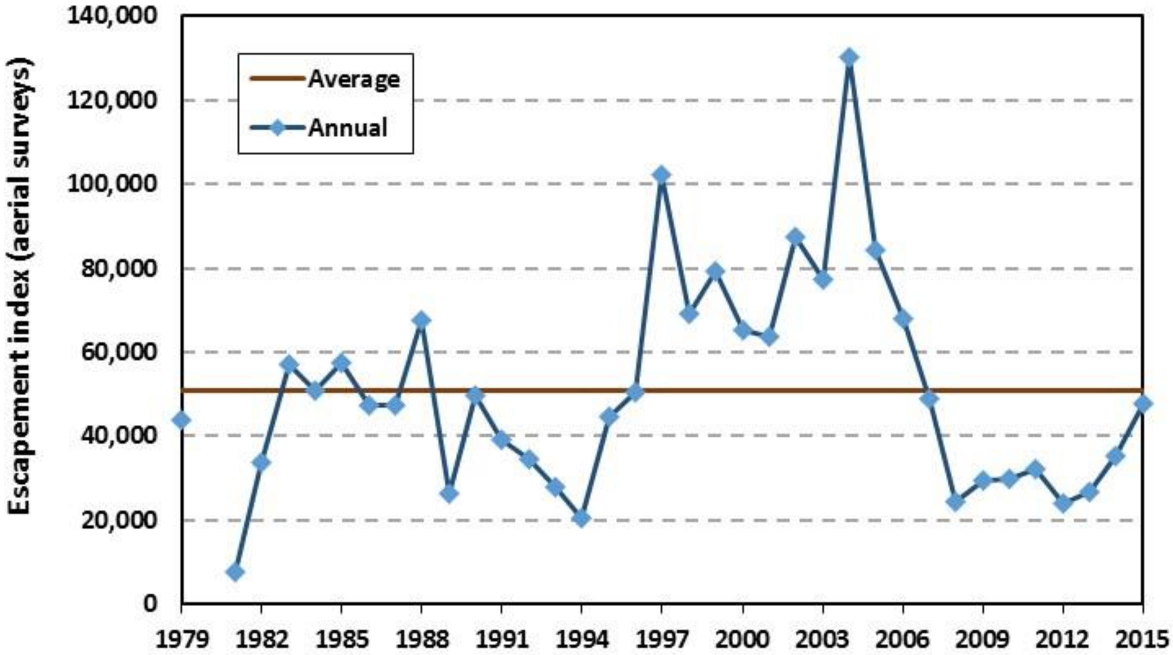

Figure 2.6.3-1. Escapement index for Northern Cook Inlet king salmon based on total index counts from Susitna and Knik Arm streams (Oslund et al. 2013; ADF&G unpublished data).

The study compared historical and current data on relative abundance of Chinook Salmon including studies during the 1980s and the 2012-2014 study. Aerial surveys of Chinook were previously conducted in 1982-1985 during a period of average escapement according to ADF&G index surveys. Peak counts of Chinook were generally consistent among years (Table) which provides some assurance that recent samples were not particularly anomalous. This information was also reported in the March 22, 2016 Initial Study Report meeting presentation for this study.

Contrary to the USFWS's contention (USFWS_pp9.7-1_ph2), changes in age and size composition of Chinook Salmon over time, documented by Lewis et al. (2015), do not confound achievement of the study objectives for estimating proportions of Chinook Salmon spawning in different areas within the Susitna River. Lewis et al. are addressing long-term changes in population dynamics that have occurred in Chinook Salmon populations throughout much of Alaska, apparently in response to changing environmental patterns in marine waters. Current size and age distributions represent the current prevailing environmental baseline condition. The current study included both large and small Chinook Salmon representative of the range in sizes that occurred in the system during collection (see Study 9.7 SCR Section 5.1). Furthermore, analyses were stratified to provide information on both large and small Chinook Salmon.

Table 2.6.3-2. Peak counts of Chinook Salmon observed in aerial surveys within the upper Susitna during historical and current studies.

Stream	1982	1983	1984	1985	2012	2013	2014
Within Devils Canyon							
Cheechako Creek	16	25	29	18	5	40	16
Chinook Creek	5	8	15	1	5	2	5
Upstream of Devils Canyon							
Devil Creek	0	1	0	0	7	25	10
Fog Creek	--	--	2	0	1	2	3
Tsusena Creek	--	--	0	0	0	4	0
Upstream of dam site							
Kosina Creek	--	--	--	--	16	3	0

2.6.3.2. Objective 1

Objective 1: Capture, radio-tag, and track adults of five species of Pacific salmon in the Middle and Upper Susitna River in proportion to their abundance. Capture and tag Chinook, Coho and Pink salmon in the Lower Susitna River

2.6.3.2.1. Response to Modification Request to Conduct Spawning Ground Surveys

NMFS (Modification 1-1; NMFS_pp9.7-3_ph1) recommends that spawning ground surveys be conducted to obtain size distribution for comparisons with tagged fish and identify any size sampling selection bias from fishwheel sampling and to obtain more accurate assessments of mark rates and escapement as provided for in the approved plan.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the request to conduct additional spawning ground surveys and additional tagging of salmon.

Size selectivity has already been addressed in the SCR. No significant size selection sampling bias was identified for Chinook and Coho salmon at Middle River fishwheels based on sampling at the Indian River weir in 2013 and inferences from sonar at Middle River tagging sites in 2014 (SCR Section 5.1.3.3.4). Some size selectivity was identified toward capture of smaller Chinook Salmon and Coho Salmon at Lower River sites based on recaptures at Montana Creek and Deshka River weirs. Very large numbers of both small and large radio-tagged fish in this study provided robust statistical power for both evaluating size selectivity and estimating abundance and distribution of spawning Chinook and Coho salmon. A total of 9,661 salmon were tagged from 2012-2014, including 4,352 Chinook Salmon and 2,291 Coho Salmon. Effects of size selectivity of Lower River tagging were effectively minimized by size-stratification in estimates of abundance and distribution of spawning Chinook and Coho salmon based on mark-recapture estimates.

Further, spawning ground surveys, like those recommended by NMFS, were proven ineffective for collecting size distribution data (SCR Section 5.1.3.3.4) and the completed study has demonstrated that effect of size-selection bias in tag sampling was negligible. Estimates of proportional fish distribution and escapement are robust and effectively satisfy study objectives.

RSP Section 9.7.4.6 indicated that Chinook Salmon would be examined on selected spawning grounds to test whether fish were equally vulnerable to being captured and radio-tagged in the Middle River. Carcass surveys were conducted in 2012 (Study 9.7 TM, *Adult Salmon Distribution and Habitat Utilization Study,* filed with FERC March 4, 2013). However, this effort determined that it would be unlikely to obtain sufficient numbers of fish samples through spawning ground surveys to provide a robust mark rate for estimating numbers of fish above Devils Canyon. In 2012, the study team conducted ground-based stream counts and carcass surveys in the Indian River and Portage Creek to sample fish for mark rates and lengths. Very few carcasses were found despite excellent survey conditions, which was likely due to carcasses being removed from the rivers by predators (SCR Section 5.1.3.3.4). A variance was implemented in 2013 to replace the spawning ground surveys with the operation of a weir and underwater video system, along with a fixed-station receiver site, on the Indian River (ISR Part A, Section 4.1.8.3). Like the spawning ground surveys, the purpose of the Indian River weir was to obtain mark rates and length samples to test whether fish were equally vulnerable to being captured and radio-tagged in the Middle River (SCR Section 4.1.6). The weir operated effectively in 2013, estimating escapement of 1,137 large Chinook Salmon with a mark rate of 6.3 percent. Comparisons of cumulative length-frequency distributions for large Chinook Salmon radio-tagged in the Middle River and those inspected and recaptured at the weir showed no evidence of size-selective sampling.

Operation of the Indian River weir was identified as a proposed modification to the Study Plan to be implemented in 2014 as described in ISR Part C Section 7.1.2.1.2. However, the Indian River weir was rendered inoperable by a flood on June 26, 2014, prior to the onset of the Chinook Salmon run. In response, the study team considered alternative methods for estimating the mark rate of Chinook Salmon in the Indian River. Sonar was considered but Chinook Salmon could not be distinguished from other species. Gillnets were considered but physical conditions were not suitable for gillnetting and fish health could be impacted. The best available option was to increase the number of aerial spawner surveys and aerial telemetry surveys (every third day during the spawning period). Chinook Salmon escapement in 2014 was estimated using aerial spawner surveys and area-under-the-curve (AUC) methods. AUC methods estimate abundance from the number of fish-days derived from an area under the escapement curve and an estimate of the residence time, or the length of time that fish are alive in the survey area (SCR Appendix H: *Chinook Salmon – Indian River Escapement Estimate for Chinook Salmon*). The purpose of the AUC estimates was not to assess size selectivity but rather to provide an alternative means to estimating numbers of spawners in Indian River and to generate a mark-rate that could be used to expand counts of tagged fish passing the proposed dam site.

RSP Section 9.7.4.1.3 indicated that a portion of Chinook, Chum, and Sockeye salmon captured in the Middle River would be spaghetti-tagged to augment the ability to test assumptions about the representativeness of fish captured in the fishwheels. After a flood rendered the Indian River weir inoperable in 2014 prior to the onset of the majority of the salmon runs, no spaghetti tags were applied at the Middle River fishwheels because of limited opportunity to sample fish on the spawning grounds.

Due to the weir failure, size selectivity of Middle River tagging in 2014 was assessed based on other information. These included fixed-site sonar at Site 1, bank of capture comparisons, and various length-frequency comparisons (SCR Section 4.1.4.2). This assessment corroborated 2013 weir findings that size-selectivity did not introduce significant bias to study results (Study 9.7 SCR Section 5.1.3.3.4). Middle River fishwheel sites were characterized as generally high gradient with moderate-to-high offshore river velocities, which were similar features of fishwheel sites on other river systems where the least size selectivity was encountered. Sonar data collected immediately downstream of the Site 1 fishwheel in the Middle River suggested that very few fish migrated upstream at distances greater than 13 meters from the shore-based transducer, and that fish of all sizes seemed equally distributed at range from shore. Higher water velocities at fishwheel Sites 2 or 3 suggested an even greater proportion of fish would be bank-oriented relative to Site 1. All size classes of salmon were captured at each fishwheel, indicating that fish of all lengths were subject to capture.

For small Chinook and Pink salmon, tagging efforts were not random at the Middle River fishwheels in 2013 and 2014 as only the larger-sized segment of the small fish captured were radio-tagged. This was due to the fact that the radio tags used in the study would simply not fit into the stomachs of smaller-sized fish. For Pink Salmon, the difference in mean length between captured and radio-tagged fish was less than 1.5 centimeter (0.6 inches), and relatively few fish captured measured less than 40 centimeter (15.7 inches) mid-eye to fork (METF), so it was unlikely that selecting for slightly larger-sized fish to tag had a material effect on the study results. Small Chinook Salmon, however, comprised a substantial portion of the total number of Chinook Salmon captured at the Middle River fishwheels (23-35 percent in 2013 and 2014), yet only a fraction were radio-tagged (11 percent or less). In 2014, the smallest radio-tagged Chinook Salmon measured 36 centimeter (14.2 inches) METF, yet 61 percent (121 of 198 fish) of small Chinook Salmon captured measured less than 36 centimeters (14.2 inches) METF. No radio-tagged small Chinook Salmon passed above Devils Canyon in the three study years, so it was unlikely that any additional fish would have passed the impediments had additional small Chinook Salmon been radio-tagged.

In contrast to the Middle River, size selective fish sampling was detected in Lower River fishwheels and drift gillnets for Chinook and Coho salmon radio-tagged at the Lower River site in 2013 and 2014. The combination of Deshka River and Montana Creek weirs provided a robust second-event sample for evaluating heterogeneity in probability of capture. Statistical tests identified disproportionate capture of smaller-sized fish in the Lower River fishwheels. Selectivity can result when large fish swim farther from the bank than smaller fish in locations where the river gradient is low and offshore velocities are modest. However, substantial numbers of all size classes of Chinook and Coho salmon were detected at recapture sites.

NMFS identified concerns over the inability of sonar to differentiate species and to accurately collect length data, use of video to capture the presence of a tag, and that sonar was not operated during a portion of the Coho Salmon run. However, these concerns were obviated because AEA had to relied on methods other than sonar and video to address size selectivity (SCR Section 5.1.3.3.4) and was able to use data collected to meet Objective 1.

2.6.3.3. Objective 2

Objective 2: Characterize the migration behavior and spawning locations of radio-tagged fish in the Lower, Middle, and Upper Susitna River. Determine the migration behavior and spawning locations of the radio-tagged fish in the Lower, Middle, and Upper Susitna River

2.6.3.3.1. Response to Modification Request Regarding Additional Radio-Tagging and Spawning Ground Surveys

NMFS (Modification 2-1; NMFS_pp9.7-4_ph2) and USFWS (Modification 1; USFWS_pp9.7-2_ph3) request additional radio-tagging in the Middle River and that AEA conduct ground surveys of Lower and Middle River salmon spawning surveys to pinpoint spawning locations to macro- and mesohabitats and characterize quality of spawning habitat, including the physical and chemical habitat characteristics of those habitats. NMFS (NMFS_pp9.7-4_ph3) recommends the surveys be directed toward tag locations from previous years of study that were assigned main-stem spawning locations and that surveys be conducted at least weekly to document peak spawning activity. In addition, USFWS (Modification 2; USFWS_pp9.7-2_ph5) requests the completion of an operational plan for an additional year of tagging and implementation of this plan.

In response, AEA requests that FERC not adopt these proposed Study Plan modifications because the Services have not demonstrated "good cause" for the proposed modifications and the proposed modifications are not necessary to meet the FERC-approved Study Plan objectives. As described in the FERC-approved Study Plan, the telemetry data "in conjunction with habitat descriptions, will allow for characterization of migratory behavior and final destinations for salmon in mainstem habitats (main channel, slough, side channel) and tributaries" (RSP Section 9.7.4.2). The three years of radiotelemetry data completed by Study 9.7 are adequate to meet Objective 2, characterizing salmon migration behavior and spawning locations at the proposed spatial resolution. The more detailed spawning habitat assessment was to be carried out in concert with field activities of Study 8.5 habitat suitability field team, who would characterize salmon spawning habitat to the "microhabitat level" (RSP Sections 8.5.4.5.1.1.4 and 8.5.4.5.1.1.5). This study, in combination with the Instream Flow Study 8.5 habitat modeling, provides the data necessary to evaluate Project effects on spawning habitat suitability throughout affected reaches. Furthermore, extensive surveys conducted during the 1980s verify the current spawning distribution results from Study 9.7 and Study 8.5. Since the Study was implemented consistent with the FERC-approved Study Plan and the Services have not shown good cause for their modification, AEA requests FERC not adopt the three related modifications.

During the three years of implementing salmon escapement studies, AEA radio-tagged 9,661 salmon from 2012-2014 including 3,951 in the Middle River. By any measure this is a very large statistical sample size. Mainstem and tributary spawning destinations were estimated in 2012-2014 using up to 23 fixed receivers, almost 30,000 river miles of aerial surveys, and hundreds of thousands of radio tag detections. No specific statistical criteria, benchmarks or sample sizes are identified in this comment regarding the number of tags necessary or the basis for sample size adequacy.

Section 9.7.4.2 of the RSP identifies two tasks for Objective 2:

- Track the locations and behavior of radio-tagged fish using an array of fixed-station receivers and mobile-tracking surveys. Aerial surveys will begin in July and end in early October each year.

- Conduct boat- and ground-based surveys to locate holding and spawning salmon to the level of microhabitat use.

AEA implemented the methods with respect to Objective 2 as described in the Study Plan (RSP Section 9.7.4.2), with the exception of variances (Study 9.7 ISR Part A, Section 4) and modifications described in Study 9.7 ISR Part C, Section 7.1.2 and variances described in Study 9.7 SCR Section 4.2.4.

Aerial surveys were conducted in the Lower River by fixed wing aircraft and helicopter, and in the Middle and Upper River by helicopter (Study 9.7 SCR Section 4.2.2). Fixed wing surveys were used to assign fish to tributaries. Likely spawning locations in the Lower mainstem (RM 22 to 98), Middle and Upper River were identified based on helicopter surveys. Fixed wing surveys were also used to assign fish to tributary habitat. Localized aggregations of individual radio-tagged salmon at specific locations and multiple years provide strong evidence of spawning locations (Study 9.7 SCR Section 4.2.2). Frequent surveys enabled high-resolution and time-intensive tracking effort to identify the locations of spawning and holding fish. During salmon spawning periods, the crew used a GPS with a GIS based map containing the locations of each fish during the previous survey. Locations where fish were repeatedly observed were further investigated to ensure an accurate position for the fish and look for visual evidence of spawning activity. In general, the spatial resolution of helicopter surveys was approximately 300 meters. Higher precision was achievable from helicopter flights in reaches where conditions were most favorable and observers could determine whether the fish was in side channel, slough, mainstem, or tributary habitat. Results of fish destination analyses were presented in Study 9.7 SCR Section 5.2.

Aerial surveys were supplemented with fixed receivers. The number of fixed receivers was adequate to determine migration behavior and spawning locations of radio-tagged fish in the Lower, Middle and Upper Susitna River (Objective 2) as well as within and above Devils Canyon (Objective 3) (Study 9.7 SCR Sections 4.2 and 4.3). NMFS (NMFS_pp9.7-4_ph3) erroneously stated that the number of fixed station radio receivers was less than proposed. A summary of planned and actual receiver sites for 2013 and 2014 in Table 2.6.3-3 shows that while receiver sites were revised during study implementation to optimize effectiveness, ten or eleven receivers were planned for the Middle and Upper River and ten or eleven receivers were operated in the Middle and Upper River.

- RSP Section 9.7.4.2.1 listed nine fixed-station receiver sites to be used in the Lower Susitna and Yentna rivers, and ten fixed-station receiver sites to be used in the Middle and Upper rivers.

- In 2013, fixed-station receivers were operated on twelve sites in the Lower Susitna and Yentna rivers and eleven sites in the Middle and Upper rivers (ISR Part A Section 4.2.1). Five sites listed in RSP Section 9.7.4.2.1 were used and six sites not listed in the Study Plan were used. Five of the fixed stations listed in RSP Section 9.7.4.2.1 were not used in 2013. CIRWG land access limitations precluded siting three of these stations (Portage, Cheechako, Chinook creeks); and the remaining two stations (Slough 11 and Slough 21) were sited elsewhere in the Middle River, where a larger number of tags would be detected (relative to the 2012 study) (ISR Part A, Section 4.2.4). In addition, to accommodate the reduction of the number of fixed receivers downstream and within Devils Canyon, AEA increased the frequency of aerial surveys. Helicopter surveys for tagged fish were flown through Devils Canyon daily starting in late June, and twice daily during the period of Chinook Salmon passage (ISR Part A, Section 4.3.5).

- ISR Part C Section 7.1.2.2 described a Study Plan modification to include eleven fixed-station receiver sites in the Middle and Upper rivers in 2014. These included seven sites listed in RSP Section 9.7.4.2.1 and four sites not listed in the RSP. Some of these modifications differ from the variances implemented in 2013 (as described in ISR Part A Section 4.2.4). Three sites listed in RSP Section 9.7.4.2.1 which were not used in 2013 were not identified for use in 2014 (Slough 11, Slough 21, and Portage Creek).
- Ten sites were used in the Middle and Upper rivers in 2014 (Study 9.7 SCR Section 4.2.1) as the Indian River site was not operated following the 2014 flood. This variance did not affect AEA's ability to achieve Objective 3. Ten sites were also operated in the Lower Susitna and Yentna rivers.

Table 2.6.3-3. Planned and actual fixed radiotelemetry station receiver sites in the Middle and Upper Susitna River.

Site	PRM	RSP	Actual	Planned ISR	Actual
		2013	2013	2014	2014
Whiskers Creek	105.1	--	X	--	--
Lane Creek area	116.7	X	X	X	X
Middle River gateway	130.1	X	X	X	X
Fourth of July Creek	134.3	--	X	--	--
Slough 11	135.3	X	--	--	--
Indian River confluence	142.0	X	X	X	X
Indian River Weir	1.6	--	X	X	X[a]
Slough 21	141.1	X	--	--	--
Powerline	145.7	--	X	--	--
Portage Creek confluence	148.8	X	--	--	--
Cheechako Creek confluence	157.3	X	--	X	X
Chinook Creek confluence	160.4	X	--	X	X
Devil Creek area	166.9	X	X	X	X
Deadman Creek	191.2	--	X	--	--
Watana Dam Sonar	187.0	--	--	X	X
Watana Creek	197.0	--	--	X	X
Kosina Creek confluence	209.0	X	X	X	X
Oshetna River	235.1	--	X	X	X
Total number		10	11	11	10

[a] The Indian Weir antenna was rendered inoperable during the June 26, 2014 flood.

From 2012 through 2014, 14 potential mainstem spawning sites were identified for radio-tagged Chinook Salmon in the Lower River of which three were associated with tributary mouths/confluences (Study 9.7 SCR Section 6.1.4 and Figure D-11). In the Middle River, 100 radio-tagged Chinook Salmon were identified with potential spawning sites within mainstem macrohabitats of the Middle River (Study 9.7 SCR Section 6.1.4 and Figure D-12 included below as Figure 2.6.3-2). Although numerous radio-tagged Chinook Salmon were tracked to mainstem habitats, spawning activity was only confirmed at the confluence of tributary mouths (Study 9.7 SCR Section 6.1.4). These results are consistent with studies conducted in the 1980s (Barrett et al. 1985a, b) where Chinook Salmon were only documented spawning within mainstem habitats at the confluence of five tributary mouths (Chinook, Cheechako, Portage, and 4th of July creeks, and Indian River).

Study 9.7 SCR Section 5.2.1.3.2 reports that Chinook Salmon were tracked to 18 potential mainstem spawning and holding sites in the Middle River between PRM 111.0 and PRM 155.9 (Study 9.7 SCR Table D-2). To assess if there was spawning activity, all 18 sites were visually examined during aerial telemetry, boat, or foot surveys and turbid water precluded visual confirmation of spawning activity at all sites. A DIDSON unit was used at six of the sites; however, the remaining 12 sites were not surveyed using sonar due to lack of boat access or bathymetric features that were not conducive to sonar sampling. Holding behavior was observed at one main channel (#10) and three tributary mouth habitats (#5, 13, 17), but no fish were observed spawning at any of the 18 sites.

A high degree of spatial resolution is readily apparent in the map of potential Middle River spawning sites reproduced below (Figure 2.6.3-2). Mainstem spawning sites were similarly located in Lower and/or Middle river mainstem sites for Chum Salmon (Study 9.7 SCR Figures D-14 and D-15), Coho Salmon (SCR Figures D-16 and D-17), Pink Salmon (Study 9.7 SCR Figures D-18 and D-19), and Sockeye Salmon (Study 9.7 SCR Figure D-20). Ground crews sampled a total of 44 potential Chinook Salmon spawning areas in mainstem areas of the Middle River from 2012-2014 (Study 9.7 SCR Section 5.4). (See also the response to NMFS_pp9.7-6_ph2 for additional details on the limitations of ground and boat surveys.)

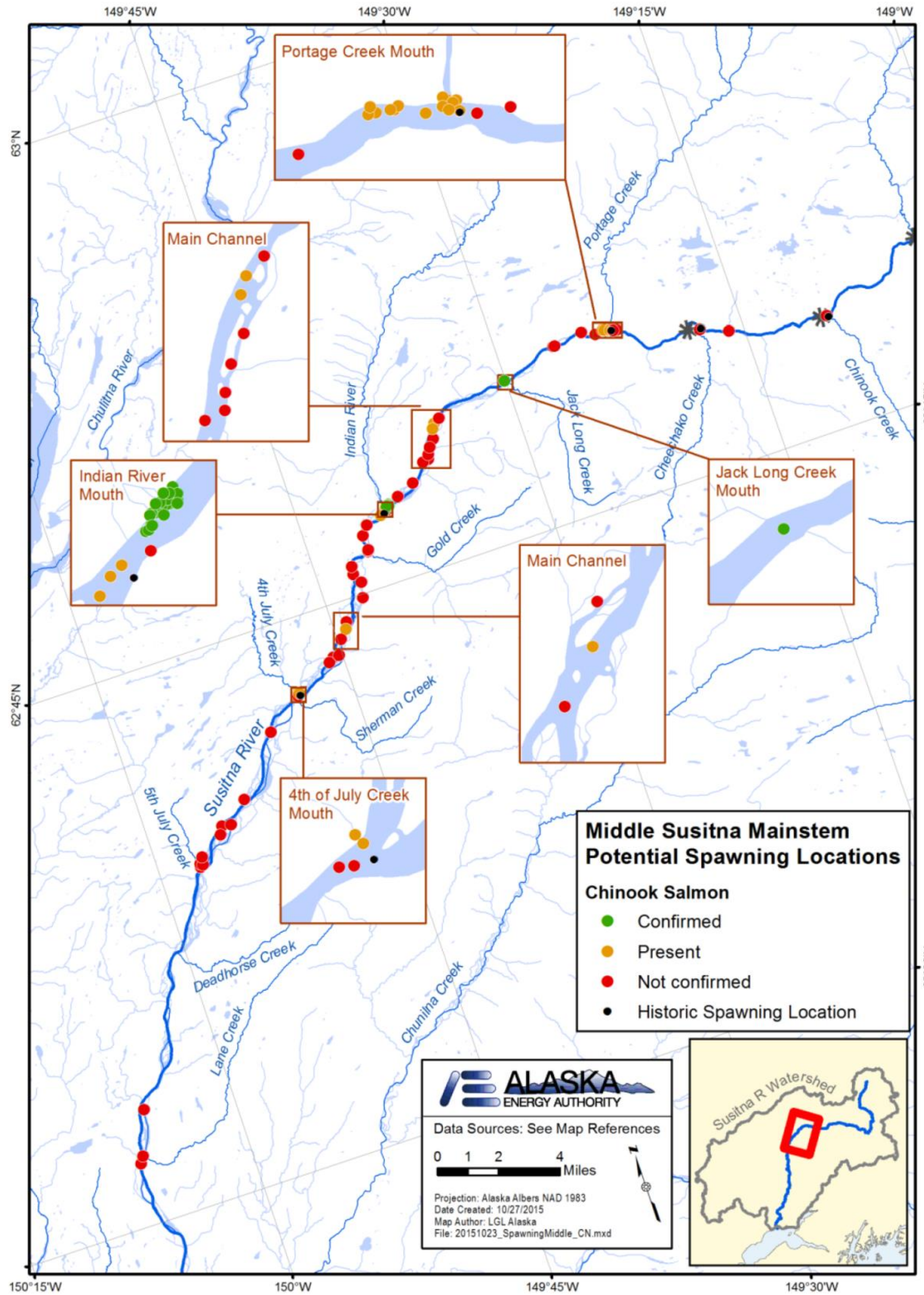

Figure 2.6.3-2. Figure D-12 in Study 9.7 SCR. Potential mainstem spawning sites for radio-tagged Chinook Salmon in the Middle River (red and yellow dots), PRM 103-157, 2012-2014. Colored dots (red, yellow, or green) indicate individual radio-tagged fish. Green dots also include locations that did not have a radio-tagged fish, but spawning was confirmed during opportunistic surveys. Black dots indicate spawning locations by Project River Mile confirmed during historic surveys (summarized in Barrett et al. 1985a,b and Thompson et al. 1986). Multiple green dots within an inset indicate a location that was confirmed for spawning and not each individual fish.

Analysis of potential Project effects on fish and aquatics is primarily to be quantified by modeling within the Fish and Aquatics Instream Flow Study (Study 8.5). Study 8.5 collected microhabitat data in a variety of macrohabitats where spawning was observed during the 1980s and 2013, both within and outside of Focus Areas. Microhabitat measurements were collected in spawning habitats of four Focus Areas (FA-128 [Slough 8A], FA-138 [Gold Creek], FA-141 [Indian River], and FA-144 [Slough 21]) in addition to a number of sites outside of Focus Areas (Study 8.5 SIR Section 4.2), not two as suggested by USFWS in its comments. Approximately 35 percent of the salmon spawning observations were in Side Slough macrohabitat types, followed by 28 percent in Side Channel macrohabitat types, 14 percent in Upland Sloughs, 7 percent each in Main Channel and Tributary Mouth habitats, 4 percent in Split Main Channel habitats, and 3 percent in Tributary habitat.

With respect to NMFS's comment under Modification 2-1 regarding Coho Salmon spawning not being addressed by the related Instream Flow Study models: the Instream Flow Study (Study 8.5) collected 3 microhabitat observations from spawning Coho Salmon in FA-128 (Slough 8A) within a side-channel habitat type; which included *all* of the spawning Coho Salmon observed. While holding behavior by Coho Salmon certainly occurs in the Middle River, visual observations of spawning Coho Salmon in mainstem or slough habitats were extremely rare during studies conducted during both the 1980s and the 2013/2014 studies. The available evidence indicates there is very low utilization of mainstem habitat types by spawning Coho Salmon in the Middle River.

The final destinations for radio-tracked Coho Salmon in Study 9.7 were categorized as "likely" or "possible" spawning or holding locations (Study 9.7 SCR Section 4.2.3.2), and none were *confirmed* spawning locations. Of the eight potential mainstem spawning or holding sites identified in the Middle River (all downstream of PRM 152.3), seven sites were inspected further during nine visits by aerial, boat, or foot surveys and no Coho Salmon spawning activity was observed. In addition, one identified tributary mouth was also visited and only Coho Salmon holding behavior was observed. Two of the foot surveys were conducted by HSC data collection crews (Study 8.5) that would have resulted in microhabitat measurements if any spawning Coho Salmon were observed. As stated in Study 9.7 SCR Section 5.2.3.3.2., seven of the sites visited had ideal water clarity for visual observations and no Coho Salmon or spawning activity was observed, but water was too turbid for unimpaired visual observations during visits to two sites.

During the 1980s, intensive spawning surveys occurred over a 4-year period. During 1981 and 1982, surveys primarily used a combination of drift gill nets, boat electroshocking, sonar, and egg deposition pumps to locate ripe fish and spawning locations in mainstem habitats of the Lower and Middle River, including main channels, side sloughs, upland sloughs, and side channels. Surveys were conducted between mid-July and early October during 1981 and August 1 to September 30 (Lower River Segment) or October 7 during 1982 by three crews responsible for one of three reaches: estuary to Kashwitna River, Kashwitna River to Chase Creek, and Chase Creek to Devils Canyon. In addition to mainstem surveys, tributary streams were surveyed by foot during 1981 and 1982. During 1981, 310 locations were sampled and Coho Salmon in spawning condition were found at three sites (Historic River Mile [RM] 76.6, 117.6, and 129.2; approximately PRM 80.4, 121.3, and 125.8). During 1982, 811 sites were surveyed in the Lower River from August 1 to October 13 and Barrett et al. 1983 concluded that Coho salmon did not spawn in the main channel between RM 7 and 98.5 in 1982 based on survey results. Similarly, 397 main channel sites were surveyed in the Middle River and no Susitna River main channel habitats between RM 98.5 and 150 were found to support Coho Salmon spawning. During 1981 Coho Salmon were not observed to spawn in any sloughs (ADF&G 1981); however during 1982 a total of 53 Coho Salmon were observed in three sloughs (6A, 8A, and 15), but spawning was only observed in Slough 8A (in FA-128) (Barrett et al. 1983).

During 1984 and 1985, between 17 and 33 tributaries were surveyed in the Lower River and 21 to 25 tributaries were surveyed in the Middle River. In addition, mainstem and slough habitat were flown weekly by helicopter during the spawning season. During 1984 flights began at the Yentna River in mid-August (Barrett et al. 1985a, b) and during 1985 flights were only in the Middle River beginning in mid-July (Thompson et al. 1986). During 1984 and 1985 surveys, two Coho Salmon were observed in the Middle River spawning in mainstem habitats near the west bank at RM 131.5 (approximately PRM 134.7; 0.4 mi upstream of Fourth of July Creek) of the Middle River (Barrett et al. (1985a, b) and nine Coho Salmon were observed spawning in FA-128 (Slough 8A) during 1985 (Thompson et al. 1986). Milling by Coho Salmon in sloughs was observed on several occasions and locations (Barrett et al. 1985a, b; Thompson et al. 1986).

Because mainstem spawning is rare for some salmon species, such as Coho Salmon, and for other species turbidity precludes confirmation of spawning, additional mainstem spawning survey efforts are not likely to further enhance our knowledge and would not be cost effective. The data collected by Study 9.7 on salmon holding and spawning destination both meets Objective 2 of Study 9.7 as well as supports modeling of salmon spawning habitat by Study 8.5. In addition, Study 8.5 has characterized salmon spawning habitat at 697 locations (Study 8.5 SIR Appendix D: *Habitat Suitability Criteria Development*, Table 5.2-2).

2.6.3.4. Objective 3

Objective 3: Characterize adult salmon migration behavior and timing within and above Devils Canyon.

2.6.3.4.1. Response to Recommendations to Capture and Tag Chinook Salmon Below Devils Canyon

In its introductory comments to Study 9.7 (NMFS_pp9.7-1_ph5), NMFS recommends that the FERC-ordered study be modified to require AEA to capture and tag salmon at a location upstream from Portage Creek and below Devils Canyon be fully implemented to understand the number, timing, and characterization of Chinook Salmon that migrate into Devils Canyon and beyond the proposed dam site. In its comment to Study Objective 3, NMFS refers to their Modification 8-1 (NMFS_pp9.7-6_ph1, NMFS_pp9.7-8_ph4) within which NMFS recommends additional tagging above Indian River but below Devils Canyon, to adequately quantify the number, size, and distribution of Chinook Salmon migrating into the Upper River.

AEA disagrees with these recommendations, and asserts that Study 9.7 SCR Section 5.3 documents the number, timing, characterization, size, and distribution of adult salmon migration within and above Devils Canyon sufficient to meet Objective 3. As explain Study 9.7 SCR Sections 5 and 6, and summarized in the response below, AEA concludes that the data collected is adequate to inform fish passage prescription decision and development of PM&Es, which will be made with consideration of other data such as Study 9.6 and importantly 9.14, neither of which have been completed at this time.

NMFS comments and recommendations overlook variances implemented to increase catch and the number of Chinook Salmon radio-tagged in the Middle River (Study 9.7 SCR Section 4.1.6), increase visual aerial spawning surveys in the Upper River (Study 9.7 SCR Section 4.3.5), results from the sonar installed at the dam site during 2014 (Study 9.7 SCR Section 5.3.1.7), and various methods of estimating the number of Chinook Salmon adults migrating past Devils Canyon (Study 9.7 SCR Section 6.1.5) in order to ensure that Objective 1 was effectively achieved. The combination of three years of telemetry surveys and concurrent visual aerial spawning surveys and the 2014 sonar data, provided a robust determination of relative numbers, timing and characterization of Chinook Salmon that migrate into Devils Canyon and beyond the proposed dam site. Additional information from additional tagging below Devils Canyon will not change fundamental outcomes of this study which has been completed. NMFS has not provided specific statistical criteria, benchmarks or sample sizes consistent with their determination of adequacy or lack thereof with respect to understanding the number, timing, and characterization of Chinook Salmon.

RSP Section 9.7.4.1 indicated that, if feasible, AEA would operate a fishwheel in Devils Canyon below the impediments from late June through late July to supplement the Middle River fishing effort for Chinook Salmon. The purpose of this recommendation was to explore whether it was possible to increase the sample size of radio-tagged Chinook Salmon moving into and above Devils Canyon. No fishwheels were operated below Devils Canyon in 2013 or 2014. Land-access limitations precluded siting a fishwheel in Devils Canyon in 2013 (ISR Part A, Section 4.1.8.1) and feasibility was further limited by uncertain catch rates at an unproven site, logistical challenges and cost (Study 9.7 SCR Section 4.1.6).

AEA implemented variances to the Study Plan in 2013 and 2014 to compensate for the lack of a Devils Canyon fishwheel:

1. Number of radio-tagged Chinook Salmon was increased in the Middle River. RSP Section 9.7.4.1 indicated that 400 radio tags would be used. Goals were increased to 560 in 2013 and 650 in 2014. In 2013, 536 large Chinook and 67 small Chinook were tagged. In 2014, 590 large Chinook and 32 small Chinook were tagged.

2. Three fishwheels were operated in the vicinity of Curry rather than the two fishwheels indicated in RSP Section 9.7.4.1.1.

3. Daily effort of fishwheels was increased from maximums of 12 to 24 hours.

In addition, radio-tagging survey effort was substantially increased to increase detection rates and distribution information. Due to land access limitations, five of the fixed-station receiver sites listed in the Study Plan (RSP Section 9.7.4.2.1) were not installed in 2013. Instead, AEA added six new fixed-station receiver sites (ISR Part A Section 4.2.4) and increased the frequency of helicopter telemetry surveys through Devils Canyon from once every 5 days to daily or twice a day when Chinook Salmon were migrating (ISR Part A Section 4.3.5). In 2014, ten fixed-station receiver sites were installed in the Middle and Upper rivers (SCR Section 4.2.4). Thus, in 2013 the number of fixed telemetry stations in the Susitna River increased from 19 to 27.

Radio-tagging is a direct, detailed, and robust method of assessing the passage of all stocks of fish that may pass through Devils Canyon and above the proposed dam site. Chinook Salmon radio-tagged at Curry ultimately improved information on migration in the Upper River than relative to that which would have been provided by tagging at Devils Canyon (Study 9.7 ISR Part C Section 7.1.2.1.2). Tagging additional fish at Curry provided a more certain and larger sample size of fish entering Devils Canyon than attempting to catch fish in an unproven location. The increased sample numbers of fish approaching Impediment 1 after being tagged at Curry exceeded the most optimistic expectation of the number of additional tags that could be applied from a fishwheel in Devils Canyon. In addition, fish tagged in Devils Canyon would have had less distance and time for potential "drop-back" effects to attenuate before they passed impediments, compared to fish tagged at Curry.

NMFS previously filed a study dispute February 20, 2013 requesting additional tagging and fish surveys relative to the RSP for the purpose of documenting fish passage at the proposed dam site. NMFS also requested expanding the study duration from 3 to 5 years. FERC subsequently determined that neither of these changes to the RSP requested by NMFS for this study were warranted.

AEA reported the variance of not operating a fishwheel in Devils Canyon at the Technical Workgroup (TWG) meeting on June 24, 2013 and again in the Study 9.7 ISR Part A Section 4.1.8.1; ISR Part C Section 7.1.2.1.2; and at the ISR meeting on October 15, 2014. To summarize, it was not feasible to locate a weir in the canyon due to land access constraints in 2013. Instead during the 2013 field season AEA increased the time Curry fishwheels were operated and increased the number of Chinook Salmon tagged by 160, and increased the frequency of flights through Devils Canyon from 2 to 3 times per week to once per day when the first tagged fish were observed at Impediment 1. After reviewing the 2013 data, AEA determined that it would increase the risk of not meeting the study objective by moving forward with an untested fishwheel site below Devils Canyon in 2014. Accordingly, Study Plan modifications to fishwheel operations and tagging effort were proposed and implemented to compensate; a third fishwheel was added at Curry and the number of tagged Chinook Salmon was increased from the original goal of 400 to 650, and the frequency of survey flights through Devils Canyon was increased from once every five days to one to two flights per day once the first tagged fish was detected at Impediment 1.

2.6.3.5. Objective 4

Objective 4: If shown to be an effective sampling method, and where feasible, use sonar to aid in documenting salmon spawning locations in turbid water in 2013 and 2014.

2.6.3.5.1. Response to Modification Request to Develop Additional Methods to Locate Spawning in Turbid Waters

NMFS (Modification 4-1; NMFS_pp9.7-6_ph2) recommends that AEA work with the TWG to develop and propose additional methods to FERC to use to locate and document Pacific Salmon spawning in turbid waters at sites classified as mainstem spawning locations in previous tagging studies. NMFS suggests several methods, including limited gill netting, late September or early October redd surveys during clear water conditions; and pumping or excavating potential redd sites.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the proposed modification.

AEA notes that, in its comments, NMFS did not cite Objective 4 as is identified in the FERC-approved Study Plan: *"If shown to be an effective sampling method [during the 2012 study], and where feasible, use sonar to aid in documenting salmon spawning locations in turbid water in 2013 and 2014."* This objective involved use of side-scan and/or Dual Frequency Identification Sonar (DIDSON) to characterize any suspected salmon spawning in turbid water of the mainstem habitats of the Susitna River (RSP Section 9.7.4.4). The study found limited utility of current sonar technology for documenting spawning behaviors due to shallow depths at which many salmon spawn, bed topography and species apportionment problems. The objective was met by demonstrating that sonar is not an effective tool given the typical habitat conditions where these species spawn.

Use of Adaptive Resolution Imaging Sonar (ARIS) was explored in 2012 (Study 9.7 ISR Part A) and continued in 2013 but met with limited success (ISR Part A Section 6.5). Potential spawning sites in side channels or sloughs were too shallow for access by a boat loaded with heavy sonar equipment. Redd depressions were difficult to distinguish in sonar imagery because of the river bed slope and substrate size. The ARIS sonar was also unable to differentiate between Chum, Coho, Pink, and Sockeye salmon due to overlap in their run timing and body size. A variance was proposed as a Study Plan modification in 2014 to focus sonar efforts on Chinook Salmon (ISR Part C Section 7.1.2.4). Chinook were more likely than other species to spawn in deeper water and spawned earlier when few other species were present. In 2014, the higher resolution DIDSON also replaced the ARIS sonar used previously.

Ground crews sampled a total of 44 potential Chinook Salmon spawning areas in mainstem areas of in the Middle River from 2012-2014. Eighteen of these locations were sampled with sonar over the three study years. Chinook Salmon spawning activity (nest-guarding behavior) was observed at one location. Chinook Salmon were documented at four turbid water locations but no behavior indicative of spawning was identified. Additionally, Chinook Salmon spawning behavior was confirmed using sonar at a creek mouth that was not identified by radiotelemetry analysis. The remaining 26 locations were either not accessible by boat, were not suitable as spawning habitat, or did not contain Chinook Salmon when viewed with sonar. Spawning activity was not confirmed for any other salmon species using sonar technology.

None of the alternatives proposed by NMFS for documenting spawning in turbid water sites will provide significantly better information than is currently available. Gillnetting might document occurrence but cannot distinguish spawning from holding or migrating. Gillnet effectiveness is habitat dependent and will be low at shallow water sites. Gillnets will also disrupt spawning and impose an incidental mortality. Previous studies of salmon spawning in the mainstem Susitna River were based on visual surveys of redds late in the season after water clears with falling temperatures. However, visual surveys underestimate the extent of spawning activity because detection varies with discharge, suspended sediment levels, and habitat type. Where redds can be identified, the associated species is unknown. Late-season survey access is also difficult due to low water and weather. Pumping or excavating potential redd sites will be very labor intensive and only feasible to conduct at a limited number of sites. Redd locations are very localized and a great many samples will be required to detect eggs. Redd pumping or excavation will be disruptive and impose mortality.

Regarding a request for development of study methods through the TWG, AEA has been doing this since 2012. All of the variances for 2013 work were reported in the ISR Part A originally filed in January 2014 and AEA filed with the Commission a table of 2014 activities by study which included proposed study modifications. AEA specifically requested consultation with the agencies prior to the initiation of the 2014 field season and tried to set up technical meetings in March and April 2014 to discuss 2014 activities and study modifications. Neither NMFS nor USFWS were available or willing to discuss Study 9.7 with AEA prior to implementing the study in 2014.

2.6.3.6. Objective 5

Objective 5: Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon

2.6.3.6.1. Response to Comments Regarding Comparisons Between Current and 1980s Studies

NMFS states it is not recommending any study modifications under this objective (NMFS_pp9.7-6_ph6) but disagrees with the presentation or interpretation of data collection efforts. NMFS also suggests that AEA needs to discuss the differences between Middle River tributary Coho Salmon spawning between current studies compared with studies conducted in the 1980s (NMFS_pp9.7-7_ph3). NMFS suggests that differences in the Middle River tagging location in current studies (Curry) versus the 1980s (Talkeetna Station) have caused use of lower Middle River tributaries to be underestimated in the current study. In addition, NMFS suggests that because “AEA did not attempt to determine the distribution of salmon into the Yentna River drainage or the Deshka River from tagging locations 22 miles upstream”, that current studies are not precise enough to confirm spawning areas in the lower Middle River (NMFS_pp9.7-7_ph3).

In response to NMFS’s comments, AEA believes that it is a misinterpretation of this objective to assume that for the data to be compared, the current study would be conducted as it was in the 1980s. The objective was to compare the data between the studies, with the current study always proposing tagging at Curry and not Talkeetna (RSP Section 7.7.4.1.1). Differences in Coho Salmon occurrence among Middle River tributaries is discussed in Study 9.7 SCR Section 6.3.3. A comparison of results of 1980s and current studies prepared for this response (Table), does not support NMFS’s suggestion (NMFS_pp9.7-7_ph3) that current studies underestimate Coho Salmon use of lower Middle River tributaries relative to 1980s studies. Both studies show that Coho Salmon are widely distributed among tributary streams throughout the Middle River and generally more abundant in larger systems than smaller systems.

Specific percentages are not directly comparable due to differences in estimation methods between the two studies. Studies during the 1980s were based on peak counts in helicopter and ground surveys of specific streams. The effectiveness of visual surveys was highly dependent on stream size and water clarity which varies considerably from stream to stream. Thus, counting efficiency is greater in smaller, clearer systems which would inflate estimated population proportions relative to larger, more turbid streams. Barrett et al. 1985a report that counts were adjusted for stream life and helicopter survey efficiency but the accuracy of corresponding assumptions is unknown. Peak counts may also be confounded by environmental conditions during the survey year because Coho Salmon distribution and movements in tributaries are highly dependent on stream flow and temperature. In contrast, radiotelemetry can be expected to provide a much more robust estimate of relative proportions of Coho Salmon using each stream because observations are not confounded by counting conditions specific to each stream and when surveys occur.

It is also important to note that as presented in the RSP Section 9.7.4.5, Objective 5 was to understand the relative proportions of salmon that used mainstem (side channel, slough habitats) versus tributaries during current and past studies. Developing the specific percentages of Coho Salmon spawning in each Middle River tributary and comparison among tributaries was never intended nor is it important to document if the relative proportion of salmon spawning in Gash Creek for example decreased or increased from the 1980s. As described above, the data collected and presented for the lower Middle River tributaries is sufficient to demonstrate that similar to the 1980s these tributaries continue to support spawning populations of Coho Salmon.

Table 2.6.3-4. Distribution of Coho Salmon in Middle River Tributaries (percent of total) in 1984 based on peak counts in ground surveys (Barrett et al. 1985a) and in 2012-2014 based on radiotelemetry (Study 9.7 SCR Figures D5 and D6).

	1984	2012-2014	
	Visual surveys	Lower River release	Middle River release
Portage	8.9	0.1	9.0
Jack Long	0.4		3.2
Indian R	32.6	1.4	37.6
4th of July	0.6		1.4
Sherman			0.2
Lane	1.7	0.1	1.9
Whiskers	21.0	0.6	3.2
Chase	16.7	0.4	1.2
Gash	16.3		0.7
Slash	0.4		0.3
Trib 113.7			0.2

From NMFS's comments, which are incorrect at times, it is unclear why NMFS concludes that they disagree with AEA's *interpretation* of the data. For example, NMFS asserts that Figure D-9 from the SCR "*only shows tagged Sockeye Salmon destined for the Yentna*". Consistent with the results presented in Study 9.7 SCR Section 6.5.4, Figure D-9, (inserted below as Figure 2.6.3-3), show 96 percent of fish tagged and released in the Lower River had final destinations in the Yentna, with the remaining 1 percent, 2 percent and 1 percent destination assigned to the Deshka, Chulitna and mainstem Susitna River. Clearly AEA has accurately represented that 1 percent of tagged Sockeye Salmon from the Lower River were destined to the mainstem. Furthermore, as stated in Study 9.7 SCR Section 6.5.4, this finding of very few mainstem spawning Sockeye Salmon is consistent with the findings in the 1980s that found no Sockeye Salmon spawning in the Lower River.

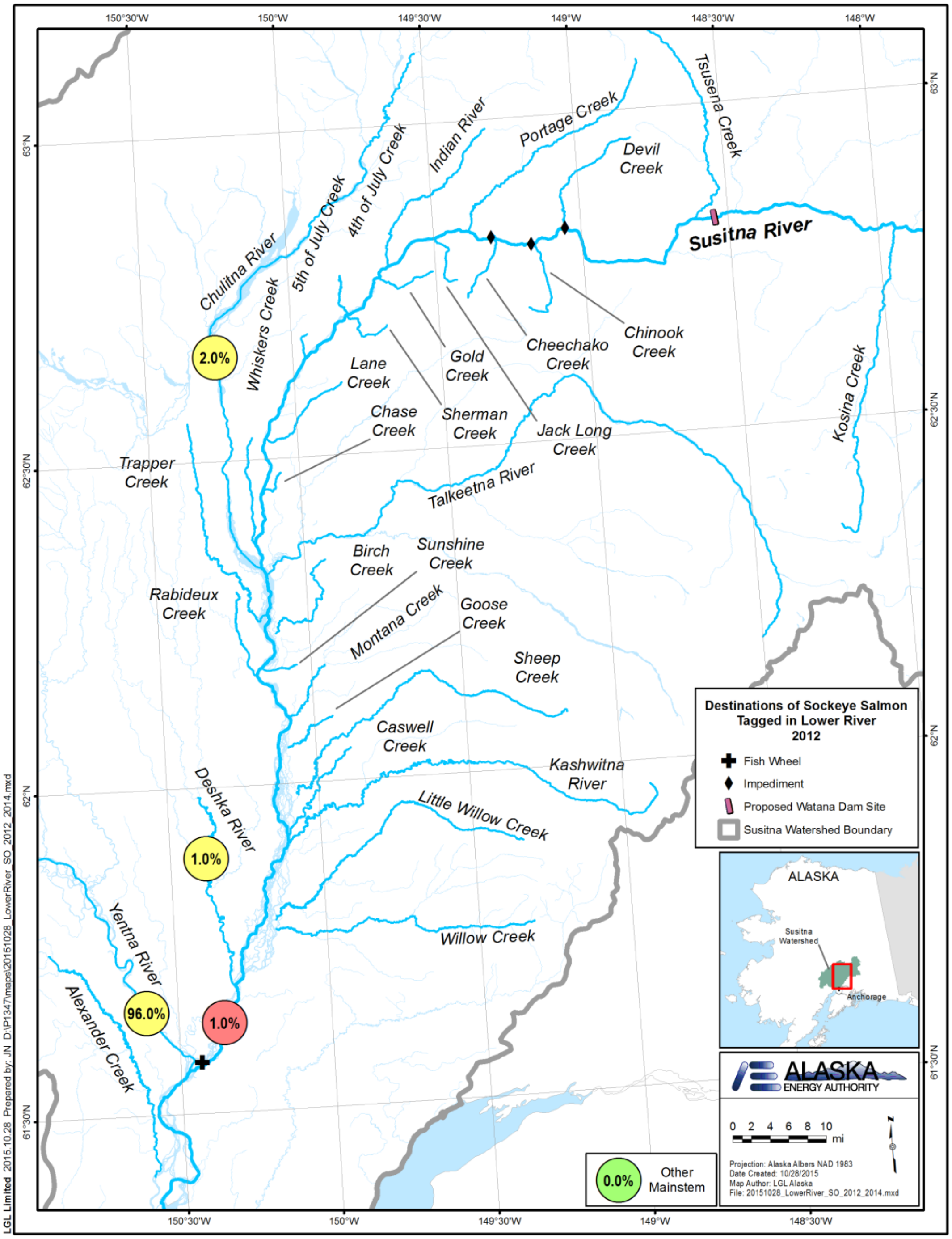

Figure 2.6.3-3. Figure D-9 in Study 9.7 SCR. Destinations for radio-tagged Sockeye Salmon released in the Lower River in 2012. Proportions classified to tributary destinations are shown in yellow circles. The proportion classified to any mainstem destination is shown in an arbitrarily-placed pink circle. In the green circle shows the proportion of fish that were tracked but that could not be conclusively assigned to a destination. Proportions are calculated from the total numbers of tags released, after excluding fish with one or fewer detections, that never moved, or moved only downstream.

In addition, NMFS suggests that not that attempting to determine the distribution of salmon into the Yentna River drainage or the Deshka River from tagging locations 22 miles upstream is evidence that current studies are not precise enough to confirm spawning areas in the lower Middle River (NMFS_pp9.7-7_ph3). This statement is fallacious. The spawning distribution of salmon in tributaries downstream from the middle river was never an objective of this study. The spawning distribution of salmon in the Yentna and Deshka has no relevance to identification of spawning areas in the lower Middle River.

2.6.3.6.2. Response to Recommendation for Additional Tagging of Coho Salmon at Talkeetna Station

NMFS (NMFS_pp9.7-7_ph1) recommends that additional tagging of Coho Salmon at Talkeetna Station should be conducted along with foot surveys to verify spawning locations. NMFS appears to be basing its recommendation on existing documentation of Coho Salmon spawning in the Middle River provided in the Study 9.7 SCR.

AEA disagrees with this recommendation, and asserts that additional tagging of Coho Salmon at Talkeetna Station and foot surveys to verify spawning locations are not necessary to document lower Middle River Coho Salmon spawning locations. Results from three years of tagging, including the number of fish tagged and tracked via fixed stations and mobile surveys, and the number of detections across river segments and habitats, characterize the distribution of salmon throughout the Middle and Lower River. These results were sufficient to determine Coho Salmon spawning sites in the Middle River between PRM102 (confluence of Middle River with Lower River) and PRM 124 (Curry) (Study 9.7 SCR Section 6.3.4).

Over the three years of study, a total of 1,635 Coho Salmon were captured and radio-tagged in the Lower Susitna River in addition to the 656 Coho captured and radio-tagged in the Middle River at Curry. Radio-tagged Coho Salmon of Lower River origin had the same opportunity to choose destinations in either section of the river. Thus, Coho Salmon tagged in the Lower River contributed substantial numbers of observations to Coho Salmon tagged in the Middle River in the identification of Middle River destinations. Tagged Coho Salmon were subsequently located by fixed and aerial surveys conducted in the Lower and Middle River mainstem and tributaries. In three years, 80 complete aerial telemetry surveys were conducted over the river from PRM 102 to PRM 124, detecting both Lower River-origin and Middle River-origin tagged Coho Salmon.

A total of 58 Lower River origin and 315 Middle River origin Coho Salmon tags were detected at the Lane Creek telemetry fixed station located at PRM 116.8. A total of four potential spawning-holding locations for Coho Salmon in mainstem habitats (tributary confluence), and 61 tags having their destination in tributaries (Lane, Whiskers, Chase, Stash, and Gash creeks) from PRM 102 to PRM 124. This compares to a total of 31 potential spawning-holding locations identified for Coho Salmon in mainstem habitats, and 320 in tributaries upstream of PRM 124.

Further, documented roaming behavior supports that Coho Salmon of Middle River origin also have substantial opportunity to choose destinations downstream of PRM 124. These results indicate that the Middle River upstream of PRM 124 includes a substantially higher proportion of spawning (89 percent of mainstem locations, 84 percent of tributaries) than that downstream of PRM 124 (11 percent of mainstem locations, 16 percent of tributaries), and is consistent with historical studies (Barrett et al. 1985a, b). Therefore, implementation of the Study Plan for radiotelemetry including all variances provided sufficient sample size and telemetry detections to evaluate spawning locations for adult Coho Salmon in the Middle River downstream and upstream of PRM 124 and meet the objective of the study.

NMFS previously filed a study dispute in February of 2013 requesting to expand the study to include additional tagging efforts, tagging locations, and fixed receiver locations in the Middle River segment. On April 12, 2013, a technical dispute resolution panel, convened by FERC to resolve the NMFS dispute, filed its findings with the Commission. In that filing, the panel recommended no change to the study in response to the NMFS study dispute after finding that existing information and the collection of the two years of data on fish escapement to the Upper Susitna would be sufficient for developing license requirements for fish passage. FERC Staff's Study Plan Determination, dated April 26, 2013, agreed with the panel and recommended no additional modifications.

It should also be noted that ADF&G has been conducting Coho Salmon spawning distribution and escapement studies throughout the Susitna Basin below Devils Canyon annually since 2009. These results are documented in a series of annual project reports and provide a strong basis for experience and consistent findings with the Salmon Escapement Study 9.7.

2.6.3.7. Objective 6

Objective 6: Generate counts of adult Chinook salmon spawning in the Susitna River and its tributaries to estimate the proportions of fish with tags for populations in the watershed

2.6.3.7.1. Response to Comment Regarding the Applied Methods for Salmon Escapement into Tributaries

NMFS (NMFS_pp9.7-7_ph4) does not recommend any study modifications directed toward achieving this objective. However, NMFS does not agree that the applied methods provide an accurate assessment of salmon escapement into tributaries and these estimates should not be relied on for assessment of current conditions or used to predict the effects of Project operations on spawning habitat.

AEA disagrees with this comment and notes that the Objective 6 citation in NMFS's comment is not consistent with the FERC-approved Study Plan. As stated in RSP Section 9.7.1.2, Objective 6: Generate counts of adult Chinook Salmon spawning in the Susitna River and its tributaries to estimate the proportions of fish with tags for populations in the watershed. Robust estimates of Chinook Salmon spawning distribution were derived from 4,352 Chinook Salmon radio-tagged over three years of study. Mainstem and tributary spawning destinations were estimated in 2012-2014 using up to 23 fixed receivers, almost 30,000 river miles of aerial surveys, and hundreds of thousands of radio tag detections. Three years of study results were averaged to produce tributary and mainstem reach-specific estimates of population proportions. Sample sizes were such that proportions could be accurately calculated to the nearest 0.1 percent.

Mark-recapture assumptions of the study design were examined extensively and no substantive biases in estimated proportions were identified (Study 9.7 SCR Section 5.1). Size selectivity of fishwheel captures was discussed in detail above in Section 2.6.3.2 of this document and in Study

9.7 SCR Section 5.1.3.3.4). Middle River fishwheels were not size selective for Chinook Salmon. Lower River fishwheels captured proportionately more small Chinook Salmon than large Chinook, but substantial numbers of all sizes were collected and marking rates were adjusted to provide a representative sample of the run. The predominate size and age classes of Chinook Salmon were tagged. Fish smaller than 50 centimeter METF were too small for placement of radio tags, however, these sizes typically comprised less than 20 percent of the total run. Hence, estimates of proportional distribution are robust with respect to size of Chinook Salmon tagged.

Contrary to NMFS's assertion, variances were improvements in the original study design and were implemented to ensure that the study objectives were met. The fact that variances occur is more indicative of original study methodology assumptions not being met than demonstration that an objective is not achieved.

The Study Plan originally called for sampling Chinook Salmon carcasses on selected spawning grounds (Portage and Indian Creeks) to test whether fish were equally vulnerable to being captured and radio-tagged in the Middle River (RSP Section 9.7.4.6). However, 2012 surveys found too few carcasses to confidently estimate a mark rate, likely due to significant predation and consumption of the carcasses. Size distributions and mark-rates were successfully estimated in 2013 with a weir, video system, and fixed receiver site in the Indian River, which was implemented as a variance (ISR Part A Section 4.1.8.3). Accordingly, this variance to the Study Plan was proposed for 2014 (Study 9.7 SCR Section 4.6.1). However, the weir failed in 2014 due to a flood mid-season, after the tagging was underway. To adjust mid-season and achieve the objective, biweekly aerial surveys were conducted in the Indian River and mark rates in Indian River were estimated from the biweekly aerial surveys and area-under-the-curve (AUC) methods.

The AUC methodology is detailed Appendix H (*Chinook Salmon – Indian River Escapement Estimate for Chinook Salmon*) of the Study Completion Report. AUC estimates escapement in numbers of fish as a function of fish counts during aerial spawning surveys, observer efficiency, and fish residence time on the spawning grounds. Residence time is estimated empirically from radio tags. Mark rate is then estimated from the number of radio tags detected and the total escapement.

Mark rates from Indian River sampling were used to estimate abundance of Chinook Salmon upstream of Devils Canyon (Study 9.7 SCR Section 6.1.5) but not population proportions which were estimated directly from radio tag detections. Indian River sampling was originally intended to provide information on fish size selection in Middle River tagging capture but other information was used in lieu of Indian River weir sampling to confirm that marking was representative for size (Section 2.6.3.2 above and Study 9.7 SCR Section 5.1.2.5).

Escapement estimates derived using AUC are dependent on assumptions regarding observer efficiency (i.e., the percentage of fish present that are seen and counted). In 2013, observer efficiencies for Chinook Salmon in Indian River aerial spawner surveys were empirically estimated to range from 36 to 46 percent based on weir counts (Study 9.7 SCR, Appendix H: *Chinook Salmon – Indian River Escapement Estimate for Chinook Salmon*, Table H-1). In 2014, observer efficiencies were estimated to range from 40 to 80 percent based on AUC estimates. Based on the 2013 results, it is possible the 2014 estimates of observer efficiency were biased high. Therefore, a sensitivity analysis was conducted on the 2014 estimates of escapement and mark rate to evaluate the effect of lower observer efficiencies values (Study 9.7 SCR Appendix H: *Chinook Salmon – Indian River Escapement Estimate for Chinook Salmon*). All else remaining constant, decreasing observer efficiencies by 15 percent for each survey and river reach led to a 29 percent increase in the escapement estimate (from 1,297 to 1,674 fish) and a 23 percent decrease in the mark rate (from 13.2 to 10.2 percent).

The study used available information including Indian River mark rate data to identify the magnitude of the Chinook escapement upstream of Devils Canyon. Results from three independent study components in 2014 indicated that the abundance of large Chinook Salmon above Devils Canyon was likely on the order of magnitude of 50 fish or less, with a portion of that number passing above the potential dam site. First, aerial spawner surveys of clear water tributaries above Devils Canyon had a peak count of 12 Chinook Salmon (10 in Devil Creek, 2 in Fog Creek). If the observer efficiencies on these surveys were as low as 40-50 percent, the peak count would expand to only 24-30 fish. Second, a net-upstream count of 24 salmon-sized fish was obtained at the Watana Canyon sonar site in 2014. Although this count was considered a minimum estimate, there was no evidence to suggest that fish passage at the site was significantly greater than that observed. And third, based on a 13.2 percent mark rate for large Chinook Salmon at the Middle River tag site (based on Indian River estimates), the two radio-tagged fish that migrated above Devils Canyon represented approximately 15 fish in total.

Thus, independent estimates of approximate abundance providing corroborating estimates for abundance of Chinook upstream of Devils Canyon. These estimates also provide strong evidence that mark rates estimated using AUC methods and corresponding observer efficiency assumptions in Indian River were reasonable. It should also be noted that even several-fold errors in any of the estimates will not substantially increase the estimated proportion of Susitna Chinook Salmon migrating above Devils Canyon (<0.2 percent of the total Susitna basin abundance above the Yentna River).

2.6.3.8. Objective 8

Objective 8: Estimate the system-wide Chinook salmon escapement to the entire Susitna River, the Coho Salmon escapement to the Susitna River above the its confluence with the Yentna River, and the distribution of Chinook, Coho, and Pink salmon among tributaries of the Susitna River (upstream of Yentna River confluence) in 2013 and 2014.

2.6.3.8.1. Response to Modification Request for an Additional Year of Study

NMFS (Modification 8-1; NMFS_pp9.7-8_ph4) recommends that an additional year of study be conducted with fish capture and tagging occurring in the lower Middle River near the historic Talkeetna Station and at a second location upstream from Indian River but below Devils Canyon. NMFS recommends an a priori statistical analysis be conducted to determine the number of additional tagged fish required to yield sufficient identification of spawning habitat locations in the lower Middle River site (Coho Salmon, Sockeye Salmon, Chum Salmon, and Chinook Salmon). The Service also recommends that all of Chinook Salmon collected at the Devils Canyon site be given a tag, and that tracking tagged fish should be conducted following the methods specified in the FERC-ordered Study Plan. NMFS finally recommends that weirs be installed and maintained on mainstem Susitna at or upstream of the head of the proposed reservoir, at Kosina Creek and the Oshetna Rivers to recapture tagged fish and for additional genetic sampling.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the proposed modification. Aspects of the supporting rationale for NMFS's study modification request were previously addressed. See Section 2.6.3.4 of this response regarding the adequacy of Middle and Upper River tagging efforts in lieu of a Devils Canyon fishwheel capture and tagging site. See Section 2.6.3.5 of this response regarding identification of Middle River spawning locations. See Section 2.6.3.7 of this response regarding use of multiple methods to corroborate estimates of the relative proportion and abundance of Chinook Salmon adults occurring above Devils Canyon.

No objective criteria are provided by NMFS as guidance for an a priori statistical analysis of the number of additional tagged fish required to yield "sufficient" identification of spawning habitat locations in the lower Middle River site. No rationale or citations are provided to support a contention that elements of study methodology were contrary to "accepted" or "standard" scientific practice.

Each year during the three years of study, fish tagged in the Lower River moved into Middle River tributaries (Study 9.7 SCR Section 6.3.3.1). Coho Salmon tagged in the Middle River also moved into the Lower River during each year of recent telemetry studies (Study 9.7 SCR Section 6.3.3.2). Coho Salmon spawning locations are documented by tagging location for 2013 in ISR Part A Table 5.2.1 and for 2014 in Study 9.7 SCR Table 5.2.1. Coho Salmon spawning locations were consistently identified among tributaries throughout the lower Middle River during recent studies just as they were in the 1980s. No Coho Salmon from recent or historic studies have been found upstream from Devils Canyon. It should also be noted that Coho Salmon distribution during the 1980s was identified based on intensive spawning surveys with drift gill nets, boat electroshocking, sonar, and egg deposition pumps. The efficiency of these sampling methods was highly habitat dependent. During recent studies, distribution was identified with radiotelemetry for which technology has advanced considerably since the 1980s. Telemetry is a much more robust method for identifying distribution independent of potentially confounding habitat-related detection effects which may have influenced 1980s sampling.

The request for additional weir installations in the Upper River reflects a lack of understanding of the nature of the channel and hydrology of the Susitna River and the two Upper River tributaries as well as what is required to successfully install and maintain weirs in remote locations. Channel widths at locations recommended range from a low of 21.9 meters at Kosina Creek, to 48.3 meters in the Oshetna and to an estimate of over 100 meters (GIS based of orthophotography) for the Susitna River upstream of the Oshetna confluence. Based on 2013-2014 stream flow data collected at gages, discharge in the lower reaches of these Upper River tributaries can be high during the open water period and is highly variable. In 2013 and 2014, measured discharged ranged from a low of 464 cfs to a high of 3200 cfs in Kosina Creek and a low of 795 cfs to a high of 4420 cfs in the Oshetna River. The closest gage at which to measure discharge for the Upper River is near Tsusena Creek (located within the reservoir inundation zone) where discharge ranged from a low of 7240 cfs to a high of 37300 in 2013 and 2014. This gage is downstream from the recommended location and includes inflows from tributaries so the discharge in the mainstem upstream of the

Oshetna would be lower (approximately 3,000-4,000 cfs on average), but the magnitude of the discharge and the variability of stream flows should be expected to be similar and likely would limit weir operation. Depth is also a potential limiting factor for weiring off the Upper Susitna based on depth profiles. While average depths of 0.7 meters may not limit weir operation on the tributaries, measured velocities exceed 3 ft/s in Kosina and 4 ft/s in the Oshetna under normal flow conditions (from AEA stream gage data) and would pose challenges for safe and effective weir operation and maintenance. Safe weir operations require water depths and velocities that are not too deep or swift to allow for safe and comfortable wading (Johnson et al. 2007) across the channel. The data available on the Upper River, Kosina Creek, and the Oshetna River suggest that it would highly infeasible that counting weirs could be safely installed and maintained during the open water period when fish would be migrating.

2.6.3.9. References Cited

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2.6.4. Study 9.8 – River Productivity Study

As established in the Study Plan[27] (FSP Section 9.8.1), the overarching goal of this study is to collect baseline data to assist in evaluating the effects of Project-induced changes in flow and the interrelated environmental factors (temperature, substrate, water quality) upon the benthic macroinvertebrate and algal communities in the Middle and Lower Susitna River.

The study objectives established in FSP Section 9.8.1 consist of the following:

- Synthesize existing literature on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities.
- Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River.
- Estimate drift of benthic macroinvertebrates in selected habitats within the Middle and Lower Susitna River to assess food availability to juvenile and resident fishes.
- Conduct a feasibility study in 2013 to evaluate the suitability of using reference sites on the Talkeetna River to monitor long-term Project-related change in benthic productivity.
- Conduct a trophic analysis to describe the food web relationships within the current riverine community within the Middle and Lower Susitna River.
- Develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats to predict potential change in these habitats downstream of the proposed dam site.
- Characterize the invertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component).
- Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including coarse particulate organic matter, fine particulate organic matter, and suspended organic matter in the Middle and Lower Susitna River.
- Estimate benthic macroinvertebrate colonization rates in the Middle Susitna Segment under pre-Project baseline conditions to assist in evaluating future post-Project changes to productivity in the Middle Susitna River.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes three modifications to Study Plan Section 9.8 in addition to carrying forward the variances reported in the ISR Part A, Section 4 and ISR Part C, Section 7.1.2 (and summarized ISR Part D, Section 6.1):

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[27] The FERC-approved Revised Study Plan (RSP) Section 9.8 for the River Productivity Study (RIVPRO) as modified by FERC's Study Plan Determination (Study 9.8 SPD, April 1, 2013) and *Final Susitna River Productivity Study Implementation Plan* (Study 9.8 IP, March 1, 2013) is collectively referred to as Study Plan Section 9.8.

1. redesign of adult insect emergence traps by increasing floatation and improving anchoring and deployment methodology to minimize loss.
2. change the colonization sampling to investigate the overall differences in colonization rates and compositions among the five macrohabitat types within sites instead of by turbidity and temperature conditions.
3. add an extra collection of six Hester-Dendy sampler sets at a main channel site at increasing depth increments to record the effects of stage changes and exposures along the main channel's fluctuating shoreline, deployed for 4-6 week periods during the open water period.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, AEA received comments on the Study 9.8 from FERC, NMFS, and USFWS. NMFS and USFWS also submitted proposals for modification of the FERC-approved Study Plan. AEA did not receive any comments specific to AEA-proposed modifications that were detailed in Study 9.8 ISR Part C Section 7, and ISR Part D Section 7 and summarized in both the October 2014 and March 2016 ISR meetings. Because NMFS and USFWS comments were nearly identical, with differences in the numbering of the proposed modifications and phrasing, they were combined. When material differences occurred between the two sets of comments, both versions of text are supplied.

For simplification and reference, AEA has organized its responses in the order of the proposed modifications, which are organized by study objective, followed by the agencies' comments pertaining to each proposed modification, and then AEA's response. Several modifications and comments repeat the same rationale, and AEA has prepared two "General Response" sections to address the similar comments. While the two agencies call for a number of "Modifications" to the study, many do not meet the FERC criteria and several are merely repeated requests for additional sites in the Middle River for which FERC has already ruled in its April 1, 2013 Study Plan Determination (SPD).

AEA's responses to the comments can be found in Table 2.6.4-1 and below.

Table 2.6.4-1. Study 9.8 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA-5_ph4	*1. Section 4.3 of the SIR states that no benthic macroinvertebrate or benthic algae sampling occurred in 2014 at the middle and lower Susitna River stations. In contrast, the September 2014 technical memorandum states that benthic macroinvertebrates, benthic algae, benthic organic matter, drifting invertebrates and seston, and emerging adult insects were collected during spring 2014. The approved study plan requires benthic macroinvertebrate and benthic algae sampling in study years 2013 and 2014 during three sampling periods (April through October) to capture seasonal variation in benthic macroinvertebrate community structure and benthic algae productivity. Additionally, the SIR does not report the missing seasons or missing year of data collection as a variance to the study plan. Please clarify the reporting discrepancy between the September 2014 technical memorandum and the SIR, and identify and address all variances to the approved study plan as appropriate.*	See Section 2.6.4.1.1 for clarification regarding what surveys have been completed and what data collection and analysis remains to be done.
FERC_ppA-5_ph5	*2. The approved study plan, required that you consult with resource agencies to identify two focus areas appropriate for stable isotope sampling, where each type of stable isotope samples would be collected, and the number of adult salmon tissues to be collected. It is unclear where in the study consultation record that you provided documentation of the required consultation. Please provide an explanation of when the required consultation was completed.*	As explained in Section 2.6.4.1.2, AEA presumed that the decision to expand the stable isotope sampling from two focus areas to a total of four out of the five available River Productivity Study stations, and to collect stable isotope samples from *all* available macrohabitats within those stations (increasing the number of sites from six to sixteen) eliminated the need for consultation regarding sampling site location. In addition, since AEA was collecting 100 percent of the salmon carcasses encountered within study sites during the scheduled sampling efforts, the need for consultation on the number of adult salmon tissue samples to be collected was considered unnecessary.
FERC_ppA-6_ph1	*3. Section 4.9.1.2 of the ISR indicates that published and unpublished length-weight equations were used to estimate the dry mass of prey items found in fish stomach contents to improve accuracy and better achieve the study objective. However, the specific equations are not presented in the ISR, SIR, or associated technical memoranda. While it is implied that equations from Benke et al. (1999) (among other authors) were used for analysis, Benke et al. (1999) provides a myriad of equations for many different taxa primarily from the southeastern United States. As such, these may not be representative of the length-weight relationship of taxa in the Susitna River or central Alaska. Please provide in the USR the length-weight equations used to estimate the mass of prey items in the stomach*	The length-weight equations used to estimate the mass of prey items in the stomach contents of sampled fish are provided below in Table 2.6.4-2, along with explanations for equations as to why they are applicable to the study. See Section 2.6.4.1.3 below for further detail.

Reference Number	Comment or Study Modification Request	AEA's Response
	contents of sampled fish as well as an explanation for each equation why the equation is applicable to the study.	
FERC_ppA-6_ph2	*4. One objective of the approved study plan is to develop Habitat Suitability Criteria (HSC) for Susitna benthic macroinvertebrate and algal habitats to predict potential changes in these habitats downstream of the proposed dam. However, no discussion of the status of the development of HSC and Habitat Suitability Indices (HSI) for benthic macroinvertebrates and algal habitat was included in the SIR or the 2014 technical memorandum. On page 11 of the ISR Part D, you state that you plan to complete all remaining data collection and analysis for development of HSC and HSI, with no modifications. Please clarify what remaining activities, data collection, or analyses are necessary to complete the above study objective.*	The remaining activities, data collection, or analyses necessary to complete the study objective are as follows: • .Analysis to evaluate the relationship between habitat variables and macroinvertebrate and algal abundance and to develop predictive multivariate benthic HSC/HSI models based on 2013 data is underway and will be completed for the USR. The analysis methods are similar to those detailed in "Habitat Suitability Curve Development. Addendum to 2014 Year End Report, Study 8.5, Appendix D". • A second year of data collection of benthic macroinvertebrates, algae, organic matter, and colonization rates, along with associated habitat variables (depth, velocity, substrates, turbidity) will be used to enhance these relationships and model development (RSP Section 9.8.4.10.; ISR Part D, Section 8). • After incorporation of the additional data, the curves will be reviewed with the TWG and the development of the final HSC and HSI curves will occur. The curves and the development methods will be presented in the USR.
FERC_ppA-6_ph3	*5. The approved study plan states, "Benthic organic material is one of the most important 'interrelated environmental factors' influencing the macroinvertebrate community, and damming the river will have significant consequences for the transport of organic matter from the upper watershed. Therefore, to address the importance of organic matter to productivity in this type of system, quantifying benthic organic matter as part of this study is essential." Sampling was to occur in 2013 and 2014 to characterize organic matter sources. In 2013, benthic and seston organic matter resources were sampled, but in 2014, only seston samples were collected. You did not report this as a study variance in the SIR. Please explain why you did not collect benthic organic matter in 2014 and how it affects achievement of the study objectives.*	See Section 2.6.4.1.1 for clarification regarding what surveys have been completed and what data collection and analysis remains to be done. The Commission is correct that benthic macroinvertebrates, benthic algae, benthic organic matter, and emerging adult insect data collection are still required to complete the objectives of this study (ISR Part D, Section 8). The 2014 field season was in support of trophic and growth models only. Additional effort including the characterization of organic matter will occur during future implementation of the study.
FERC_ppA-6_ph4	*6. An objective of this study was to estimate benthic macroinvertebrate colonization rates in the Middle Susitna River segment under current baseline conditions in 2013 and 2014 to support an evaluation of potential*	Initial cutoff turbidity levels were visual. "Clear" sites had no visible turbidity, whereas "turbid" sites were notably so. Examination of the data from colonization efforts (http://gis.suhydro.org/SIR/09-

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	project effects. As such, benthic macroinvertebrate colonization rates were to be monitored under four treatments: (1) turbid/warm, (2) clear/warm, (3) turbid/cold, and (4) clear/cold conditions during the 2013 and 2014 study seasons. You deployed Hester-Dendy samplers at different locations in the Whiskers Slough. Temperatures classified as cold were temperatures less than 13°C; whereas, temperatures classified as warm were greater than 13°C. However, the parameters for the turbidity cutoffs were unidentified. Please specify the turbidity cutoff among the four treatments.	Fish_and_Aquatics/9.8-River_Productivity/SIR_9_8_RIVPRO_2013_FieldData_20151028.xlsx, SW3_RP_Coloniz_A_Site_R2 tab; posted October 28, 2015) show that "clear" ranged from 0.12 to 2.8 NTU, with an outlier of 28 NTU (August storm event). The average with the outlier was 3.3 NTU, 0.93 NTU without. "Turbid" sites ranged from 9.33 to 118 NTU, averaging 50 NTU overall.
FERC_ppA-7_ph1	*6. In addition, given the large geographic extent of the Middle Susitna River segment, and that Whiskers Slough is located far downstream of the proposed dam location, please explain how colonization rates in Whiskers Slough are representative of the entire Middle Susitna River segment.*	See Section 2.6.4.1.4 below.
NMFS_pp9.8-1_ph2; USFWS_pp9.8-1-ph2	*This study was not implemented in accordance with the approved study plan, limiting its value for providing information necessary for NMFS in assessing project impacts. The objectives of the River Productivity study were not met through implementation of the "first" study year's field methods (2013 and 2014). Our review identified inconsistencies between the study plan (RSP) and the implementation plan (3/1/2013), including inconsistent sampling methods or sampling effort among sampling locations which compromise the data and obfuscate analysis.*	AEA submitted the RSP with some details on sampling methods and efforts. The Services indicated that there was not enough detail, and FERC agreed, requiring AEA to provide an Implementation Plan (IP) with more details on sampling methods, efforts, and proposed sites in a draft IP, and then a final IP. The River Productivity IP contains much more specific detail than was given in the RSP, as was requested and as indicated in ISR Part D, Section 5, the IP supplements and, in some cases, supersedes the methods presented in the RSP. In addition, the April 1, 2013 FERC Study Plan Determination made additional requests that further altered several site selections and sampling methodology detailed in the IP. Any departures from these detailed methods and efforts have been documented in the variances in the ISR Part C and ISR Part D.
USFWS_pp9.8-1_ph2	*The study effort was also not coordinated with other interrelated studies as well as it could have been, in terms of sampling locations.*	AEA disagrees with this statement. The River Productivity study was set up to overlap considerably with multiple studies, especially the Fish Distribution and Abundance (FDA) studies, by targeting Focus Areas as shared sampling areas. As part of the presentations in the ISR meetings in October 2014, the River Productivity Study presentation shows maps of RP-81, FA-104, FA-141, FA-173, and FA-184 that illustrate the overlap of River Productivity locations with those efforts of Study 5.5 (Water Quality), Study 8.5 (HSC), and Study 9.6 (FDA Middle and Lower River). Out of a total 20 sites in 2013, 14 sites were conducted at locations with at least one of the other studies.

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NMFS_pp9.8-5_ph6; USFWS_pp9.8-6_ph1	***NMFS Modification 1-1; USFWS Modification 1-1:*** *Provide a description of the key words and data bases used for literature searches in order for review participants and FERC to determine the completeness of this review.*	As explained below in Section 2.6.4.2.1.1, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $20,000.
NMFS_pp9.8-3_ph2	*NMFS Modification 2-1(a-c):* *Repeat benthic macroinvertebrate, benthic organic matter, and periphytic algal sampling at all tributary mouth sampling locations, or at a minimum of 6 in total, to complete the study the approved study plan. Complete periphytic algal sampling at upland slough sampling locations (minimum of five) to complete the study per the approved study plan.* *a. Sample at a minimum of five replicate upland slough habitats per the study plan. Do not use data from the sampling sites referred to as upland slough near Montana Creek. Instead, select and sample actual upland slough habitat.* *b. Co-locate upland slough sites selected or the River Productivity study be co-with upland sloughs sampled for the Fish Distribution and Abundance (FDA) study.* *c. Sample additional upland sloughs in the Middle River below Devils Canyon.*	As explained below in Section 2.6.4.2.2.3 (tributary mouths) and Section 2.6.4.2.2.4 (upland sloughs), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification, which is the same as USFWS Modification 2-1 (tributary mouths) and Modification 2-2 (upland sloughs), is approximately $725,000 per additional year.
USFWS_pp9.8-2_ph7	*USFWS Modification 2-1:* *Repeat benthic macroinvertebrate, benthic organic matter, and periphytic algal sampling at all tributary mouth sampling locations to complete the study according to the study plan, using appropriate sampling methods for water depths and velocities. Implement accepted scientific practices for macroinvertebrate and algal sampling scientific practices. Sample a minimum of 6 additional tributary mouths in the Middle River, below Devils Canyon. As implemented, sampling did not adhere to the approved study plan.*	As explained below in Section 2.6.4.2.2.3 (tributary mouths), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification, which is fully included within NMFS Modification 2-1(a-c) for tributary mouths, is approximately $450,000 per additional year.
USFWS_pp9.8-2_ph8	*USFWS Modification 2-2:* *Complete periphytic algal sampling at upland slough locations to complete the study, according to the approved study plan.* • *Repeat sampling of benthic macroinvertebrates, macroinvertebrate drift, benthic organic matter, and periphytic algae at upland slough sampling locations per the study plan, using appropriate sampling methods for water*	As explained below in Section 2.6.4.2.2.4 (upland sloughs), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification, which is fully included within NMFS Modification 2-1(a-c) for upland sloughs, is approximately $275,000 per additional year.

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	depths and velocities, and implementing accepted macroinvertebrate and algal sampling scientific practices. *• Sample a minimum of five replicate upland slough habitats per the study plan. Avoid incorrect classification and inclusion of sites that did not fit the upland slough definition, namely the aquatic habitat near Montana Creek.* *• Co-locate upland slough sites selected for the River Productivity study be co-located with upland sloughs sampled for the FDA study.* *• Sample additional upland sloughs in the Middle River below Devils Canyon.*	
NMFS_pp9.8-9_ph1; USFWS_pp9.8-7_ph2	*Replicate samples within a sampling unit were all collected within very close proximity to each other (< 10m apart), rather than from distributed locations as required in the study plan. The Final River Productivity Implementation Plan (IP) states that benthic sample will be collected from five "suitable locations, spacing them as equidistantly as possible, to be representative of the site." Therefore, for a 200 m tributary mouth, sampling locations should have been selected about every 40 m. The IP further states, "If five unique and separate locations are not available, it will be necessary to collect more than one sample within the same location. If this is the case, space the sample locations out as far as possible. For example, if conditions require two samples in one riffle area, sample at the downstream end and then the upstream end. As a general rule, samples should not be taken within 10 m of each other. Selected locations at each site should be sampled in a downstream-to-upstream direction." It is clear from the sampling locations presented in Figures 1 through 3 [the distribution of sampling sites in AEA's Study Implementation Report (SIR) largely expand on GPS points in the ISR figures], that this methodology was not implemented per the study plan. If samples were collected every 10 m then sampling would be distributed at a minimum over 40 m; however, samples tributary mouth samples were all collected within the tributary delta and within close proximity to each other.*	As explained in Sections 2.6.4.2.2 and 2.6.4.2.3, AEA disagrees with the agencies characterization of AEA's implementation of the FERC-approved Study Plan.
NMFS_pp9.8-15_ph1; USFWS_pp9.8-9_ph2	*Sampling locations within the FA 141 upland slough sampling unit appear to be inappropriately selected, based on limitations imposed by the Hess sampler. The SIR (Table 4.8-1) stated that both Hess and Ponar samplers were used to collect samples. No drift was sampled and it is not possible to determine which substrate was sampled to collect algae. The upland slough backwater is dominated by fine substrate and deep water. As such, sampling does not appear representative of this habitat and instead seems*	As explained in Section 2.6.4.2.2.5, AEA disagrees.

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	to have been conducted around the limitations imposed by the Hess sampler. In addition, replicate samples were all collected within close proximity to each other, particularly during spring and summer. Therefore, sampling was not conducted according to the study plan specifications, regarding representativeness.	
NMFS_pp9.8-15_ph2; USFWS_pp9.8-9_ph3	*The FA 141 upland slough River Productivity sampling unit was not co-located with fish sampling from the FDA study (see AEA ISR 9.6 Appendix A). FDA sampling occurred in the large upland slough beaver complex on the right bank upstream from Indian River while River Productivity sampling occurred in an upland slough on the left bank.*	See Section 2.6.4.2.2.5.
NMFS_pp9.8-15_ph3; USFWS_pp9.8-9_ph4	*Upland slough habitat was available in FA 173 but was not sampled (Figure A7). FERC recommended sampling all macrohabitats within all focus areas selected for River Productivity sampling. River Productivity sampling within the upland slough in FA 173 should have been conducted per the study plan in subsequent study.*	The Services incorrectly assert that upland slough habitat in FA-173 was not sampled. As stated in ISR Part A, Section 4.2.4.2, as well as in the Study 9.8 SIR, Section 4.2.3.1, the upland sloughs in FA-173 were located on CIRWG lands, and access was not permitted in 2013. Access was granted in 2014, and an upland slough site (RP-173-5) was sampled for fish, drift, and stable isotope components. This upland slough will be sampled again during future study implementation.
NMFS_pp9.8-16_ph2; USFWS_pp9.8-10_ph2	***NMFS Modification 2-2; USFWS Modification 2-3:*** *Side slough sampling units and sampling locations within side slough sampling units must be selected as provided for in the study plan. Additional Middle River side slough sampling units must be selected and sampled below Devils Canyon.*	As explained below in Section 2.6.4.2.2.6, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is approximately $235,000 per additional year.
NMFS_pp9.8-16_ph3; USFWS_pp9.8-10_ph3	*Within side slough sampling units, all five replicate samples were collected from the same location (Figure A8). This sampling did not implement the study plan; accepted scientific practice is to distribute sampling locations randomly or systematically through the sampling unit, at a length of 20x the width of the channel.*	As explained below in Section 2.6.4.2.2.2 and 2.5.4.2.2.6, AEA's implementation of the FERC-approved Study Plan.
NMFS_pp9.8-19_ph3; USFWS_pp9.8-11_ph2	***NMFS Modification 2-3; USFWS Modification 2-4:*** *Benthic invertebrate, organic matter, and algal samples collected at the side channel sampling units in the ISR must not be not used to address study objectives. Correct this sampling irregularity by selecting and sampling side channel sampling units that are representative of this macrohabitat type ensuring that sampling locations within the side channel sampling units are distributed throughout the 500 m sampling unit as provided for in the study plan.*	As explained below in Section 2.6.4.2.2.7, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $400,000 per additional year.

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NMFS_pp9.8-21_ph2; USFWS_pp9.8-11_ph6	*Within each side channel sampling unit, all sampling locations were selected in close proximity to each other, instead of distributing the locations systematically as provided for in the approved plan. Side channel sampling sites for the FDA study are 500 m long and the accepted scientific practice is sampling units of 20 times channel width (i.e., Moulton et al. 2002). The Final River Productivity IP states that benthic sample will be collected from five "suitable locations, spacing them as equidistantly as possible, to be representative of the site. If five unique and separate locations are not available, it will be necessary to collect more than one sample within the same location. If this is the case, space the sample locations out as far as possible. For example, if conditions require two samples in one riffle area, sampling at the downstream end and then the upstream end would provide greater representation. As a general rule, samples should not be taken within 10 m of each other. Selected locations at each site should be sampled in a downstream-to-upstream direction." For a 500 m sampling unit sampling locations could have been separated by 100 m. However at a minimum, according to the implementation plan, samples should not have been collected from the same riffle and should have been at least 10 m apart. Review of Figures A10 through A14 illustrates that all samples were collected on the same point bar (FA 184 and FA 141) or riffle (FA 104).*	As explained below in Section 2.6.4.2.2.2 and 2.5.4.2.2.7, AEA's implementation of the FERC-approved Study Plan.
NMFS_pp9.8-25_ph2; USFWS_pp9.8-12_ph2	***NMFS Modification 2-4; USFWS Modification 2-5:*** *Benthic invertebrate, organic matter, and benthic algal samples collected at the main channel sampling units are erroneous and must not be used to address study objectives. To correct, select main channel sampling units that are representative of this macrohabitat type, sampling locations within the main channel sampling units that are distributed throughout the 500 m sampling unit per the study plan.*	As explained below in Section 2.6.4.2.2.8, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $190,000 per additional year.
NMFS_pp9.8-26_ph3; USFWS_pp9.8-12_ph7	***NMFS Modification 2-5; USFWS Modification 2-6:*** *Collect macroinvertebrate samples from locations and depths that are within the active channel under most flow conditions and for main-stem and side channels alternative methods need to be employed including dome samplers and SCUBA if necessary (see NMFS RSP comments (March 18, 2013). Hess samplers should not be used, as they cannot sample at these depths.*	As explained below in Section 2.6.4.2.2.9, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $50,000

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NMFS_pp9.8-27_ph3; USFWS_pp9.8-14_ph1	***NMFS Modification 2-6; USFWS Modification 2-7:*** *Collect invertebrate and algal samples from sites dominated by fine substrates so that the samples are representative of the dominant habitat per the study plan.*	As explained below in Section 2.6.4.2.2.10, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $10,000.
NMFS_pp9.8-27_ph6; USFWS_pp9.8-14_ph3	***NMFS Modification 2-7; USFWS Modification 2-8:*** *Collect algal samples from multiple depths (0-1, 1-2, 2-3 feet) within each macrohabitat, proportional to the depths present and such that all sites are inundated for 30 day prior to sampling per the study plan.*	As explained below in Section 2.6.4.2.2.11, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $15,000.
NMFS_pp9.8-28_ph2; USFWS_pp9.8-14_ph5	***NMFS Modification 2-8; USFWS Modification 2-9:*** *Collect benthic macroinvertebrate and algal samples during the spring, summer, and fall sampling periods for a minimum of two years as described in the study plan. Spring sampling must occur prior to June 1, and Fall sampling in October.*	As explained below in Section 2.6.4.2.2.12, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $100,000 per additional year.
NMFS_pp9.8-29_ph3; USFWS_pp9.8-15_ph3	***NMFS Modification 2-9; USFWS Modification 2-10:*** *The macroinvertebrate emergence study should be repeated to obtain adequate replication among all microhabitats, avoiding dewatered sample locations. At a minimum, there should be five replicate sampling locations distributed within each 200 to 500 m macrohabitat sampling unit. Sampling should be conducted within sampling units representing each of the five macrohabitat types (main channel, side channel, side slough upland slough, and tributary mouth). Samples need to be collected in the spring, prior to breakup, to coincide with the emergence of juvenile salmon as provided for in the approved plan.*	As explained below in Section 2.6.4.2.2.13, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $265,000 per additional year.
NMFS_pp9.8-30_ph2; USFWS_pp9.8-16_ph3	***Modification 3-1:*** *Invertebrate drift must be measured upstream and downstream from tributary mouths as provided for in the approved study plan during the second year of sampling. If invertebrate drift is measured in the tributary, tributary discharge also must be measured to allow for adequate estimation of the relative contribution of a tributary to main-stem food availability.*	As explained below in Section 2.6.4.2.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $30,000 per additional year.
NMFS_pp9.8-30_ph6; USFWS_pp9.8-17_ph2	***Modification 3-2:*** *Drift sampling must be conducted every four hours in one or more of each representative macrohabitat to determine diel variation in drift during each sampling event.*	As explained below in Section 2.6.4.2.3.2, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $140,000 per additional year.
NMFS_pp9.8-32_ph3; USFWS_pp9.8-18_ph3	***Modification 3-3:*** *Study methods should be modified to use finer mesh when conducting tows in slow water habitats, in order to estimate the contribution of zooplankton as a food resource in these habitats.*	AEA chose the same mesh size (243 µm) as all other sampler types to make results comparable to both drift and Hess samples. However, AEA agrees that a finer mesh size of 50 µm or less would collect a

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		larger array of zooplankton, if present, in slow water habitats. Therefore, AEA agrees to this modification request, and will use a finer mesh size in plankton tows for future efforts. AEA estimates that costs to implement this modification request would total $1,000.
NMFS_pp9.8-32_ph5; USFWS_pp9.8-18_ph6	***Modification 4-1:*** *Modify the study so that reference sampling in the Talkeetna River provides replicate measures of all five major macrohabitats (main channel, side channel, side slough, upland slough, and tributary mouth).*	As explained below in Section 2.6.4.2.4.1, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $86,000 per additional year.
NMFS_pp9.8-33_ph2; USFWS_pp9.8-19_ph3	***Modification 5-1 (a-e):*** *We request the following substantial modifications to the Growth Rate and Growth Rate Potential Modelling study:* ***a.*** *Refine study objectives using bioenergetics modelling to evaluate the pre- and post-project influence of temperature, water velocity, food availability and food quality on juvenile Coho and Chinook Salmon at five or more replicate Middle River main channel or side channel, tributary mouth, side slough, and upland slough macrohabitats.*	As explained below in Section 2.6.4.2.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $260,000 per additional year.
NMFS_pp9.8-33_ph3; USFWS_pp9.8-19_ph4	***Modification 5-1 (a-e):*** *We request the following substantial modifications to the Growth Rate and Growth Rate Potential Modelling study:* ***b.*** *Macrohabitats should be located within Middle River focus areas below Devils Canyon to take advantage of 2D hydraulic modelling and to overlap with the distribution of juvenile salmon. However, not all macrohabitats within a focus area need to be sampled as long as there are five or more replicates of each macrohabitat type. These macrohabitats are most likely to support rearing juvenile Coho and Chinook Salmon, and vary in temperature, water velocities, and macroinvertebrate species.*	As explained below in Section 2.6.4.2.5.2, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $230,000 per additional year.
NMFS_pp9.8-33_ph4; USFWS_pp9.8-19_ph5	***Modification 5-1 (a-e):*** *We request the following substantial modifications to the Growth Rate and Growth Rate Potential Modelling study:* ***c.*** *Conduct the study between July and early September. Sampling during this time period will reduce effort and allow time for age-0 juvenile salmon to move from spawning to summer rearing locations, and for most age1+ Chinook Salmon to emigrate from the Middle River. Fish sampling must be conducted to provide a measure of relative abundance on each sampling date and at each sampling site.*	As explained below in Section 2.6.4.2.5.3, AEA requests that FERC not adopt this proposed Study Plan modification. Since, this modification adjusts the time period for sampling, but not the amount of sampling AEA estimates no additional cost for this request. Extra costs are included with the other Modification 5-1 requests.
NMFS_pp9.8-33_ph5; USFWS_pp9.8-19_ph6	*Modification 5-1 (a-e): We request the following substantial modifications to the Growth Rate and Growth Rate Potential Modelling study:* ***d.*** *Cold brand all Chinook and Coho Salmon captured on each sampling event with unique marks for sampling location, and individuals to determine average*	As explained below in Section 2.6.4.2.5.4, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $417,000 per additional year.

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	growth within a site between sampling events and individual growth for recaptured fish. Measure at the fork length of all fish and the first 50 of each species at each sampling location and each sampling event should be weighed to the nearest 0.1 g (instead of to the nearest 1.0 g). Invertebrate drift sampling should occur every other week throughout this time period.	
NMFS_pp9.8-33_ph6; USFWS_pp9.8-19_ph7	***Modification 5-1 (a-e):*** *We request the following substantial modifications to the Growth Rate and Growth Rate Potential Modelling study:* ***e.*** *Coordinate this study with other studies to determine the number and locations of additional water temperature monitoring locations within each sampling site to provide accurate and representative values. This modification will be best accomplished within a new study for Model Integration. A New Study request for Model Integration is included as an enclosure.*	As explained below in Section 2.6.4.2.5.5, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $154,000 per additional year.
NMFS_pp9.8-33_ph7; USFWS_pp9.8-19_ph8	*Sampling locations for juvenile salmon and other target fish species were not representative of the macrohabitat sampled and did not provide replication. The study plan required sampling of four or five replicates of each macrohabitat type. This replication was particularly important for side sloughs, upland sloughs, and tributary mouth habitats that are likely more variable in drift and water temperature than main channel and side channels. The study was instead implemented at a total of only three sites AEA classified as upland sloughs. However, the site near Montana Creek was not an upland slough, and no Coho Salmon were captured at the upland slough in FA 141. Therefore the study only reflected Coho Salmon growth in the FA 104 upland slough. Similarly, only one side slough was sampled at FA 104, even though side slough habitat was present near Montana Creek (RM 81) and Indian River (FA 141). Any measures of Coho or Chinook Salmon growth or consumption rates of Coho or Chinook Salmon are only representative of a single side slough, and the side slough in FA 104 cannot be considered representative of Middle River side sloughs.*	See Section 2.6.4.2.2.1., as well as responses in Section 2.6.4.2.2.3 (Tributary Mouths), Section 2.6.4.2.2.4 (Upland Sloughs), and Section 2.6.4.2.2.6 (Side Sloughs).
NMFS_pp9.8-34_ph1; USFWS_pp9.8-20_ph2	*Macroinvertebrate drift, water temperature, and fish sampling was not conducted in the two tributary mouths (Montana Creek and Indian River) but instead in tributary deltas which are not preferred habitat for juvenile salmon. Sampling of FA 104 tributary mouth/side slough (RP 104-1) did not occur in either of these habitats (tributary mouths discharging into side channels or main channels) but was conducted in a tributary. NMFS*	See Section 2.6.4.2.2.1., as well as Section 2.6.4.2.3.1. (drift in Tributary Mouths) Also see responses in Section 2.6.4.2.2.3 (Tributary Mouths), Section 2.6.4.2.2.4 (Upland Sloughs), Section 2.6.4.2.2.6 (Side Sloughs),

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	recommends that the study be repeated at five or more side slough, upland slough, tributary mouth, main channel and side channel habitats.	Section 2.6.4.2.2.7 (Side Channels), and Section 2.6.4.2.2.8 (Main Channels).
NMFS_pp9.8-34_ph2; USFWS_pp9.8-20_ph3	*Not using subcutaneous dye marking affected success of meeting study objectives. As study variance, AEA proposed to determine growth from recaptured PIT tagged fish. NMFS does not agree with using this proposed study variance to meet the objective. because (1) only fish > 55 mm can be PIT tagged, (2) PIT tagged fish also could leave and return to a macrohabitat undetected (although NMFS believes this is unlikely), (3) PIT tagged fish for estimating growth for length at age (as proposed in the RSP) will provide measures for fish that may not represent the population, particularly as larger fish are selected for PIT tags, (4) cold branding can be applied to a larger number of fish at a much lower cost, and (5) combined locations and colors of tagging can be used to mark individual fish. To date, AEA has not recaptured enough PIT tagged fish to determine growth within each replicate macrohabitat.*	As explained in Section 2.6.4.2.5.4, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $150,000 per additional year.
NMFS_pp9.8-34_ph3; USFWS_pp9.8-20_ph4	*Since juvenile salmon were not marked, it is not clear if growth occurred within the habitat under investigation. Ultimately, the change in the mean weight at age was used to estimate growth. Growth based on changes in the mean weight of target fish species of open populations did not account for any loss, recruitment, immigration, or emigration. Apparent growth, as a change in the mean weight can be due to the death of smaller juvenile fish. The death of smaller fish will result in an increase in mean weight but is not due to true growth. A reduction in relative abundance over time (truncation of the size frequency distribution) could indicate the loss of fish from the population. However, since abundance or relative abundance was not measured in each macrohabitat type, it is not clear whether the changes in length over time are due to growth, or the death of smaller fish. Similarly, immigration of larger fish or emigration of smaller fish would result in a change in the mean weight over time and would results in errors in growth measurements and all modelled parameters.*	See Section 2.6.4.2.5.6.
NMFS_pp9.8-34_ph4; USFWS_pp9.8-21_ph1	*At a minimum, intensive fish sampling must be conducted to obtain measures of relative abundance to determine if change in the mode of the size distribution could be due to the death or emigration of smaller fish (reduced relative abundance) or the immigration or recruitment of fry (increase in relative abundance). AEA does not clearly specify the level of effort applied to fish sampling at productivity sites. In 2013, an unknown number of fish traps were set for 90 minutes. This level of fish sampling*	AEA disagrees that relative abundance is necessary to estimate potential growth of a cohort using size frequency analysis or scale analysis. Modal analysis is commonly used as a simple method to estimate growth of fish from field data, especially for younger age classes with non-overlapping size distributions (Quist, Pegg and DeVries 2012). To estimate the size of age-0 fish during spring, AEA followed the length-frequency analysis methods described in Isely and

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	effort was insufficient. For juvenile Coho and Chinook Salmon, NMFS recommends the use of baited minnow traps fished for 20 to 24 hours at a density of one trap per every ten meters of shoreline. This would require 20 traps for all productivity sampling units in off-channel habitats.	Graboswki (2007) and Quist, Pegg and DeVries (2012). To determine the size of all other age classes and seasons, AEA developed growth estimates using scale analysis. All sampled fish were aged from scales (except for a small number with only regenerated or otherwise unreadable scales) and growth rates were determined using the mean weight of each age class during each season (Quist, Pegg, and DeVries 2012). Furthermore, these methods provided estimates that were corroborated by precise data generated with individually tagged fish indicating the reasonable nature of this approach at this location.
NMFS_pp9.8-35_ph2; USFWS_pp9.8-21_ph2	*NMFS does not agree with AEA's changes in target fish species. The study must evaluate the bioenergetics of juvenile Coho Salmon and Chinook Salmon. The FDA study demonstrated that juvenile Chinook and Coho Salmon are abundant in main- and off-channel habitats of the Middle River.*	The FERC-approved Study Plan does not require evaluation of the bioenergetics of juvenile Coho and Chinook salmon. Target fish species were changed only to add Arctic Grayling to the study not to remove Coho or Chinook salmon as discussed as a study modification in Study 9.8 ISR Part C, Section 7.1.2.4 and 7.1.2.5. The addition of Arctic Grayling as a target species would address the lack of fish diet samples collected from target fish species at FA-173 (Stephan Lake Complex) and FA-184 (Watana Dam). Due to the presence of Arctic Grayling at sites both above and below Devils Canyon, the addition of this species will help provide better comparisons and help define differences in diet and food availability among all sites.
NMFS_pp9.8-35_ph3; USFWS_pp9.8-21_ph3	*Sample sizes of Chinook Salmon in 2013 and 2014 were too small to accurately represent Middle River Chinook Salmon or macrohabitats. In 2013, a total of four age-0 Chinook Salmon were captured and aged, and only five during the fall (AEA Figure 5.4-2). These samples sizes do not allow for an accurate measure of weight at age for Chinook Salmon in 2013. This also means that accurate diet could not be determined to calculate the energy derived from different prey items used to model consumption and growth efficiency. In 2014, only 3 age-0 Chinook Salmon juveniles were captured during the summer from the single Middle River side slough habitat and none in spring or fall (AEA Table 4.7-1 through 3). During 2014, a total of 10 Chinook Salmon were sampled during summer and 13 during fall from the two Middle River tributary mouths. For upland sloughs, the total number Middle River juvenile Chinook Salmon sampled was 11 in summer and four in the fall. This means that spring to summer juvenile Chinook Salmon growth in side sloughs, which are common throughout the Middle River and provide important juvenile Chinook*	AEA believes the study was successful at evaluating the bioenergetics of juvenile Coho and Chinook salmon and met the study objective as proposed in the Revised Study Plan. Low sample sizes in 2013 did limit the inferences that could be drawn from the data; these limitations were acknowledged in each report produced by the study. Much greater sample sizes were collected in 2014. Sample size limitations within specific "habitat type by season" analysis cells were also carefully considered during the analysis, and the study conclusions were limited to those points that were supported by sufficient data.

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	Salmon habitat (1980s study), is based on the length of only three fish from one side slough, and cannot be measured for the summer to fall time period. However, AEA Table 5.4-2 reports values for these habitats without recognizing these limitations.	
NMFS_pp9.8-35_ph4; USFWS_pp9.8-21_ph4	*Diet composition was variable among fish species at a given site, over time, and, based on diet and stable isotope mixing models, among sites and macrohabitat types. Water temperature was variable within a site, and among macrohabitats. However, as shown in Table 5.4-2, a single value is reported for modelled consumption and growth efficiency for pooled habitat types. Using a single value for growth but different values for water temperature and diet as study results documented, should result in different modelled values of consumption and growth efficiency for each site. If measured water temperature is different between side sloughs, upland sloughs, and tributary mouths, and diets differ among these habitats, but growth rates are the same, then it is not possible to have a single value for modelled consumption and growth efficiency that represents all three habitat types. In addition, maximum consumption rates (Pmax) also varies with water temperature and would result in different values for growth efficiency among sampling sites. It may be that using site specific values of diet composition results in unrealistic consumption and growth efficiency values, which would strongly suggest errors in growth estimates. If the model was run using only values of temperature and diet from a single site or average values, then results are not representative of multiple different macrohabitat types and must not be reported as such.*	AEA structured the bioenergetics model simulations around the lowest-common denominator in the input data: growth rates. Statistical models were used to identify groups of habitats with similar growth rates and pooled these habitats together to increase sample sizes and reduce any influence of random variability in growth and diet inputs. AEA averaged the temperature, diet, and growth inputs across these groups of habitats in which fish exhibited similar growth. This approach was conservative, in that it meant averaging across observed differences in temperature, for example, among habitat types, rather than running separate simulations for each habitat. Averaging some types of input data across sampling sites is a common practice in running these types of models because the input data are collected on different scales. Inputs such as temperature can be measured precisely at each site, but many sites must be sampled to catch enough fish to generate a reliable growth rate estimate. Running separate simulations for each habitat would require either 1) using small sample sizes to estimate growth unreliably at each habitat or 2) running a separate model simulation for each specific habitats using aggregate growth data collected largely outside that habitat. These approaches could be appropriate in some cases, but AEA opted for the more conservative approach of pooling habitats. Although AEA's approach required some loss of specificity in our results, it provided more confidence that the reported differences are real, and not simply an artifact of low sample sizes and random variability.
NMFS_pp9.8-35_ph5; USFWS_pp9.8-22_ph2	*Water temperature data and turbidity data reported by the River Productivity Study do not appear to be representative of the sampling sites. No quality assurance project plan was developed for water temperature or turbidity monitoring. As reported, water temperature loggers in some macrohabitats appear to have been placed in upwelling waters or buried in sediment. No details are provided in the study report on finding locations of representative well-mixed water temperatures for logger placement or seasonal maintenance of water temperature loggers. For some sampling sites multiple water temperature loggers may be*	See Response to NMFS_pp9.8-33_ph6, USFWS_pp9.8-19_ph7 (Section 2.6.4.2.5.5.)

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	necessary to document current conditions. Prior to the next year of study, AEA must develop a quality assurance project plan to describe the quality assurance and field methods that will be implemented to ensure that accurate and representative water temperature and turbidity data are collected.	
NMFS_pp9.8-36_ph2; USFWS_pp9.8-22_ph3	***Modification 5-2:*** *In regards to the Growth Rate Potential Study, until a foraging model for age-0 Coho and Chinook salmon becomes available and applicable for all water velocities, the effort directed toward this study should be shifted to obtain more accurate field measures of juvenile salmon growth and water temperatures within all macrohabitats.*	As explained below in Section 2.6.4.2.5.7, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $100,000 per additional year.
NMFS_pp9.8-36_ph5; USFWS_pp9.8-22_ph6	***Modification 5-3:*** *The study must be modified to include four Middle River Focus Areas including Indian River (FA141), Gold Creek (FA 138), Skull Creek (FA-128), and Whiskers Creek (FA 104). If only two focus areas are studied, which we do not recommend, they should be FA 128 and FA 104. This would provide some continuity with the 2013/2014 study, but a site should be added with Sockeye Salmon and Chum Salmon spawning and rearing populations of the target fish species (e.g., FA 128).*	As explained below in Section 2.6.4.2.5.8, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $200,000 per additional year.
NMFS_pp9.8-36_ph7; USFWS_pp9.8-22_ph8	***Modification 5-4:*** *We request modification of the study so that that the requirement to sample 10 g of macroinvertebrates, and 5 g of algae, terrestrial invertebrates, benthic organic matter are obtained from a composite collected from 10 or more locations distributed systematically (20 m between sampling locations) or selected randomly within each macrohabitat within each focus area.*	As explained below in Section 2.6.4.2.5.9, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $25,000 per additional year.
NMFS_pp9.8-36_ph9; USFWS_pp9.8-23_ph1	*NMFS (RSP comments, March 18, 2013) identified the lack of detail in IP regarding the focus areas, and locations within focus areas (specific macrohabitats), and number of salmon carcasses, algae, invertebrates, and target fish species that would be sampled at each sampling location as primary detail required to meet this objective. NMFS concern was that the Indian River focus area was near the upper extent of the spawning distribution of anadromous fish, and therefore, less likely to contain delta C ratios indicating marine nutrient sources. In addition, the Indian River FA supports most of the spawning salmon, and the tributary is at the downstream end of the focus area, therefore, sampling locations within the focus area upstream of the Indian River would be less likely to contain marine nutrients. Carbon and nitrogen uptake from decomposing salmon carcasses would occur primarily within Indian River, and downstream of*	See Section 2.6.4.2.5.10.

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	Indian River in the main-stem Susitna River. Marine sources of carbon and nitrogen upstream from Indian River could only come from spawning locations upstream (Portage and Slough 21) or from fish migrating upstream out of Indian River in the Susitna River. NMFS recommended a number of additional potential sites within the Middle Susitna River that support salmon spawning and were more likely to contain the target fish species (Coho and Chinook Salmon, and Rainbow Trout). FERC required consultation with NMFS prior to selecting sampling locations. AEA did not consult with the Services and conducted the study in the Indian River Focus area. AEA added additional sampling locations, but the new sampling locations were not those recommended by NMFS.	
NMFS_pp9.8-37_ph3; USFWS_pp9.8-23_ph3	*The IP states that samples would be collected from salmon carcasses, target fish species, aquatic insects, terrestrial insects, algae, benthic organic matter, and transported organic matter and analyzed for carbon and nitrogen isotopes. The ISR does not state the number of target fish species that were sampled or where they were collected or sampling locations and numbers of samples for any of the insects, algae, or organic matter. Only 260 samples were collected from a potential 1,920 in 2013. This sampling is inadequate to meet study objectives. The study report is also deficient as it does not state where salmon carcasses were obtained or what species samples were collected from.*	See Section 2.6.4.2.5.11
NMFS_pp9.8-38_ph3; USFWS_pp9.8-24_ph3	***Modification 7-1:*** *Diets from a minimum of 8 fish with food in their stomachs for each fish species and life stage be analyzed as provided for in the approved study plan.*	As explained below in Section 2.6.4.2.6.1, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $200,000 per additional year.
NMFS_pp9.8-38_ph4	*The AEA (2014 Fish Diet Analyses Technical Memorandum) report does not demonstrate that 8 stomachs adequately represent diet composition for each species by site and sample period for the 2013 data. The literature cited does not support this either.*	See Section 2.6.4.2.6.2.
NMFS_pp9.8-38_ph5	*The diminishing number of stomachs as sample size increases from one to eight creates an artificial decrease in the potential to observe new taxa, most likely artificially creating an asymptote well before it would occur in an adequate sample size. This should be rectified before further analysis or data collection occurs.*	See Section 2.6.4.2.6.3.
NMFS_pp9.8-38_ph6	*We recommend that the AEA pool all sites to see if the same pattern occurs or if a plateau occurs beyond the 8 samples suggested in their*	See Section 2.6.4.2.6.4.

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	report. We further recommend assessment of diet data collected in earlier studies to help determine adequate sample size for each species, site and sample period. The results for this study reported in the ISR indicate that the 2013 sample period does not adequately represent diets of target fish species and that the goals of the study were not met for that period.	
NMFS_pp9.8-38_ph7; USFWS_pp9.8-24_ph5 (Modification 7-2)	***Modification G-1 (Global):*** *Expand the geographic scope of the River Productivity study to the entire Lower River.*	As explained below in Section 2.6.4.2.7, AEA requests that FERC not adopt this proposed Study Plan modification. AEA estimates that costs to implement this modification request would total $1,500,000 per additional year.

2.6.4.1. Responses to FERC Comments

2.6.4.1.1. Response to Comment Requesting Clarification of 2014 Sampling Efforts

FERC (FERC_ppA-5_ph4) comments that Section 4.3 of the Study 9.8 SIR states that no benthic macroinvertebrate or benthic algae sampling occurred in 2014 at the Middle and Lower Susitna River stations. FERC notes that in contrast, the September 2014 technical memorandum states that benthic macroinvertebrates, benthic algae, benthic organic matter, drifting invertebrates and seston, and emerging adult insects were collected during spring 2014. FERC states that the approved Study Plan requires benthic macroinvertebrate and benthic algae sampling in study years 2013 and 2014 during three sampling periods (April through October) to capture seasonal variation in benthic macroinvertebrate community structure and benthic algae productivity, but that the SIR does not report the missing seasons or missing year of data collection as a variance to the Study Plan. FERC requests that AEA clarify the reporting discrepancy between the September 2014 technical memorandum and the SIR, and identify and address all variances to the approved Study Plan as appropriate.

AEA confirms that the Commission is correct that benthic macroinvertebrates, benthic algae, benthic organic matter, and emerging adult insect data collection are still required to complete the objectives of this study. In the January 6, 2014 letter to FERC titled "*Request for Extension of Time for Submission of Initial Study Report and Modification of Integrated Licensing Process Schedule*," AEA requested a modification of the remaining ILP schedule to accommodate a 2015 study season due to the Governor's reduced Project budget for Fiscal Year (FY) 2015. As AEA stated in the letter, "*AEA will work with stakeholders to further prioritize necessary studies and will shift field studies originally planned for the 2014 study season to the 2015 study season. With remaining FY 2014 funds and the proposed FY 2015 budget, AEA can continue its analysis of the 2012 and 2013 data in comparison to the extensive data collected in the 1980s and prioritize certain field activities in 2014.*"

In the March 24, 2014 letter to FERC titled "*Update Regarding Study Plan Implementation During 2014 Field Season*", AEA further detailed the study activities prioritized for 2014. Reflective of that prioritization, the ISR Part C, Section 7.2, Schedule (AEA 2014) indicated the River Productivity study activities scheduled for 2014 efforts. These were: estimating drift of invertebrates; trophic modeling and stable isotope analysis; fish diet analysis; and the River Productivity in Susitna River tributaries and lakes above Devils Canyon Study. The ISR Part C, Section 7.2, Schedule (AEA 2014) also indicated that "In 2015, AEA plans to complete all remaining data collection and analysis for this study."

The September 2014 TM "*2014 Field Season River Productivity Progress Report*" explains in Sections 1 and 2.1 that activities conducted during the Spring field sampling event in June 2014 were focused on data collection to support the needs of the trophic modeling and stable isotope analysis objectives of the study, as was indicated in the ISR Part C, Section 7.2 (AEA 2014) for 2014 efforts. These modeling efforts were conducted and completed in 2014, as planned, and results are reported in the Study 9.8 SIR, Section 5, and discussed in Study 9.8 SIR, Section 6.

Section 4.3 of the Study 9.8 SIR refers to the objective, "Characterize the Pre-Project Benthic Macroinvertebrate and Algal Communities with Regard to Species Composition and Abundance in the Middle and Lower Susitna River" which correctly states that no sampling for that objective was conducted in 2014. However, ISR Part D, Section 8, (Steps to Complete the Study) indicates the following data collection and analysis activities AEA plans to complete for this study: characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River; evaluate the suitability of using reference sites on the Talkeetna River (RSP 9.8.4.6), pursuant to a decision point based on 2013 results; develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats; characterize organic matter resources in the Middle and Lower Susitna River; and estimate benthic macroinvertebrate colonization rates in the Middle Susitna River Segment under pre-Project baseline conditions.

2.6.4.1.2. Response to Comment Regarding Consultation on Stable Isotope Analysis Sites

FERC (FERC_ppA-5_ph5) comments that the approved Study Plan, required that AEA consult with resource agencies to identify two focus areas appropriate for stable isotope sampling, where each type of stable isotope samples would be collected, and the number of adult salmon tissues to be collected. FERC states that it is unclear where in the study consultation record that AEA provided documentation of the required consultation, and requests that AEA provide an explanation of when the required consultation was completed.

In response to this comment, AEA notes that, as part of the Susitna River Productivity Study (Study 9.8), one of the stated objectives is to "conduct a trophic analysis to describe the food web relationships within the current riverine community within the Middle and Lower Susitna River." This objective was broken up into two related tasks, with the first being to develop a trophic model to estimate how environmental factors and food availability affect the growth rate potential of focal fish species under current and future conditions. The second task was to conduct a stable isotope analysis of food web components to help determine energy sources and pathways supporting juvenile salmonid production in the riverine communities. Of particular interest to the agencies was the fact that stable isotope analysis can be used to trace marine derived nutrients (MDN) through freshwater ecosystems, and ultimately can be used to quantify the contribution of marine-derived nitrogen or carbon to freshwater food webs (Kline et al. 1990; Hicks et al. 2005).

With regard to the site locations in which stable isotope samples would be collected, the Susitna River Productivity Implementation Plan, filed with FERC on March 1, 2013, stated in Section 2.1.1.: *"Isotope samples will be collected from two of the River Productivity Study sampling stations in the Middle Susitna River, with three habitat-specific sampling sites per station, for a total of six sampling sites."* Within the Middle Susitna River segment, the sampling stations selected for the River Productivity Study were FA-104 (Whiskers Slough), FA-141 (Indian River), FA-173 (Stephan Lake Complex), and FA-184 (Watana Dam). The proposed design was to collect from two of these four selected stations, at three sites within each. Tissue samples collected for analysis would come from the multiple study components (benthic macroinvertebrates, benthic algae, benthic organic matter, terrestrial invertebrates and organic matter in drift samples, salmon carcasses, and fin clip samples from the fish diet analysis collections) at the sites within these two stations, thus providing the additional information on each component, and its place within the food web within a site. Not having visited any of the four stations at the time of synthesis of the Revised Study Plan and Implementation Plan, selection of the two stations, and the sites within each, was held in reserve until such a time that a reconnaissance trip would provide further information to assist in making the selections.

As part of the April 1, 2013 SPD (B-200), FERC noted this, stating, "AEA does not identify which two focus areas would be the subject of the stable isotope sampling or which macrohabitat types (sites) would be sampled."

Furthermore, the April 1, 2013 SPD (B-200, 201) stated "Based on our review, data generated from the stable isotope analysis component of the river productivity study has little bearing on the study as a whole and would not likely inform the development of potential license requirements (section 5.9(b)(5)). We recognize, however, the stable isotope analysis would provide baseline information on the nutrients transported from the marine environment to freshwater habitats of the Susitna River. Given the limited use of the study data, AEA's proposed level of effort is reasonable to document baseline conditions and that AEA should consult with the agencies when identifying the appropriate two focus areas for sampling, where within the focus areas each type of stable isotope samples would be collected, and the number of adult salmon tissue samples to be collected."

"We recommend that AEA consult with NMFS and FWS when identifying the appropriate two focus areas for stable isotope sampling, where within the focus areas each type of stable isotope samples would be collected, and the number of adult salmon tissue samples to be collected."

AEA did not initiate the consultation with NMFS and USFWS prior to implementation of the 2013 sampling season because changes to the study design that resulted from FERC recommendations and preliminary sampling in 2013 increased sampling stations at Focus Areas, and maximized the macrohabitat sites and number of carcasses sampled. With these changes, as detailed below, AEA understood that the need for consultation was no longer necessary. Instead, AEA reported on the changes to the study at TWG meetings (June 24, September 23, and December 4, 2013), Technical Team meeting (March 21, 2014), and in both the ISR (Part A, Section 4.7.3.1.; Part C, Section 7.1.2.4.; Part D, Section 6.1.) and Study 9.8 SIR (Section 4.6.3).

In order to prevent a loss of sampling during the initial spring sampling event in 2013, stable isotope sampling was conducted at the only two focus areas used by the River Productivity Study that were located in the Middle River below Devils Canyon, FA-104 (Whiskers Slough) and FA-141 (Indian River), due to their importance as rearing habitats for juvenile salmonids. However, as stated in the April 1, 2013 SPD (B-181), FERC recommended that AEA sample in all unique macrohabitat types present at each proposed study station for river productivity sampling in the Middle River and Lower River segments. AEA incorporated this recommendation and since sampling would then occur in all possible macrohabitats, assumed the need for consultation on where within the focus areas to collect stable isotope samples was no longer necessary. Implementation of FERC's recommendation increased the number of sampling sites at these two stations from six to nine.

Further consideration by UAF and AEA during the 2013 spring sampling event indicated that additional resolution along a gradient of high to low levels of MDN from spawning salmon would be valuable. This was also in agreement with requests made by the agencies in their comments on the draft Implementation Plan, to increase the number of study stations in the Middle River segment. Thus, isotope sampling was added at two additional stations, Montana Creek at RM-81 and FA-184 (Watana Dam). There were seven additional macrohabitat sites added by sampling at these two additional stations, bringing the total number of sites for stable isotope sampling up to sixteen.

The study design had changed with an increase by both sampling sites at each station and sampling at all macrohabitats found at a station. The four sampling-station design provided a clearer understanding of any food web differences that may exist between stations with high and low densities of spawning salmon. By including locations with different densities of spawners, the approach was better suited for quantifying the relative influence of riverine, terrestrial, and marine energy sources to juvenile salmon and the broader river food web. The goal was to sample stations with varying levels of MDN inputs. The three stations below Devils Canyon were expected to have moderate to high levels, while the upstream station (FA-184 [Watana Dam]) was expected to have the lowest MDN levels.

Of note, the Services' comments on the draft Implementation Plan and during TWG meetings included the suggestion of collecting additional isotope samples at important salmon spawning areas outside of the River Productivity Study focus areas (e.g., Gold Creek and Slough 8A). These suggestions were considered, but it was concluded that prioritizing the stations used by the River Productivity study would be a more effective strategy to achieve the objectives. Stable isotopes and stomach contents are complementary approaches to quantify diet composition, and they are most powerful when used in combination (Vinson and Budy 2011), and stomach contents were only being collected at the Focus Areas used by the River Productivity Study.

In summary, AEA presumed that the decision to expand the stable isotope sampling to a total of four out of the five River Productivity Study stations available, and to collect stable isotope samples from all available macrohabitats within those stations (increasing the number of sites from six to sixteen) eliminated the need for consultation regarding *"identifying the appropriate two focus areas for stable isotope sampling, and where within the focus areas each type of stable isotope samples would be collected.*"

With regard to consultation on the number of adult salmon tissue samples to be collected, AEA did not initiate the consultation with NMFS and USFWS prior to implementation of the 2013 sampling season, due to scheduling constraints with the Services' contractors. The Study Plan originally set the number at 20 salmon carcasses at each of the two focus areas to be selected, for a total of 40 carcasses in each study year. The target number of 40 carcasses was maintained for the study in 2013. It is important to point out that this number was simply a goal to shoot for and that in reality the sampling of carcasses would be dependent upon the number of carcasses observed in the vicinity of sampling stations at the time of sampling. Given the number of predators and scavengers in the Susitna River, it became quickly evident that AEA's sampling of salmon carcasses would require sampling 100 percent of salmon carcasses observed. In 2013, a total of 21 carcasses were collected (Table 3.4-3 of the *2013 Initial River Productivity Results TM* filed on September 26, 2014*)* and in 2014, 9 carcasses were collected (Table 4.6-1 in the *Study 9.8 SIR).* Since AEA was collecting 100 percent of the salmon carcasses encountered within study sites during the scheduled sampling efforts, the need for consultation on the number of adult salmon tissue samples to be collected was considered unnecessary.

In accordance with the SPD, AEA held a consultation meeting during the September 23, 2013 Technical Workgroup meeting. In that meeting, AEA explained the above details in selecting FA-104 (Whiskers Slough) and FA-141 (Indian River) from the four possible candidate stations (FA-104 [Whiskers Slough], FA-141 [Indian River], FA-173 [Stephan Lake Complex], and FA-184 [Watana Dam]), and in adding supplemental sampling at Montana Creek RP-81 and FA-184 (Watana Dam) to add resolution along a gradient of high to low levels of marine derived nutrients (MDN) from spawning salmon (http://www.susitna-watanahydro.org/wp-content/uploads/2013/09/RSP9.8_RiverProductivity_SPD_Consult_Stable-Isotopes.pdf). According to meeting notes (http://www.susitna-watanahydro.org/wp-content/uploads/2013/10/2013.09.23TWG_FA_Notes.pdf), "Ken Hogan questioned if the TWG had concerns as to what was conducted and where. Sue Walker and others requested more information and further consultation. AEA indicated that it had not consulted prior to implementing this work due to scheduling constraints with the agencies' contractors." AEA continued to seek the input of the agencies on this consultation, presenting the information and sampling approach again at the March 21, 2014 Fisheries Technical Meeting (http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/20140321TTPresentationRivPro.pdf) for further discussion. Meeting notes (http://www.susitna-watanahydro.org/wp-content/uploads/2014/04/2014-03-21TT_Fish_Notes.pdf) revealed that the agencies were not in attendance, and that AEA received no comments at that time. With no responses from NMFS or USFWS received prior to the 2014 sampling season, stable isotope sampling efforts were repeated at the four stations selected in 2013, and AEA listed this as a variance (Study 9.8 SIR, Section 4.6.3.) accordingly.

In conclusion, the original study design, as described in the Implementation Plan, and addressed in the April 1, 2013 SPD, proposed two sampling stations for stable isotopes, collected at three sites within each station (a main channel and two off-channel). The field efforts that were implemented in 2013 and 2014 expanded the stable isotope sampling to a total of four out of the five River Productivity Study stations, spanning over 100 miles of river, from approximately PRM 184 down to PRM 81. The field efforts also increased from the original Study Plan, collecting stable isotope samples from sixteen sites: four main channel, four side channel, three tributary mouths, three upland sloughs, and two side sloughs. Sampling of carcasses was maximized by sampling 100 percent of carcasses encountered. This expanded approach allowed the study to sample a wider variety of locations and macrohabitats, with varying levels of MDN inputs, which provides a clearer understanding of any food web differences that may exist between stations with high and low densities of spawning salmon. Thus, the addition of these stations better addressed the study objective of quantifying the relative influence of riverine, terrestrial, and marine energy sources to juvenile salmon and the broader river food web.

2.6.4.1.3. Response to Comment Regarding Length-Weight Equations Used to Estimate the Mass of Prey Items

FERC (FERC_ppA-6_ph1) states that Section 4.9.1.2 of the ISR indicates that published and unpublished length-weight equations were used to estimate the dry mass of prey items found in fish stomach contents to improve accuracy and better achieve the study objective. FERC notes, however, that the specific equations are not presented in the ISR, SIR, or associated technical memoranda. FERC requests that AEA provide in the USR the length-weight equations used to estimate the mass of prey items in the stomach contents of sampled fish as well as an explanation for each equation why the equation is applicable to the study.

In response, AEA has provided the length-weight equations used to estimate the mass of prey items in the stomach contents of sampled fish in Table 2.6.4-2, as requested, along with explanations for equations as to why they are applicable to the study.

Regarding their applicability, published taxa-specific equations are widely used in studies to estimate mass because they are broadly applicable across North America. For example, Baetidae and Chironomidae (and most other commonly collected taxa) have very similar if not identical body morphologies (i.e., proportionally similar girth to length ratios, and shape) regardless of where they occur. Sample et al. (1999) found that length-mass relationships did not differ significantly between specimens collected in West Virginia, Washington, and Massachusetts for seven out of the eight invertebrate taxa examined. Methot et al. (2002) compared length-mass relationships for freshwater invertebrate taxa collected on four continents in 13 separate studies. They found that relatively little (0-17 percent) of the variability in length-mass relationships was explained by continent, suggesting that length-mass relationships are relatively consistent within taxa regardless of where they are collected. Methot et al. (2002) concluded that "overall variability caused by L–DM relationships was smaller than variability in total invertebrate density among replicate samples, so more effort should be devoted to improving the accuracy of estimates of invertebrate density than to the development of site-specific L–DM relationships when assessing benthic invertebrate biomass in freshwater." So published equations are ideal for estimating the bulk of the taxa collected, which in turn comprised the bulk of the mass.

In a few cases, AEA used equations that UAF had developed in Alaska, as needed. AEA further broke down mass calculations according to invertebrate stage (e.g., larva, pupa, adult) for additional accuracy when possible. In a few rare instances, an equation from a closely related taxon was used when a taxa-specific equation was not available, but these cases were rare and only done on rarely-collected taxa that accounted for a minuscule amount of mass (e.g., Copepods for Ostracods). Furthermore, equations were uniformly applied across all treatments/habitats, so any biomass error estimates that theoretically occurred were applied across all habitats, without bias.

2.6.4.1.4. Response to Comment Regarding the Representativeness of Colonization Rates in Whiskers Slough

Given the large geographic extent of the Middle Susitna River segment, and that Whiskers Slough is located far downstream of the proposed dam location, FERC (FERC_ppA-7_ph1) requests that AEA explain how colonization rates in Whiskers Slough are representative of the entire Middle Susitna River segment.

Colonization tests were intended to examine colonization potentials under different turbidity and temperature conditions representing a range of conditions that occur in the Middle River. Each site may have a number of localized confounding factors affecting colonization rates, as was clearly seen in the 2013 results (2013 Initial Results TM, September 2014). Note that ISR Part C, Section 7.1.2.6, details additional modifications to the colonization due to the difficulties of isolating turbidity and temperature from depth and velocity conditions. Given those proposed modifications, FA-104 (Whiskers Slough) also offers all five macrohabitats for testing. Testing in

FA-104 (Whiskers Slough) was more accessible to frequent visits, and logistically more feasible to conduct tests there.

Regarding the applicability of colonization results at FA-104 (Whiskers Slough) to other sites, 2013 results from Hess samples from FA-104 (Whiskers Slough) are generally similar to FA-141 (Indian River) and RP-173 (Stephan Lake Complex) results. The contribution of EPT taxa is slightly greater at sites farther upstream, but overall macroinvertebrate densities are similar. Water temperatures at FA-104 (Whiskers Slough) are slightly warmer, thus colonization would be faster, and numbers greater. Colonization rates and potential are largely influenced by factors such as depth, velocity, substrate, and turbidity, and the combinations therein; therefore, colonization estimates would be generally applicable to similar conditions at other locations in the Susitna River.

2.6.4.2. Responses to Modification Requests and Comments from NMFS and USFWS

2.6.4.2.1. Objective 1

Objective 1. Synthesize existing literature on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities (RSP Section 9.8.1).

2.6.4.2.1.1. Response to Modification Request Regarding Literature Review

NMFS (Modification 1-1; NMFS_pp9.8-5_ph6) and USFWS (Modification 1-1; USFWS_pp9.8-6_ph1) request that AEA provide a description of the key words and data bases used for literature searches in order for review participants and FERC to determine the completeness of this review. Additionally, NMFS asserts that AEA's literature review is incomplete and does not meet the study objectives because AEA did not include "literature which addresses changes to river productivity due to climate change."

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan. AEA has completed this objective according to the FERC-approved Study Plan (RSP Section 9.8.4.1).

The objective in RSP Section 9.8.4.1 stated, "General information on the effects of hydropower on riverine habitats, especially glacially-fed river systems, as well as Project-specific information, will be reviewed and synthesized in a written report." As documented in the literature cited section, AEA reviewed 500 reports and documents and prepared a written report summarizing relevant literature on macroinvertebrate and algal community information in Alaska, including 1980s Susitna River data; AEA reviewed and summarized literature on general influences of changes in flow, temperature, substrates, nutrients, organic matter, turbidity, light penetration, and riparian habitat on benthic communities; and AEA reviewed and summarized the potential effects of dams and hydropower operations, including flushing flows and load-following, on benthic communities and their habitats.

Neither NMFS nor USFWS provide any documentation of "salient scientific documents and reports" that may have been omitted from the literature review. Further, NMFS incorrectly asserts that AEA's literature review does not meet the study objectives because AEA did not include "literature which addresses changes to river productivity due to climate change". Reviewing literature to assess the impacts of climate change on river productivity is not part of the FERC-approved Study Plan and is irrelevant to meeting this objective of the FERC-approved Study. The objective in the FERC-approved Study Plan addresses the effects of hydropower on benthic macroinvertebrate and algal communities not the effects of climate change on these communities. AEA maintains that the objective of the FERC-approved Study Plan has been successfully met. AEA has also provided a general response to the NRDC's new study request on climate change in Section 3.2.

2.6.4.2.2. Objective 2

Objective 2. Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River (RSP Section 9.8.1). NMFS and USFWS requested 9 and 10 modifications, respectively, to the study associated with Objective 2. There were two themes, macrohabitat classification and sampling proximity, common to many of these modifications for which AEA provides background information below followed by more specific responses to each of the modifications.

2.6.4.2.2.1. General Response to Comments Regarding Macrohabitat Classification

Several of the modifications (NMFS: Modifications 2-1, 2-1a, 2-2, 2-3, 2-4, and 5-1; USFWS: Modifications 2-1, 2-2, 2-3, 2-4, 2-5, and 5-1) request to repeat benthic macroinvertebrate, benthic organic matter, and periphytic algal sampling at multiple sampling sites due to disagreement with AEA's macrohabitat classifications.

In these six study modifications, the Services disagree with AEA's site selection for sampling the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). For tributary mouths, the Services disagree on the classifications of the size and extent of a tributary mouth macrohabitat (mouth versus delta versus plume), such as for Whiskers Creek in FA-104. For upland sloughs, the Services disagree with the classification of the upland slough selected in RP-81. For side sloughs, the Services disagree with the representativeness of the side slough in FA-104, and identify a number of side channels in the Lower River as side sloughs that AEA could have selected in Station RP-81. For side channels, the Services disagree with four of five of AEA's choices for side channel sites, stating that only RP-81-4 was correct. For main channels, the Services disagree with all five of AEA's choices for main channel sites, classifying them as side channel sites due to their locations. Please see Section 2.6.5.2.1 under Study 9.9 Characterization and Mapping of Aquatic Habitats for AEA's response to the Services assertions of apparent discrepancies in habitat classifications.

AEA's site selections for the River Productivity Study (9.8) were based on the *Middle Susitna River Segment Remote Line Habitat Mapping Technical Memorandum* (HDR 2013), with maps and information provided within the *Technical Memorandum*, *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014* (R2 2013) and the subsequent *Adjustments to Middle River Focus Areas Technical*

Memorandum (R2 2013). This was a snap shot of aquatic habitat at one point in time and under one flow condition. It was used to assist field crews in sampling across multiple habitat types. This was accomplished successfully, with crews for Study 9.8 sampling 2-5 of each of 5 habitats at 5 stations in the Middle and Lower River (Study 9.8 SIR, Section 9, Table 4.2-1).

For Lower River site selection within the Montana Creek station area (RP-81), data from Appendix 4 of the *Mapping of Aquatic Macrohabitat Types at Selected Sites in the Middle and Lower Susitna River Segments from 1980s and 2012 Aerials 2012 Study Technical Memorandum* (Tetra Tech 2013), and initial database information from the Geomorphology Study (6.5) which is depicted in Sheet 13 of 18 in both Appendices H and J in the *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials Technical Memorandum* (Tetra Tech 2014) were used in site selection.

2.6.4.2.2.2. General Response to Comments Regarding Sampling Proximity and Sample Length

Several of the modifications (NMFS Modifications 2-1, 2-1a, 2-2, 2-3, and 2-4; USFWS: Modifications 2-1, 2-2, 2-3, 2-4, and 2-5) request AEA to repeat benthic macroinvertebrate, benthic organic matter, and periphytic algal sampling at all sampling sites due to not sampling within a 200-m or 500-m sampling unit, thus all five replicate samples were collected within close proximity (< 10 m).

The River Productivity Study Plan does not specify required lengths for sampling reaches. The sampling methodology for Hess sampling is described in the RSP, Section 9.8.4.3, and then in greater detail in the RP IP Section 2.2.1.1. Nowhere in this FERC-approved Study Plan did AEA designate a 200-m, 500-m, or 20-times-the-stream-width standard reach length, as the Services repeatedly assert throughout their comments (unlike the Fish Distribution and Abundance Study Plans, which included fish sampling reach length requirements).

Several state and federal bioassessment protocols adopt a designated distance for a sample reach, but it is important to note that rapid bioassessment methods are intended to collect general information about an entire site or location, and all the various habitats within it. It combines all materials from all 20 samples collected from a variety of habitats into one sample, from which metrics are calculated that represent the site as a whole. While this is preferable to agencies that need to assess the health and conditions of multiple streams region-wide, it is not an appropriate sampling method when setting up a study design that will require statistical comparisons among reaches, seasons, and years. This lack of replication, by reducing the sample size to one, will prevent any statistical analysis with other sites, time periods, and any pre- versus post-Project comparisons.

Due to the large number of sites and the intensive amount of sampling involved in the River Productivity study, AEA's approach is a more robust sampling design which focuses sampling coarser substrates and faster velocities, i.e., riffle/run habitats (the richest-targeted habitat) because: 1) those areas that are higher in macroinvertebrate diversity and abundances (Barbour et al 1999; Carter and Resh 2001; Moulton et al. 2002; Resh and Jackson 1993); 2) offer a level of standardization in terms of habitat stratification, which reduces sample variability and facilitates comparisons among sites (Carter and Resh 2001; Resh and Jackson 1993; Klemm et al. 1990;

Hilsenhoff 1988). With FERC's recommendation, AEA also implemented the depositional-targeted habitat sampling in slow-water areas as well, collecting five Ponar grab samples in each site. If AEA would start taking replicate samples in distinctly different substrates, flows, or depths, this would introduce a large amount of variability among the replicate samples, and that variability would extend to the overall estimate for the site, which would prevent detections of smaller spatial or temporal changes or differences.

In addition, the Services' repeated comments on the sampling locations and distances between samples appears to rely upon the site-specific images supplied in the ISR Part A, Appendix B and the Study 9.8 SIR, Appendix B. The Services have misinterpreted the intent of providing those graphics, which were to be used to show approximate locations of each site and where sampling occurred within those sites, not to measure precise locations down to 10 m or less. While several sites do reveal samples being taken close together, measurements from the center of each marker to the next closest often reveals the minimum 10 m (ca. 30 ft) distances were implemented.

Examination of the 227 measurements between Hess sampling locations taken in 2013 (Table 2.6.4-3) via GIS reveals that sampling reaches ranged from 10.5 to 207.4 m long, and averaged 63.5 m. Distance between Hess samples ranged from 4.6 to 55.5 m, and averaged 17.6 m. Approximately 66 percent, or 150, of the 227 measurements between Hess samples taken were 10-m or greater apart (Table 2.6.4-4). However, it is important to note that handheld GPS units are considered to have accuracy less than 3 m. Using a conservative accuracy allowance of 1 m, 74 percent of the Hess samples were at least 9 m apart, and 60 percent were at least 11 m apart (Table 2.6.4-4). When examined by macrohabitat, tributary mouths and upland sloughs had the lowest percentages of Hess samples with distances of 10 m between samples (60 percent and 53.8 percent, respectively). While these percentages appear large at first look, it is important to remember that sites were visited three times and under varying flow conditions. The percentages of samples closer than 10 m was related to the limited habitat areas available in sampled macrohabitats during the second and third sampling events. This was particularly true for the collection of Hess samples. When examined by season, the percentages of Hess samples taken at least 10 m apart gradually decreased over time, with Spring sampling showing 87.2 percent, Summer at 59.7 percent, and Fall at 50 percent, indicating a reduction in suitable sampling areas as water levels dropped during the open-water season (Table 2.6.4-4). Given these changing conditions over the sampling season, the orthographic imagery for each site, which is taken at one flow, may or may not be an accurate depiction of site conditions at all sampling events. For instance, October 2013 sampling had extremely low flows, which limited the amount of suitable sampling area available at many sites. As the between-sample measurements show, in those cases, sampling locations are clustered more tightly together than the general guideline of being 10 m apart, due to reduced wetted area within which sampling could occur.

2.6.4.2.2.3. Response to Modification Request Regarding Sampling at Tributary Mouth Macrohabitats

Both NMFS (Modification 2-1; NMFS_pp9.8-6_ph1) and USFWS (Modification 2-1; USFWS_pp9.8-6-ph3) request benthic macroinvertebrate, benthic organic matter, and periphytic algal sampling be repeated at all tributary mouth sampling locations to complete the study per the Study Plan using appropriate sampling methods for water depths and velocities. They request implementation of accepted macroinvertebrate and algal sampling scientific practices and for benthic macroinvertebrates, benthic organic matter, and periphytic algae to be sampled from six or more additional tributary mouths in the Middle River below Devils Canyon.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or that it was implemented under anomalous conditions. Instead, the Services modifications and comments reflect their fundamental disagreement with the FERC-approved Study Plan.

The Services have discounted the location of established sites, the macrohabitat classifications of the sites, where sampling occurred within sites, and the number of sites that must be sampled, as presented in RP IP Section 2.1, and the FERC Study Plan Determination (see pages B-179, B-181) and implemented by AEA. First, the Services disagree with AEA's site selection for sampling the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). For tributary mouths, the Services disagree on the classifications of the size and extent of a tributary mouth macrohabitat (mouth versus delta versus plume; see Section 2.6.5.2.1 for AEA's response to apparent discrepancies in habitat classifications as asserted by the Services (Study 9.9 Modification 5; NMFS_p9.9-5_ph8, and USFWS_pp9.9-6_ph2).

As previously stated, AEA's site selections for the River Productivity Study (9.8) were based on a number of technical memorandums produced in early 2013 to map the aquatic habitats in the Middle and Lower Susitna River, especially within the selection of Focus Areas. The river productivity field crews used habitat maps generated by aquatic habitat specialists, based on the available imagery at the time. The available information was used to assist field crews in sampling across multiple habitat types, including tributary mouths. This was accomplished successfully, with crews for Study 9.8 sampling 5 tributary mouths at each of the 5 stations in the Middle and Lower River (Study 9.8 SIR, Section 9, Table 4.2-1). For a more detailed discussion of which documents were used in determining sites based on macrohabitats, please refer to Section 2.6.4.2.2.1 above.

The Services maintain that AEA's efforts provide an insufficient number to evaluate the value of tributary mouths for rearing juvenile salmon and resident fish species. Yet, this was not the stated objective of the study, which was to "Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River." In the *2013 Initial River Productivity Results Technical Memorandum* (Section 4.1), AEA reported "initial differences in several metrics between mainstem macrohabitats (main channel and side channel habitats) when compared to other macrohabitat types, especially tributary mouths and off-channel habitats (side sloughs, upland sloughs). Tributary mouths were generally highest in mean benthic density, taxa richness, and EPT richness, and often showed higher percentages of those EPT taxa in community compositions." Therefore, AEA's efforts in collecting benthic community data from tributary mouths have been adequate, and are accomplishing the stated study objective.

The Services assert that AEA's sampling locations were too close together (NMFS_pp9.8-9_ph1, USFWS_pp9.8-7_ph2). Sampling within Tributary Mouth macrohabitat was limited to the area designated on station maps (see Appendix 2, *Adjustments to Middle River Focus Areas Technical*

Memorandum [R2 2013]), that the crews referred to and endeavored to stay within for sampling (i.e., what the Services call the delta). Plumes were considered a separate designation from Tributary Mouth, as seen in the Appendix 2 maps, as well, and crews were not instructed to sample them, as they are mainstem macrohabitats (main channel or side channel) *influenced* by tributaries, and not tributaries or tributary mouths. The Services also make repeated references to a required 200-m sampling unit. As was explained in Section 2.6.4.2.2.2, nowhere in the Study Plan documents did AEA designate a 200-m, 500-m, or 20-times-the-stream-width standard reach length for sampling benthic communities.

The Services' repeated comments on the sampling locations and distances between samples appears to rely upon the site-specific images supplied in the ISR Part A, Appendix B and the Study 9.8 SIR, Appendix B. The Services have misinterpreted the intent of providing those graphics, which were to be used to show approximate locations of each site and where sampling occurred within those sites, not to measure precise locations down to 10 m or less. Examination of the 227 measurements between Hess sampling locations taken in 2013 (Table 2.6.4-3) via GIS reveals that distances between Hess samples taken in tributary mouths ranged from 1.2 to 98.6 m, and averaged 17.6 m. Some of the tributary mouths have limited area (Whisker's Creek in FA-104 [Whiskers Slough], Unnamed Tributary 174.8 in FA-173 [Stephan Lake Complex]), therefore it was sometimes necessary to sample closer than 10 m apart to stay within that designated macrohabitat area, as is discussed below in Section 2.6.4.2.2.2. Approximately 60-percent, or 33 of the 55 side slough measurements between Hess samples taken were 10-m or greater apart (Table 2.6.4-4). However, it is important to note that handheld GPS units are considered to have accuracy within 3 m. If a more conservative accuracy allowance of 1 m (9-11 m range) is taken into account, 69-percent of the Hess samples were at least 9 m apart, and 58-percent were at least 11 m apart (Table 2.6.4-4).

A final element of the Services' proposed modification is a request for additional sampling for all study components at 6 additional tributary mouths in the Middle River below Devils Canyon. This level of effort goes above and beyond that needed for characterization of the habitat and to support Project-level effects. This additional and intensive sampling requested by the Services has been previously requested by them in response to the RSP as noted on B-178, and FERC has already ruled on the request, as FERC stated in the April 1, 2013 Study Plan Determination (B-182):

> *Regarding FWS' request for additional focus areas in the Middle and Lower River, with our recommendation (discussed below under Macrohabitat Replicates) to increase the sampling effort at the four Middle River stations and the one Lower River station, the information needed to evaluate potential project effects and inform the NMFS and FWS study objectives would be collected. Therefore, we do not consider it necessary to add any new focus areas as requested by FWS.*

2.6.4.2.2.4. Response to Modification Request Regarding Sampling at Upland Slough Macrohabitats

Both NMFS (Modification 2-1[a-c]; NMFS_pp9.8-11_ph3) and USFWS (Modification 2-2; USFWS_pp9.8-8_ph3) request the following: Repeat sampling of benthic macroinvertebrates, macroinvertebrate drift, benthic organic matter, and periphytic algae at upland slough sampling locations per the Study Plan, using appropriate sampling methods for water depths and velocities, and implement accepted macroinvertebrate and algal sampling scientific practices:

1. Sample at a minimum of five replicate upland slough habitats, per the Study Plan. Do not use data from the sampling sites referred to as upland slough near Montana Creek as they did not fit the definition. Instead, select and sample actual upland slough habitat.

2. Co-locate upland slough sites selected or the River Productivity study be co-located with upland sloughs sampled for the FDA study.

3. Sample additional upland sloughs in the Middle River below Devils Canyon.

In response, AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions. Instead, the Services comments regarding upland sloughs reflect their fundamental disagreement with the FERC-approved Study Plan. They have discounted the location of established sites, the macrohabitat classifications at the sites, where sampling occurred within sites, and the number of sites that must be sampled, as presented in the RP IP Section 2.1, and the FERC Study Plan Determination (see pages B-179, B-181), and implemented by AEA.

Specifically, the Services disagree with AEA's site selection for sampling the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). As presented in Study 9.8 SIR, Section 9, Table 4.2-1, the Study 9.8 field crews sampled in 4 upland slough habitats based on the habitat map provided for study planning in 2012. The Services do not agree with of some of these habitat classifications. Given that the nature of habitat mapping is to characterize and delineate a dynamic feature in a static fashion, it is not surprising that different interpretations arise. One example of differences in habitat type interpretation is the upland slough (RP-81-1) selected at station RP-81 (Montana Creek). The Services have asserted that this is in fact not an upland slough, but is "an old Montana Creek distributary channel." However, this slough was labeled upland slough in the 2012 mapping exercise (Appendix 4 of the *Mapping of Aquatic Macrohabitat Types at Selected Sites in the Middle and Lower Susitna River Segments from 1980s and 2012 Aerials 2012 Study Technical Memorandum*; Tetra Tech 2013) and it was also classified historically by others as an upland slough in 1980s, and 1950s maps (Sheet 13 of 18 in both Appendices H and J in the *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials Technical Memorandum*; Tetra Tech 2014). The Services also indicate that an alternative upland slough is available "just upstream of Montana Creek." This particular upland slough was initially considered by AEA for 2013 sampling efforts, but due to its proximity to the railroad right of way, access was denied by the Alaska Railroad Corporation. In order to secure an upland slough site at RP-81 (Montana Creek) in accordance to the Study Plan, the upland slough at RP-81-1 was selected, and permission to access the site was granted by the landowner.

It is also important to note that habitat maps provide a snap shot of aquatic habitat at a point in time. This fixed interpretation was provided to AEA field crews to assist in ensuring sampling across multiple habitat types, including upland sloughs. This was accomplished successfully, with crews for Study 9.8 sampling 4 upland sloughs at 4 stations in the Middle and Lower River (Study 9.8 SIR, Section 9, Table 4.2-1).

The Services also repeat their comment that samples must be distributed evenly throughout a 200-m sampling unit, and that samples were collected too close together. As was explained above in Section 2.6.4.2.2.2, nowhere in the Study Plan documents did AEA designate a 200-m, 500-m, or 20-times-the-stream-width standard reach length. The Services' repeated comments on the sampling locations and distances between samples appears to rely upon the site-specific images supplied in the ISR Part A, Appendix B and the Study 9.8 SIR, Appendix B. The Services have misinterpreted the intent of providing those graphics, which were to be used to show approximate locations of each site, and where sampling occurred within those sites, not to measure precise locations down to 10 m or less. It should also be noted that in the site-specific images in the ISR Part A, Appendix B, grab and plankton tow markers are the representative general centralized location of 5 replicate samples; replicates were not all collected at the same exact location, but spread throughout the slow water reach within a site.

The last component of the Services' proposed modification requests that AEA conduct all sampling components at 3 additional upland sloughs in the Middle River below Devils Canyon (FA-115, FA-138, and FA-144). This level of effort goes above and beyond that needed for characterization of the habitat and to support Project-level effects. The current selection of upland slough sites has been successfully sampled, and addresses the objective to "characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River." In the *2013 Initial River Productivity Results Technical Memorandum* (Section 4.1), AEA reported "initial differences in several metrics between mainstem macrohabitats (main channel and side channel habitats) when compared to other macrohabitat types, especially tributary mouths and off-channel habitats (side sloughs, upland sloughs). Where tributary mouths were generally more diverse and productive, upland sloughs displayed higher densities and taxa richness measures later in the sampling season, during summer and fall. Additionally, results from the Study 9.8 SIR (Section 6.5) show that upland sloughs had among the highest averaged overall total benthic OM, which were dominated by FPOM material. A longitudinal trend was also noted, with station-wide averages of benthic OM increasing at each station/focus area in a downstream direction, thus indicating an observable longitudinal trend. As has been shown, AEA's efforts in collecting benthic community data from upland sloughs have been adequate, and are well on the way to successfully meeting the stated study objective.

Also to be noted, this additional and intensive sampling requested by the Services has been previously requested by them in response to the RSP as noted on page B-178 of FERC's April 1, 2013 Study Plan Determination; FERC ruled on their request (page B-179), stating: "*Regarding FWS' request for additional focus areas in the Middle and Lower River, with our recommendation (discussed below under Macrohabitat Replicates) to increase the sampling effort at the four Middle River stations and the one Lower River station, the information needed to evaluate potential project effects and inform the NMFS and FWS study objectives would be collected. Therefore, we do not consider it necessary to add any new focus areas as requested by FWS.*" Furthermore, the number and location of study sites needed to meet study objectives was approved by FERC in their Study Plan Determination on Page B-181, which states "that AEA sample in all unique macrohabitat types present at each proposed study station for river productivity sampling in the Middle River and Lower River segments. This resulted in 16 sites in the Middle River and five sites in the Lower River." AEA implemented this recommendation, with variances, which included: 1) moving the Lower River site from Trapper Creek to Montana Creek, which resulted in the loss of sampling a side slough, but had no effect on any of the study objectives, as it still established one study station within the Lower River Segment (ISR Part A, Section 4.2.4.1); and 2) replacing the upland slough site at FA-173 (Stephan Lake Complex) with a small unnamed tributary mouth (ISR Section 4.2.4.2), due to lack of permission to access Cook Inlet Regional Working Group (CIRWG) land in 2013. This had no effect on accomplishing the study objectives, because in 2014, land access for CIRWG lands was permitted, and this upland slough site was sampled (RP-173-5), and ultimately resulted in a net gain of one tributary mouth site in that Focus Area.

2.6.4.2.2.5. Response to Comments Regarding the Upland Slough at FA-141

NMFS (NMFS_pp9.8-15_ph1) and USFWS (USFWS_pp9.8-9_ph2) comment that sampling locations within the FA-141 upland slough sampling unit appear to be inappropriately selected, based on limitations imposed by the Hess sampler. The Study 9.8 SIR (Table 4.8-1) stated that both Hess and Ponar samplers were used to collect samples. The Services state that no drift was sampled and it is not possible to determine which substrate was sampled to collect algae. The Services also comment that the upland slough backwater is dominated by fine substrate and deep water, and as such, sampling does not appear representative of this habitat and instead seems to have been conducted around the limitations imposed by the Hess sampler. In addition, the Services note that replicate samples were all collected within close proximity to each other, particularly during spring and summer. Therefore, the Services conclude that sampling was not conducted according to the Study Plan specifications, regarding representativeness.

AEA disagrees with the Services' comments regarding the appropriateness of the sampling locations within FA-141. AEA believes these comments indicate some misunderstanding of AEA's efforts at the FA-141 upland slough site. The upland slough (RP-141-4) selected in FA-141 was sampled by both a Ponar grab sampler and a Hess sampler. Within this slough, AEA sampled the slow water area that had fine substrates with the grab sampler and plankton tow net. While on site, crews found that the water source was farther upstream and there was an area of upwelling with extremely cold and clear water. AEA sampled the small, upwelling area with a Hess sampler for *additional* samples, to collect potentially valuable information. Samples were collected in close proximity, due to the limited area in which the upwelling occurred; however Hess and Ponar samples were kept separate, as reported in the ISR Part A, Table 3.1-1 and in Appendix A, Tables A3.1-7 through A3.1-9.

NMFS (NMFS_pp9.8-15_ph2) and USFWS (USFWS_pp9.8-9_ph3) also comment that the FA-141 upland slough River Productivity sampling unit was not co-located with fish sampling from the FDA study, which occurred in the large upland slough beaver complex on the right bank upstream from Indian River while River Productivity sampling occurred in an upland slough on the left bank.

The Services are correct that AEA did not co-locate the upland slough in FA-141 with the FDA sampling, as the FDA study selected a beaver complex with an upland slough behind it. Beaver complexes are not one of the five macrohabitats identified in the River Productivity Study for sampling. The upland slough behind it was thoroughly investigated before selecting the upland slough, RP-141-4. Field crews walked the entire reach of the upland slough behind the beaver complex during the Spring 2013 sampling event and found the entire area to be largely a marsh-like area, with no open water available for using either a Hess, or a Ponar grab sampler. It was determined unsuitable for River Productivity study needs. While this presented a problem with fish sampling efforts in 2013 (see ISR Part A, Section 6 for discussion on 2013 fish sampling efforts), fish sampling in 2014 utilized a dedicated fish crew at each sampling site during each event. Efforts within the RP-141-4 site in 2014 collected juvenile Chinook Salmon, as well as a number of salmon carcasses. The Services maintain that AEA's efforts within the four upland slough sampled, provides an insufficient number to document macroinvertebrate and algal communities within upland sloughs. Yet, this was not the stated objective of the study, which was to "Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River." In the *2013 Initial River Productivity Results Technical Memorandum (Section 3.1, and 3.2),* AEA has shown that upland sloughs and side sloughs recorded higher mean benthic densities and plankton tow densities as compared to main channel and side channel macrohabitats, but with relatively lower taxa richness, especially for EPT taxa, dominated by chironomids, zooplankton, and other non-insect taxa. Efforts in 2014 confirmed this trend with plankton tow samples (Study 9.08 SIR, Section 5.2). In addition, the extra Hess sampling in the upper extent of RP-141-4 revealed it to be one of the most productive samples of the study, with mean density estimates of nearly 20,000 individuals/m^2 recorded in the spring and summer events (ISR Part A, Figure 3.1-7). Therefore, AEA's efforts in collecting benthic community data from upland sloughs are accomplishing the stated study objective.

2.6.4.2.2.6. Response to Modification Request Regarding Sampling at Side Slough Macrohabitats

NMFS (Modification 2-2; NMFS_pp9.8-16_ph2) and USFWS (Modification 2-3; USFWS_pp9.8-10_ph2) request that side slough sampling units and sampling locations within side slough sampling units be selected according to the Study Plan and request additional Middle River side slough sampling units be selected below Devils Canyon and sampled. The Services also recommend that results from samples collected from the sampling units and locations as reported in the ISR for side channels should be discarded and sampling repeated (NMFS_pp9.8-23_ph2, USFWS_pp9.8-12_ph1)

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

In this modification, the Services again disagree with AEA's site selection for sampling one of the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). For side sloughs, the Services specifically disagree with the representativeness of the side slough in FA-104, and identify a number of side channels in the Lower River as side sloughs that AEA could have selected in Station RP-81.

Consistent with the FERC-approved Study Plan, AEA's site selections for the River Productivity Study (9.8) were based on a number of technical memorandums produced in early 2013 to define the aquatic habitats in the Middle and Lower Susitna River, especially within the selection of Focus Areas. These documents, with maps and information within, provided a snap shot of aquatic habitat at one point in time and under one flow condition. It was used to assist field crews in sampling across multiple habitat types. This was accomplished successfully, with crews for Study 9.8 sampling 2-5 of each of 5 habitats at 5 stations in the Middle and Lower River (Study 9.8 SIR, Section 9, Table 4.2-1). For a more detailed discussion of which documents were used in determining sites based on macrohabitats, please refer to Section 2.6.4.2.2.1 above.

AEA strongly disagrees with the Services assertion that the data collected in 2013 is of no value and should be discarded (NMFS_pp9.8-23_ph2, USFWS_pp9.8-12_ph1). AEA sampled the habitats consistent with the FERC-approved Study Plan and asserts that the few differences in professional opinion on habitat classifications are understandable when applying static definitions to continuous and dynamic features. Indeed, during the 1980s some sides sloughs were designated as sloughs at lower flows and their designation changed to side channel at higher flow. These differences in how scientists choose to classify a habitat feature does not invalidate the data collected within. Habitat types were clearly defined and these definitions were consistently applied. The data gathered within the habitat units accurately characterizes the existing conditions.

In 2013, AEA sampled 17 sites in the Middle River, and four sites in the Lower River, for a total of 21 sites. This was reported as two variances in the ISR Part A, Sections 4.2.4.1 and 4.2.4.3. The predicted number of side slough sites in the Study Plan was likely four sites, counting those in the Lower River at Trapper Creek, FA-104, FA-173, and an additional side slough at FA-144 (Slough 21) as a storm event site (RP IP Table 1.2-1). As the Services point out, the relocation of the Lower River site to the Montana Creek area resulted in the loss of a side slough site, but they assert that AEA did not sample available side sloughs in the vicinity (NMFS Figure 7; USFWS Figure A7). Referring to Sheet 13 of 18 in both Appendices H and J in the *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials Technical Memorandum* (Tetra Tech 2014), these macrohabitats the Services call side sloughs were designated by AEA as "vegetated island side channel complexes," which is why they were not sampled as side sloughs in 2013 or 2014.

In addition to the loss of a side slough in the Lower Susitna River study site, the side slough at FA-173 was substituted for Slough 21 (in FA-144), in order to capture pre- and post-storm event samples in a side slough (see ISR Part A, Section 4.2.4.3. for the variance detailing this decision). This resulted in only two side sloughs for the 2013 study. AEA agrees that the addition of two side slough sites, one downstream from Indian River and the other at FA-138 or FA-128, would correct for habitat losses and help to achieve the study's objectives (RP IP Table 1.2-1). However, AEA maintains that sampling four additional side sloughs (FA-114, FA-128, FA-138, and FA-144) as recommended by the Services is beyond what is necessary to meet study objectives. Results from the 2013 sampling efforts were able to successfully achieve the study objectives by characterizing side slough benthic communities, to the extent that AEA was able to show "initial differences in several metrics between mainstem macrohabitats (main channel and side channel habitats) when compared to other macrohabitat types, especially tributary mouths and off-channel habitats (side sloughs, upland sloughs)" *(2013 Initial River Productivity Results TM*, Section 4.1).

AEA was also able to discern that two sites classified as side channels (RP-141-2 and RP-173-3) functioned more like side sloughs, with macroinvertebrate densities and taxa richness measures appearing more similar to the two side sloughs also sampled (RP-104-2 and RP-173-4) than to other side channels, further demonstrating that the study is able to define and characterize side slough communities. Therefore, AEA would agree that adding two additional side sloughs in the Middle Susitna River in the next year of study would achieve the FERC recommended total of four side sloughs, and would be more than sufficient to meet the requirements of the Study Plan, especially with the additional sampling tied to the storm event sampling efforts that are also required within two of the side slough sites.

The Services also repeat their comment that samples were collected too close together (NMFS_pp9.8-16_ph3, USFWS_pp9.8-10_ph2), and samples must be distributed evenly throughout a sampling unit of 20 times the channel width. As was explained below in Section 2.6.4.2.2.2, nowhere in the Study Plan documents did AEA designate a 200-m, 500-m, or 20-times-the-stream-width standard reach length. Again, the Services' repeated comments on the sampling locations and distances between samples appears to rely upon the site-specific images supplied in the ISR Part A, Appendix B and the Study 9.8 SIR, Appendix B. The Services have misinterpreted the intent of providing those graphics, which were to be used to show approximate locations of each site and where sampling occurred within those sites, not to measure precise locations down to 10 m or less. Examination of the 227 measurements between Hess sampling locations taken in 2013 (Table 2.6.4-3) via GIS reveals that distances between Hess samples taken in side sloughs ranged from 2.7 to 55.5 m, and averaged 16.9 m. Approximately 74-percent, or 23 of the 31 side slough measurements between Hess samples taken were 10-m or greater apart (Table 2.6.4-4). However, it is important to note that handheld GPS units are considered to have accuracy within 3 m. If a more conservative accuracy allowance of 1 m (9-11 m range) is taken into account, 77-percent of the Hess samples were at least 9 m apart, and 61-percent were at least 11 m apart (Table 2.6.4-4).

Also, AEA would like to correct the Services’ misinterpretation of sampling locations for RP-104-1. The Services stated that AEA was trying to sample Whisker’s Creek as a side slough, in reference to the upper image of Figures 8a (NMFS) and A8 (USFWS). This statement is incorrect; all samples taken within the confluence of Whisker’s Creek and Whiskers Slough were part of the sampling effort for RP-104-1, the tributary mouth site. Samples for RP-104-2 were taken primarily at the upper and lower ends of the side slough, with the summer event samples also serving as the pre-storm event samples.

2.6.4.2.2.7. Response to Modification Request Regarding Sampling at Side Channel Macrohabitats

Both NMFS (Modification 2-3; NMFS_pp9.8-19_ph3) and USFWS (Modification 2-4; USFWS_pp9.8-11_ph2) request that side channel sampling units be representative of the macrohabitat type, ensuring that sampling locations within the side channel sampling units are distributed throughout the 500 m sampling unit as provided for in the Study Plan.

In their rationale for this modification, the Services again disagree with AEA’s site selection for sampling one of the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). For side channels, the Services disagree with four of the five of AEA’s choices for side channel sites, stating that only RP-81-4 was correct, but that samples were taken too close together.

As previously stated, AEA's site selections for the River Productivity Study (9.8) were based on a number of technical memorandums produced in early 2013 to define the aquatic habitats in the Middle and Lower Susitna River, especially within the selection of Focus Areas. These documents, with maps and information within, provided a snap shot of aquatic habitat at one point in time and under one flow condition. It was used to assist field crews in sampling across multiple habitat types. This was accomplished successfully, with crews for Study 9.8 sampling 2-5 of each of 5 habitats at 5 stations in the Middle and Lower River (Study 9.8 SIR, Section 9, Table 4.2-1). For a more detailed discussion of which documents were used in determining sites based on macrohabitats, please refer to Section 2.6.4.2.2.1 above.

For two side channels in question, RP-141-2 and RP-173-3, sites were chosen according to the habitat mapping designations available before the 2013 field season, as described above. During the spring sampling event, flows were higher, and the two sites functioned like side channels, with macroinvertebrate results from 2013 appearing similar to other side channel and main channel sites. However, during the summer and fall sampling events study results from 2013 suggested that these two side channels functioned more like side sloughs, with macroinvertebrate densities and taxa richness measures appearing more similar to other side sloughs than to other side channels (*2013 Initial River Productivity Results Technical Memorandum, Sect 4.1*). AEA agrees that these two sites were functioning as side sloughs during summer and fall sampling, and that selecting additional side channel sites should be considered for FA-141 (Indian River) and FA-173 (Stephan Lake complex), if alternatives are present. However, AEA also believes that there is added value in retaining these two sites as examples of locations that function differently at various flows throughout the open-water season, given the amount of baseline data already collected at these two sites, as well as the Agencies' perception that the study is lacking in the number of side slough sites

At FA-184 (Watana Dam), the Services point out that the main channel and side channel sites are both collected off the head of an island. However, side channel samples are clearly taken on the opposite side of the island from the main channel site, and the majority of samples are greater than 10 m apart (Table 2.6.4-3), with the exception of the summer event, when sampling occurred during the beginning of a storm event, causing water levels to quickly rise, and samples to be taken closer together. Results from 2013 show that while benthic macroinvertebrate and drift metrics were similar between the two sites (largely due to them both being mainstem macrohabitats with high turbidities), results between the two sites tended to be different during the fall event (*2013 Initial River Productivity Results Technical Memorandum,* Section 3.1, and 3.2; Appendix Tables A3.1-1, A3.1-2, A3.2-1, A3.2-2). Additionally, the side channel across the main channel was not suitable, as it became completely dry during the summer.

The Services also claim that the side channel site RP-104-5 is actually within an upland slough site. AEA disagrees. This site was determined based on designations as seen in the Figure 2-10 in Appendix 2 of *Adjustments to Middle River Focus Areas Technical Memorandum* (R2 2013). As seen in Figure B-9 of Appendix B of the ISR Part A, AEA field crews sampled in the side channel areas, and not within the upland slough area (the entrance of said upland slough is marked by the placement of a Hester-Dendy sample location). Measurements of turbidity confirm that this site was not in upland slough, with spring and summer recordings of greater than 100 NTUs (http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.8-River_Productivity/SIR_9_8_RIVPRO_2013_FieldData_20151028.xlsx, SW3_RP_BenDr_A_SiteSurvey_R2 tab; posted October 28, 2015).

The Services repeat their comment that samples were collected too close together (NMFS_pp9.8-16_ph3, USFWS_pp9.8-10_ph3), and samples must be distributed evenly throughout a sampling unit of 500 m, separated by 100 m. As was explained in Section 2.6.4.2.2.2, nowhere in the Study Plan documents did AEA designate a 200-m, 500-m, or 20-times-the-stream-width standard reach length. Again, the Services' repeated comments on the sampling locations and distances between samples appears to rely upon the site-specific images supplied in the ISR Part A, Appendix B and the Study 9.8 SIR, Appendix B. The Services have misinterpreted the intent of providing those graphics, which were to be used to show approximate locations of each site and where sampling occurred within those sites, not to measure precise locations down to 10 m or less. Examination of the 227 measurements between Hess sampling locations taken in 2013 (Table 2.6.4-3) via GIS reveals that distances between Hess samples taken in side channels ranged from 0.5 to 118.6 m, and averaged 21 m. Approximately 75-percent, or 51 of the 68 side channel measurements between Hess samples taken were 10-m or greater apart (Table 2.6.4-4). However, it is important to note that handheld GPS units are considered to have accuracy within 3 m. If a more conservative accuracy allowance of 1 m (9-11 m range) is taken into account, 82-percent of the Hess samples were at least 9 m apart, and 72-percent were at least 11 m apart (Table 2.6.4-4). Specifically, for the side channel at RP-81-4, distances between Hess samples ranged from 6.9 to 33.3 m, and averaged 17.7 m, taken over total distances of 50.1 to 89.9 m.

Finally, the Services request that during the second study year a minimum of 6 side channel sites must be sampled downstream from Devils Canyon. NMFS (NMFS_pp9.8-23_ph2**)** additionally calls for all samples collected in side channels by AEA thus far to be discarded and sampling repeated. AEA disagrees with the proposed modification's request that AEA discard all side channel samples collected to date, establish new side channel sites to the Services' specifications, with side channels in four additional Focus Areas in the Middle River below Devils Canyon, and repeat all sampling at the six sites as necessary to meet Study 9.8 objectives. The Agencies' repeated request to relocate sampling efforts to focus on the Middle River below Devils Canyon is not in agreement with the stated objective of the study, which was to "Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River." The Agencies' approach disregards that the extent of the Middle Susitna River that is above Devil Canyon will be in closest proximity to the proposed dam, and the benthic macroinvertebrate community residing within this stretch of river will potentially be the most impacted by Project operations. Focusing only on sites with anadromous salmonids ignores the importance of documenting and monitoring the entire continuum, from immediately below the dam to increasing distances downstream, that will be critical in defining the impact of the Project operations on the macroinvertebrate and algal communities. Sampling at AEA's current side channel sites, along with two new sites established for RP-141-2 and RP-173-3 to examine side channels less affected by lower flows, is sufficient to meet the stated study objective.

It is also important to note that this additional and intensive sampling requested by the Services has been previously requested by them in response to the RSP as noted on B-178, and has already been ruled on by FERC, in the April 1, 2013 Study Plan Determination (B-179), stating: "*Regarding FWS' request for additional focus areas in the Middle and Lower River, with our recommendation (discussed below under Macrohabitat Replicates) to increase the sampling effort at the four Middle River stations and the one Lower River station, the information needed to evaluate potential project effects and inform the NMFS and FWS study objectives would be collected. Therefore, we do not consider it necessary to add any new focus areas as requested by FWS.*" Furthermore, the number and location of study sites needed to meet study objectives was approved by FERC in their Study Plan Determination on Page B-181, which states "that AEA sample in all unique macrohabitat types present at each proposed study station for river productivity sampling in the Middle River and Lower River segments. This would result in 16 sites in the Middle River and five sites in the Lower River."

To summarize, although side channel sites at RP-141-2 and RP-173-3 were functioning more like side sloughs during summer and fall sampling events, the value of selecting additional side channel sites should be considered for *those two* Focus Areas, if alternatives are present. AEA disagrees with the Services' assessments of the classifications of the other side channel sites, as well as the requests that 2013 data collected at side channels be discarded, and that full sampling efforts be repeated at the additional side channel sites selected by the Services to be located exclusively in the Middle Susitna River below Devils Canyon. AEA requests that FERC not adopt these elements of this proposed Study Plan modification because these requests do not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for these elements of this modification.

2.6.4.2.2.8. Response to Modification Request Regarding Sampling at Main Channel Macrohabitats

Both NMFS (Modification 2-4; NMFS_pp9.8-25_ph2) and USFWS (Modification 2-5; USFWS_pp9.8-12_ph2) request AEA select main channel sampling units that are representative of this macrohabitat type, and sampling locations within the main channel sampling units that are distributed throughout the 500 m sampling unit per the Study Plan.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

In this modification, the Services again disagree with AEA's site selection for sampling one of the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). For main channels, the agencies disagree with all five of AEA's choices for main channel sites. AEA disagrees with the notion that none of the five main channel sites was correctly located, and according to NMFS that all samples collected at these selected sites "are erroneous and must not be used to address study objectives."

AEA maintains that all main channel sites were properly established in locations that are representative of main channel macrohabitats, and sampling at those sites in 2013 and 2014 achieved study objectives. As previously stated, AEA's site selections for the River Productivity

Study (9.8) were based on the *Middle Susitna River Segment Remote Line Habitat Mapping Technical Memorandum* (HDR 2013), with maps and information provided within the *Technical Memorandum, Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014* (R2 2013) and the subsequent *Adjustments to Middle River Focus Areas Technical Memorandum* (R2 2013), which clearly show the following: the main channel site at FA-184 (Watana Dam), discussed above in comments concerning side channels, while in close proximity to the side channel sites, was sampled on the main channel side of the island; the main channel site at RP-141-3 was established in a multiple split main channel, which still qualifies as a main channel macrohabitat; and the main channel site at RP-104-3 is located at the point bar of an island, along the main channel side, not along the side channel side.

For Lower River site selection within the Montana Creek station area (RP-81), data from Appendix 4 of the *Mapping of Aquatic Macrohabitat Types at Selected Sites in the Middle and Lower Susitna River Segments from 1980s and 2012 Aerials 2012 Study Technical Memorandum* (Tetra Tech 2013), and initial database information from the Geomorphology Study (6.5) which is depicted in Sheet 13 of 18 in both Appendices H and J in the *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials Technical Memorandum* (Tetra Tech 2014) were used in site selection. These sources show that the main channel site, RP-81-3, is classified as a split main channel, so spring event sampling did not occur in a side channel, as the Services submit.

The Services repeat their comment that samples were collected too close together, and samples must be distributed evenly throughout a sampling unit of 500 m, separated by 100 m. As was explained above in Section 2.6.4.2.2.2, nowhere in the Study Plan documents did AEA designate a 200-m, 500-m, or 20-times-the-stream-width standard reach length. The Services' repeated comments on the sampling locations and distances between samples appears to rely upon the site-specific images supplied in the ISR Part A, Appendix B and the Study 9.8 SIR, Appendix B to measure precise locations down to 10 m or less. This was not AEA's intent in providing those graphics, which were to be used to show approximate locations of each site, and where sampling generally occurred within those sites. Examination of the 227 measurements between Hess sampling locations taken in 2013 (Table 2.6.4-3) via GIS reveals that distances between Hess samples taken in main channels ranged from 1.5 to 61.5 m, and averaged 14 m. Approximately 60 percent, or 36 of the 60 main channel measurements between Hess samples taken were 10-m or greater apart (Table 2.6.4-4). Given that handheld GPS units are considered to have accuracy within 3 m., if a more conservative accuracy allowance of 1 m (9-11 m range) is taken into account, 70 percent of the Hess samples were at least 9 m apart, and 47 percent were at least 11 m apart (Table 2.6.4-4).

2.6.4.2.2.9. Response to Modification Request Regarding Using a Hess Sampler at Main-stem Macrohabitats

Both NMFS (Modification 2-5; NMFS_pp9.8-26_ph3) and USFWS (Modification 2-6; USFWS_pp9.8-12_ph7) request AEA collect macroinvertebrate samples from locations and depths that are within the active channel under most flow conditions and for main-stem and side channels, and that the Hess sampler is inappropriate for collecting representative samples in mainstem macrohabitats. The Services recommend alternative methods to sample active channel depths (supposedly 3 ft. or greater).

In response, AEA requests that FERC not adopt this proposed Study Plan modification because it is not realistically achievable and does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

The April 1, 2013 FERC recommendation (B-187) stated that AEA should "collect BMI and algae samples in macrohabitats with fine substrate and low velocities using a bottom dredge or grab sampler. AEA should select the most appropriate sampler according to the bottom substrate, water velocity, and other conditions (see Klemm et al. 1990), but should endeavor to use the same sampler in all macrohabitats of this type to ensure consistency among samples." The sampling was conducted according to the recommendation. A petite Ponar grab sampler was used in all areas of low velocities and fine substrates, whereas the Hess sampler was used in faster water velocities with coarse substrates (cobble and gravel). The protocol of sampling shoreline areas for larger non-wadeable streams and rivers is an accepted one. Johnson et al. (2006) noted in the Benthic Macroinvertebrate chapter of the EPA's "Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers":

> *Even though the wadeable shore zone only accounts for a small proportion of the entire river channel, it may be the most productive and diverse zone for benthic macroinvertebrates (Wetzel 2001). The shallows along main-channel margins have the greatest light penetration for benthic algae and aquatic macrophytes. Allochthonous organic matter also accumulates in the shallows as a result of direct riparian inputs and from backeddies and currents that deposit LWD and FPOM along the shore. The shoreline substrates of many large rivers tend to be dominated by LWD and other stable substrates, such as cobbles and boulders. As a result of their relatively high habitat complexity and productivity, large river shorelines are similar to the highly productive littoral zones of lentic ecosystems.*

In mainstem macrohabitats, the Hess sampler was primarily used to sample shoreline areas that will be most impacted by Project effects (fluctuations creating a varial zone). The glacial melting already causes diurnal fluctuations in shoreline areas, so measuring the communities in these shoreline areas indicates the current conditions. In addition, high turbidity in the mainstem macrohabitats prevents algal growth and macroinvertebrate colonization to a large degree. Measurements of light penetration revealed that light levels needed for photosynthesis (PAR) rarely reached beyond a depth of 1-1.5 ft. (0.3-0.5 m) at mainstem sites efforts (http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.8-River_Productivity/SIR_9_8_RIVPRO_2013_FieldData_20151028.xlsx, SW3_RP_BenDr_A_SitePAR_R2 tab; posted October 28, 2015). The 2013 results showing low macroinvertebrate densities in main channel and side channel sites (2013 Initial River Productivity Results TM, Figures 3.1-1, 3.1-4, 3.1-7, 3.1-10, and 3.1-13) corroborate this assertion of reduced productivity beyond approximately 1.5 ft. in turbid waters. This is consistent with results reported for main channel and side channel sites in the 1980s during the summer months when turbidity was high (1980s results summarized in ISR Part A, Appendix A *"Review of the Effects of Hydropower on Factors Controlling Benthic Communities"*, Section 2.4).

AEA acknowledged the difficulties to conduct sampling at sites where all substrates had remained submerged for 30 days or more, due to the rapid and sudden changes in flow and river stage during the 2013 sampling season. This was included as a variance in the ISR Part A, Section 4.4.3.1. In addition, Alaska Department of Fish and Game requested that an estimate of the proportion of samples subject to dewatering be provided as part of the ISR, which AEA did provide in the ISR Part A, Appendix C "*Analysis of Potentially Dewatered River Productivity Sampling Sites in 2013*." Estimates revealed that 24 percent of the Hess samples, specifically those in main channel macrohabitats, could have been potentially dewatered at some point during the preceding 30 days due to river stage changes in 2013. Examination of the river stage over the 2013 open-water season shows high variability in the stage levels during the spring and summer index events, likely due to the late ice-break up followed by record-high temperatures in 2013.

The technical memorandum concluded, "While this analysis makes a number of assumptions in order to apply the available river stage data collected by USGS gaging stations on the Susitna River, the exercise does demonstrate the difficulties in adhering to a sampling criterion of 30 days of inundation at a site on the Susitna River. The dynamics of a glacially-fed river system make flow difficult to predict, and the timing of sampling trips are often determined weeks in advance to meet field logistical demands. It is important to consider that benthic macroinvertebrate communities exist under these naturally fluctuating flows and water levels. Sampling under these conditions accurately reflects the benthic community structure as shaped by the seasonally variable flow regime."

Many of the Services' suggestions for alternative techniques, while certainly possible, are logistically impractical for the Susitna River. Open D-nets or kick nets are unable to exclude the high amounts of drifting material present in the mainstem macrohabitats from entering the net. AEA's experience with drift sampling in the main channels and side channels resulted in nets often clogged within 2 minutes of deployment. This clogging of the mesh net impedes further flow from entering the net, and results in potential losses. Using open nets would also make it difficult to isolate drifting organisms and organic matter from benthic organisms and organic matter. The advantage of the Hess sampler is that it isolates the sampling area, and keeps out drifting materials. There is also considerable difficulty and personal risk in conducting kick samples in depths exceeding 2.5 feet with higher velocities, as it is harder for personnel to maintain their balance and position while actively kicking in velocities exceeding 3 feet per second. The suggestion to employ sampling that is reliant on SCUBA is equally impractical, introducing logistical complications of requiring certified divers collect samples in high velocities with zero visibility due to the high glacial turbidity in Susitna River. The logistics of utilizing an air-lift sampler are restrictive, as it would require a costly custom-fabricated sampling device and either an air compressor or tanks of compressed air that could only be operated on-board a highly maneuverable boat able to maintain a steady position in high velocity currents for the duration of collecting an individual sample in deep water locations. These suggested methods are also unnecessary, given the high levels of glacial turbidities precluding benthic community colonization at these greater water depths. As detailed in the *2013 Initial River Productivity Results Technical Memorandum* (Section 4.1), AEA's current sampling methods have returned results which have successfully characterized benthic macroinvertebrate communities, showing "initial differences in several metrics between mainstem macrohabitats (main channel and side channel habitats) when compared to other macrohabitat types, especially tributary mouths and off-channel habitats (side sloughs, upland sloughs).

In the Fisheries Technical Meeting presentation on March 21, 2014, (http://www.susitna-watanahydro.org/wp-content/uploads/2014/03/20140321TTPresentationRivPro.pdf) AEA suggested several different approaches to sampling in the mainstem macrohabitats to sample out in deeper waters of the mainstem macrohabitats: take samples at the 12-14 inch depth maximum allowed by the Hess device, if available within the site; for periods with large stage changes, attach a 1-ft. extension to the Hess sampler, allowing it to sample in depths of up to 2 ft. if necessary; and equip one team member with a dry suit, so that samples can be retrieved at increased depths (if within safety limits due to velocities). During that Technical Meeting, AEA also detailed a proposed modification involving an additional colonization experiment, which was incorporated into the ISR Part C, Section 7.1.2.6. As a modification to the Study Plan, AEA plans to add an extra collection of six Hester-Dendy sampler sets at a main channel site at increasing depth increments. This modification will allow AEA to record the effects of stage changes and exposures along the main channel's fluctuating shoreline. Sampling along a depth gradient will address the challenges of sampling along a fluctuating shoreline as detailed in ISR Section 4.4.3.1., will provide information on macroinvertebrate densities at increasing water depths, and provide insight into inundation and exposure limits for benthic macroinvertebrates for HSC/HSI models (RSP Section 9.8.4.10). This collection of samplers will be deployed for 4-6 week periods, resulting in a potential of two or three collections over the open water period.

2.6.4.2.2.10. Response to Modification Request Regarding Collection of Samples from Sites with Finer Substrates

Both NMFS (Modification 2-6; NMFS_pp9.8-27_ph3) and USFWS (Modification 2-7; USFWS_pp9.8-14_ph1) request that invertebrate and algal samples be collected from sites dominated by a range of finer grained substrates, so that samples are representative of the dominant habitat, according to the Study Plan.

AEA has implemented data collection consistent with the FERC-approved Study Plan and stated variance as reported in the ISR Part D, Section 6, and has demonstrated progress toward meeting this objective. Therefore, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan and as described above would not necessarily improve data collected on the Susitna River.

The Services' comments are largely focused upon the collection of algae, and AEA has addressed this issue, consistent with FERC's recommendation to extract algae samples from the benthic grab sampler, in a variance in the ISR Part C, Section 4.4.3.3. The variance explains that while the grab sampler is ideal for collecting macroinvertebrates in fine sediment, it is unsuitable for sampling algae because the sediment surface is disturbed in the process of collection and removal of the material from the grab sampler. The USGS National Water-Quality Assessment (NAWQA) Program protocol, which was the model for this study's co-located algal and macroinvertebrate samples, recommends algal sample collections from epilithic (natural, coarse-grained substrates) or epidendric (woody debris) habitats (Moulton et al. 2002; Hambrook Berkman and Canova

2007). The USGS NAWQA protocol for algal sampling from soft substrates uses the inverted petri dish method, but those samples are only analyzed for taxonomic identification, and not chlorophyll-a or ash free dry mass (AFDM), as is required for this study.

The Services also argue that "Chlorophyll-a can easily be extracted from fine sediment samples." While fine sediment samples (petri dish method) may yield Chlorophyll-a results, the high organic matter content of such samples would result in very high AFDM results that would not be due to periphyton alone, and would be difficult to decipher, as was seen for the upland slough site on the Talkeetna River (ISR Part A, Section 5.4). Fall index event estimates for AFDM at the upland slough site RP-TKA-2 averaged 242.6 g/m^2, a large departure from Susitna River algal test results. It is likely that this is the reason why the USGS NAWQA protocol for algal sampling from soft substrates does not analyze their soft substrate samples for chlorophyll-a or AFDM.

2.6.4.2.2.11. Response to Modification Request Regarding Collection of Benthic Samples at Multiple Depths

Both NMFS (Modification 2-7; NMFS_pp9.8-27_ph6) and USFWS (Modification 2-8; USFWS_pp9.8-14_ph3) request that algal samples are collected from multiple depths (0-1, 1-2, 2-3 feet) within each macrohabitat, proportional to the depths present and such that all sites are inundated for 30 days prior to sampling per the Study Plan.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, AEA has collected data consistent with the FERC-approved Study Plan and has demonstrated progress towards the objective. NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated that the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA has implemented this objective according to the FERC-approved Study Plan. Attempts were made to sample algae at the three depth strata when available. In 2013, AEA crews collected 1,770 substrates for algae. Sample depths ranged from 0.05 to 3.3 feet deep, with an overall average of 0.58 feet deep. Approximately 84.5 percent of the substrates were collected at 0–1 foot, 14.3 percent at 1–2 feet, and 1.2 percent at 2–3 feet. FERC's recommendation was that *"AEA should sample benthic algae on cobble substrates at multiple depths up to 3 feet (e.g., depth categories of 0–1 foot, 1–2 feet, and 2–3 feet) at each macrohabitat site (main channel, tributary confluences, side channels, and sloughs), to the extent feasible given the limits of field safety."* In main channel and side channel sites, sampling in depths of greater than 2 feet often put the crew at risk. To retrieve a cobble by hand (so that the periphyton on the rock surface would remain undisturbed) in depths of 2 feet would require complete submergence by the crew member, in velocities often exceeding 3 ft/s. These depths were often far out into the river, away from shore, the boat, and any tree or object to which to tether.

Furthermore, high turbidity in the mainstem macrohabitats limits light penetration and restricts both algal growth and macroinvertebrate colonization to a large degree. Measurements of light penetration revealed that light levels needed for photosynthesis rarely reach beyond a depth of 1-1.5 ft. (0.3-0.5 m) (http://gis.suhydro.org/SIR/09-Fish_and_Aquatics/9.8-River_Productivity/SIR_9_8_RIVPRO_2013_FieldData_20151028.xlsx, SW3_RP_BenDr_A_SitePAR_R2 tab; posted October 28, 2015). Algal results reported in the ISR Part A, Figures 5.2-1 to 5.2-12 show that main channel and side channel sites, those sites with consistently higher turbidities during the study, were lowest in chlorophyll-a and AFDM estimates, indicating low algal production at those sites due to lack of photosynthetic active radiation (PAR) reaching the substrates.

2.6.4.2.2.12. Response to Modification Request Regarding Timing of Season Sampling Events

Both NMFS (Modification 2-8; NMFS_pp9.8-28_ph2) and USFWS (Modification 2-9; USFWS_pp9.8-14_ph5) request that AEA collect benthic macroinvertebrate and algal samples during the spring, summer, and fall sampling periods for a minimum of two years as described in the Study Plan. Spring sampling must occur prior to June 1, and Fall sampling in October.

Based on the reasons to follow, AEA requests that FERC not adopt this proposed modification because it is not realistically achievable and does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA agrees that spreading the sampling out over a longer open water window such as sampling in June, August and October would make for a better study design if practical to implement; however, in this instance and at this location it is not feasible to plan to sample consistently prior to June 1st or after October 6th due to ice conditions. Data collected from 2013-2015 have shown that the open water period is more restrictive on the Susitna River. Thus, a more feasible design is one that has sampling as early in the open water period, during the peak of the growing season, and as late in possible in the open water period. This is the design that was implemented in 2013 and is proposed for future implementation of the study.

Based on the past five years the timing of break-up and peak glacial melt have been quite variable and hard to predict, so planning a realistic start date prior to June 1 would be problematic. The probability that break-up will have happened increases dramatically in early June. Also, the rapid mobilizing of field crews that would be required to complete sampling post-break up and prior to glacial melt would poses substantial cost, logistic and safety challenges (such as dedicated helicopters for rapid evacuation) would limit the size of field crews instead of allowing more field members to ensure the data is all collected prior to June 1.

Access to sampling sites prior to break-up would also poses logistic and safety challenges, especially in mainstem areas. Similar to the Early Life History component of Study 9.6, sampling would require a dedicated helicopter as rapid flooding (on the order of feet per hour) can occur and risk of stranding or immersion is significant. The increased logistical support would increase the study cost considerably. Additional time would be required for sampling in off-channel sites and sampling would be limited to open water leads and these will need to be located at the time of sampling not pre-selected. The logistics required for sampling pre-break up also would result in a longer time sampling at one site and would likely prevent crews from completing more than 1 site per day, extending the sampling event to over three weeks or requiring additional crews.

The 2013 season had an extremely late break up, followed by record high temperatures in June. The River Productivity study began field sampling as soon as feasibly possible, given the resources available with a number of other studies also trying to get out into the field after the late start. AEA had the option to skip sampling altogether for Spring 2013, since weather conditions had effectively eliminated chances to collect in the April to early June period set in the RSP, but conducted the sampling event trip in order to begin collecting data to document the benthic community conditions in the Susitna.

Based on timing of ice-in for the past three years, initiating the fall sampling event in October also would present sampling difficulties associated with freezing conditions and ice formation that would likely compromise AEA’s ability to complete sampling of all sites. In October 2013, boat access to sampling locations was complicated by low flows and ice, and crews finished with the third sampling event just days before they pulled all boats from the river. In October 2014 field sampling for Study 9.5 and 9.6 was stopped due to ice affecting gear and access.

2.6.4.2.2.13. Response to Modification Request Regarding Emergence Traps

Both NMFS (Modification 2-9; NMFS_pp9.8-29_ph3) and USFWS (Modification 2-10; USFWS_pp9.8-15_ph3) request that the macroinvertebrate emergence study should be repeated to obtain adequate replication among all five macrohabitats, with a minimum of five replicate sampling locations distributed within each 200 to 500 m macrohabitat sampling unit. The Services also state that samples need to be collected in the spring, prior to breakup, to coincide with the emergence of juvenile salmon as provided for in the approved plan.

To clarify, emergence trap sampling has been not completed, and a second year of sampling, as provided in the FERC-approved Study Plan, remains to be completed.

AEA requests that FERC not adopt this proposed Study Plan modification because the proposed modification request is premature. Admittedly, deployment of emergence traps in 2013 was not as successful as planned due to schedule and unforeseen challenges from wildlife and flow fluctuations. Many of the difficulties with the emergence traps are discussed in ISR Part A, Section 6, and in the Study 9.8 SIR, Section 6.1. The occurrences of losses and stranded or disturbed samples resulted in coverage gaps at many of the sampling sites, making it difficult to assess trends or patterns in emergence timing for the various insect taxa present. Due to the prolonged set times of two weeks or longer, the exact timing occurrence of a disturbance within that period was unknown, making any sample data that could be retrieved from the trap bottle qualitative, not quantitative, since the total sampling time was in question.

The Services comment that due to the difficulties in the methodology which resulted in non-standard data collection, these results should not be used for evaluations of differences in emergence timing or insect production. AEA agrees with this conclusion; however, despite these difficulties, these results indicate that the emergence traps do function as intended when successfully deployed and left undisturbed during their deployment. The main issue appears to be that traps are left unobserved for long periods of time, during which they have increased chance of disturbance, the timing of which is unknown. Additional modifications were proposed in ISR Part C, Section 7.1.2.1, and an alternative deployment method was utilized as a test during the 2014 field season, when traps were used to collect specimens for stable isotopes, where traps were deployed for 24-48 hours instead of 2 weeks. A modification is proposed in the SIR, Section 6, that "in addition to a physical redesign of the traps to prevent sinking, deployment methods would be altered to allow sampling for shorter durations (24-48 hours) in order to provide consistent samples by minimizing losses due to unobserved disturbances or stranding."

Regarding the lack of deployment in the spring prior to breakup, AEA was unable to construct and deploy traps in April 2013, less than 30 days from FERC's issuance of its determination that required trap deployments in April, however intends to do so during a second year of study. The Services also commented that traps were not placed randomly within each macrohabitat. AEA crews have found that traps cannot be successfully deployed in high velocities as currently designed for extended periods. Traps are typically pulled underwater in higher current areas, and samples are lost. Increased flotation height, and decreased deployment period lengths could rectify this issue. The request for deployment of a set of multiple traps, similar to drift nets, would be also a useful modification.

2.6.4.2.3. Objective 3

Objective 3: Estimate drift of benthic macroinvertebrates in selected habitats within the Middle and Lower Susitna River to assess food availability to juvenile and resident fishes.

2.6.4.2.3.1. Response to Modification Request Regarding Measuring Drift in Tributary Mouths

NMFS (Modification 3-1; NMFS_pp9.8-30_ph2) and USFWS (Modification 3-1; USFWS_pp9.8-16_ph3) request that invertebrate drift be measured upstream and downstream from tributary mouths as provided for in the approved Study Plan during the second year of sampling. The Services also recognize that if invertebrate drift is measured in the tributary, tributary discharge also must be measured to allow for adequate estimation of the relative contribution of a tributary to main-stem food availability.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because AEA follow the approved Study Plan and sampled adequately to characterize the relative contributions of tributaries and mainstem. The agency study modification does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

In the April 1 2013 SPD, FERC recommended that AEA "conduct macroinvertebrate drift sampling upstream and immediately downstream of tributary mouths to collect information needed to assess the relative contribution of tributaries and the mainstem Susitna River to fish food resources." AEA established sites upstream of the selected tributary sites in 2013 and 2014. Sites "immediately downstream of tributary mouths" were interpreted to be collecting drift from the tributary on the delta. Any drifting invertebrates emanating from the tributary to the mainstem invariably would be captured in those drift nets. All flow from the tributary extends downstream into the area known as the plume, before it begins to mix with mainstem waters. Establishing additional drift nets in this plume area would still sample the full drift content as in the delta, as the tributary outflow has not mixed yet with the turbid mainstem water. Differences in drift would only be apparent the farther downstream one sampled, due to dilution or dispersion, which AEA does not interpret as the intent of the request from FERC. AEA believes that drift samples at the mouth of the tributary satisfied the requirement to sample drifting invertebrates below each tributary mouth.

In regards to tributary discharge being measured, collection of discharge data was not a required part of methods detailed in the 9.8 Study Plan. However, Study 8.5's "2014-2015 Study Implementation Report Appendix B *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*" reported the gaging measurements in nearly all the tributaries sampled by the River Productivity study. Information in Table 5 of Appendix B shows Tsusena Creek (FA-184), Indian River (FA-141), and Whiskers Creek (FA-104) all have continuous gaging in 2014; Indian River and Whiskers Creek also have continuous gaging data for 2013. The Unnamed Tributary 173.8 in FA-173 (Stephan Lake Complex; Site RP-173-1 in the River Productivity Study) had spot measurements in 2014. In addition, the USGS gage 15292800 at Montana Creek provides continuous discharge data for 2013-2014. While 2013 coverage of tributary discharge is only partial, covering only three of the tributaries, 2014 is nearly complete, with continuous gaging at four of the five tributaries. If these gaging stations are maintained in future years of study, AEA will be able to adequately provide tributary discharge in conjunction with drift sampling in these selected tributaries**.**

2.6.4.2.3.2. Response to Modification Request to Measure Diel Drift Variation

NMFS (Modification 3-2; NMFS_pp9.8-30_ph6) and USFWS (Modification 3-2; USFWS_pp9.8-17_ph2) request that AEA must conduct drift sampling every four hours in one or more of each representative macrohabitats to determine diel variation in drift during each sampling event.

Considering the data presented in 2013 and 2014 for drift, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

While AEA cannot find fault with the general concept of measuring diel drift, it is important to note that diel sampling was not part of the approved Study Plan because all of the literature cited to support this modification are based on measuring drift in rivers and streams in the lower 48 states, where clear diurnal patterns are evident. Alaska photoperiods are significantly different than that experienced at these southern locations, with summers having little to no darkness, and winters with few daylight hours. As explained in the RP IP (Section 2.5), Müller (1973) found that the reaction of stream invertebrates to the long photoperiods of summers in higher latitudes is much different in that it extinguishes drift rhythm entirely. Chironomidae are usually reported to be aperiodic, showing either no diel variation in drift densities, maximum drift during daylight hours, or a maximum drift at night (Brittain and Eikeland 1988). Measures of drift in a glacial river and its non-glacial tributary in Western Norway found that Chironomidae were the most abundant in drift and showed significant peaks in drift density at mid-day sampling (Saltveit et al. 2001). For glacial rivers, factors like glacial turbidity in summer and ice cover in winter limits light penetration into the water column even further, precluding visual site predation in mainstem habitats.

Contrary to the Services' comment that "results from 2013 show that while Chironomids may have the highest relative abundance, they rarely account for more than 60 percent of drift samples in numbers, and likely far less in biomass (Study 9.8 SIR Table 5.2-1)," it should be clarified that SIR Table 5.2-1 through 5.2-3 are summary tables showing averages over all three seasonal collections. In the Study 9.8 SIR Appendix A, Tables A5.2-1 through A5.2-10 show the relative abundances for all the major taxa groups for each site and season in 2014; similar tables for 2013 drift samples can be found in the *2013 Initial River Productivity Results TM*, Appendix A, Tables A3.2-1 through A3.2-10 (R2 and UAF 2014). In these tables, it is clear that a majority of drifting invertebrates at many sites are comprised of chironomids and "other diptera," which in most cases are dominated by Simuliidae (black flies) larvae. Saltveit et al. (2001) also noted the predominately daytime drift of Simuliidae in the glacial river they studied.

2.6.4.2.4. Objective 4

Objective 4: Conduct a feasibility study in 2013 to evaluate the suitability of using reference sites on the Talkeetna River to monitor long-term Project-related change in benthic productivity.

2.6.4.2.4.1. Response to Modification Request Regarding Increased Reference Sampling in the Talkeetna River

NMFS (Modification 4-1; NMFS_pp9.8-32_ph5) and USFWS (Modification 4-1; USFWS_pp9.8-18_ph6) request that AEA modify the study so that reference sampling in the Talkeetna River provides replicate measures of all five major macrohabitats (main channel, side channel, side slough, upland slough, and tributary mouth).

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

The objective of sampling in the Talkeetna was to determine if the Talkeetna River would provide a valid reference location suited to monitoring long-term Project related changes in benthic productivity. For this component of the study, AEA selected three sites that were as similar to sites being sampled in the mainstem river as was feasible (RP IP, Section 2.1.4). The variance to not incorporate both main and off-channel sites in the Talkeetna River is described in Study 9.8 ISR Part A, Section 4.6.1. This site selection was done with input from the agencies, as was recommended by FERC in the Study Plan Determination (B-201), and detailed in the ISR Part A, Appendix D. Although no main channel site was established, the TWG representative agreed that a side channel was appropriate as a main channel habitat within that braided reach of the Talkeetna River where the study station was located. Given that the main channel habitat in the comparable Susitna River station location is primarily split main channel and multiple split main channel, the selection of a side channel would serve a better comparison.

At this time it is not necessary to increase sampling in the Talkeetna but rather to look at the data collected in comparison with Susitna River data to determine if this location is a good reference site or if another location would be better. Although the agency's request would provide additional data, it is not clear that the data collected in 2013 is deficient for the intended purpose or if additional data would add to our ability to evaluate the Talkeetna as a reference site.

Therefore, AEA has implemented this objective as a feasibility study in accordance with the FERC-approved Study Plan. The proposed modification's request that AEA sample additional sites is not necessary to meet Study 9.8 objectives.

2.6.4.2.5. Objective 5

Objective 5: Conduct a trophic analysis to describe the food web relationships within the current riverine community within the Middle and Lower Susitna River.

2.6.4.2.5.1. Response to Modification Request Regarding Macrohabitat Site Selection for the Growth Rate and Growth Rate Potential Modelling Study

The first of a five-part modification request for substantial modifications to the Growth Rate and Growth Rate Potential Modelling study, NMFS (Modification 5-1[a]; NMFS_pp9.8-33_ph2) and USFWS (Modification 5-1; USFWS_pp9.8-19_ph3) request the AEA refine study objectives using bioenergetics modeling to evaluate the pre- and post-Project influence of temperature, water velocity, food availability and food quality on juvenile Coho and Chinook Salmon at five or more replicate Middle River main channel or side channel, tributary mouth, side slough, and upland slough macrohabitats.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

The Services comment again on their disagreements with AEA's site selection for sampling the five macrohabitats, as recommended by FERC in its April 1, 2013 Study Plan Determination (B-181). As previously stated in Section 2.6.4.2.2.1 above, AEA's site selections for the River Productivity Study (9.8) were based on the *Middle Susitna River Segment Remote Line Habitat Mapping Technical Memorandum* (HDR 2013), with maps and information provided within the Technical Memorandum, *Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies – 2013 and 2014* (R2 2013) and the subsequent *Adjustments to Middle River Focus Areas Technical Memorandum* (R2 2013). For Lower River site selection within the Montana Creek station area (RP-81), data from Appendix 4 of the *Mapping of Aquatic Macrohabitat Types at Selected Sites in the Middle and Lower Susitna River Segments from 1980s and 2012 Aerials 2012 Study Technical Memorandum* (Tetra Tech 2013), and initial database information from the Geomorphology Study (6.5) which is depicted in Sheet 13 of 18 in both Appendices H and J in the *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials Technical Memorandum* (Tetra Tech 2014) were used in site selection. These documents provided a snap shot of aquatic habitat at specific points in time and under flow conditions at those times. It was used to assist field crews in sampling across multiple habitat types. This was accomplished successfully, with crews for Study 9.8 sampling 2-5 of each of 5 habitats at 5 stations in the Middle and Lower River (Study 9.8 SIR, Section 9, Table 4.2-1).

2.6.4.2.5.2. Response to Modification Request for Additional Macrohabitat Sites in the Middle River

The second of a five-part modification request for substantial modifications to the Growth Rate and Growth Rate Potential Modelling study, NMFS (Modification 5-1[b]; NMFS_pp9.8-33_ph3) and USFWS (Modification 5-1; USFWS_pp9.8-19_ph4) request that macrohabitats should be located within Middle River focus areas below Devils Canyon to take advantage of 2D hydraulic modeling and to overlap with the distribution of juvenile salmon. However, the Services state that not all macrohabitats within a focus area need to be sampled as long as there are five or more replicates of each macrohabitat type.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification nor have demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

The proposed modification's request that AEA conduct all Growth Rate and Growth Rate Potential Modelling study components in the Middle River focus areas below Devils Canyon is not necessary to meet Study 9.8 objectives. The additional and intensive sampling requested by the agencies has been previously requested by them in response to the RSP, has already been ruled on by FERC in the April 1, 2013 Study Plan Determination (B-199): "*We address the agencies request that AEA conduct fish growth and trophic modeling studies in their requested focus areas above in 'Modified Sampling Stations'.*"

Specifically, FERC's "Modified Sampling Stations" recommendation (B-179) states: "*Regarding FWS' request for additional focus areas in the Middle and Lower River, with our recommendation (discussed below under Macrohabitat Replicates) to increase the sampling effort at the four Middle River stations and the one Lower River station, the information needed to evaluate potential project effects and inform the NMFS and FWS study objectives would be collected. Therefore, we do not consider it necessary to add any new focus areas as requested by FWS.*"

In addition, FERC recommended on B-199 *"that AEA collect fish for the trophic modeling studies at all available macrohabitat types (up to five per study station) in each Middle River and Lower River study station."* Therefore, AEA has implemented this objective according to the FERC-approved Study Plan. The proposed modification's request that AEA sample additional sites is not necessary to meet Study 9.8 objectives.

2.6.4.2.5.3. Response to Modification Request to Conduct Sampling between July and early September

The third of a five-part modification request for substantial modifications to the Growth Rate and Growth Rate Potential Modelling study, NMFS (Modification 5-1[c]; NMFS_pp9.8-33_ph4) and

USFWS (Modification 5-1; USFWS_pp9.8-19_ph5) request that AEA conduct the study between July and early September. The Services comment that sampling during this time period will reduce effort and allow time for age-0 juvenile salmon to move from spawning to summer rearing locations, and for most age1+ Chinook Salmon to emigrate from the Middle River. The Services also state that fish sampling must be conducted to provide a measure of relative abundance on each sampling date and at each sampling site.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

It is unclear how the monthly sampling modification requested is markedly different from what AEA implemented and how it would "reduce effort", especially in light of other requests (NMFS Modification 2-8, USFWS Modification 2-9) for sampling prior to June 1 and after October 1. AEA conducted River Productivity sampling in late June-early July, mid-August, and late September/early October in 2013 (ISR Part A, Table 4.4-1), with some assistance from FDA crews. In 2014, AEA conducted River Productivity sampling in mid-June, mid-August, and late September (Study 9.8 SIR, Table 4.4-1), and the River Productivity crew had a dedicated fish crew accompanying each sampling event at each site (Study 9.8 SIR, Section 4.7). The field efforts in 2013 and 2014 should have allowed time for age-0 juvenile salmon to move from spawning to summer rearing locations, and for most age1+ Chinook Salmon to emigrate from the Middle River. As the fish sampling efforts of 2013 and 2014 generally adhere to the proposed modification, the proposed modification's request is not necessary to meet Study 9.8 objectives.

2.6.4.2.5.4. Response to Modification Request to Cold Brand Target Fish Species

The fourth of a five-part modification request for substantial modifications to the Growth Rate and Growth Rate Potential Modelling study, NMFS (Modification 5-1[d]; NMFS_pp9.8-33_ph5) and USFWS (Modification 5-1; USFWS_pp9.8-19_ph6) request that AEA cold brand all Chinook and Coho Salmon captured on each sampling event with unique marks for sampling location, and individuals to determine average growth within a site between sampling events and individual growth for recaptured fish. The Services request that AEA measure at the fork length of all fish and the first 50 of each species at each sampling location and each sampling event should be weighed to the nearest 0.1 g (instead of to the nearest 1.0 g), and that additional invertebrate drift sampling should occur every other week throughout this time period.

For part "d" of this modification, the Services comment that not using subcutaneous dye marking affected the success of meeting study objectives, that they disagree with AEA's determination of growth from recaptured PIT tagged fish, and propose cold branding or use of colored tagging to mark fish (Comment NMFS_pp9.8-34_ph2 / USFWS_pp9.8-20_ph3).

To review, the FERC Study Plan Determination recommended dye marking of groups of fish smaller than 50 mm fork length (B-199). AEA did not dye mark juvenile salmon, and discussed this variance and their rationale behind in in Study 9.8 ISR Part A, Section 4.7.3.2.

Even with this variance, AEA was able to estimate growth using cohort analysis and that growth was corroborated by instantaneous growth rates from PIT-tagging fish. The effect on fish below PIT tagging size is discussed in ISR Part A, Section 4.7.3.2 and was considered not significant to the development of the growth model.

The Study Plan Determination did not mention cold branding or individual dye marking methods. Individual marks would be difficult to administer on large numbers of such small fish without long periods of handling. In the study referenced by the Services, Merz (2002) used individual marks to track the growth of much larger fish (92-442 mm fork length). While dye marking groups of fish may have provided some additional information about fish movement over time, it would not have allowed AEA to track growth rates of individuals, as indicated in the variance in the ISR (ISR Part A, Section 4.7.3.2). The data AEA obtained by using PIT tagged fish for instantaneous growth measurements was more accurate that could be achieved by batch marking.

A recent study successfully used visual implant elastomer (VIE) tags to mark small rainbows (<40 mm; Leblanc and Noakes 2012); however, the experiment only used 30 fish, and the test was performed in the laboratory for a total of 34 days. Conditions for the River Productivity study would require several hundred unique marking combinations, and retention would need to last over 90 days or longer.

Northwest Marine Technology's VIE tags, used in the study above, come in 6 fluorescent colors (plus 4 non-fluorescent colors), but they caution that certain colors are indistinguishable under blue or amber lighting. In order to make more than 864 individual marks using 6 colors, AEA would need to inject 3 varying tag color combinations in each fish in 3 of 4 different places. The VIE tags are implanted internally beneath transparent or translucent tissues; tags must be implanted correctly without breaking the skin, otherwise the tag is likely to fall out later. The level of handling required to implant 3 tags per fish would significantly increase the stress and mortality of the fish, and would at least double the crew time necessary to process each fish (including anesthetizing, measuring, weighing, lavage, scale sampling, and fin clipping). Also, the study above recommended tagging fish between the caudal fin rays, but AEA clipped part of the caudal fin for stable isotope sampling. This could easily increase the rate of VIE tag loss. If AEA recaptured a VIE-marked fish that had lost even 1 out of its 4 tags, crews would not be able to identify it.

For all these reasons, AEA concluded that individually marking small fish was impractical and unnecessary to meet the growth objectives of the River Productivity study. Therefore, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established “good cause” for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

2.6.4.2.5.5. Response to Modification Request Regarding Water Temperature and Turbidity Monitoring Locations

The last of a five-part modification request for substantial modifications to the Growth Rate and Growth Rate Potential Modelling study, NMFS (Modification 5-1[e]; NMFS_pp9.8-33_ph6) and

USFWS (Modification 5-1; USFWS_pp9.8-19_ph7) request that AEA coordinate this study with other studies to determine the number and locations of additional water temperature monitoring locations within each sampling site to provide accurate and representative values. The Services believe this modification will be best accomplished within a new study for Model Integration.

The Services also comment that water temperature and turbidity data reported by the River Productivity Study do not appear to be representative of the sampling sites, have no quality assurance procedures developed for those parameters, and provide no details on specific locations, so AEA should develop a quality assurance plan prior to the next year of study to ensure that accurate and representative water temperature and turbidity data are collected (NMFS_pp9.8-35_ph5 / USFWS_pp9.8-22_ph2).

To further clarify, water temperature loggers (TidBits) were deployed as described in the ISR Part A, Section 4.4 and the Study 9.8 SIR, Section 4.6.1.2. Loggers were attached to heavier rebar stakes that were tethered or anchored to shoreline structures, to prevent loss. Installation locations were placed in proximity to sampling locations within the site, and centralized as much as possible to record temperatures at the sampling locations. No loggers were buried in sediment, although some loggers were found dewatered upon site visits, due to dropping water levels in the late summer and fall periods.

Turbidity measurements were made using a portable turbidity meter in the field. These were spot measurements, often taken in conjunction with other sampling efforts (benthic and algal sampling) for a site and date during each sampling visit. Spot measurements of photosynthetic active radiation (PAR) were also taken in conjunction with benthic and algal sampling as well.

A complete and comprehensive coverage of temperatures and turbidity levels throughout each site area using multiple loggers or sensor and temperature modeling was not included as part of the Study Plan. Such efforts are already covered to a much greater degree by the Water Quality Study (5.5), the Groundwater Study (7.5), and to a lesser degree by the Instream Flow and Habitat Suitability Criteria Study (8.5), often within the same locations and overlapping in time periods. Additional coordination with these studies in future sampling seasons would provide accurate and representative water temperature and turbidity data that this modification is requesting. The Services have also suggested that their proposed new study for Model Integration will help to accomplish this modification. AEA's response to the Services' new study proposal can be found below in Section 3.4.

For these reasons, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

2.6.4.2.5.6. Response to Comments Regarding Growth Rates and Errors

NMFS (NMFS_pp9.8-34_ph3) and USFWS (USFWS_pp9.8-20_ph4) comment that since juvenile salmon were not marked, it is not clear if growth occurred within the habitat under investigation. Also, since abundance or relative abundance was not measured in each macrohabitat type, the Services believe it is not clear whether the changes in length over time are due to growth, the death of smaller fish, immigration of larger fish, or emigration of smaller fish, any of which would result in a change in the mean weight over time and would results in errors in growth measurements and all modelled parameters.

In response, AEA asserts that batch marking salmon would not have ensured that growth incurred within the habitat under investigation. As a matter of fact, because PIT tags allowed AEA to identify individual fish it is possible to test the hypothesis of fish moving out by looking at the proportion of recaptures within and outside of the study area. In fact, as explained in the Study 9.8 SIR (Section 6.3), "Both the PIT tag study (Study 9.6) and the stable isotope analysis (Section 5.4.2) provided evidence of relatively strong site fidelity by rearing juvenile salmon. Based on an analysis of provisional PIT tag data collected within the River Productivity study area, the vast majority (75/78) of juvenile Chinook and Coho salmon tagged during 2013 and 2014 and later recaptured were found in the same habitat in which they had previously been marked. This analysis did not include PIT tags recorded by fish swimming past fixed antennas, only events when the fish were recaptured and reweighed. The pattern was consistent whether days, weeks, or months elapsed between capture events. While these results do not necessarily indicate that fish remained in the same habitat between recaptures, they can be explained most parsimoniously by site fidelity. Further, the isotopic signatures of juvenile salmon were similar to those of other salmon captured in the same macrohabitat and to the basal nutrient sources within that habitat. Based on the isotopic turnover time of fin tissue, this suggests that most fish fed in the habitat where they were captured for at least 1-2 weeks prior to capture. Both the PIT tag study and the stable isotope analysis provided evidence of occasional fish movements among macrohabitats; however, fish did not appear to move frequently."

Size-selective mortality, immigration, and emigration, are indeed important caveats of any study using apparent growth rates to estimate growth. AEA considered these processes and discussed how they might have influenced the study conclusions. However, the range of mass-specific growth rates estimated with the apparent growth approach (tracking mean weights over time) was similar to the range of individual growth rates measured from individual PIT tagged fish (ISR SIR Section 5.4.1.3), suggesting that these processes did not bias the growth estimates. Further, evidence from both PIT tag recaptures (indicated above) and stable isotope signatures suggested that the sampled fish mostly exhibited site fidelity. This supports the overall findings of the growth rate analysis and bioenergetics modeling, as noted in the Discussion section of the Study 9.8 SIR (Sections 6.3 and 6.4).

2.6.4.2.5.7. Response to Modification Request to Shift Efforts of the Growth Rate Potential Study

NMFS (Modification 5-2; NMFS_pp9.8-36_ph2) and USFWS (Modification 5-2; USFWS_pp9.8-22_ph3) request that until a foraging model for age-0 Coho and Chinook salmon becomes available and applicable for all water velocities, the effort directed toward the Growth Rate Potential Study should be shifted to obtain more accurate field measures of juvenile salmon growth and water temperatures within all macrohabitats.

AEA has carried out this study for two years of sampling (2013 and 2014) in order to complete the trophic modeling objectives in accordance with FERC-approved Study Plan, with the stated variances in the ISR Part A, Section 4.7.3. AEA acknowledges, as was indicated early on in the Revised Study Plan (Section 9.8.4.5.1) and RP IP (Section 2.10.1), that drift foraging model parameters are currently only available for age-1 Coho salmon (and age-1 rainbow trout, which were too uncommon in the study area to generate useable model inputs). However, as discussed in the Study 9.8 SIR, Section 6.3, "the growth rate potential analysis illustrated potential relationships between measurable habitat characteristics and fish growth, based on previously published experiments. The growth rates predicted by the model were broadly similar to the growth rates observed in this study, and the model identified certain known hotspots for juvenile salmon, such as the Indian River tributary mouth (RP-141-1) as high-growth habitats."

AEA also noted in the SIR Discussion section that this application of the growth rate potential analysis revealed three key challenges for applying such models in large, heterogeneous, glacial rivers. First, the drift foraging submodel assumed that juvenile salmon fed solely on invertebrate drift. However, results from the two years of study of the stomach content and stable isotope analysis showed that salmon eggs were a very important diet item at some sites, and the growth rate potential analysis did not take this into account. Second, many salmon were captured in slow-velocity habitats, including upland sloughs, side sloughs, and slowly flowing tributary mouths. Salmon are likely switch to search feeding in these habitats; however, this behavior is not accounted for in the standard drift foraging model framework (Hughes and Dill 1990). Novel foraging models allowing fish to switch between drift and search feeding modes may be worth investigation for future applications in the Susitna Basin (Harvey and Railsback 2013). Finally, foraging dynamics in the shallow margins of mainstem rivers are poorly understood, and most existing drift-feeding research has focused instead on small streams. The growth rate potential model generally predicted that main channel and side channel habitats would not support positive salmon growth, due largely to their high velocities. However, this study provides evidence that juvenile salmon do utilize main channel and side channel habitats in the Susitna River for feeding and rearing, and in some cases achieved faster growth in these habitats than in cooler, slowly flowing sloughs. As currently formulated, growth rate potential models based on drift foraging are most likely to be useful in tributaries to the Susitna River.

Therefore, AEA concluded in the SIR that to fully account for the diversity of habitats and feeding modes utilized by juvenile Chinook and Coho salmon in the Susitna River, any future development of the growth models should consider incorporation of feeding mechanism in both sloughs and mainstem habitats. However, AEA has also shown that the two years of data collection and analysis have addressed the stated objective, to "develop a trophic model to estimate how environmental factors and food availability affect the growth rate potential of focal fish species under current and future conditions." While continuing development and application of the growth rate potential and bioenergetics would enhance scientific understanding, a continued and increasingly intensive sampling program for multiple years is not necessary to meet study objectives.

Therefore, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

2.6.4.2.5.8. Response to Modification Request Proposing Focus Areas for Stable Isotope Analysis

NMFS (Modification 5-3; NMFS_pp9.8-36_ph5) and USFWS (Modification 5-3; USFWS_pp9.8-22_ph6) request that the study be modified to include four Middle River Focus Areas including FA-141 (Indian River), FA-138 (Gold Creek), FA-128 (Skull Creek), and FA-104 (Whiskers Slough), and that if only two focus areas are studied, FA-128 and FA-104 be selected.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA is unclear as to what portion of the Trophic Modeling objective this proposed Study Plan modification refers to, the Growth Rate Potential component or the Stable Isotope Analysis component. Given the reference to "only two focus areas," it is assumed that this refers to the Stable Isotope Analysis, as the Study Plan required stated that AEA would collect stable isotope samples from two of the River Productivity Study stations (Study 9.8 RP IP, Section 2.11).

In the April 1 SPD (B-200, 201) FERC stated, "We recommend that AEA consult with NMFS and FWS when identifying the appropriate two focus areas for stable isotope sampling, where within the focus areas each type of stable isotope samples would be collected, and the number of adult salmon tissue samples to be collected."

In summary, the original study design, as described in the Implementation Plan, and addressed in the April 1 SPD, proposed two sampling stations for stable isotopes, collected at three sites within each station (a main channel and two off-channel). The field efforts that were implemented in 2013 and 2014 expanded the stable isotope sampling to a total of four out of the five River Productivity Study stations, spanning over 100 miles of river, from approximately PRM 184 down to PRM 81. The field efforts also increased from the original Study Plan, collecting stable isotope samples from sixteen sites: four main channel, four side channel, three tributary mouths, three upland sloughs, and two side sloughs. This expanded approach allowed the study to sample a wider variety of locations and macrohabitats, with varying levels of MDN inputs, which provides a clearer understanding of any food web differences that may exist between stations with high and low densities of spawning salmon. Thus, the addition of these stations better addressed the study objective of quantifying the relative influence of riverine, terrestrial, and marine energy sources to juvenile salmon and the broader river food web. The Services appear to want sampling to focus on locations with the highest salmon presence, which would only show sites with high marine derived nutrient (MDN) levels. The objective, though, was not to sample in locations with highest MDN, but to detect an MDN gradient along the river by comparing MDN levels spatially among macrohabitats and reaches, which would inevitably include locations with low MDN levels. The addition of FA-184 was intended to provide more support for detecting the lower end of the MDN gradient if there was one, as well as gaining information on the food web at the location nearest to the proposed dam, where impacts are likely to be the highest. Sampling in the Lower River at RP-81 (Montana Creek) was to provide support for detecting the higher end of the MDN gradient, in addition to gathering food web information at a site that would likely experience a minimized effect from the proposed dam, due to distance and the influences of the Chulitna and Talkeetna River.

Please refer AEA's comment response to FERC_ppA-5_ph5 in Section 2.6.4.1.2 above for additional detail regarding stable isotope site selection, consultation, and the study variance.

The proposed modification's request that AEA continue to conduct stable isotope sampling, and only at the listed Middle Susitna River focus areas, is not necessary to meet Study 9.8 objectives.

2.6.4.2.5.9. Response to Modification Request Regarding Stable Isotope Samples

NMFS (Modification 5-4; NMFS_pp9.8-36_ph7) and USFWS (Modification 5-4; USFWS_pp9.8-22_ph8) recommend that AEA obtain a sample 10 g of macroinvertebrates, and 5 g of algae, terrestrial invertebrates, and benthic organic matter from a composite sample collected from 10 or more locations, and that these samples should be distributed systematically (20 m between sampling locations) or selected randomly within each focus area macrohabitat.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA collected material for isotopic analysis throughout the site area, utilizing the Hess, Ponar, and drift nets. Often, beyond the sampling bounds of the Hess/Ponar sampling, a D-net sampler was used to collect at more locations throughout the macrohabitat site. Therefore, isotopic sampling components should be considered representative of each focus area macrohabitat, as the Services' comment implies. It is unclear, however, why the targeted sample weights are requested to be lower than those adopted by AEA for this study. River Productivity Study target amounts given in the Study 9.8 RP IP were 20 g wet mass, and 10 g of algae, 20 g for terrestrial invertebrates, and 10 g for benthic organic matter Study 9.8 RP IP, Section 2.11.1).

AEA did not measure wet weights of each sample collected in the field, as invertebrate/OM samples were collected together before knowing the final weights after sorting. This same approach was applied to algae samples that were filtered for Stable Isotope Analysis (SIA) in the lab. Sample mass was often limited by low benthic productivity, as was seen in main channel and side channel sites (see 2013 Initial River Productivity Results TM, Figures 3.1-1, 3.1-4, 3.1-7, 3.1-10, and 3.1-13). Therefore, sample sizes collected by AEA exceed the sized of recommended samples and are sufficient to meet the study objective.

2.6.4.2.5.10. Response to Comments Regarding Stable Isotope Analysis Efforts

NMFS (NMFS_pp9.8-36_ph9) and USFWS (USFWS_pp9.8-23_ph1) make a number of additional comments regarding the stable isotope analysis efforts conducted by AEA in 2013 and 2014. Their first comment was in regards to an apparent lack of detail in the River Productivity IP regarding the focus areas and locations within focus areas (specific macrohabitats), as well as the number of salmon carcasses, algae samples, invertebrate samples, and target fish species that would be sampled at each sampling location. The Services also expressed concern that the Indian

River focus area was near the upper extent of the spawning distribution of anadromous fish, and therefore, was less likely to contain delta C ratios indicating marine nutrient sources. The Services also reiterate that they recommended a number of additional potential sites within the Middle Susitna River that support salmon spawning and were more likely to contain the target fish species (Coho and Chinook salmon, and Rainbow Trout), and that FERC required consultation with NMFS and USFWS prior to selecting sampling locations, but the Services were not consulted and the study was conducted in the Indian River Focus area.

For clarification about the apparent lack of detail about focus areas and site locations, details regarding the exact locations of specific macrohabitats within each focus area were not possible to include in the River Productivity IP, since the FERC Study Determination (April 1, 2013) was released after the RP IP, and required AEA to sample at all macrohabitats available within each focus area /study station. See AEA's response in Section 2.6.4.2.2.1 above for a complete explanation in regards to sources for the macrohabitat typing used for site selections.

Details regarding the number of stable isotope sampling components were provided in Table 4.6-1 of in the Study 9.8 SIR and in Table 2.2-1 of the *2014 Field Season River Productivity Progress Report TM* filed on September 26, 2014. The total number of components samples collected was 1,557 exceeding the goal of 1,246 identified in the RP IP (Tables 2.11-1).

The Services' comments about their concerns about marine derived nutrient (MDN) levels in the Indian River Focus Area imply that the study objective was to sample in locations that are most likely to show high MDN levels. However, the objective was not to sample in locations with highest MDN, but to detect an MDN gradient along the river by comparing MDN levels spatially among macrohabitats and reaches, which would inevitably include locations with low MDN levels. The addition of FA-184 was intended to provide more support for detecting a gradient if there was one.

Marine sources of carbon and nitrogen upstream from Indian River could also include FA-141 main channel macrohabitats where spawning was unconfirmed due to turbidity. The presence of sockeye spawners, redds, and eggs was confirmed in the FA-141 upland slough in 2014 (recorded on field forms), as well as a number of salmon carcasses collected in RP-141-4. In addition, studies in the 1980s and more recently AEA's studies 9.6 and 9.7 have documented Chinook Salmon adults and/or juveniles, indicative of spawning in 7 Middle River tributaries upstream of Indian River, including Jack Long, Portage, Cheechako, Chinook, Devil, Fog and Tsusena creeks.

Finally, regarding consultation in selecting sites for stable isotope sampling, in the April 1 SPD (B-200, 201) FERC stated, "We recommend that AEA consult with NMFS and FWS when identifying the appropriate two focus areas for stable isotope sampling, where within the focus areas each type of stable isotope samples would be collected, and the number of adult salmon tissue samples to be collected."

AEA interpreted this recommendation for the selection of the two focus areas to be within those focus areas used for the river productivity study, not within all of the 10 focus areas established by Study 8.5, as the agencies submit. Establishment of entirely new sites solely for stable isotope sampling would have lacked the gathering of supporting information from the other study objectives (e.g., drift and fish diets). AEA expanded their collections to three of the four focus areas used in the River Productivity study in the Middle River segment, as well as its Lower River station, covering four of the five focus areas used for the River Productivity study, and expanding the number of required sites from six to sixteen, exceeding FERC's recommendation, as detailed in the ISR, Part A, Section 4.7.3.1. This effort was repeated in 2014, in order to complete the study objective due to its grant funding status with the University of Alaska-Fairbanks. This expanded approach allowed the study to sample a wider variety of locations and macrohabitats, with varying levels of MDN inputs, which provides a clearer understanding of any food web differences that may exist between stations with high and low densities of spawning salmon. Thus, the addition of these stations better addressed the study objective of quantifying the relative influence of riverine, terrestrial, and marine energy sources to juvenile salmon and the broader river food web. Please refer to the comment response to FERC_ppA-5_ph5 above for additional detail regarding stable isotope site selection, consultation, and the study variance.

2.6.4.2.5.11. Response to Comments Regarding Stable Isotope Sampling Information

NMFS (NMFS_pp9.8-37_ph3) and USFWS (USFWS_pp9.8-23_ph3) comment that the ISR does not state the number of target fish species that were sampled, or where they were collected, nor does it state the sampling locations and numbers of samples for any of the insects, algae, or organic matter. They also state that only 260 samples were collected from a potential 1,920 in 2013, and that this level of sampling appears inadequate to meet stated objectives and determinations.

For clarification, all information regarding the stable isotope samples, including the Mean $\delta^{13}C$ and $\delta^{15}N \pm SD$ values and the number of samples for all component types (fish, insects, algae, organic matter) is provided in the "*2013 Initial River Productivity Results Technical Memorandum*, *Appendix A* Tables A3.4-1 through A3.4-12," for 2013, and the "*Study 9.8 SIR*, *Appendix A* Tables A5.4-1 through A5.4-12" for 2014.

The Services mischaracterize sampling and analysis sample sizes for this study component. They state that only 260 samples were collected from a potential 1,920 in 2013. In fact, 252 fish samples were collected in 2013 and 1,155 total samples were collected, with fish being only one of many components of the Stable Isotope Analysis. In the "*2013 Initial River Productivity Results Technical Memorandum*," Table 3.4-3 shows that 1,155 samples were analyzed for stable isotopes in 2013, of which 231 were target species fish, and 21 were salmon carcasses. In 2014, Table 4.6-1 of in the *Study 9.8 SIR* shows that 1,557 samples were analyzed for stable isotopes, of which 445 were target species fish, and 9 were salmon carcasses.

2.6.4.2.6. Objective 7

Objective 7: Characterize the invertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component).

2.6.4.2.6.1. Response to Modification Request Regarding the Fish Diet Analysis

NMFS (Modification 7-1; NMFS_pp9.8-38_ph3) and USFWS (Modification 7-1; USFWS_pp9.8-24_ph3) request that the diets from a minimum of 8 fish, for each species and life stage, with food in their stomachs should be analyzed according to the approved Study Plan.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification nor have they demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA agrees that the fish stomach content sampling during 2013 was indeed insufficient during some sampling events, which is discussed in the ISR Part A, Sections 4.9 and 6. However, sample sizes were improved substantially in 2014, and overall the study collected and analyzed sufficient stomach content data to meet the study objective. It is important to note that the study was not designed to comprehensively quantify the diet composition of each fish species during each individual sampling event. Instead, the study design treated sampling events as replicates to test for large-scale dietary patterns across seasons, macrohabitat types, and focus areas. Like all field studies, this study faced a trade-off between maximizing sample size within each sampling event and maximizing the seasonal and spatial coverage of sampling. The overall number of diet samples collected in the study (> 600 non-empty fish stomach content samples containing > 42,000 individual prey items) were fairly large for a diet study combining stomach contents with stable isotope analysis, especially considering the large and remote sampling area.

Additionally, the efforts of this study have dramatically improved the knowledge base on juvenile salmon diets in the Middle Susitna River beyond that supplied by the efforts in the 1980s. For the Middle Susitna River in the 1980s, Hansen and Richards (1985) reported their fish diet analysis results based on collected stomach contents from just 72 juvenile Chinook salmon total, pooled across 3 sampling trips (June, July, and August) at four different sites (Slough 9, Side Channel 10, Upper Side Channels 11 and 21), and 5 fish collected in drift nets (Hansen and Richards 1985; Appendix Table E-1).

2.6.4.2.6.2. Response to Comment Regarding the Adequacy of Sample Size for Fish Stomachs

NMFS (NMFS_pp9.8-38_ph4) commented that the AEA (*2014 Fish Diet Analyses Technical Memorandum*) report does not demonstrate that 8 stomachs adequately represent diet composition for each species by site and sample period for the 2013 data, nor does the literature cited support this either.

AEA must point out that the objectives of the study did not include precisely estimating the "diet composition for each species by site and sample period". Instead, the study was designed to quantify broad seasonal and spatial patterns in aquatic, terrestrial, and marine-derived energy flow to salmonids. A manuscript based on the River Productivity study examining this question was recently peer reviewed and accepted by a top, peer-reviewed fisheries science journal (Rine et al. In press, *Canadian Journal of Fisheries and Aquatic Science* [CJFAS], http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2015-0555). Sample size was apparently sufficient to address the objective according to the accepted standards of publication by the scientific community at large and, furthermore, through publication in CJFAS, the study has demonstrably "provided significant new knowledge and understanding of fish and aquatic sciences."

The *2014 Fish Diet Sample Size Sufficiency Analysis Technical Memorandum* was developed in response to a suggestion from the Technical Working Group. This analysis was intended to provide useful supplementary information on the sufficiency of sample sizes, but should not be considered as the primary justification. As noted above, the study design balanced a tradeoff between the seasonal and spatial coverage of sampling and the sample size within each sampling event. The technical memorandum did show that increasing sample sizes from ≈6-8 produced diminishing returns in terms of additional prey taxa identified during each sampling event.

The two literature sources cited in the TM (Beauchamp et al. 2007, Vinson and Budy 2011) address the general question of how increasing sample size increases precision in estimates of the diet composition of salmonids. In other words, at what sample size do additional samples begin to produce diminishing returns in precision? Beauchamp et al. (2007) state *"In diets of lake trout from several western lakes, mean proportions of the major prey types tended to stabilize at sample sizes of 7–15 nonempty stomachs per season x size-class cell."* Vinson and Budy (2011) state, *"Based on our bootstrapping exercise, precision in* $\delta^{15}N$ *or* $\delta^{13}C$ *increased dramatically up to a sample size of n = 10, with considerably less increase in precision as sample size increased further… For stomach content analyses, mean diet overlap values among all three species plateaued around n = 10, and variation around mean values (95 percent CI) was consistently less (wider 95 percent CI) for sample sizes less than n = 25 for all comparisons."* Neither of these studies directly addressed the specific question of what sample sizes were optimal for the River Productivity study, but AEA used these sources as rough guidelines. AEA selected a sample size target of n = 8, on the low end of the ranges provided in these sources, because stomach content sampling was used in combination with stable isotopes, and so the seasonal and spatial coverage of the study could be maximized in accordance with the study objectives. Given the realities of limited resources and logistical constraints, collecting more samples at each site would have required reducing the spatial coverage of the study.

2.6.4.2.6.3. Response to Comment Regarding the Fish Diet Sample Size Sufficiency Analysis Methods

NMFS (NMFS_pp9.8-38_ph5) also makes the comment that the diminishing number of stomachs as sample size increases from one to eight creates an artificial decrease in the potential to observe new taxa, most likely artificially creating an asymptote well before it would occur in an adequate sample size, and that this should be rectified before further analysis or data collection occurs.

AEA disagrees with this comment. The analysis conducted by AEA in the *2014 Fish Diet Sample Size Sufficiency Analysis Technical Memorandum* was not biased in the way described. The mean increase in prey types per sample (red lines in Figure 1) were calculated in such a way that the means at a given sample size were not affected by sampling events that did not achieve that sample size. For example, in 2013, 10 sampling events yielded ≥ 6 coho salmon diet samples. On average across these 10 events, adding the sixth diet sample (ordered randomly) increased the number of prey types detected at that sampling event by 0.6. The denominator of this average did not include zeroes representing the sampling events with fewer than six samples, which if included would have biased the average downward. The sampling events with fewer than six samples were simply excluded from the calculation.

2.6.4.2.6.4. Response to Comments Regarding Fish Diet Sample Size Sufficiency Analysis

NMFS (NMFS_pp9.8-38_ph6) makes a number of recommendations regarding the analysis of fish diet sample size sufficiency, including that AEA pool all sites to see if the same pattern occurs or if a plateau occurs beyond the 8 samples suggested in their report. NMFS also recommends assessing diet data collected in earlier studies to help determine adequate sample size for each species, site and sample period. NMFS further asserts that 2013 results do not adequately represent diets of target fish species and that the goals of the study were not met for that period.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification or demonstrated the plan has not been implemented as provided by the approved Study Plan or under anomalous conditions.

AEA believes that if all sampling events were pooled, this would indeed probably result in a plateau occurring at > 8 samples. However, this would be expected since the pooled sampling events would include a greater diversity of habitat types, seasons, and focus areas, and thus a greater diversity of available prey items. This would not address the question of whether the study adequately achieved the objectives. Again, the study objectives addressed broad spatial and temporal patterns of energy flow, not a comprehensive diet analysis at every site during every season. AEA agrees that sample sizes were insufficient for some sampling events in 2013; however, AEA disagrees that the goals of the study were not met, given the additional increased effort and sample numbers collected in 2014.

2.6.4.2.7. Response to Modification Request to Expand Study to the Entire Lower River

NMFS (Modification G-1; NMFS_pp9.8-38_ph7) and USFWS (Modification 7-2; USFWS_pp9.8-24_ph5) request that AEA expand the geographic scope of the River Productivity study to the entire Lower River.

In response, AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS and USFWS have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

The River Productivity Study currently has a Lower Susitna River study station established at PRM 81, around the mouth of Montana Creek. This station was placed as part of the overall study design to establish study stations for evaluating and monitoring the benthic communities along the longitudinal gradient of downstream effects from the proposed dam site, recognizing that a dam and its impoundment disrupts the river continuum, but that the river system has a tendency to reset itself towards natural or unregulated conditions as the distance downstream from the dam or river regulation increases (Stanford and Ward 2001). This concept is called the serial discontinuity concept (SDC) (Ward and Stanford, 1983, 1995; Stanford et al. 1996; Stanford and Ward 2001), and it predicts that the physical and ecological changes caused by river regulation "will ameliorate downstream as a natural consequence of the biophysical energetics of rivers." The rate and distance (termed the "discontinuity distance" in Stanford and Ward 2001) at which this system resetting can occur is dependent upon a number of factors: 1) the limnological attributes of the reservoir (depth, volume, retention time, trophic state); 2) dam operations (reduced flow, short-term flow fluctuations, flow constancy) and level-releases (hypolimnetic, surface, selective); and 3) the influence of downstream tributaries (Stanford et al. 1996). A review of the SDC by Ellis and Jones (2013) further describes that there are likely two recovery SDC gradients that exist in regulated rivers: a shorter, resource subsidy gradient recovering with 1-4 kilometers downstream of an impoundment, and a longer, thermal gradient extending much farther downstream. Stanford and Ward (2001) provide a short list of examples of discontinuity distances for several regulated rivers in Montana, Idaho, and Colorado, as well as some larger rivers in Europe and Africa, with reaches ranging from 46 – 210 miles, and reset distances ranging from 18 – 93 miles. Large and unregulated tributaries have been shown to substantially mediate the reset distance (Stanford and Hauer 1992). Given such distances, it is highly likely that any Project effects on the benthic communities in the Lower River would be ameliorated by the multiple tributaries over 80 miles of river and the joining of the Chulitna and Talkeetna rivers.

Therefore, the placement of the Montana Creek station at PRM-81 extends the distance from the dam that the study covers, and allows AEA to evaluate any potential project effects that may occur in the Lower River, factoring in any ameliorating influence the Chulitna and Talkeetna rivers may have on the Lower Susitna River benthic macroinvertebrate and algal communities. Preliminary results of the most recent open-water flow routing model (OWFRM), version 2.8 and the ILF-1 scenario (see *ISR Study 8.5, SIR Appendix B: Open-water Hydrology Data Collection and Open-water Flow Routing Model [Version 2.8]*) for the lower reach from the Sunshine gage to PRM 29.9 predicts that the post-Project average daily stage will be 1.7 feet or less than the pre-project average daily stage, with larger changes in wet years, and mostly in July and August months. In regards to the range of daily stage, i.e., the difference between the maximum daily stage and the minimum daily stage, for the lower reach from the Sunshine gage to PRM 29.9, the OWFRM v.2.8, under the ILF-1 scenario predicts that it will be essentially unchanged between the pre- and post-Project conditions, with the range differing by 0.16 feet or less.

For example, modeling at the Sunshine gage (PRM 88) in summer months (June through September) shows the average daily stage ranges from 0.1 feet higher to 1.0 feet lower post-Project in a dry year (1976), 0.27 to 1.4 feet lower post-Project in an average year (1985), and 0.1 feet higher to 1.7 feet lower post-Project in a wet year (1981). Downstream, at PRM 64.6, the changes are reduced; in summer months (June through September), the average daily stage ranges from 0.05 feet higher to 0.45 feet lower post-Project in a dry year (1976), 0.08 to 0.49 feet lower post-Project in an average year (1985), and 0.07 feet higher to 0.66 feet lower post-Project in a wet year (1981). In comparison, the OWFRM version 2.8 ILF-1 scenario run at PRM 140 (Gold Creek) predicts much larger changes upstream in the Middle River. For the June through September period, the average daily stage at PRM 140 ranges from 0.32 feet higher to 1.8 feet lower post-Project in a dry year (1976), 0.54 to 2.6 feet lower post-Project in an average year (1985), and 0.08 feet higher to 2.9 feet lower post-Project in a wet year (1981). It is important to note that the range of modeled stage changes due to project effects in the Lower Susitna River is reduced when compared to those at Gold Creek (PRM 140) further upstream, because of the contributions of flow and influence of the Chulitna and Talkeetna River, thus supporting the SDC. Given these changes, the establishment of the Montana Creek station would be able to successfully evaluate any impacts such a stage change would have at any of the four macrohabitat sites within the station. The Services do not indicate why they would require additional sites to make such an assessment.

As results from the 2013 sampling season have shown, the highest densities of benthic macroinvertebrates and highest algal levels have occurred in those macrohabitats with clearer waters. The project is projected to intercept the glacial silt behind the dam, producing outflow with less turbid water, which will benefit benthic communities downstream. However, any anticipated reductions in turbidity in the Susitna River due to project effects would likely be undetectable below the Three Rivers Confluence, due to the high levels of glacial silt supplied by the Chulitna and Talkeetna.

In terms of temperature changes due to project operations, water quality models show that while temperature is 2 – 3°C cooler in summer immediately below the proposed dam site, the difference in temperatures is negligible at PRM 87.8 in the Lower River (Figures A-3 and A-5 in Water Quality Modeling Study 5.6, 2014 Study Implementation Report, Appendix A). Conversely, the model also shows that winter temperatures will be warmer immediately below the dam, but this effect is nearly negated by PRM 131. These model results lend additional support to the application of the SDC, further suggesting that project effects would be ameliorated by the multiple tributaries over the 80 – 100 mile distance.

The proposed modification's request that AEA expand the River Productivity Study to the entire Lower River is excessive and unnecessary, given that the current establishment of a study station at PRM 81 was done so to monitor any possible project effects, factoring in the ameliorating influences of the Chulitna and Talkeetna rivers. The addition of an entire Lower River study with "an equivalent level of detail in the River Productivity study in Middle and Upper reaches" suggests that AEA would be expected to duplicate the efforts seen in 2013 in the Middle River. If done in addition to another year of sampling at the 4 Middle River stations and 17 sites, this request could effectively double the cost of the River Productivity Study, (estimated at approximately $1,400,000) and would be a study of such size that it would likely need to be a separate study, much like that seen for Studies 9.5 and 9.6. A Lower River study would require its own crews, equipment, and logistical needs that would likely compete with Middle River efforts. The number of samples would also double, and would likely strain the processing capacities of the taxonomic laboratory, resulting in a delay in receiving final results by 1 year or more. An option to utilize additional laboratories introduces additional complications with QA/QC errors in how samples are processed, raising additional questions as to the comparability of results from different laboratories.

Table 2.6.4-2. Length-weight equations used to estimate the mass of prey items in the stomach contents of sampled fish, along with explanations for equations as to why they are applicable to the study, and literature sources.

The table provides the parameters a and b for the following formula: Mass = a * Length ^ b, where mass is dry mass (DM) in mg (invertebrates) or wet mass (WM) in mg (salmon eggs) and length is total body length in mm (invertebrates) or diameter in mm (eggs).

Prey Type	Model	a	b	Source for L-M	Rationale	Prey Category
COLLEMBOLA ADULT	L-DM	0.0056	2.809	Gruner 2003	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
COLLEMBOLA LARVAE	L-DM	0.0056	2.809	Gruner 2003	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
SMINTHURIDAE ADULT	L-DM	0.0056	2.809	Gruner 2003	Taxon-specific L-DM relationship	InvertAquatic
COLEOPTERA ADULT	L-DM	0.04	2.64	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
COLEOPTERA LARVAE	L-DM	0.0077	2.91	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
DYTISCIDAE ADULT	L-DM	0.0618	2.502	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
DYTISCIDAE LARVAE	L-DM	0.0077	2.91	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
HALIPLIDAE ADULT	L-DM	0.0077	2.91	Benke et al. 1999	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
STAPHYLINIDAE ADULT	L-DM	0.001	4.026	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
DIPTERA ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_UnkOrigin
DIPTERA LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
DIPTERA PUPAE [1]	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
AGROMYZIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
ANTHOMYIIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
ASILIDAE ADULT	L-DM	0.38	1.5	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CECIDOMYIIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CERATAPOGONIDAE LARVAE	L-DM	0.0025	2.469	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
CERATAPOGONIDAE PUPAE [1]	L-DM	0.0025	2.469	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
CERATAPOGONIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
CHIRONOMIDAE LARVAE	L-DM	0.0018	2.617	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
CHIRONOMIDAE PUPAE	L-DM	0.004571	2.53	Methot et al. 2012	Taxon-specific L-DM relationship	InvertAquatic
CHIRONOMIDAE ADULT [2]	L-DM	0.1	1.57	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
CULICIDAE LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
CULICIDAE ADULT [2]	L-DM	0.1	1.57	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
DIXIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
DIXIDAE LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
DIXIDAE PUPAE [1]	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
DOLICHOPODIDAE LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
DROSOPHILIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
EMPIDIDAE LARVAE	L-DM	0.0054	2.546	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
EMPIDIDAE PUPAE [1]	L-DM	0.0054	2.546	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
EMPIDIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
EPHYDRIDAE LARVAE	L-DM	0.005401925	2.43	Smock 1980	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
FANNIIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
HELEOMYZIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
LONCHOPTERIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin

Prey Type	Model	a	b	Source for L-M	Rationale	Prey Category
MUSCIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
MYCETOPHILIDAE ADULT [2]	L-DM	0.1	1.57	Sample et al. 1993	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
PIPUNCULIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
PSYCHODIDAE LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
SCATHOPHAGIDAE LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
SIMULIIDAE LARVAE	L-DM	0.002	3.011	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
SIMULIIDAE PUPAE [1]	L-DM	0.002	3.011	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
SIMULIIDAE ADULT [2]	L-DM	0.1	1.57	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
STRATIOMYIDAE LARVAE	L-DM	0.005401925	2.43	Smock 1980	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
SYRPHIDAE ADULT	L-DM	0.04	2.26	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
SYRPHIDAE LARVAE	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
TABANIDAE LARVAE	L-DM	0.005	2.591	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
TANYDERIDAE PUPAE [1]	L-DM	0.0025	2.692	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
TIPULIDAE LARVAE	L-DM	0.0029	2.681	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
TIPULIDAE PUPAE [1]	L-DM	0.0029	2.681	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
TIPULIDAE ADULT [2]	L-DM	0.1	1.57	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
EPHEMEROPTERA ADULT	L-DM	0.014	2.49	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
EPHEMEROPTERA LARVAE	L-DM	0.0071	2.832	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
AMELETIDAE LARVAE	L-DM	0.0077	2.588	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
BAETIDAE LARVAE	L-DM	0.0053	2.875	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
BAETIDAE ADULT	L-DM	0.014	2.49	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
EPHEMERELLIDAE LARVAE	L-DM	0.0103	2.676	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
HEPTAGENIIDAE LARVAE	L-DM	0.0108	2.754	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
HEPTAGENIIDAE ADULT	L-DM	0.014	2.49	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
HEMIPTERA ADULT	L-DM	0.0421	2.311	Johnson and Strong 2000	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
HEMIPTERA LARVAE	L-DM	0.049886742	2.27	Rogers et al. 1977	Taxon-specific L-DM relationship	InvertUnknown
ANTHOCORIDAE ADULT	L-DM	0.0421	2.311	Johnson and Strong 2000	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
APHIDIDAE LARVAE	L-DM	0.036589279	2.696	Rogers et al. 1977	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
APHIDIDAE ADULT	L-DM	0.005	3.33	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CERCOPIDAE ADULT	L-DM	0.0421	2.311	Johnson and Strong 2000	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CICADELLIDAE LARVAE	L-DM	0.0067	3.141	Gruner 2003	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CICADELLIDAE ADULT	L-DM	0.004	3.373	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
COCCOIDEA LARVAE	L-DM	0.049886742	2.27	Rogers et al. 1977	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CORIXIDAE ADULT	L-DM	0.0031	2.904	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
GERRIDAE ADULT	L-DM	0.015	2.596	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
MESOVELLIDAE ADULT	L-DM	0.0421	2.311	Johnson and Strong 2000	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
PENTATOMIDAE ADULT	L-DM	0.0421	2.311	Johnson and Strong 2000	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin

Prey Type	Model	a	b	Source for L-M	Rationale	Prey Category
PSYLLIDAE ADULT	L-DM	0.0421	2.311	Johnson and Strong 2000	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
PSYLLIDAE LARVAE	L-DM	0.049886742	2.27	Rogers et al. 1977	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
HYMENOPTERA ADULT	L-DM	0.56	1.56	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
HYMENOPTERA LARVAE [3]	L-DM	0.56	1.56	Sabo et al. 2002	L-DM relationship for taxon of similar body shape	InvertTerrestrial_TerOrigin
BRACONIDAE ADULT	L-DM	0.56	1.56	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
FORMICIDAE ADULT	L-DM	0.027	2.666	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
ICHNEUMONIDAE ADULT	L-DM	0.56	1.56	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
PTEROMALIDAE ADULT	L-DM	0.56	1.56	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
LEPIDOPTERA ADULT	L-DM	0.012	2.69	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
LEPIDOPTERA LARVAE	L-DM	0.002715	2.959	Sample et al. 1993	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
PYRALIDAE ADULT	L-DM	0.012	2.695	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
NEUROPTERA ADULT	L-DM	0.0113	2.57	Sample et al. 1993	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
NEUROPTERA LARVAE [4]	L-DM	0.0113	2.57	Sample et al. 1993	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
PLECOPTERA ADULT	L-DM	0.26	1.69	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
PLECOPTERA LARVAE	L-DM	0.0094	2.754	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
CHLOROPERLIDAE ADULT	L-DM	0.005	2.732	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
CHLOROPERLIDAE LARVAE	L-DM	0.0065	2.724	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
LEUTRICIDAE ADULT	L-DM	0.006036083	2.46	Baumgartner and Rotthaupt 2003	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
LEUTRICIDAE LARVAE	L-DM	0.0028	2.719	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
NEMOURIDAE LARVAE	L-DM	0.0056	2.762	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
PERLODIDAE LARVAE	L-DM	0.0196	2.742	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
PERLODIDAE ADULT	L-DM	0.26	1.69	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
PTERONARYCIDAE LARVAE	L-DM	0.0324	2.573	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
PSOCOPTERA ADULT	L-DM	0.0136	3.115	Gruner 2003	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
THYSANOPTERA ADULT [5]	L-DM	0.0136	3.115	Gruner 2003	L-DM relationship for taxon of similar body shape	InvertTerrestrial_TerOrigin
TRICHOPTERA ADULT	L-DM	0.01	2.9	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
TRICHOPTERA LARVAE	L-DM	0.0056	2.839	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
TRICHOPTERA PUPAE [1]	L-DM	0.0056	2.839	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
BRACHYCENTRIDAE LARVAE	L-DM	0.0083	2.818	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
BRACHYCENTRIDAE ADULT	L-DM	0.01	2.9	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
GLOSSOSTOMATIDAE LARVAE	L-DM	0.0082	2.958	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
HYDROPSYCHIDAE LARVAE	L-DM	0.0046	2.926	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
HYDROPTILIDAE LARVAE	L-DM	0.012155178	2.57	Baumgartner and Rotthaupt 2003	Taxon-specific L-DM relationship	InvertAquatic
LIMNEPHILIDAE LARVAE	L-DM	0.004	2.933	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
LIMNEPHILIDAE PUPAE [1]	L-DM	0.004	2.933	Benke et al. 1999	Taxon-specific L-DM relationship	InvertAquatic
LIMNEPHILIDAE ADULT	L-DM	0.01	2.9	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_AqOrigin
RHYACOPHILIDAE LARVAE	L-DM	0.010520811	2.287	Wipfli unpublished	Taxon-specific L-DM relationship	InvertAquatic

Prey Type	Model	a	b	Source for L-M	Rationale	Prey Category
ACARI ADULT	L-DM	0.132655465	1.66	Baumgartner and Rotthaupt 2003	Taxon-specific L-DM relationship	InvertAquatic
ARANEAE ADULT	L-DM	0.05	2.74	Sabo et al. 2002	Taxon-specific L-DM relationship	InvertTerrestrial_TerOrigin
CLADOCERAN ADULT [6]	L-DM	0.005	2.84	Dumont et al. 1975	Taxon-specific L-DM relationship	InvertAquatic
COPEPOD ADULT	L-DM	0.0055	2.46	Dumont et al. 1975	Taxon-specific L-DM relationship	InvertAquatic
OSTRACODA ADULT [7]	L-DM	0.0055	2.46	Dumont et al. 1975	L-DM relationship for taxon of similar body shape	InvertAquatic
CHILOPODA ADULT [8]	L-DM	0.037320967	2.1006	Ganihar 1997	L-DM relationship for taxon of similar body shape	InvertTerrestrial_TerOrigin
NEMATODA ADULT [9]	L-DM	0.005888	1.54	Methot et al. 2012	L-DM relationship for taxon of similar body shape	InvertUnknown
OLIGOCHAETA ADULT	L-DM	0.005888	1.54	Methot et al. 2012	Taxon-specific L-DM relationship	InvertAquatic
GASTROPODA ADULT	L-DM	0.075858	2.9	Methot et al. 2012	Taxon-specific L-DM relationship	InvertAquatic
SALMON EGGS *	L-WM	0.69	2.889	Fleming and Ng 1987	Taxon-specific L-WM relationship and % dry matter estimate	SalmonEggs

Notes:

1 No pupae reference, used larvae as surrogate
2 Sub-order= Nematocera
3 No reference found, used hymenoptera adult as surrogate
4 No reference found, using adult as surrogate
5 No reference found, used Psocoptera as surrogate
6 Value is for Daphnia spp.
7 No reference found, used copepod as surrogate
8 No reference found, used Scutigeromorpha as surrogate
9 No reference found, used Oligochaeta as surrogate
* Percent Dry Matter = 0.4 (Ashton et al. 1993)

Table 2.6.4-3. Distances measured between Hess samples collected in 2013 for the River Productivity Study using GPS coordinates in ArcGIS.

QC5 Site Key	Macro-habitat	Distance 1 (m)	Distance 2 (m)	Distance 3 (m)	Distance 4 (m)	Average Distance Between	Hess Site Length (m)	Distance Measure Order
RP-184-1-Spring	TM	27.5	21.9	21.8	24.3	23.9	95.5	1-2-3-4-5
RP-184-1-Summer	TM	5.3	6.7	4.7	9.8	6.6	26.5	1-2-3-4-5
RP-184-1-Fall	TM	9.0	16.3	8.2	8.9	10.6	42.4	1-2-3-5-4
RP-184-2-Spring	SC	11.0	15.9	11.1	14.5	13.2	52.6	2-3-4-5-1
RP-184-2-Summer	SC	4.5	7.6	11.2	9.3	8.1	32.6	5-4-3-2-1
RP-184-2-Fall	SC	8.8	11.2	11.6	9.1	10.2	40.7	1-2-3-4-5
RP-184-3-Spring	MC	12.2	10.7	8.8	7.6	9.8	39.3	1-2-4-3-5
RP-184-3-Summer	MC	7.5	5.4	4.5	10.2	6.9	27.6	3-2-1-4-5
RP-184-3-Fall	MC	9.2	7.5	10.7	13.0	10.1	40.3	1-2-3-4-5
RP-173-1-Spring	TM	98.6	13.4		12.8	41.6	124.8	5-1-2-3-4
RP-173-1-Summer	TM	48.2	6.9	16.3	9.8	20.3	81.1	5-4-1-2-3
RP-173-1-Fall	TM	66.7	7.2	6.5	9.6	22.5	90.0	5-4-3-2-1
RP-173-2-Spring	MC	6.6	15.0	16.0	10.8	12.1	48.4	1-2-3-4-5
RP-173-2-Summer	MC	6.7	9.0	12.5	11.0	9.8	39.2	1-2-3-4-5
RP-173-2-Fall	MC	1.5	14.9	15.2	12.6	11.0	44.1	2-1-3-4-5
RP-173-3-Spring	SC	10.5	30.4	9.6	10.5	15.3	61.1	1-2-3-4-5
RP-173-3-Summer	SC	14.7	22.4	14.4	28.1	19.9	79.6	1-2-3-4-5
RP-173-3-Fall	SC	27.1	7.0	9.8	26.6	17.6	70.4	1-2-3-4-5
RP-173-4-Spring	SS	27.6	31.9	12.3	33.5	26.3	105.3	1-2-3-4-5
RP-173-4-Summer	SS	14.4	21.9	39.0	15.2	22.6	90.4	1-2-3-4-5
RP-173-4-Fall	SS	10.5				10.5	10.5	1-2
RP-141-1-Spring	TM	26.7	21.2	17.9	12.2	19.5	77.9	1-2-3-4-5
RP-141-1-Summer	TM	16.9	12.2	9.6	14.0	13.2	52.6	1-2-3-4-5
RP-141-1-Fall	TM	18.9	19.2	16.6	14.4	17.3	69.2	1-2-3-4-5
RP-141-2-Spring	SC	17.0	21.2	12.8	19.3	17.6	70.2	5-4-3-2-1
RP-141-2-Summer	SC	22.8	15.5	9.7	26.4	18.6	74.3	5-4-2-1-3
RP-141-2-Fall	SC	Ponar						
RP-141-3-Spring	MC	9.1	21.3	17.0	11.2	14.6	58.6	1-2-3-4-5
RP-141-3-Summer	MC	7.4	10.1	5.3	24.1	11.7	46.9	5-4-3-2-1
RP-141-3-Fall	MC	9.1	9.6	8.0	11.5	9.5	38.1	1-2-3-4-5
RP-141-4-Spring	US	12.0	2.3	8.2	5.8	7.1	28.3	1-3-2-4-5
RP-141-4-Summer	US	26.4	15.7	9.1		17.1	51.3	1-2-3-4
RP-141-4-Fall	US	28.1	15.4			21.7	43.5	1-2-3
RP-104-1-Spring	SS	21.3	10.8	21.3	29.7	20.8	83.2	5-4-2-1-3
RP-104-1-Summer	TM	1.2	10.0	4.7	6.8	5.7	22.7	1-2-3-4-5
RP-104-1-Fall	TM	3.4	4.5	3.4	7.0	4.6	18.3	1-2-3-4-5
RP-104-2-DS-Spring	SS	11.9				11.9	11.9	1-2
RP-104-2-DS-Summer	SS							1
RP-104-2-DS-Fall	SS	Ponar						
RP-104-2-MS-Summer	SS	21.2				21.2	21.2	2-3
RP-104-2-MS-Fall	SS	14.2				14.2	14.2	1-2
RP-104-2-US-Spring	SS	15.5	15.9			15.7	31.4	3-4-5
RP-104-2-US-Summer	SS	55.5				55.5	55.5	4-5
RP-104-2-US-Fall	SS	Ponar						
RP-104-3-Spring	MC	20.5	16.9	25.1	31.8	23.6	94.3	1-2-3-4-5
RP-104-3-Summer	MC	26.2	24.8	20.2	37.3	27.1	108.6	1-2-3-4-5

Table 2.6.4-3. Distances measured between Hess samples collected in 2013 for the River Productivity Study using GPS coordinates in ArcGIS.

QC5 Site Key	Macro-habitat	Distance 1 (m)	Distance 2 (m)	Distance 3 (m)	Distance 4 (m)	Average Distance Between	Hess Site Length (m)	Distance Measure Order
RP-104-3-Fall	MC	9.5	7.8	8.4	7.2	8.2	32.9	1-2-3-4-5
RP-104-4-Spring	US	Ponar						
RP-104-4-Summer	US	Ponar						
RP-104-4-Fall	US	Ponar						
RP-104-5-Spring	SC	13.5	51.9	54.9	22.6	35.7	143.0	2-1-3-4-5
RP-104-5-Summer	SC	38.2	33.0	93.4	42.8	51.9	207.4	3-1-2-4-5
RP-104-5-Fall	SC	41.3	60.3	35.9	22.4	40.0	160.0	1-2-3-4-5
RP-81-1-Spring	US	Ponar						
RP-81-1-Summer	US	Ponar						
RP-81-1-Fall	US	8.1	7.4	19.3	17.8	13.2	52.7	1-2-3-4-5
RP-81-2-Spring	TM	17.7	28.7	50.0	41.7	34.5	138.2	1-2-3-5-4
RP-81-2-Summer	TM	25.4	24.4	12.2	21.9	21.0	83.9	1-5-4-3-2
RP-81-2-Fall	TM	8.4	15.6	11.5	9.4	11.2	45.0	1-2-3-4-5
RP-81-3-Spring	MC	13.0	19.3	61.5	24.6	29.6	118.4	1-2-3-4-5
RP-81-3-Summer	MC	17.7	10.5	14.4	22.4	16.3	65.0	1-2-5-3-4
RP-81-3-Fall	MC	10.9	10.0	9.0	7.9	9.4	37.7	1-2-3-4-5
RP-81-4-Spring	SC	13.6	13.8	33.3	29.2	22.5	89.9	1-2-3-4-5
RP-81-4-Summer	SC	6.9	11.9	15.8	15.5	12.5	50.1	4-3-5-2-1
RP-81-4-Fall	SC	31.4	14.8	11.8	14.8	18.2	72.8	1-2-4-5-3
RP-TKA-1-Spring	SC	13.3	12.6	37.8	15.1	19.7	78.8	5-4-3-2-1
RP-TKA-1-Summer	SC	5.2	4.3	3.5	5.6	4.6	18.6	5-4-3-2-1
RP-TKA-1-Fall	SC	118.6	3.0	3.4	0.5	31.4	125.6	1-2-3-4-5
RP-TKA-2-Spring	US	Ponar						
RP-TKA-2-Summer	US	Ponar						
RP-TKA-2-Fall	US	Ponar						
RP-TKA-3-Spring	SS	10.6	13.2	8.9	6.5	9.8	39.2	2-1-3-4-5
RP-TKA-3-Summer	SS	10.0	4.9	2.7	3.8	5.3	21.4	1-2-3-5-4
RP-TKA-3-Fall	SS	12.8	10.9	8.1	8.9	10.2	40.8	1-2-3-4-5

Table 2.6.4-4. Counts of the distances between Hess samples collected in 2013 for the River Productivity Study using GPS coordinates in ArcGIS at 9m, 9.5 m, 10 m, and 11 m, grouped by macrohabitats and seasons.

Macrohabitat	Total Number of Distances	9 m or more		9.5 m or more		10 m or more		11 m or more	
		Total	Percent	Total	Percent	Total	Percent	Total	Percent
MC	60	42	70.0	39	65.0	36	60.0	28	46.7
SC	68	56	82.4	54	79.4	51	75.0	49	72.1
SS	31	24	77.4	24	77.4	23	74.2	19	61.3
US	13	8	61.5	7	53.8	7	53.8	7	53.8
TM	55	38	69.1	37	67.3	33	60.0	32	58.2
Total	227	168	74.0	161	70.9	150	66.1	135	59.5
Season									
Spring	78	70	89.7	69	88.5	68	87.2	62	79.5
Summer	77	53	68.8	51	66.2	46	59.7	41	53.2
Fall	72	45	62.5	41	56.9	36	50.0	32	44.4

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2.6.5. Study 9.9 – Characterization and Mapping of Aquatic Habitats

As established in the Study Plan[28] (RSP Section 9.9.1), the goal of this study is to characterize and map all aquatic habitats with the potential to be altered and/or lost as the result of reservoir filling, hydropower operations, and associated changes in flow, water surface elevation, sediment regime, and temperature.

Study objectives for collecting baseline data vary depending on the nature of the potential Project effects and where in the study area the effects may occur. Study methods will, therefore, also vary within the study area. Objectives are described below according to the following breakdown.

- Upper River Habitats
  - Characterize and map Upper River tributary and lake habitat for the purpose of evaluating the potential loss or gain in available fluvial habitat that may result from dam emplacement and inundation by the reservoir.
  - Characterize and map Upper River tributary and lake habitat for the purposes of informing other studies including Fish Distribution and Abundance in the Upper River (Section 9.5) and River Productivity (Section 9.8).
  - Characterize and map the Upper River mainstem upstream from the Watana dam site to the confluence with the Oshetna River:
    - To provide baseline data for the purpose of evaluating the potential loss or gain in accessible available fluvial habitat that may result from dam emplacement and inundation by the reservoir.
    - To inform other studies including Fish Distribution and Abundance in the Upper River (Section 9.5), River Productivity (Section 9.8), and Future Watana Reservoir Fish Community and Risk of Entrainment (Section 9.10).
- Middle River Habitats
  - Characterize and map the Middle River mainstem from the Chulitna River confluence to the proposed Watana Dam site, including tributaries within the zone of hydrologic influence (ZHI[29]):

[28] The FERC-approved Revised Study Plan (RSP) Section 9.9 for the Characterization and Mapping of Aquatic Habitats Study (AQHAB) as modified by FERC's Study Plan Determination (Study 9.9 SPD, April 1, 2013) and *Characterization and Mapping of Aquatic Habitats Technical Memorandum* (Study 9.9 TM, July 16, 2013) is collectively referred to as Study Plan Section 9.9.

29 The ZHI (zone of hydrologic influence) is defined as the approximated section of tributary extending from the Susitna River's modeled water's edge at a 1.5 year flow return interval downstream to the tributary's confluence with the Susitna River at a base flow.

- To provide baseline data for the purpose of evaluating the potential loss or gain in accessible available fluvial habitat that may result from flow regulation below the proposed Watana Dam.
- To inform other studies including Fish Distribution and Abundance in the Middle and Lower River (Section 9.6), River Productivity (Section 9.8), and Instream Flow (Section 8.5).

- **Lower River Habitats**
  - Characterize and map the Lower River mainstem from the upper limit of tidal influence to the Three Rivers Confluence:
    - To provide baseline data for the purpose of evaluating the potential loss or gain in available fluvial habitat that may result from flow regulation below the proposed Watana Dam.
    - To inform other studies including Fish Distribution and Abundance in the Middle and Lower River (Section 9.6), River Productivity (Section 9.8), and Instream Flow (Section 8.5).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes no modifications to Study Plan Section 9.9, as this study is complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS and USFWS submitted 12 and 11 study modification proposals, respectively, for Study 9.9. The 11 USFWS modification requests were nearly identical to NMFS Modifications 1 through 11, and were therefore combined. AEA's responses can be found in Table 2.6.5-1 and below. As the Services organized their study modification requests by study objective, AEA organized responses in the same manner. In addition, FERC and ADF&G requested clarification or additional information. In response, AEA has also developed and provided the *Characterization and Mapping of Aquatic Habitats Study Plan Section 9.9 Supplement to the Study Completion Report* (Attachment 9).

Table 2.6.5-1 Study 9.9 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA7_ph2	*Please include a table that describes the background photo date and associated flow for each line map provided in Appendix A of the SCR.*	A table summarizing imagery and flow conditions is provided in the Supplement to the SCR (Table 9-1).
FERC_ppA7_ph3	*Table 4.1.1 which defines mesohabitats in the SCR includes a footnote reference for off-channel habitat and for upland slough, but the footnotes are missing…Please provide a revised table with the footnotes.*	An updated SCR Table 4.1.1 is provided in the Supplement to the SCR (Table 9-2).
ADNR_ADFG_pp14_ph7	*This study characterized aquatic habitats of the Susitna River using a hierarchical and nested classification system based on historic and current data. This information was used in the development of study plans and will be used in*	AEA appreciates ADF&G's review and support for AEA's implementation of the FERC-approved Study Plan.

Reference Number	Comment or Study Modification Request	AEA's Response
	the evaluation of study results. We believe AEA has successfully completed all aspects of this study and has met all FERC-approved study objectives.	
ADNR_ADFG_pp14_ph8	*Comment 1* *Study Area, Page 3, please complete the last sentence of footnote 1. "Mapping and characterization in the Lower River segment has been completed (see Section 4.4) using……..." Not clear what is intended.*	Footnote 1 should be revised to read: *The Study Plan (RSP Section 9.9.4) provided that AEA would consider the study area for the Lower River segment to extend downstream to the upper extent of tidal influence. AEA adjusted the study area for the Lower River segment to extend downstream to PRM 3.3. Mapping and characterization in the Lower River segment has been completed (see Section 4.4) using LiDAR and aerial imagery from the Matanuska-Susitna Borough LiDAR and Imagery Project by the Geomorphology study team.*
ADNR_ADFG_pp15_ph1	*Comment 2* *2. Table 5.2-17 Instream Cover: The table indicates that only 5 of the 28 streams surveyed contained undercut banks. Was this data collected using aerial video, ground surveys, or both? Was the depth (horizontal distance) of the undercut measured? If aerial video was used on much of the habitat assessment how were undercut banks identified? For example, in Fog Creek 35.0% of the instream cover were undercut banks. Does the 35% represent 35% of the bank lengths or 35% of water surface area? If the actual depths of the undercut are not measured, then the calculation of what % that undercuts contribute to fish cover may not be accurate and should be described more clearly.*	Estimates of instream cover were collected during ground surveys. Total instream cover was estimated and the dominant cover type was recorded. Table 5.2-17 suggests that undercut banks were the dominant instream cover type in at least 1 reach of only 5 of 28 tributaries in the Middle River. Similarly, in Geomorphic Reach 4 of Fog Creek, one habitat unit's instream cover was primarily undercut banks with the total cover percent (of all types) of 35 percent by area. Table 5.2-9 provides the estimate of undercut bank length, expressed as a percent, by mesohabitat type. The depth of undercut was estimated during ground surveys; the minimum size requirements for undercut banks were lengths greater than or equal to 1.0 meter and depths greater than or equal to 0.3 meters.
NMFS_pp9.9-4_ph6; USFWS_pp9.9-4_ph6	*NMFS Modification 1; USFWS Modification 1:* [The Services] *recommend that the Upper River habitat classification be provided in a single document. This recommendation is necessary to ensure that all information provided is current and includes any study modifications or additional analyses recommended through TWG meetings or by FERC.*	As explained below in Section 2.6.5.1.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan and this information was provided in the SCR. As such, there is no additional cost for implementing this modification. The modification request that AEA report study results differently is not necessary to meet Study 9.9 objectives.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.9-4_ph8; USFWS_pp9.9-5_ph1	*NMFS Modification 2; USFWS Modification 2: Study results should be provided in a table for each Upper River tributary that show the starting elevation and ending elevation of each geomorphic reach, reach slope, confinement, channel width, substrate, and other habitat variables. Information on each geomorphic reach will provide* [the Services] *with the ability to determine if habitat and fish distributions are similar among geomorphic reaches, with the same physical characteristics within a stream and among streams.*	This modification to the Study Plan is not necessary. This request combines map-based and field-based attributes of Upper River tributaries. It is not practical to consolidate reach-wide attributes like slope with local attributes like substrate composition. As described in Section 4.1.2.1.2 of the Study 9.9 SCR, AEA used desktop tools to identify geomorphic reaches using changes in slope, confinement and significant contributions of tributary flow. Ground surveys were then conducted within each reach to characterize aquatic habitat at the mesohabitat scale. The Study 9.9 SCR includes survey data by tributary geomorphic reach including summaries by mesohabitat of slope (Study 9.9 SCR Table 5.1-2), channel widths (Study 9.9 SCR Tables 5.1-4 and 5.1-5), substrate (Study 9.9 SCR Tables 5.1-11 through 5.1-16) and other variables. However, AEA agrees that it is of value to provide the geomorphic reach attributes for Upper River tributaries. Accordingly, AEA has provided a summary of map-based geomorphic reach attributes including tributary river mile, elevation, confinement and reach-scale gradient in the attached Supplement to the SCR (Table 9-3).
NMFS_pp9.9-5_ph2; USFWS_pp9.9-5_ph3	*NMFS Modification 3; USFWS Modification 3: Study results for Upper River tributaries should be presented to show the relative distribution of habitats below the inundation zone, and classified habitats within the varial zone and above maximum pool elevation.*	As explained below in Section 2.6.5.1.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $5,000.
NMFS_pp9.9-5_ph4; USFWS_pp9.9-5_ph5	*NMFS Modification 4; USFWS Modification 4:* [The Services] *recommend that AEA provide the geomorphic classification for all Middle River tributaries, as provided for in the FERC Study Plan determination (April 1, 2013).*	This modification to the Study Plan is not necessary. Consistent with FERC's April 1, 2013 SPD recommendation to "classify the Middle River tributary reaches within the zone of hydrologic influence into geomorphic reaches based on tributary basin drainage area and stream gradient to provide a general understanding of the relative potential value to fish and aquatic resources" (SPD p.B-213), AEA has provided this information in Table 9-4 of the Supplement to Study 9.9 SCR (see Attachment 9).

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.9-5_ph8; USFWS_pp9.9-6_ph2	*NMFS Modification 5; USFWS Modification 5:* [The Services] *recommend that FERC require AEA to review the aerial videography for the Middle and Upper River and accurately and consistently classify the Level 3 macrohabitats and Level 4 mesohabitats for the main channel and visible off-channel habitats, using the classification definitions or criteria provided for in the SPD (April 1, 2013). Ground surveys need to be conducted at survey flows to classify those macrohabitats that cannot be definitively identified from aerial videography.*	As explained below in Section 2.6.5.2.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $1,500,000.
NMFS_pp9.9-21_ph1; USFWS_pp9.9-12_ph1	*NMFS Modification 6; USFWS Modification 6:* [The Services] *recommend that ephemeral flood channels (cross-island channels) not be classified as side channels, side sloughs, or upland sloughs. They should also not be used to address study objectives. These channels should have a distinct classification for FDA and River Productivity sampling or not be sampled.*	As explained below in Section 2.6.5.2.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $15,000 with additional cost implications for coordinated studies estimated at $2,000,000.
NMFS_pp9.9-21_ph5; USFWS_pp9.9-12_ph5	*NMFS Modification 7; USFWS Modification 7:* [The Services] *recommend that AEA clearly define and accurately apply mesohabitat classifications to Susitna River habitats. If selection of FDA surveys, summaries, and analyses are to be conducted at the mesohabitat level, then AEAs mesohabitat classification must be completed for all main and off-channel habitats in the Middle and Upper segments of the Susitna River.*	As explained below in Section 2.6.5.2.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $1,250,000.
NMFS_pp9.9-22_ph3; USFWS_pp9.9-13_ph3	*NMFS Modification 8; USFWS Modification 8:* [The Services] *recommend that providing the results of the mainstem classification in tables showing lengths of each line on the line maps for all mainstem macrohabitats (main channel and off-channel) as specified in the approved plan.*	As explained below in Section 2.6.5.2.4, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $15,000.
NMFS_pp9.9-22_ph7; USFWS_pp9.9-14_ph1	*USFWS Modification 9; USFWS Modification 9:* [The Services] *recommend that AEA provide maps and tables showing Upper River and Middle River macrohabitat area as provided for in the approved plan.*	As explained below in Section 2.6.5.2.5, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $45,000.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.9-23_ph3; USFWS_pp9.9-4_ph4	*NMFS Modification 10; USFWS Modification 10:* [The Services] *recommend that AEA complete the ground surveys of 5 to 10 Upper River mainstem mesohabitats and off-channel habitats, classification of mesohabitats for off channel macrohabitats, and provide Tier III habitat characteristics as provided for in the approved plan*. [The Services] *recommend that AEA complete the ground surveys of 5 to 10 Middle River mainstem mesohabitats and off-channel habitats, classification of mesohabitats within these off-channel habitats, and provide the Tier III habitat characteristics for these sites*. [The Services] *recommend that AEA complete the 100% survey and classification of mesohabitats for all FAs areas as specified in the approved plan. For each macrohabitat within each focus area, provide the percent of each mesohabitat, and Tier III habitat characteristics as specified in the approved plan.*	As explained below in Section 2.6.5.2.6, AEA requests that FERC not adopt this proposed Study Plan modification. The field component of this request is addressed in Study 9.9 SCR, the estimated cost of the modified data summary is $35,000.
NMFS_pp9.9-25_ph4; USFWS_pp9.9-16_ph5	*NMFS Modification 11; USFWS Modification 11:* [The Services] *recommend that beaver pond complex and backwater mesohabitats should be shown on classification maps for the entire Middle River and not just when they occur in FAs.*	As explained below in Section 2.6.5.2.7, AEA requests that FERC not adopt this proposed Study Plan modification. This request is addressed in Study 9.9 SCR.
NMFS_pp9.9-26_ph2	*Modification 12: NMFS recommends expanding the geographic scope of this study from the three rivers confluence to the Cook Inlet.*	As explained below in Section 2.6.5.3.1, AEA does not object to FERC's adoption of some elements of this proposed Study Plan modification. AEA has reviewed integrated information across studies from 2013 and 2014 and is proposing to extend habitat characterization ground surveys to select macrohabitats in the Lower River to address potential affects to aquatic habitats. In response to NMFS Study 9.6 Modification 10, as described in Section 2.6.5.3.1 AEA proposed a modification to the FERC-approved Study 9.6 that includes additional habitat surveys in the Lower River. The estimated cost of implementing AEA's proposed modification is approximately $300,000 to $400,000. However, AEA requests that FERC not adopt NMFS's study modification request to extend remote line mapping into the Lower River. The estimated cost for the remote mapping in the Lower River would be $8M.

2.6.5.1. Objectives 1 and 2

Objective 1: Characterize and map Upper River tributary and lake habitat for the purpose of evaluating the potential loss or gain in available fluvial habitat that may result from dam emplacement and inundation by the reservoir.

Objective 2: Characterize and map Upper River tributary and lake habitat for the purposes of informing other studies including Fish Distribution and Abundance in the Upper River (Section 9.5) and River Productivity (Section 9.8).

2.6.5.1.1. Response to Modification Request Regarding Presentation of Upper River Study Results

NMFS (Modification 1; NMFS_pp9.9-4_ph6) and the USFWS (Modification 1; USFWS_pp9.9-4_ph6) recommend that the Upper River habitat classification be provided in a single document.

The modification request that AEA report study results differently is not necessary to meet Study 9.9 objectives. AEA has integrated all results of Study 9.9 into the SCR. The Study 9.9 SCR is comprehensive and includes descriptions of both methods and results for all remote and ground mapping of Upper River tributaries, mainstem habitats, and lakes. All results pertinent to study objectives, including results from 2012 and 2013, were included in the SCR (with previous reports referenced to integrate all study products). A comprehensive geospatial database inclusive of all study years is publically available at http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.9-Mapping_of_Aquatic_Habitats/SCR_9_9_AQHAB_RemoteLineMapping_2012-2014_GIS.zip. A comprehensive database of associated survey data is available at http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.9-Mapping_of_Aquatic_Habitats/9.09_AQHAB%20final%20databases/

2.6.5.1.2. Response to Modification Request Regarding Presentation of Upper River Tributary Data

NMFS (Modification 3; NMFS_pp9.9-5_ph2) and the USFWS (Modification 3; USFWS_pp9.9-5_ph3) request that study results for Upper River tributaries be presented to show the relative distribution of habitats below the inundation zone, within the varial zone, and above maximum pool elevation.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

AEA agrees that it will be important to evaluate potential effects within the inundation zones for alternatives considered, because the timing, frequency, and magnitude of reservoir fluctuations may affect tributaries within the inundation zone. Alternate operational scenarios will be evaluated as part of the effects analysis, which will be completed as part of the License Application.

However, the modification request that AEA summarize survey data differently is not necessary to meet the Study 9.9 objectives. AEA has presented all tributary habitat data with respect to tributary geomorphic reach. This presentation is in keeping with study objectives and the study design, which provided for collection of survey data within tributary geomorphic reaches. Reporting aquatic habitat attributes within geomorphic reaches summarizes aquatic habitat at a functionally relevant and meaningful scale. All data collection locations have been reported in the associated data delivery (http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.9-Mapping_of_Aquatic_Habitats/SCR_9_9_AQHAB_RemoteLineMapping_2012-2014_GIS.zip). These baseline data are spatially referenced and GIS can be used to evaluate the relative distribution of habitats within the inundation zone, within the varial zone, and upstream of the maximum pool from the data provided. Collection of baseline data has been completed according to the Study Plan, summary of baseline data in relation to Project features is beyond the scope of study objectives.

2.6.5.2. Objectives 3 and 4

Objective 3: Characterize and map Upper River mainstem from the Watana dam site to the confluence with the Oshetna River to a) evaluate the loss or gain in available fluvial habitat that may results from dam emplacement and inundation by the reservoir and b) inform other studies including Fish Distribution and Abundance in the Upper River (Section 9.5) and River Productivity (Section 9.8) and Future Watana Reservoir Fish Community and Risk of Entrainment (Section 9.10).

Objective 4: Characterize and map the Middle River mainstem from the Chulitna River confluence to the proposed Watana Dam site, including tributaries within the zone of hydrologic influence (ZHI) to a) provide baseline data for the purpose of evaluating the potential loss or gain in accessible available fluvial habitat that may result from flow regulation below the proposed Watana Dam and b) inform other studies including Fish Distribution and Abundance in the Middle and Lower River (Section 9.6), River Productivity (Section 9.8), and Instream Flow (Section 8.5).

2.6.5.2.1. Response to Modification Request to Review and Reclassify Habitats and Conduct Additional Surveys

NMFS (Modification 5; NMFS_pp9.9-5_ph8) and USFWS (Modification 5; USFWS_pp9.9-6_ph2) request that AEA review the aerial videography for the Middle and Upper River to reclassify the Level 3 macrohabitats and Level 4 mesohabitats for the main channel and visible off channel habitats using the classification definitions or criteria provided for in the SPD (April 1, 2013) and conduct ground surveys for macrohabitats that cannot be definitively identified from aerial videography. The Services base this request on their assertion that the study results in the ISR and SCR are “inaccurate and incomplete” and that this may prevent meeting study objectives.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established “good cause” for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan.

The modification request that AEA conduct additional surveys is not necessary to meet Study 9.9 objectives. The Services describe the habitat classification in Study 9.9 as “inaccurate and incomplete" based on their review of AEA's habitat classifications and discrepancies between their own habitat assessments and AEA's mapping efforts. The Services' inability to replicate AEA's classifications using different imagery at different reference flows and different classification definitions does not mean that apparent discrepancies are errors, but rather highlights the flow-dependent nature of the habitat definitions and the degree that this baseline data is merely a snapshot in time of a complex and dynamic river system. AEA disagrees with the claim that the study methodology was implemented inconsistently and asserts that it is differences in method application between AEA and the Services that resulted in what appear to be habitat classification discrepancies. The discrepancies described in the Services comments are largely due to two issues:

- a difference in source imagery for remote line mapping, and
- differences in habitat definitions.

Differences in classification are not errors in the habitat mapping, but rather the result of two different mapping methods producing two sets of results. These apparent discrepancies can be understood through understanding flow-dependent classifications and clarification of classification definitions.

When considering these apparent discrepencies it is important to consider both the objectives of the study and the use of study results. The habitat mapping characterization study is not intended to provide a spatially explicit static template of every aquatic habitat in the Susitna River over the full range of flow conditions.

Aquatic habitats in the Susitna River are dynamic, with variability on daily, seasonal and annual scales. Habitat sizes and shapes change as they are inundated and dewatered by flow changes while being altered by episodic events including floods, ice processes, riparian vegetation and beavers. The Services comment that, "one objective of the habitat characterization study is to consistently survey and measure changes in fluvial habitat" (NMFS_pp.9.9-20_ph1, USFWS_pp.9.9-11_ph3). However, measuring change in habitat is not an objective of Study 9.9. The objective of Study 9.9 is to characterize and map aquatic habitats in the study area. AEA worked with licensing participants to develop a Study Plan to meet this objective. Although alternative methods may generate different results, the methods AEA has followed are consistent with the FERC-approved Study Plan and support both study objectives: 1) to provide a baseline for future analysis of impacts of the Project; and 2) to support coordinated aquatics studies. Through the implementation of the Study Plan, AEA has fulfilled these objectives.

AEA responds to the Services' rationale for Modification 5 in the following sections describing methodological details, macrohabitat classification criteria and the status of the study.

2.6.5.2.1.1. Integrating Ground Surveys with Remote Line Mapping

RSP Section 9.9.5.4.1 provided that field based ground-truthing and refinement of line mapping would occur. Study 9.9 SCR Section 5.2.3 describes how AEA used ground surveys to refine remote line mapping. When conflicts between remote line mapping and ground surveys occurred, the data were reviewed in the context of: 1) target flow conditions and 2) with respect to changes in the classification system that was an outcome of FERC's Study Plan Determination (backwaters, beaver complexes and clearwater plumes were categorized as Level 3 macrohabitats at the time of

2012 remote line mapping). A third category of review was if the conflict resulted from new segments or features being mapped during field surveys that were previously unidentified in the remote line mapping layer.

The Services have identified differences between 2013 ground survey classifications that were reported in ISR Part A, Appendix D (*Middle River Mainstem Surveys, 2013*) and the 2012 line mapping classifications in revised Appendix A (*Remote Line Mapping, 2012*) of the ISR Part A (Errata filed November 14, 2014). The Services' also conducted an analysis in an attempt to document differences between the 2013 ground survey classifications (ISR Part A, Appendix D) and the final line mapping (Study 9.9 SCR, Appendix A), but used classifications that were not used in the final line mapping due to FERC SPD recommendations (e.g., UC BW [Backwater in an unclassified macrohabitat]; SS BC [Beaver Complex in a Side Slough]). Unfortunately, this is not a direct comparison because the Services used classifications that were later modified by FERC's Study Plan Determination and are, therefore, inconsistent with the final habitat maps presented in the SCR. Still, the 2012 line mapping, ground survey maps in ISR Part A and final integrated SCR line maps do reflect some differences in classification over the course of the study. The Services' comments reflect concern about how these differences were or were not incorporated into the final line mapping and how this may have impacted coordinated studies.

First, the macrohabitat classifications that were changed based on ground surveys did not affect the habitat classifications used by any coordinated studies and do not prevent their use of habitat classification proportions. In the example of the habitat downstream of the confluence of Whisker's Creek and Whisker's Slough, both the 2012 line mapping used to support coordinated studies and the final line map classify the macrohabitat as slough habitat. Notably the Services write that they have "always identified the habitat downstream of Whiskers Creek confluence as a tributary mouth (due to the dominance of tributary flow) that contains backwater and a clearwater plume." While AEA habitat teams agree there are mainstem low flow conditions when the tributary flow dominates the slough, the corollary is also true that at higher river flows, slough influence dominates. This later flow condition was the condition at the time the imagery was collected, and is the basis of the remote line mapping. AEA's final line mapping identifies this same area as a side slough with a backwater and a clearwater plume.

For the differences between 2013 field surveys and 2012 line mapping that did result in "ground truthing" classification changes, the Services comment that "the habitat classification should only have been modified if systematic errors, that could have been applied to the entire Middle and Upper River, were identified." AEA disagrees with this approach to the habitat classification. As reported in the Study 9.9 SCR (Section 5.2.3), 6 out of 192 classifications in the Middle River were revised with ground data and these ratios indicate a relatively low (3 percent) uncertainty in AEA's remote line mapping classifications. AEA disagrees with the Services' request to dismiss these improvements in classifications simply because they were not systematic or uniform across the study area.

The Services also express concern that additional differences between ground mapping and line mapping did not always result in changes to the line mapping, or were not reported as differences. Study 9.9 SCR Section 5.2.4 describes additional variations between line mapping and ground survey classifications. Many of these differences are explained by updates to the classification system made in response to FERC's April 1, 2013 SPD. For example, many backwaters either had no Level 3 macrohabitat classification assigned in the original line mapping, or were assigned the macrohabitat of the water source during field surveys in 2013. The FERC SPD recommended changing the classification of backwater, beaver complex and clearwater plume habitats from Level 3 macrohabitats to Level 4 mesohabitats. In 2014 surveys, and during final QC of the line mapping, backwaters were considered mesohabitats and assigned the macrohabitat of the receiving macrohabitat. For example, a backwater in a slough mouth was assigned a slough macrohabitat rather than the main channel habitat of the water backing up into the slough. Similarly, beaver complexes became mesohabitats within sloughs in accordance with the FERC SPD. These changes do not reflect inaccuracies, but rather a refinement of the classification hierarchy in accordance with the FERC-approved Study Plan. In addition, when reviewing differences in macrohabitat classifications, field notes, photos, and habitat data were considered alongside the field macrohabitat classification and in a few instances, these data were used to evaluate whether the line mapping should be changed. For example, a side channel at PRM 129.2 was remotely mapped as a side channel using an image taken at 18,300 cfs. Ground crews noted the lack of an upstream connection at flows of 17,000 and classified the feature as a side slough. Review of the two calls resulted in no change to the line mapping as the difference in classification was clearly flow dependent. Finally, field crews identified and characterized new features that were subsequently incorporated as improvements to the final map.

2.6.5.2.1.2. Line Mapping Imagery

As described in the Study 9.9 SCR (Section 4.1.1.1), the primary imagery used to map aquatic habitats was *orthoimagery* not video. As described in Study 9.9 SCR, Section 4.1.1.1, data derived from aerial photographs were *supplemented* with information from video mapping to generate a geospatial database within a GIS (geographic information systems) framework during the 2012 remote line mapping effort. The remote line mapping effort used high-resolution elevation data and aerial imagery for 3,680 square miles of the Matanuska-Susitna Borough (MSB) collected as part of the MSB LiDAR and Imagery Project. Aerial imagery was obtained over five days between May 25, 2011 and August 16, 2011. Flows for the majority of these flights – as measured at the Gold Creek USGS gage (PRM 140) – ranged between 16,700 and 18,300 cfs with one day occurring at a high flow of 30,600 cfs; videography was collected from September 7-11, 2012. During the video collection, mean daily discharge from Gold Creek steadily declined from 16,500 cfs on September 7 to 10,800 cfs on September 11, 2012. These two media would be expected to result in variable habitat maps. Because the orthoimagery was more comprehensive, it was selected as the primary source for generating the remote line mapping. AEA's use of video imagery was limited to off-channel and tributary habitats.

The Services' analysis appears to have used the videography to evaluate classifications made using aerial imagery, collected at different flows, and then concluded that AEA's habitat classifications were incorrect. As stated previously, it is not surprising that they observed differences in habitat classifications, particularly in flow-dependent features like clearwater plumes and side sloughs. Similarly, the Services "used AEA's classifications to develop their own dichotomous macrohabitat classification key." Unfortunately, this key mischaracterizes definitions and ultimately led to additional "errors" in classification, particularly for features like tributary mouths. To clarify definitions and habitat classifications made by ground crews, AEA has included the dichotomous key used by field staff during aquatic habitat ground surveys in the *Supplement to*

Study 9.9 SCR (Attachment 9). The Services organized their specific comments by habitat type; AEA's responses are similarly organized below.

2.6.5.2.1.3. Tributary Mouths

The Services contend that the tributary mouth macrohabitat should include the tributary delta, any backwater, and the clearwater plume. They continue to state that because FERC's SPD recommended that the Fish Distribution and Abundance Study (Study 9.5) sample 200 meters downstream of tributary confluences as part of tributary mouth habitat sampling, the Aquatic Habitat study should have included clearwater plumes within tributary mouth macrohabitats. Study 9.9 did not define tributary mouths as including clearwater plumes. Instead, clearwater plumes were categorized as a main channel habitat and were given the macrohabitat classification of the main channel feature. In practical terms, this is a distinction without a difference; clearwater plumes are a unique habitat mesotype and could reasonably be nested under either a tributary mouth or mainstem macrohabitat type. AEA chose to nest clearwater plume habitats under mainstem macrohabitats because this captures the influence of mainstem flows on plume size and will support evaluation of potential Project effects.

The Services comment that, "If clearwater plumes are a mesohabitat of main channels or side channels, then all 69 Middle River tributaries flowing into the Susitna River need to be identified as tributary mouths." Section 4.1.1.1 of the Study 9.9 SCR defines tributary mouths as the length of the wetted area of the tributary mouth that extended from the vegetation line out to the edge of the gravel bank. In some of the larger tributaries, the mouth habitat was extended inland beyond the vegetation line based on visible habitat breaks between the tributary channel and the alluvial gravel areas at the mouth. By this definition, when the Susitna River is near Ordinary High Water, not every tributary confluence includes tributary mouth habitat. The line mapping includes tributaries, mainstem habitats, and tributary mouths and clearwater plumes when present.

The Services used aerial videography to identify clearwater plumes that were not included in the line mapping downstream of the confluences of Tributary 117.4, Little Portage Creek, and Unnamed Tributary 124.4. The aerial video was taken during very low flow conditions when plumes would be expected to be largest. At the confluences of Tributary 117.4, Little Portage Creek, and Unnamed Tributary 124.4, no plumes were visible at flows captured by the orthoimagery nor were they noted by ground crews.

2.6.5.2.1.4. Side Channels versus Split Main Channels

The Services comment that, "departure from the classification criteria led to inconsistent classification of side and split main channels." AEA disagrees with this characterization. The Services mischaracterize the definitions of these two features and the distinctions between them with respect to flow, size and vegetation and then proceed to illustrate how these incorrect definitions do not match AEA's classifications.

To clarify the flow criterion, side channels generally contain less than 10 percent of the main channel flow to be consistent with the classification for this feature that was used in the 1980s. Split channels generally had flows greater than 10 percent of the total flow on each side and although multi-split channels could have a small flow percentage in each channel when multiple parallel channels were present, they were relatively more balanced. The Services defined "nondominant" as "exactly equal" flow around an island and then characterized channels with between 10 and 50 percent of the flow as unclassified. Non-dominant flow was defined by AEA as less than 10 percent of the total flow in channels with 2 channels and could be less in more complex channel configurations.

To clarify the size criterion, all classified habitat features were at least as long as they were wide. For side channels, this meant that the side channel itself should have been longer than it was wide. The Services misapply this requirement to the mid-channel islands and bars and interpret the criteria to mean the island should be at least as long as the full channel width in order to classify a feature as a side channel. Island size was not used by AEA to distinguish between side channels and split main channels. This criterion is taken from the US Forest Service protocol as referenced in RSP Section 9.9.5.1.

To clarify the vegetation criterion, Section 4.1.1.1 of the Study 9.9 SCR describes split main channels as when, "the flow was dispersed into two relatively evenly sized channels where the bar or island separating the channels was typically not vegetated." The SCR goes on to state, "Aerial video was also used to confirm the extent of vegetation on more permanent gravel bars that showed some vegetation, which was sometimes not evident in the aerial imagery. If the aerial video indicated a bar had vegetation on it, but vegetation was not evident in the aerial imagery, the island was considered vegetated and this criteria was used to aid in separating the main channel line segment into a main channel segment containing the dominant portion of flow and a side channel segment containing less than ten percent of flow around the island. AEA used perennial vegetation, not solely woody vegetation (as the Services assumed) for this determination.

2.6.5.2.1.5. Side Channels versus Side Sloughs

The Services comment that, "the side channel classification was also inaccurately and inconsistently applied to side sloughs." AEA disagrees with this characterization. The Services mischaracterize the reference flows used for classification and then proceed to illustrate how the incorrect definition does not match AEA's classifications. It is this misuse of habitat type definitions that has resulted in apparent inconsistencies between the Services' habitat typing and AEA's, not errors or inconsistent application of definitions by AEA. As stated in Study 9.9 SCR Section 4.1.1, habitat classification was conducted based on imagery collected primarily between 16,700 and 18,300 cfs, not the 10,000 to 12,000 cfs stated by the Services. The flow-dependent nature of the distinction between side channel and side slough explains the apparent discrepancies between the review of aerial imagery and the Services' use of videography. Table 9-1 in the *Supplement to the Study 9.9 SCR* provides the flow ranges for each map in the line mapping mapbook. During the video collection, mean daily discharge from Gold Creek was lower and steadily declined from 16,500 cfs on September 7, 2012 to 10,800 cfs on September 11, 2012. Therefore, differences in habitat classifications are not surprising nor do they indicate inconsistencies.

2.6.5.2.1.6. Macrohabitat Confluences

The Services comment that, "The habitats downstream from where two different macrohabitats join, was also inconsistently classified." AEA disagrees with this characterization. The classification downstream of macrohabitat confluences was determined by the macrohabitat with the most mainstem influence. The Services highlight FA-173 (Stephan Lake Complex) as an exception to this rule. However, a close inspection of these features reveals that all of the side channel habitats contributing to the side slough in question were dry. When both habitats were off-channel habitats, such as two sloughs coming together or a slough confluence with a tributary, the larger feature carried the classification downstream.

2.6.5.2.1.7. Study Status

As part of Modification 5, the Services recommend that AEA reclassify all Middle and Upper River macrohabitats. They also request the opportunity to review and comment on revised maps and that final classifications be approved by FERC prior to any additional field sampling by the FDA or River Productivity studies. AEA does not agree that this modification is required to meet study objectives and requests FERC not adopt this proposed modification. AEA has conducted a thorough classification of aquatic habitats in the Study Area in accordance with the approved Study Plan using a systematic and repeatable approach. All data have been provided in digital format for review by licensing participants. The Services inability to replicate AEA's classifications with imagery from different flows does not justify the need to reclassify all Upper and Middle River habitats, but instead highlights the flow-dependent nature of the habitat definitions and the degree that this baseline data is merely a snapshot in time of a complex and dynamic river system. The coordinated aquatic studies have used this habitat map to ensure sampling in the range of aquatic habitat types that occurred throughout the geomorphic reaches.

2.6.5.2.2. Response to Modification Request Regarding Macrohabitat Classification of Mid-Channel Features

NMFS (Modification 6; NMFS_pp9.9-21_ph1) and the USFWS (Modification 6; USFWS_pp9.9-12_ph1) request that ephemeral flood channels (cross-island channels) not be classified as side channels, side sloughs, or upland sloughs and that they be eliminated from the habitat baseline and coordinated sampling by the FDA and River Productivity Studies.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan.

The modification request that AEA change the classification hierarchy is not necessary to provide a baseline for future analysis of impacts of the Project or to support coordinated aquatics studies. AEA does not agree that cross-island channels should be added as a macrohabitat type in the habitat classification hierarchy and then removed from the habitat characterization and mapping study. The classification hierarchy was developed in consultation with licensing participants during the Study Planning phase, FERC made recommendations for changes to the hierarchy in the April 1, 2013 SPD, and AEA has applied the FERC-approved hierarchy to this study. The goal of the aquatic habitat and fish distribution studies is to map and characterize all aquatic habitats, not just "good" fish habitat, to establish a baseline for evaluating potential Project effects. Mid-channel features are likely to be impacted by the proposed Project and should be mapped and included in studies of aquatic resources.

The Services do not provide any documentation for the claim that juvenile salmon use drives all fish assemblage patterns in the Susitna River or that aquatic habitat "value" is driven by juvenile salmon use. No new information about fish-habitat associations is provided to support this new classification or removal of these features from associated studies. Collection of data according to the Study Plan will support evaluation of this type of hypotheses about fish distribution and habitat associations, but only if the data are collected in all available habitat types. Furthermore, and of interest to the Services, FDA sampling has documented juvenile salmon use of mid-channel sloughs. For example, the side slough at PRM 120 had juvenile Sockeye Salmon rearing in all three sampling events in 2013 and Coho Salmon were found in the fall (FDA Sites FDA-MR7-120-P82-SS, FDA-MR7-120-P83-SS, and FDA-MR7-120-P84-SS).

AEA requests that FERC maintain the hierarchical habitat classifications where cross-island channels are classified based on their connectivity with the main channel as either side channels or sloughs. A modified hierarchy will not improve AEA's ability to meet study objectives. The estimated cost of implementing this modification is $15,000; however, that does not include the additional cost implications for coordinated studies including Studies 9.6 and 9.8. The cost to resample fish and invertebrates and reanalyze side slough and side channel data would be considerable. If 10 sites were reclassified and replaced with new sampling locations, AEA estimates the total cost for two years of additional sampling and associated analysis to be $2,000,000. If the intent of this modification request is to repeat the entire first year of study, the cost would be between $8,000,000 and $9,000,000.

2.6.5.2.3. Response to Modification Request Regarding Mesohabitat Classification

NMFS (Modification 7; NMFS_pp9.9-21_ph5) and the USFWS (Modification 7; USFWS_pp9.9-12_ph5) request that all Upper and Middle River habitats be classified to the mesohabitat level.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

AEA has used remote imagery to classify main channel mesohabitats in the Upper and Middle River. The modification request that AEA use remote imagery to classify off-channel habitats to the mesohabitat level is not necessary to meet Study 9.9 objectives. Remote imagery cannot be used to comprehensively characterize off-channel habitats at the mesohabitat scale due to the scale of off-channel habitats and the extent of riparian vegetation cover. It is theoretically possible to classify off-channel mesohabitats using ground surveys, but it is impractical to ground survey habitats given the extensive study area within a narrow range of reference flows. More importantly, this scale of information is not necessary to characterize habitats or support coordinated studies. Habitat impact assessment will be completed using instream flow models summarized at the macrohabitat scale (see Study 8.5, RSP Section 8.5.4.6). Study 8.5 will collect data and information that can be used to characterize, quantify, and model mainstem and lateral Susitna River habitat types at different scales including existing conditions and alternative operational scenarios.

NMFS and the USFWS assert that FDA surveys were selected at the mesohabitat level as justification for comprehensive mesohabitat classification. This mischaracterizes the FDA study design which sampled mesohabitats within macrohabitats selected based on designations at the time (before the FERC April 1, 2013 SPD changed backwaters, beaver complexes and clearwater plumes from macrohabitats to mesohabitats). Clearwater plumes are main channel habitats and were included in the line mapping effort. Backwaters were sampled at the mouths of associated sloughs per the FERC SPD. Mesohabitat typing for FDA sampling was based on field conditions at the time of each FDA survey. Due to the extent of seasonal sampling and the range of flow conditions encountered, mesohabitat types changed among FDA sampling events and were not based on the snapshot characterization made by this aquatic habitat study.

2.6.5.2.4. Response to Modification Request Regarding Presentation of Mainstem Habitat Classifications

NMFS (Modification 8; NMFS_ pp9.9-22_ph3) and the USFWS (Modification 8; USFWS_pp9.9-13_ph3) request that AEA provide the results of the mainstem classification in tables showing the lengths of each line on the line maps for all mainstem macrohabitats.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

As indicated in the Study 9.9 SCR, AEA has provided all licensing participants the GIS database described in the RSP (http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.9-Mapping_of_Aquatic_ Habitats/SCR_9_9_AQHAB_RemoteLineMapping_2012-2014_GIS.zip). The GIS line length for each feature, in feet, is provided in the GIS attribute table under the field name ArcLenFt as documented in the metadata file SCR_9_9_AQHAB_RemoteLineMapping_2012-2014_Metadata.pdf within the zip file. The habitat data supporting the line mapping are extensive and not amenable to presentation in flat tables due to their large size. Presenting the data in a different way will not improve AEA's ability to meet the objectives of Study 9.9. The GIS database allows any user to summarize classifications at Levels 1 through 4, as well as review each individual line segment. The GIS database anticipated by the RSP and provided by AEA is the most straightforward way to link line segments and maps with their associated attributes and survey data as the Services are requesting.

2.6.5.2.5. Response to Modification Request Regarding Macrohabitat Area Estimates

NMFS (Modification 9; NMFS_ pp9.9-22_ph7) and the USFWS (Modification 9; USFWS_pp9.9-14_ph1) request that AEA provide maps and tables showing Upper River and Middle River macrohabitat area as provided for in the approved plan.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

The modification request that AEA generate additional calculations of habitat area is not necessary to meet Study 9.9 objectives. In their request, the Services assert that AEA did not implement the FERC-approved Study Plan and include an incomplete citation from the RSP to justify their request to add aerial mapping of all off-channel habitats under Study 9.9; the omitted sentence preceding their citation provides significant meaning. RSP Section 9.9.5.4.2 stated:

> *The Middle River habitat data will also be used by the Instream Flow study to establish habitat complexity and frequency. All habitat segments will be identified using a mid-channel line, which will provide habitat length; however, off-channel slough habitat will be drawn separately in an area (polygon) in the Middle River to identify the size of each slough and better characterize slough diversity for Instream Flow Study needs. Area mapping will be reported separately from the linear database.*

AEA intended this language to differentiate the line mapping in Study 9.9 from the Instream Flow Study's (Study 8.5) conversion of macrohabitat from a linear to an area basis in Focus Areas. The Services suggest that Study 9.9 should use this data to evaluate the representativeness of Focus Areas and evaluate flow-based changes in off-channel habitat area. These objectives are clearly beyond the objectives of Study 9.9 and fall under the Instream Flow Study (8.5) which is expressly designed to evaluate the impact of flow and stage changes on fish habitat quantity and quality. For instance, during the April 2014 Proof-of-Concept meeting with licensing participants, example calculations of habitat metrics were developed using macrohabitat polygons of Focus Area-128 (Slough 8A). This work will be completed and reported in the Study 8.5 USR for baseline conditions and one operational scenario; the License Application will include additional operation scenarios.

2.6.5.2.6. Response to Modification Request Regarding Ground Surveys

NMFS (Modification 10; NMFS_pp9.9-23_ph3) and USFWS (Modification 10; USFWS_pp9.9-4_ph4) request that AEA complete ground surveys of 5-10 Upper River mainstem mesohabitats and off-channel habitats, 5-10 Middle River mainstem mesohabitats and off-channel habitats, and 100 percent of Focus Area habitats. The Services also request that lengths of mesohabitats by macrohabitat be reported for each Focus Area.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

AEA has already completed the surveys requested by this modification and provided the data with the Study 9.9 SCR. Table 4.2-1 of the Study 9.9 SCR summarizes ground surveys completed in both the Upper and Middle River within and outside of Focus Areas. Upper River ground surveys included 7 tributary mouths, 6 upland sloughs, 8 side sloughs, 5 side channels, 8 split main channels, and 1 multi-split main channel. Eight riffles and 8 run/glide mesohabitats were sampled in main channel habitats. Multi-split main channel units were rare in the Upper River, which was the cause of limited ground surveys. Middle River ground surveys outside of Focus Areas included

7 tributary mouths, 12 upland sloughs, 11 side sloughs, 7 side channels, 9 split main channels, and 10 multi-split main channels. Riffle habitats were limited in main channel habitats outside of Focus Areas; all four of the mapped riffles and 12 run/glide mesohabitats were sampled. Focus Areas were completely ground surveyed. Survey results are summarized in Study 9.9 SCR Tables 5.1-21 through 5.1-29, including mesohabitat composition and Tier III habitat characteristics. As described above, the detailed survey data is available in an associated database at http://gis.suhydro.org/suwareports/SIR/09-Fish_and_Aquatics/9.9-Mapping_of_Aquatic_Habitats/9.09_AQHAB%20final%20databases/.

2.6.5.2.7. Response to Modification Request Regarding Presentation of Off-channel Mesohabitats in Maps of the Middle River

NMFS (Modification 11; NMFS_ pp9.9-25_ph4) and USFWS (Modification 11; USFWS_pp9.9-16_ph5) recommend that beaver pond complex and backwater mesohabitats be shown on classification maps for the entire Middle River and not just where they occur in Focus Areas.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

Furthermore, AEA requests that FERC not adopt this modification because the beaver complex/pond and backwater (Level 4 mesohabitats) are currently shown on all *ground survey* maps, including the ground surveys completed outside of Focus Areas (Study 9.9 SCR, Appendix B). Furthermore, AEA has not limited Level 4 mesohabitat characterizations to Focus Areas, as stated by the Services, but rather to areas of ground surveys, which include areas both within and outside of Focus Areas. Study 9.9 SCR, Appendix A provides maps of classifications developed using *remote line mapping* methods. These maps do not include Level 4 mesohabitat classifications for off channel habitats, and thus do not include beaver complex/ponds or backwaters. However, Study 9.9 SCR, Appendix B presents *ground survey* data and includes these two mesohabitat types in accordance with the FERC-approved study methods.

These data have also been provided in the database associated with the Study 9.9 SCR and the GIS database made available to licensing participants. In addition, a remote assessment of beaver dams is presented in the Study 9.12 SIR. This data has also been provided in a GIS format that can be overlaid with the habitat mapping data for additional information about beaver activity in off-channel habitats.

Finally, AEA would like to clarify that FDA sampling did not use beaver dam complexes as a unit of selection. Rather, FDA characterized slough macrohabitats as either beaver-influenced or not. Beaver-influenced sloughs were defined as sloughs in which any beaver activity was documented in the remote line mapping. This level of stratification has since been abandoned in the FDA studies as ground surveys identified beaver influence in nearly all surveyed sloughs.

2.6.5.3. Objective 5

Objective 5: Characterize and map Lower River mainstem from the upper limit of tidal influence to the Three Rivers Confluence, to a) provide baseline data for the purpose of evaluating the potential loss or gain in available fluvial habitat that may result from flow regulation below the proposed Watana Dam, and b) inform other studies including Fish Distribution and Abundance in the Middle and Lower River (Section 9.6), River Productivity (Section 9.8), and Instream Flow (Section 8.5).

2.6.5.3.1. Response to Modification Request Regarding the Lower River Study Area

NMFS (Modification 12; NMFS_pp9.9-26_ph2) recommends expanding the geographic scope of this study from the Three Rivers Confluence to the Cook Inlet. NMFS comments that Study 9.9 has not included the lowest 30 miles of the Susitna River, but based on comparison of alternative operating scenarios ILF-1 to Existing Conditions, NMFS states that there may be significant stage change and daily fluctuation mid-winter. NMFS comments that the overall objective of describing the effects of Susitna-Watana dam will be better met if this modification is enacted.

NMFS also recommended modification to Study 9.9 within their comments to Study 9.17. NMFS Study 9.17 Modification 6a was linked to Study 9.9 Modification 12. NMFS Study 9.17 Modification 6b was not directly linked to the Study 9.9 modification; but, because it pertains to refining aquatic habitat maps in the Lower River, AEA's response to that comment is included in this section as well. Additional discussion of NMFS's comment about mapping habitat in the lowest reach to the appropriate level of detail can be found in Section 2.3.1.1.2.

AEA does not object to FERC's adoption of some elements of this proposed Study Plan modification. AEA has reviewed integrated information across studies from 2013 and 2014 and is proposing to extend habitat characterization ground surveys to select macrohabitats in the Lower River to address potential affects to aquatic habitats. However, AEA requests that FERC not adopt NMFS's study modification request to extend remote line mapping into the Lower River.

As described in AEA's response to NMFS comment to Fish Distribution and Abundance in the Middle and Lower River Study 9.6 (NMFS_pp9.6-12_ph3; see in Section 2.6.2.9.1), AEA's habitat survey site selection will be coordinated with fish distribution and abundance sampling and will rely upon a GRTS site selection approach based on existing geomorphic mapping. Surveys will be conducted in lateral and off-channel habitats that have the potential to be impacted by Project-induced changes in surface water elevation that are predicted from hydrologic modeling. This approach is similar to that proposed and tested for the Upper River in 2014. One subtle but important difference is that habitat surveys will be paired with FDA GRTS sampling in the Lower River. See also Section 2.6.2.11.1.

It is important to note that AEA's proposed habitat survey effort will not include main channel habitats. The predicted changes to these habitats are well within the natural variation of these channels and thus, would not be expected to affect aquatic habitats. Furthermore, the lower extent of this off-channel survey effort is proposed to be RM 32.3, the lower extent of LR-4, because elevation changes downstream from this point are predicted to be too small (on the order of a few inches) to have any measureable effect on fish habitats. With respect to CIBW, the data collected from AEA's proposed habitat survey may be useful to address potential indirect effects on CIBW PCE's if appropriate fish species are found to be rearing in these Lower River lateral habitats.

It is also important to note that AEA's proposed modification will not include refining remote mapping because it is not feasible to produce more detailed maps of the complex network of channels found in the Lower River. The current remote mapping in the Lower Susitna River extends from PRM 102.4 to the upper extent of tidal influence. As reported in Study 9.9 SCR Section 4.4 and the Revised Study Plan (RSP Section 9.9.5.4.3), it was impractical to map the entire river segment beyond Level 3 (macrohabitat) because of the very large size and channel complexity of the Lower River (Figure 4.4-1). The result of the test videography completed for a short segment of the Lower River concluded that aerial videotaping was not a practical method for habitat mapping the Lower River. Instead, geomorphic typing was used to characterize macrohabitat types in the Lower River. The September 2014 technical memorandum *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials* (Study 6.5 TM, September 26, 2014) summarizes geomorphic features in the mainstem Lower Susitna River in Section 5.1.1 with corresponding maps in Appendix H (*2012 Lower Susitna River Segment Geomorphic Features*). Geomorphic delineation was completed in the Lower River by Study 6.5 from the Three Rivers Confluence (PRM 102.4 / RM 98.5) downstream to Cook Inlet (PRM 3.3 / RM 0).

The cost for the additional habitat surveys AEA proposes in response to NMFS Modification 10 for Study 9.6 is approximately $300,000 to $400,000 (Table 2.6.2-1). The estimated cost for extending the remote mapping into the Lower River, as requested here by NMFS would be $8M. AEA's proposed targeted approach to characterizing habitats with the highest potential to be affected by dam operation will meet Study Objective 5 at a significantly reduced cost. Remote mapping of Level 3 mesohabitat types is impractical and will not improve AEA's ability to describe the loss or gain of fluvial habitat that may result from flow regulation below the proposed Watana Dam or inform coordinated studies of Fish Distribution and Abundance in the Middle and Lower River (Section 9.6), River Productivity (Section 9.8), and Instream Flow, which all select sites at the macrohabitat (Level 4) scale.

2.6.6. Study 9.10 – The Future Watana Reservoir Fish Community and Risk of Entrainment Study

As established in the Study Plan[30] (RSP Section 9.10.1), the goal of this study is to predict the fish community that will develop in the Project reservoir based on the existing species and the habitat that will be created in the inundation zone, and to characterize the potential loss from entrainment.

The study objectives established in RSP Section 9.10.1 consist of the following:

[30] The FERC-approved Revised Study Plan (RSP) Section 9.10 for the Future Watana Reservoir Fish Community and Risk of Entrainment Study (RESFSH) as modified by FERC's Study Plan Determination (Study 9.10 SPD, February 1, 2013) is referred to as Study Plan Section 9.10.

- Develop scenarios for anticipated daily and seasonal changes in reservoir habitat characteristics based on predicted reservoir operations, size, temperatures, and water quality and depth profiles.
- Develop scenarios for future reservoir fish communities based on current fish species composition upstream of the proposed dam site and enhancement potential for select salmon species incorporating anticipated daily and seasonal changes in reservoir habitat characteristics.
- Characterize potential management options including recreational, commercial, and subsistence uses of the reservoir fishery.
- Conduct a qualitative desktop analysis on the potential for entrainment of fish species inhabiting the proposed reservoir upstream of Watana Dam.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes no modifications to Study Plan Section 9.10. Study 9.10 ISR Part C, Section 7, filed in June 2014, described that the implementation of this desktop study was deferred. Since that time, AEA has not completed any additional work on this study.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 9.10.

2.6.7. Study 9.11 – Study of Fish Passage Feasibility at Watana Dam

As established in the Study Plan[31] (RSP Section 9.11.1), the goal of this study is to develop, to the feasibility level, a fish passage strategy in support of the License Application for the proposed Project. The methods section of this report outlines the process that is being used to achieve this objective.

The objectives of the Study of Fish Passage Feasibility at Watana Dam, as described in the RSP (Section 9.11.1), are that the study will explore various alternatives in support of three basic strategies related to fish passage: (1) proposed Project without fish passage, (2) integration of upstream and downstream passage features into the current Project design, and (3) the retrofit of upstream and downstream fish passage features to a Project designed without passage.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes no modifications to Study Plan Section 9.11.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, the NMFS and USFWS submitted three and one study modification proposals,

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[31] The FERC-approved Revised Study Plan (RSP) Section 9.11 for the Fish Passage Feasibility at Watana Dam Study (PASS) as modified by FERC's Study Dispute Determination (Study 9.11 SDD, April 26, 2013) is referred to as Study Plan Section 9.11.

respectively, for Study 9.11. USFWS also submitted 12 recommendations. With the exception of schedule, the Services' comments and modification requests were largely focused on the existing information that the study was relying upon, including literature reviewed and data provided from other studies, and were not directly aimed at the progress AEA has made toward meeting the objectives of Study 9.11. Based on the nature of the comments, it appears that the Services did not incorporate the SIR and post-ISR meeting materials in their review, despite participation in both Fish Passage Technical Team (FPTT) meetings (September 9-11, 2014 and December 3, 2014) and March 2016 ISR Meetings. Because they did not consider all of the information on the record, some comments are outdated and no longer apply. Many of these are addressed in Table 2.6.7-1. Comments that seem to reflect a misunderstanding of the ILP process also are addressed in the table, or discussed below.

It is worth noting that the NMFS review stated that two of their three study modifications "might be more appropriate" under studies other than Study 9.11. The Services organized their comments by study objective, or "task". Accordingly, AEA organized the comment responses in a similar manner with general thematic comments addressed up-front.

Table 2.6.7-1 Study 9.11 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.11-2_ph9	*Modification 2-1: Expand the literature review to better understand how well adult and juvenile riverine species navigate through a still water body.*	As explained below in Section 2.6.7.1.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan and AEA will continue to incorporate literature. As such, there is no additional cost for implementing this modification.
NMFS_pp9.11-3_ph4	*A brainstorming workshop was carried out and over 100 concepts were identified. Shortly after this the project was put in abeyance and it is not clear to what extent the concepts were organized.* *While this objective got off to a good start it has not been completed.*	This comment does not reflect a review of the entire record. The brainstorming concepts were organized and published as a product from the Fish Passage Technical Team (FPTT) Meeting #5 held on December 3, 2014, as reported in the Study 9.11 2014 Study Implementation Report (SIR) Section 5.1.2, filed with the Commission November 4, 2015,. This information is specifically noted in the SIR as "A reconciled version of the brainstorm concepts and tally (Appendix C)." Further development and organization of this list is planned to continue during Study implementation.
NMFS_pp9.11-3_ph7	*Objective 5: Develop an evaluation matrix to advance the existing state of each alternative's conceptual design and allow a relative comparison of the alternatives. This information would be presented at a final workshop, with the goal of selecting a final list of alternatives for refinement by AEA in Task 6.* *This objective has not been started.*	This statement is incorrect and not supported by the record. A comprehensive set of evaluation criteria for use with the matrix has been developed and addressed at each FPTT meeting; a sample matrix communicating how it would be formatted was presented at the September 2013 site tour; and a preliminary example of the BPT framework was developed as reported in the Study 9.11 SIR, Section 5.1.2 and Appendix A: Information Item B11. Biological Performance Tool. In addition, a review of the draft evaluation criteria and matrix was conducted during the FPTT meeting on December 3, 2014. NMFS staff have participated in all FPTT meetings throughout implementation of Study 9.11. See Section 2.6.7.2 for addition information on Task 5.
NMFS_pp9.11-3_ph5	*Modification 5-1: Determine the timing (now and in the future) when juvenile salmon would need to be collected from tributary mouths, moved across the reservoir and finally moved over the dam by evaluating current and future outmigration timing in 9.5 FDA Upper River and coupling that with information about earlier melt out and warmer stream temperatures in the 7.7 Glacier and Runoff Changes study.*	As explained below in Section 2.6.7.2.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification to support development of a predictive model of melt out and temperature changes due to climate change ranges from $150,000 for a sensitivity analysis to $500,000 for linkage to a climate model.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.11-4_ph1	*Modification 6-1: NMFS recommends the number of tributaries above the reservoir where fish spawn be determined. Without this information, the scale and therefore cost of any fish passage operation is unknown.*	As explained below in Section 2.6.7.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assuming all 80 tributaries upstream of the Oshetna will need to be surveyed using aerial spawning surveys as conducted for Study 9.7, the estimate cost of this modification is $1,500,000 and would only confirm what is already known regarding the spawning distribution of Chinook Salmon.
USFWS_pp9.11-1_ph2	*It should be noted that the objectives stated in the FSP vary somewhat from those identified in earlier version of the proposed study plans for the Project.*	This comment reflects a lack of understanding of FERC's ILP licensing process. It is intended that Study Plans, including objectives evolve as comments are made and inputs are incorporated from the applicant's initial proposal in the Proposed Study Plan, through the Revised Study Plan and again after the FERC Study Plan Determination, if applicable per FERC's recommendations.
USFWS_pp9.11-3_ph1	*The AEA was to compile the existing and background information available in an extensive list of items (Draft ISR 9.11, Appendix C), and disseminate this information to the FPTWG [sic]in preparation for the conceptual development brainstorming workshop, which has not yet occurred.*	It appears that USFWS did not consider the entire record. USFWS incorrectly states that the conceptual development brainstorming workshop has not yet occurred. The noted workshop did occur, defined as Workshop #2 on September 9-11, 2014 as reported in the SIR filed November 4, 2015, Section 5.1.1. Moreover, both USFWS staff and AEA-funded technical support for the Services participated in the workshop.
USFWS_pp9.11-4_ph5	*The FSP indicated these data would be used to develop the spreadsheet-based BPT, and the tool would be introduced to the FPTWG [sic] as a deliverable. Although an example of the BPT from another project was overviewed, the application of this BPT to the Project either had not yet been made or was not revealed to the FPTWG [sic].*	This statement is incorrect and not supported by the record. A preliminary example of the BPT framework for the Sustina-Watana Hydroelectric Project was developed as reported in the Study 9.11 SIR, Section 5.1.2 and Appendix A: Information Item B11. Biological Performance Tool. See Section 2.6.7.2 for additional information on Task 5.
USFWS_pp9.11-8_ph2	*At the time of drafting these comments, work on Task 4 had not commenced, nor has word on when it may commence been received. Delayed Task 4 work could cause a cascade effect to the schedule, and delay subsequent tasks (e.g., Task 5 and 6) and reporting.*	While AEA has reported schedule delay as a variance in the Study 9.11 ISR and SIR, at this point in the ILP process there is no reason to expect that these delays will affect AEA's ability to achieve study objectives when the study resumes. Tasks 1-4 have been initiated and Tasks 1-3 completed as reported in the Study 9.11 ISR Part D, Section 3. Task 4 has started and the brainstorming workshop occurred (Study 9.11 ISR, Part D, Section 3). Task 4, 5 and 6 will occur in the next year of study (Study 9.11 ISR Part D, Section 8). These latter tasks comprise the evaluation and refinement of passage alternatives and will actually benefit from the delay due to the ability to fully incorporate and

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		understand the additional data collected in 2014 of fish distribution and movements as summarized in the Study 9.5 and 9.6 SIRs and 9.7 SCR.
USFWS_pp9.11-10_ph3	*The lack of ecohydraulic models and predictive capability for the Devils Canyon reach is a problem when assessing passage conditions… Without an accurate model or assessment of the Devils Canyon reach, passage conditions cannot be correctly evaluated.*	See Section 2.6.7.4 below.
USFWS_pp9.11-10_ph7	*Recommendation 1. Work to get the study back on schedule.*	See Section 2.6.7.2 below.
USFWS_pp9.11-4_ph2	*The delayed schedule may have implications on Project design. An example of a potential negative implication is that the dam design may advance to a stage where incorporating certain fish passage components is not viable or much more difficult. This point was made by USFWS during the FPTWG [sic} meetings.*	AEA does not agree that the schedule delay for this study has implications for meeting the study objectives. The feasibility assessment will only benefit from data collection and Project plan refinement when the next year of study resumes. As stated in the ISR and SIR, delay in the schedule is not expected to have any impact on meeting study objectives. Even with a delayed schedule this fish passage feasibility study will be in synch with dam design to ensure the consideration of potential fish passage concepts. The FPTTincluded representatives from AEA and their dam design consultant MWH, and both the FPTT and designers were working in parallel and fully informed of goals. To this date, the dam design has not yet advanced to a point that would jeopardize any fish passage options.
USFWS_pp9.11-11_ph1	*Recommendation 2. Research Lake Trout life cycle, biological data, and predation behaviors of Lake Trout, including an assessment of the effect of Lake Trout in reservoirs on other fish populations (Vogel and Beauchamp, 2011; Yule and Luecke, 1993).*	While AEA thinks a more appropriate format for providing this information would have been during USFWS's participation in the FPTT during the brainstorming workshop conducted September 9-11, 2014 when the biological information was reviewed and discussed, AEA is appreciative of the citations provided, has reviewed and incorporated information from some documents already, and will review and incorporate additional relevant information into the biological information during the next update.
USFWS_pp9.11-11_ph2	*Recommendation 3. Conduct reservoir suitability research for rearing Chinook Salmon and other species (Connor, W.P., et. al., 2002; Rondorf, et. al. 1990)*	See Section 2.6.7.1.1.
USFWS_pp9.11-11_ph3	*Recommendation 4. Conduct evaluation of Chinook Salmon, and other species, life cycle response to swimming through the reservoir as this may help direct tributary juvenile collector requirements (Venditti, D.A., et. al., 2000; Berggren, T.J., and M.J. Filardo, 1993).*	See Section 2.6.7.1.1.

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USFWS_pp9.11-11_ph4	*Recommendation 5. Evaluate the potential effects of the anomalous hydrology experienced in the Susitna River in 2012 and 2013 with unusual increased late summer flows on species assemblages passing into the Upper River reaches. Specifically, determine if these higher than normal late summer and early fall flows may have adversely impacted the presence or absence of typical target species in the Upper River (e.g. Sockeye and Coho Salmon in particular).*	AEA does not agree that the hydrology of the Susitna River during the three years of data collection amounted to "anomalous environmental conditions" for the purposes of FERC's ILP regulations, 18 CFR § 5.15(d). Please see Section 1.5.1 for further discussion on the environmental conditions during data collection. See Section 2.6.7.3.1 regarding the extensive documentation of Chinook Salmon as the only anadromous salmonid ever found above Devils Canyon and the lack of evidence of the presence of any other anadromous salmonid above Devils Canyon.
USFWS_pp9.11-9_ph8	*In 2013, the Susitna River again experienced unusual increased flows in late August and early September. The effects of these late summer increased flows on species assemblages, passage conditions, and other passage-related environmental variables would have been observed in the sampling data collected in field studies in 2013, but were not distinguished as possibly having anomalous results.* *However, it is important to note that these two successive, anomalous hydrologic years may skew data sets compared to a typical or average year. In particular, passage conditions through the Devil's Canyon and dam site reaches may have been more adverse than in a typical year for late arriving fish, leading to anomalous observations of anadromous adult and resulting juvenile progeny salmonid presence. The USFWS questions whether the species observations made in juvenile collection efforts would have been different had a more normal hydrologic year been experienced (i.e., steadily declining flows from the peak in June through late fall).*	Please see Section 1.5.1 for further discussion on the environmental conditions during data collection. See Section 2.6.7.3.1 regarding the extensive documentation of Chinook Salmon as the only anadromous salmonid ever found above Devils Canyon and the lack of evidence of the presence of any other anadromous salmonid above Devils Canyon.
USFWS_pp9.11-11_ph5	*Recommendation 6. It is understood that water temperature downstream of the dam will likely increase and flows will likely be moderated during summer migration periods. Both of these factors may improve upstream migration capabilities of fish through Devil's Canyon. Conduct a thorough assessment of the Devil's Canyon impediments including water level and velocity profiles at different flows and cross sections and an assessment of potential fish abundance affected by the proposed dam (Powers, P.D. and J.F. Orsborn, 1985, Salinger, D.H., and J.J. Anderson, 2006).*	See Section 2.6.7.1.2.
USFWS_pp9.11-11_ph6	*Recommendation 7. Radio tagging fish has been suggested to potentially affect swimming capabilities and/or affect natural behavioral*	See Section 2.6.7.3.1.

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	tendencies. If this is the case for the AEA radio tagging assessments then a bias may be introduced to the studies where the population of Chinook Salmon is being underestimated and where other species with similar swimming capabilities (such as coho and sockeye) is being excluded (Gray, R.H., and J.M. Haynes, 1979; Mellas, E.J., and J.M. Haynes, 1985; Matter, A.L., and B.P. Sandford, 2003; Thorstad, E.B. et. al., 2000).	
USFWS_pp9.11-11_ph7	*Recommendation 8. The statement: "In general, Upper River Catch Per Unit Effort (CPUE) averages for juvenile chinook salmon were similar in magnitude to estimates of CPUE for Middle and Lower River sites" (ISR 9.5, Draft Feb 2014), may suggest that a larger percentage of the chinook run is migrating to the upper river than the radio tagging program indicates. Suggest that the timing of juvenile catch efforts could be modified, and additional years of replication might confirm upper river fish population and production.*	As explained in Section 2.6.7.3.1, AEA disagrees with this interpretation of the CPUE data. The comment also ignores the three years of Chinook Salmon aerial spawning surveys and sonar survey at the dam site that AEA conducted concurrent to the radiotelemetry study, as well as two years of juvenile sampling which all support that there are very few Chinook Salmon above Devils Canyon.
USFWS_pp9.11-11_ph8	*Recommendation 9. Recommend AEA evaluate methods other than radio tagging for assessing upstream migration capabilities and population estimates in the upper river for chinook and other species with similar swimming capabilities such as coho. Perhaps other methods of determining upstream populations are available that would not introduce tagging effects.*	This recommendation pertains to Study 9.7 and is directed at the FERC-approved Study Plan itself and not AEA's implementation. As explained in Section 2.6.7.3.1, there is no evidence of any anadromous salmonid above Devils Canyon other than Chinook Salmon which occur in very low numbers.
USFWS_pp9.11-11_ph9	*Recommendation 10. Large Coho Salmon will have similar swimming capabilities as Chinook Salmon (Bell, 1991) and Coho Salmon have been noted as having a Susitna River population (ISR 9.6 20160622-5099 FERC PDF (Unofficial) 6/22/2016 11:53:38 AM Initial Study Report-USFWS Comments Fish Passage Feasibility at the Watana Dam (9.11) Susitna-Watana Hydropower Project U.S. Fish and Wildlife Service FERC No. 14241 12 Save Date: June 20, 2016 Appendix D, Draft Feb 2014), yet this species has not been observed by AEA in the upper river reach. We recommend that AEA further investigate Coho Salmon passage into and through Devil's Canyon.*	As explained in Section 2.6.7.3.1, there is absolutely no evidence of Coho Salmon occurring above Devils Canyon..
USFWS_pp9.11-12_ph2	*Recommendation 11. Sockeye Salmon have been observed above the dam site by an ADFG biologist in the 1980s; however he did not photograph his observation so the information is not being used in the fish presence studies, yet it should be. However, sockeye have been*	As explained in Section 2.6.7.3.1, there is no evidence of any anadromous salmonid above Devils Canyon other than Chinook Salmon which occur in very low numbers.

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	noted in the Susitna River (ISR 9.6 Appendix D, Draft Feb 2014), and this information should be included in the evaluation of fish passage	
USFWS_pp9.11-12_ph3	*Recommendation 12. Research fish collection facilities and various effects on them with respect to ice conditions, including sheet ice, anchor ice, and frazil ice formation and breakup.*	The effects of ice on passage facilities has been discussed and is being incorporated in the fish passage feasibility study (Table 2 in Study 9.11 ISR Part A, Appendix A: *Fish Passage Technical Working Group Consultation Record*).
USFWS_pp9.11-12_ph5	*Under the "retrofit" alternative, AEA should identify any temporary measures that would be implemented to maintain Chinook Salmon (and other target species) access into the upper watershed, above the dam site, during both construction and initial operation of the proposed project (pending the construction of more permanent facilities).*	While not a specific objective of the feasibility study, identification of possible temporary solutions for fish passage has been addressed during Study 9.11. During the brainstorming workshop to develop conceptual alternatives, several alternatives were identified that were also suited for consideration as temporary passage alternatives. This characterization was carried forward into the reconciled brainstorm concepts and tally presented in Appendix C (*Reconciled Brainstorm Concepts and Tally*) of the Study 9.11 SIR.
USFWS_pp9.11-12_ph7	Hence, the proposed fish passage facility alternatives need to incorporate structural characteristics that would not only facilitate adult and juvenile salmonid passage but also the unique passage requirements of Arctic Lamprey, Burbot, Longnose Sucker, and other native target species with relatively unique swimming/migration characteristics and constraints.	This comment appears to reflect a lack of familiarity with the record for Study 9.11. AEA proposed and the FPTT discussed target species for inclusion in the fish passage feasibility analysis. The FPTT decided upon a representative species approach for incorporating biological information into the study. Species were selected that represent a larger group of fishes with similar life history characteristics, including: Chinook Salmon representing the anadromous salmon and Artic Grayling represent migratory non-anadromous salmonids and catostomids as well as Burbot due to their unique spawning periodicity and mode of swimming. Arctic Lamprey are not currently being targeted because the current data indicates their presence is restricted to the Middle and Lower River. The representative species concept is used to help build in flexibility of passage alternatives that will be successful passing a variety of species and life stages. Using assumptions and building in flexibility are accepted approaches in the industry for fish passage feasibility studies in lieu of expensive models or studies that may or may not provide sufficient information for understanding future conditions.
USFWS_pp9.11-13_ph1	*When the conceptual fish passage alternatives analysis is commenced, it should consider operations and maintenance issues as well as fish passage, collection and transportation issues.*	AEA agrees that operation and maintenance issues should be considered as well as fish passage, collection and transportation issues, and have been included in the draft evaluation criteria and will be refined per the Study Plan through Task 6. A comprehensive set of evaluation

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		criteria has been provided as noted in the Study 9.11 SIR Section 5.1.2 filed with the Commission November 4, 2015.
USFWS_pp9.11-13_ph2	*Modification 1: Given that the Project is expected to modify downstream water temperatures in winter, USFWS recommends that water quality studies include consideration of temperature effects on benthic macro invertebrate populations and juvenile salmonid egg and embryo development and timing. Water temperature effects on invertebrate and salmonid eggs and embroyo development is connected to the fish passage studies because Middle and Upper River fish populations including anadromous, adfluvial, and resident species will be affected by water temperature modifications. For example, warmer winter water temperature in the Upper and Middle River reaches below the dam may increase the speed of development of salmonid and other species' eggs and move up the timing of embryo emergence (BC Hydro, 2012). If this timing occurs before the annual increase in benthic invertebrate abundance, the emerging salmonid fry may experience difficulty in finding adequate food sources.*	AEA requests that FERC not adopt this proposed Study Plan modification as this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan and it is well beyond the scope of Study 9.11 as approved by FERC and is unnecessary for a fish passage feasibility study. The instream flow (Study 8.5), fish distribution and abundance (Studies 9.5 and 9.6) and river productivity (Study 9.8) study plans, the ice processes study (Study 7.6), and the water-quality modeling study (Study 5.6) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. The impact analysis will consider Project-induced changes to temperature and ice processes and how those changes would impact salmonid life history and benthic macroinvertebrates. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). There is no cost estimated for this modification as temperature effects on aquatic species will be evaluated as part of the impact analysis supporting the License Application.

2.6.7.1. Task 2: Prepare for Feasibility Study

2.6.7.1.1. Response to Modification Request to Expand the Literature Review

NMFS (Modification 2-1; NMFS_pp9.11-2_ph9) and USFWS (Recommendation 3 [USFWS_pp9.11-11_ph2]; and Recommendation 4 [USFWS_pp9.11-11_ph3]) have requested the literature review be expanded to better understand how well juvenile and adult riverine species navigate through a still body of water).

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not demonstrated that the literature review was not implemented as provided by the approved Study Plan.

In its comments, NMFS asserted that "*the study was not conducted as provided for in the approved Study Plan because salient information about whether adult and juvenile fish will efficiently navigate miles of flat water without negative impacts was not included.*"

This statement disregards materials that have been provided to the Fish Passage Technical Working Group and reflects a misinterpretation of the intent of the Study Plan regarding use of biological information. First, information about the ability of fish to navigate reservoirs has been included in the SIR, Appendix B: *Information Item B12. Summary of Biological Information*. This document presents conceptual models for each of three representative species and discusses how these fish are likely to respond to the future impoundment conditions based on existing information at other projects. Furthermore, SIR, Appendix A: *Information Item B11. Biological Performance Tool* includes metrics that will be used to evaluate reservoir passaging, including estimates of reservoir mortality and travel time. In addition, as stated in Study 9.11 ISR Part A, Section 5.2, the physical and biological information lists used by the Fish Passage Technical Working Group are by design "living documents" that will be updated throughout the study as new, relevant information becomes available. Because Study 9.11 is not yet complete, all existing and new information (some from other ongoing Susitna-Watana studies) will be used to evaluate alternatives after they are developed. This concept is also shown in RSP Figure 9.11-2, *Fish passage feasibility interdependencies with other AEA studies*, in the FERC-approved Study Plan. Given the demonstrated intent of incorporating new salient biological information during this study, including available information of fish passage through reservoirs, the NMFS modification is not necessary.

2.6.7.1.2. Response to Recommendation to Assess Devils Canyon Impediments

USFWS contends that water temperature downstream of the dam will likely increase and flows will likely be moderated during summer migration periods, possibly improving upstream migration capabilities of fish through Devils Canyon. Therefore, USFWS has recommended a thorough assessment of the Devils Canyon impediments including water level and velocity profiles at different flows and cross sections and an assessment of potential fish abundance affected by the proposed dam (Recommendation 6; USFWS_pp9.11-11_ph5).

AEA asserts that the potential for improved passage conditions at Devils Canyon are conjecture and are irrelevant to the Fish Passage Feasibility Study. The Fish Passage Feasibility Study will be informed by available information regarding fish species biology and ecology because even if passage were improved there is no basis for assuming which species would expand their range upstream into or through Devils Canyon. Regardless, adaptability of potential passage alternatives is one of the draft evaluation criteria presented at the December 3, 2014 FPTT meeting and would address the uncertainty around future needs for passage and unknown number of additional fish species, life stages.

It is important to note that AEA will be managing the temperature of water released during the summer so as to not substantially change water temperatures downstream of the dam during the period that anadromous fish are migrating, from approximately July 1 through September. In addition, even small temperature changes that might occur would be expected to be lower than ambient river temperature in the summer due to a temperature lag in the reservoir warming as compared to the river. Thus, it is not at all likely the Project would increase the water temperature through Devils Canyon during the anadromous fish migration period.

2.6.7.2. Task 5: Evaluate Feasibility of Conceptual Alternatives

NMFS requested one modification to Task 5, Evaluate Feasibility of Conceptual Alternatives (see below). In addition, the Services submitted other comments associated with Task 5 which are not substantiated by the FERC record. NMFS indicated that Task 5 had not been initiated (NMFS_pp9.11-3_ph7) while USFWS recommended getting *"the study back on schedule*" (USFWS_pp9.11-10_ph7) and stated that the application of this BPT to the Project either had not yet been made or was not revealed to the FPTT (USFWS_pp9.11-4_ph5). These statements are incorrect. A comprehensive set of evaluation criteria for use with the matrix has been developed and addressed at each FPTT meeting; a sample matrix communicating how it would be formatted was presented at the September 2013 site tour; and a preliminary example of the biological performance tool (BPT) framework was developed as reported in the Study 9.11 SIR, Section 5.1.2 and Appendix A: *Information Item B11. Biological Performance Tool*. In addition, a review of the draft evaluation criteria and matrix was conducted during the FPTT meeting on December 3, 2014, for which both the USFWS and NMFS staff participated.

2.6.7.2.1. Response to Modification Request to Determine Timing Information for Passing Juvenile Salmon

NMFS (Modification 5-1; NMFS_pp9.11-3_ph7) requests that AEA determine the timing (now and in the future) when juvenile salmon would need to be collected from tributary mouths, moved across the reservoir and finally over the dam by evaluating current and future outmigration timing in Study 9.5 Fish Distribution and Abundance in the Upper River and coupling that information with earlier melt out and water stream temperatures in the Study 7.7 Glacier and Runoff Changes.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

Information regarding the timing of fish movements into and out of tributaries as well as past the proposed dam site is being gathered under the fish distribution and abundance studies (RSP

Sections 9.5 and 9.6) and not Study 9.11. The timing information has been incorporated into this study as it has become available. The existing biological information was provided with the ISR (Study 9.11 ISR Part A, Appendix B: *Biological Information*), and was updated for representative species in the SIR (Study 9.11 SIR, Appendix B: *Information Item B12. Summary of Biological Information*). As stated in the ISR (Study 9.11 ISR Part A, Section 5.2), these biological appendices are intended to be living documents and will be updated with new, relevant information from other studies, including those conducted by AEA and others published in the scientific community throughout the implementation of Study 9.11.

While AEA agrees that downstream passage alternatives are complicated by the potential for fish outmigration under ice, the NMFS's Modification 5-1 is not necessary for completion of the fish passage feasibility analysis. First of all, relevant information on the timing of fry emergence and juvenile outmigration is available from studies 9.5 and 9.6. This information will be considered in the analysis along with relevant periodicity information from the literature. In addition, the BPT will allow the FPTT to adjust migration timing to understand the implications for inter-annual variability, as well as help assess the risks associated with partial collections of outmigrating juveniles when considering both tributary collectors as well as other downstream passage facilities within the reservoir.

The BPT will be used to address downstream passage data uncertainties. As stated in RSP Section 9.11.4 of the FERC-approved Study Plan:

> *Due to the nature of this Project, particularly with respect to its location in the Upper River and the uncertainty around the potential benefits and risks of passage to fish species, this task also involves development of a spreadsheet-based biological performance tool. This tool will be used to qualitatively estimate potential passage success using concepts to be identified and refined in the feasibility study. Examples of challenging issues that can be addressed with this tool include the following: low survival success of downstream migrants through the reservoir, the potential for transporting adult Chinook Salmon upstream that do not intend to go there, and the potential for spread of non-native fishes. The biological performance tool will present the positive and negative biological effects associated with the various passage concepts under consideration.*

Even with additional study it will not be feasible to quantify the extent or timing of fish movement that will occur under ice or with break up. Instead, as is often the case during the feasibility analysis, the FPTT will be asked to generate assumptions about likelihood of occurrence of this life history strategy. The BPT model will then be used to evaluate how the different downstream passage alternatives will be able to perform to maximize passage and minimize risks given the varying assumptions. The BPT model has been used successfully during fish passage feasibility analysis to help passage experts envision future potential scenarios where data are limited or are not applicable to future conditions. Staff from the NMFS Southwest Region have approved use of the BPT to help evaluate passage alternatives and most recently have requested the application of the BPT in a fish passage feasibility study on the Santa Inez River specifically because data collection relevant to the future condition is not feasible, as is the case with the Susitna.

2.6.7.3. Task 6: Develop Refined Passage Strategy(ies)

NMFS requested one modification to the Study Plan under Task 6 and the USFWS staff made several comments or "recommendations" regarding the adequacy of the existing information on the occurrence and distribution of spawning salmon above Devils Canyon, related to NMFS's modification request. The USFWS also made one modification request pertaining to future changes in migration through Devils Canyon.

2.6.7.3.1. Response to Modification Request Regarding the Adequacy of Upper River Data to Support the Feasibility Study

NMFS (Modification 6-1; NMSF_pp9.11-4_ph1) recommends that the number of tributaries above the reservoir where fish spawn be determined. Without this information, NMFS states that the scale and therefore cost of any fish passage operation is unknown. The USFWS (Recommendation 5; USFWS_pp9.11-11_ph4) recommends AEA evaluate the potential effects of the "anomalous" hydrology experienced in the Susitna River in 2012 and 2013 to determine if these higher than normal late summer and early fall flows may have adversely impacted the presence or absence of typical target species in the Upper River (e.g. Sockeye and Coho Salmon in particular) and comments that collecting fish distribution and abundance data during two anomalous years could skew the data set (USFWS_pp9.11-9_ph8). The USFWS also made recommendations for additional desktop or field-based data collection based on their concerns regarding potential bias from a behavioral response to radio tagging which may have resulted in missing other salmon species passing upstream of Devils Canyon (Recommendation 7 [USFWS_pp9.11-11_ph6]; Recommendation 9 [USFWS_pp9.11-11_ph8]) or that Coho Salmon (Recommendation 10; USFWS_pp9.11-11_ph9) or Sockeye Salmon (Recommendation 11; USFWS_pp9.11-12_ph2) may occur in the Upper River or that the numbers of adult Chinook Salmon may be underestimated due to similar CPUE between the Middle and Upper River (Recommendation 8; USFWS_pp9.11-11_ph7).

AEA requests that FERC not adopt NMFS's proposed Study Plan modification or consider the USFWS's recommendations because neither the request nor the recommendations meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification or demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions.

These comments disregard the three years of results presented in the documents associated with Study 9.5 Fish Distribution and Abundance in the Upper River and Study 9.7 Salmon Escapement that demonstrate the limited distribution of anadromous salmon spawning in the Upper River (SIR Sections 5.3.1.5 and 5.3.1.6) and reflect a lack of understanding about the existing biological information that has been presented in the Study 9.11 SIR regarding salmon spawning distribution in the Upper River as well as the use of the evaluation tools, the BPT and the evaluation matrix. As explained in RSP Section 9.11.4 and at length during FPTT meetings, the BPT will be used to address data uncertainties and an evaluation matrix will be used to advance the existing state of each alternative's conceptual design for better performance, and will allow a relative comparison of the alternatives. The evaluation will be done by using a grid analysis technique, or Pugh Matrix, which breaks the alternatives down into discrete elements for comparison, evaluation, and optimization. It is reasonable to see how one of these elements could be the ability to incorporate collection of juveniles from future occupied spawning tributaries, or flexibility of the alternative to increasing run size. Breaking the alternatives into discrete elements reduces the possibility of alternatives being selected based on general prejudiced opinions. The matrix will result in consolidated scores that reflect the relative success of achieving criteria, and will thus help rank or prioritize alternatives.

The existing data is sufficient to inform the fish passage alternatives analysis and no additional information on the "number of tributaries where fish spawn" is needed to meet the objective of the fish passage feasibility study. Even if the scale of the salmon run were to change by one or two orders of magnitude, the feasibility study can be conducted in a way to address such a variation in scale. In addition, variation in the number of potential spawning streams that may result post-impoundment can be addressed when using the evaluation matrix to compare and contrast among downstream passage alternatives.

As to the distribution of anadromous fish spawning in the Upper Susitna, AEA disagrees with the USFWS implications (USFWS_pp9.11-11_ph4; USFWS_pp9.11-11_ph6; USFWS_pp9.11-11_ph7; USFWS_pp9.11-11_ph8) that AEA data collection efforts are insufficient or biased with respect to providing relevant existing data on salmon in the Upper River for Study 9.11 and the comments ignore other existing information. Chinook Salmon are the only anadromous fish ever documented upstream of Devils Canyon.

From 2012 to 2014, AEA radio tagged 9,661 adult salmon including, 4,352 Chinook, 2,291 Coho, 1,431 Pink, 1,080 Chum, and 509 Sockeye salmon. Of these 9,661 tagged fish, a total of 17, over three years, were detected upstream of the Devils Canyon passage impediments and they were all Chinook Salmon. None of the tagged Sockeye or Coho salmon passed upstream of Devils Canyon in any of the three years. Previously, ADF&G had tagged and tracked 2,031 Susitna River salmon including 833 Coho Salmon in 2001, 2009-2010, 614 Chum Salmon in 2009 and 2010 and 684 Sockeye Salmon in 2006-2008 and none of these tagged salmon were ever detected above Devils Canyon (Cleary et al. 2013, Merizon et al.2010, Yanusz et al. 2011a, Yanusz et al. 2011b). In addition, Chinook Salmon are the only anadromous fish documented during the 7 years of aerial spawning surveys conducted in tributaries from Cheechako to Fog creeks (1982-1985) and from Cheechako Creek to the Oshetna River (2012-2014) (Study 9.7 SCR 5.3.1.6). Six years of juvenile fish sampling (1984, 2003, 2011, 2012, 2013, 2014) by both ADF&G and AEA (more than 17,850 fish collected from 2012 through 2014 alone), including genetic sampling of 819 juvenile salmon collected by AEA within and upstream of Devils Canyon), has only documented Chinook Salmon presence within and above the Canyon and upstream in the Upper River.

Despite independent efforts to do so, no other anadromous salmon has ever been documented upstream of Devils Canyon. The Services maintain a lingering notion that an ADF&G fish biologist anecdotally noted many Sockeye Salmon adults near the mouth of the Oshetna River (USFWS_pp9.11-12_ph1). The fish biologist has never documented this occurrence and cannot substantiate the date, the location or the fish species identification; ADF&G does not have any report of this occurrence in its Anadromous Waters Catalogue (http://www.sf.adfg.state.ak.us/SARR/AWC/index.cfm). In addition, both the Susitna River and the Oshetna River are turbid during the time that, if present, Sockeye Salmon adults would be migrating, holding, or spawning in this area; the visibility would be poor. While AEA was conducting these studies, a guide from the area contacted the then regional ADF&G biologist indicating he thought he observed, from the air, many “spawning salmon” in a headwater lake to Tsisi Creek, a tributary to Kosina Creek. At the request of ADF&G, AEA further investigated the potential sighting and added this area to both the aerial spawning surveys and fish distribution sampling. The large salmonids in Tsisi Creek were positively identified as a large school of Lake Trout; no anadromous salmonids were located (Study 9.7 SCR Section 5.3.2.3; Study 9.5 SIR Section 5.1.1.2.

Additional data on the presence of adult and juvenile Chinook Salmon has been used to infer use of tributaries for spawning since 1982. Spawning tributaries, within and upstream of Devils Canyon, that have been documented from the many years of data collected by both ADF&G and AEA observational and radio tag data include Cheechacko (downstream of Impediment 2), Chinook (downstream of Impediment 3), Devil, Fog, Tsusena, and Kosina creeks and the Oshetna River. Of these streams, only Kosina Creek and the Oshetna River are located upstream of the proposed dam site.

The USFWS concerns regarding representativeness of the data due to recent collection during anomalous years of hydrology (USFWS_pp9.11-9_ph8, USFWS_pp9.11-11_ph4) or potential bias from a behavioral response to radio tagging which may have resulted in missing other salmon species passing upstream of Devils Canyon (USFWS_pp9.11-11_ph6; USFWS_pp9.11-11_ph8) or that Coho Salmon (USFWS_pp9.11-11_ph9) or Sockeye Salmon (USFWS_pp9.11-12_ph2) may occur in the Upper River or that the numbers of adult Chinook Salmon may be underestimated due to similar CPUE between the Middle and Upper River (USFWS_pp9.11-11_ph7) are unfounded as they do not consider the extensive existing dataset. All of the data collected in Upper Susitna River from 9 years of study conducted during the last 32 years, using multiple methods in various years, repeated methods across some years, concurrent sampling by varying methods, and targeting both juveniles and adults in some years point to the same conclusion. All existing data consistently confirm the presence of only Chinook Salmon above Devils Canyon, that they occur in very low numbers and within a limited and patchy distribution.

Furthermore, AEA disagrees with the USFWS assertion that collecting data that incorporates annual variation in fish distribution and abundance could skew the data sets. It rather provides additional data points to add to the existing data to characterize fish populations in the Upper River. In addition, it is important to note that to date, AEA has conducted surveys in the Upper River in 2102, 2013 and 2014. With the next year of study implementation for Study 9.5 and 9.6, AEA will have collected data over four calander years. AEA reminds FERC that during this time a total of 21,380 fish were collected in the Upper River, 9,600 adult salmon were radio-tagged, and annual spawner surveys were conducted from 2012 to 2014. All of these data are consistent with previous studies by ADF&G in the 1980s and 2003. For example the peak counts of fish within and upstream of Devils Canyon are the same order of magnitude as in the 1980s (Table 2.6.7-2). These data do not indicate that the data set collected by AEA is skewed, in fact it supports the historic ADF&G data about use of the Upper River basin by anadromous salmon.

Table 2.6.7-2. Peak Count of Adult Chinook Salmon From Aerial Spawner Surveys and by Year (9.7 SCR, Table 5.3-5).

Stream	Year						
	1982	1983	1984	1985	2012	2013	2014
Within Devils Canyon							

Cheechacko	16	25	19	18	5	40	16
Chinook Creek	5	8	15	1	5	2	5
Upstream of Devils Canyon							
Devil Creek	0	1	0	0	7	25	10
Fog Creek	--	--	2	0	1	2	3
Tsusena Creek	--	--	0	0	0	4	
Upstream of Proposed Dam Site							
Kosina Creek	--	--	--	--	16	3	0

AEA's analysis of potential handling effects for radio-tagged salmon have been presented in Study 9.7 ISR Part A, Section 5.1.5 and Study 9.7 Study Completion Report (SCR), Section 5.1.4 and indicate that there was no detectable behavioral response to tagging.

Regarding the implications CPUEs of similar magnitude in the Upper and Middle River study areas, AEA disagrees that similar CPUEs implies anything about estimates of the number of adult salmon moving into the Upper River. Instead what this data does indicate is that AEA's sampling of Chinook Salmon, in habitats where they were present, was similarly effective in both river segments. A further look at the CPUE data would show a large number of sites sampled in the Upper River had zero catch of Chinook Salmon indicating that these fish are rare and very patchy throughout the study area (see Section 2.6.1.9.2 for additional discussion).

AEA has collected data on the distribution and abundance of anadromous fish in the Upper River that is consistent with historic records and strengthens our scientific understanding of the current distribution of anadromous salmon in Susitna River. Requiring more study, above and beyond what has already been done (Study 9.5 Fish Distribution and Abundance in the Upper Susitna River, Study 9.6 Fish Distribution and Abundance in the Middle and Lower Susitna River, Study 9.7 Salmon Escapement Study, Study 9.8 River Productivity) and the remaining steps to complete the FERC-approved Fish Distribution and Abundance studies (Study 9.5 and Study 9.6) would be costly and has very little probability of finding information to contradict the historic and recent data on salmon distribution in the Upper River.

2.6.7.4. Response to Comment Regarding the Lack of Ecohydraulic Models for the Devils Canyon Reach

USFWS (USFWS_pp9.11-10_ph3) comments that the lack of ecohydraulic models and predictive capability for the Devils Canyon reach is a problem when assessing passage conditions through the reach leading up to the dam. Without an accurate model or assessment of the Devils Canyon reach, USFWS asserts that passage conditions cannot be correctly evaluated. USFWS also believes this shortfall should be addressed as soon as possible in the ongoing hydraulic and hydrologic studies of the Middle and Upper River reaches.

Evaluating fish passage through Devils Canyon is not an objective of Study 9.11. While rigorous predictive models can be helpful in understanding future conditions, AEA disagrees that modeling passage through Devils Canyon is necessary to meet the Study 9.11 goal of assessing passage alternatives for upstream and downstream passage of fish at the proposed dam. This study will make use of existing information that has been and will continue to be collected by other studies and the modeling tools used in this study will allow for the evaluation of uncertainties in the existing data. However, because the ability to predict the future is challenged even with the use of ecohydraulic models, the study is being conducted using assumptions about upstream migrating fish that, based on existing information, are likely to arrive at the dam site, and is exploring means on how to pass them.

Furthermore, as discussed with the FPTT during meetings, the brainstorm workshop, and as presented in the Study 9.11 SIR Appendix B, a representative species concept is being used for incorporating biological information into the study. Several representative species were selected that represent a larger group of fishes with similar life history characteristics, including: Chinook Salmon representing the anadromous salmon and Artic Grayling represent migratory non-anadromous salmonids and catostomids as well as Burbot due to their unique spawning periodicity and mode of swimming. The representative species concept is used to help build in flexibility of passage alternatives that will be successful passing a variety of species and life stages. Using assumptions and building in flexibility are accepted approaches in the industry for fish passage feasibility studies in lieu of expensive models or studies that may or may not provide sufficient information for understanding future conditions.

Finally, it is worth noting that the collection of data that would be required to develop an ecohydraulic model of Devils Canyon would likely pose unacceptable risk. Given the channel configuration, gradient, substrate, water temperture and flows the majority of the Canyon is not safe for surveying.

2.6.7.5. References Cited

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2.6.8. Study 9.12 – Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries

As established in the Study Plan[32] (RSP Section 9.12.1), the goal of the study is to evaluate the potential effects of Project-induced changes in flow and water surface elevation on free access of fish into, within, and out of suitable habitats in the Upper Susitna River (inundation zone above the Watana Dam site) and the Middle Susitna River (Watana Dam site to the confluence of Chulitna and Talkeetna rivers).

The specific objectives of the Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries, as described in the Study Plan (Study 9.12 RSP, Section 9.12.1 and IP Section 3), are:

- Locate and categorize all existing fish passage barriers (e.g., falls, cascade, beaver dam, road or railroad crossings) located in selected tributaries in the Middle and Upper Susitna River (Middle River tributaries to be determined during study refinement).
- Identify and locate using GPS the type (permanent, temporary, seasonal, partial) and characterize the physical nature of any existing fish barriers located within the Project's ZHI.
- Evaluate the potential changes to existing fish barriers (both natural and man-made) located within the Project's ZHI.
- Evaluate the potential creation of fish passage barriers within existing habitats (tributaries, sloughs, side channels, off-channel habitats) related to future flow conditions, water surface elevations, and sediment transport.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes no modifications to Study Plan Section 9.12.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS and USFWS submitted the same seven study modification proposals for Study 9.12. Several comments were also filed by the Services and ADF&G. AEA's responses to the proposed modifications and comments can be found in Table 2.6.8-1 and below. For the narrative responses, AEA organized similar comments by topic to provide integrated responses and facilitate review.

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[32] The FERC-approved Revised Study Plan (RSP) Section 9.12 for the Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries Study (BARR) as modified by FERC's Study Plan Determination (Study 9.12 SPD, February 1, 2013) and *Study of Fish Passage Barriers Implementation Plan* (Study 9.12 IP, June 17, 2013) is collectively referred to as Study Plan Section 9.12.

Table 2.6.8-1. Study 9.12 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp15_ph2	*We noticed that there was no upper Susitna River fish passage barrier information presented in the ISR report. The uppermost site described in the report was Tsusena Creek, below the proposed dam site. Upper River barriers need to be identified in future results/studies.*	Most of the Upper River barriers study field data was collected in 2012 and reported on in Section 2-6 of the 2012 9.5 Fish Distribution and Habitat study report (HDR 2013). As indicated in ISR Part A, Section 4.3.1, 79 Upper River tributaries were surveyed between the proposed dam site and the Oshetna River (Table 4.3-1 I in HDR 2013). Field teams covered 851 stream miles, and 72% of barriers were located in tributaries draining into the reach from Devils Canyon upstream to the proposed dam site. Five of the tributaries located upstream of Devils Canyon that were surveyed in 2012 required follow up in 2013. These were reported on in Study 9.12 ISR Part A, Section 5.1 with photos and field notes provided in 9.12 ISR Part A, Appendix A.
ADNR_ADFG_pp15_ph3	*We are in agreement with the target fish species and passage criteria developed for the selected fish species. We believe significant progress has been made and that the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's reviews and support for AEA's ongoing implementation of the FERC-approved Study Plan.
NMFS_pp9.12-1_ph4, USFWS_pp9.12-4_ph1	*Modification 1-1 (NMFS), Modification 1 (USFWS). For Upper River tributaries, [the Services] recommend collecting field data and model velocities and water depths over distance to determine the location of the first velocity migration barrier upstream from the mainstem Susitna River for all target fish species and life stages. We recognize that modeling water velocities in Upper River tributaries to evaluate AEA's passage criteria may be onerous. As an alternative, [the Services] recommend that AEA identify the combination of channel slope and distance that will likely results in velocity barriers….Tributary water surface elevations may be available from LiDAR data or may require additional field work. .*	As explained below in Section 2.6.8.1, AEA requests FERC not adopt this proposed Study Plan modification. AEA disagrees that this modification is necessary to evaluate Project effects. Because existing LiDAR data is limited to the reservoir varial zone, additional field work would be needed.to collect data on velocities. Thus, the estimated cost of implementing this modification is a minimum of $100,000 per tributary (based on the cost of 2-D modeling on the order of 1 mile of tributary, on the average), or much greater per tributary depending on the length on tributary surveyed and the number of survey nodes acceptable. Given that the current distribution and fish movement data show migratory fishes moving over 10 miles into some tributaries (e.g., Kosina, Watana), the per tributary cost could be one or more orders of magnitude greater than $100,000 for these tributaries. Even assuming the minimum cost of $100,000 per tributary with 47 primary tributaries in the Upper River, the minimum estimated cost of implementing this modification is $4,700,000.
NMFS_pp9.12-2_ph1, USFWS_pp9.12-5_ph6	*Modification 1-2 (NMFS), Modification 2 (USFWS). For all Middle River tributaries downstream from and including Portage Creek, [the Services] recommend collecting field data and model water velocities in two dimensions to evaluate fish passage criteria target fish species and life stages.*	As explained below in Section 2.6.8.2, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is from $3,000,000 to $6,000,000 to model the 4 basic with-Project scenarios, depending on the number of the 69 Middle River tributaries with active fans that are added to the 2-D modeling effort. Each additional operational scenario would cost on the order of $300,000 to $700,000 depending on the number of tributaries modeled.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.12-2_ph2, USFWS_pp9.12-6_ph1	*Modification 2-1 (NMFS), Modification 3 (USFWS). [The Services] recommend conducting winter field surveys during January and February in all Middle River focus areas to measure water depth and velocity longitudinally throughout all side channels, side sloughs, and upland sloughs to identify locations that are currently barriers to fish migration.*	As explained below in Section 2.6.8.3 AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost for implementing this modification is $300,000 to $600,000 and assuming one year implementation is sufficient.
NMFS_pp9.12-2_ph3, USFWS_pp9.12-6_ph4	*Modification 2-2 (NMFS), Modification 4 (USFWS). The [Services] recommend installing water level loggers and develop stage discharge relationships (rating curves) at multiple locations in all Middle River focus area side sloughs and side channels in order to estimate water velocity and fish passage barriers during winter ice development.*	As explained below in Section 2.6.8.4, AEA requests FERC not adopt this proposed Study Plan modification. AEA disagrees that this modification is necessary to evaluate Project effects. The estimated cost for implementing this modification is $130,000 to $200,000.
NMFS_pp9.12-2_ph4, USFWS_pp9.12-7_ph2	*Modification 3-1 (NMFS), Modification 5 (USFWS). For the Upper River tributaries collect field data and conduct two-dimensional modeling of water depths and velocities to locate all velocity, depth and leap barriers to target fish species from the low pool elevation under low water years and under all operational scenarios upstream to the first barrier upstream from high pool elevation.*	As explained below in Section 2.6.8.5, AEA requests FERC not adopt this proposed Study Plan modification. Based on the 2-D modeling costs for Middle River Tributary deltas, the estimated cost for implementing this modification would be $100,000 per tributary delta or $6,800,000 total and likely much greater depending on the distance subject to 2-D modeling in each of the 68 Upper River tributaries.
NMFS_pp9.12-2_ph5, USFWS_pp9.12-7_ph4	*Modification 3-2 (NMFS), Modification 6 (USFWS). The [Services] recommend a study modification that would incorporate results from the 6.6 geomorphology study and 8.6 riparian instream flow to model tributary delta formation and channel morphology, water depths and water velocities within the reservoir varial zone. (This is similar to modifications 2.5 in Study 6.6).*	As explained below in Section 2.6.8.6, AEA requests FERC not adopt this proposed Study Plan modification. There would be no cost associated with this modification assuming that the approach AEA has already proposed for tributary delta modeling under Study 6.5 (1-D BEM at mainstem above the reservoir and 6 tributaries for an estimated cost of $400,000 - $500,000 [Table 7.1-1 of 6.5 ISR Part C]) is sufficient.
NMFS_pp9.12-2_ph6, USFWS_pp9.12-8_ph2	*Modification G- (Global) (NMFS), New Study Modification (USFWS). [The Services] recommend expanding the geographic scope of this study 9.12 to include the Lower River from Talkeetna to PRM 24.*	As explained below in Section 2.6.8.7, AEA requests FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this proposed modification ranges from $1,000,000 upward dependent upon the number of tributaries, sloughs, culverts surveyed and modeled. The approximate cost for each habitat modeled would be $100,000.
NMFS_pp9.12-2_ph7, USFWS_pp9.12-1_ph4a	*The [Services] believe that the approved study plan remains incomplete and does*	AEA disagrees that the FERC-approved Study Plan itself is incomplete. AEA has laid out the field and analytical approach that will be used to evaluate barriers in the

Reference Number	Comment or Study Modification Request	AEA's Response
	not provide the methods necessary to meet the study objectives	RSP Section 9.12, the Study 9.12 Implementation Plan (IP), and in the ISR. While not all details of model integration are refined at this time, an approach, similar to that implemented by ADF&G in the 1980s was presented in Section 9.12.4 of the RSP, the study sites were described in Section 7.1 of the IP, models that will be used for predicting future impacts were presented in IP Sections 7.2 and 7.3, and criteria that will be used to evaluate the model have been presented (Section 5.1 of the SIR) and discussed with the technical team and modified with team input (March 19, 2014 and December 2, 2014). AEA has made progress towards meeting the study objectives and as stated in Study 9.12 ISR Part D, Section 8, is at the point of determining how best to integrate the barrier data collected under this study with data collected in Study 6.5, with 1-D and 2-D models developed as part of studies 6.6 and 8.5.
NMFS_pp9.12-2_ph7a, USFWS_pp9.12-1_ph4b	*Passage criteria are incomplete, and the specific criteria that will be used to identify leap barriers, depth barriers, or velocities and times to fish exhaustion (prolonged and burst) are still unclear.*	AEA disagrees with this comment. AEA has proposed very specific species and life stage specific criteria and has presented and discussed these criteria with agencies at least at two different meetings where NMFS and USFWS staff participated and provided input (March 19, 2014 and December 2, 2014) as well as at the March 2016 ISR meetings and in the Study 9.12 SIR. The criteria were taken from the literature and are well established for most species. There are a few species where surrogates were necessary and they were identified in the Study 9.12 SIR, Section 5.1.2 and Table 5.1-5. As AEA reported at the March 2016 ISR Meetings and in the 9.12 SIR, Section 8, what remains to be determined is how the data collected in the field, the passage criteria, and model outputs all can be integrated for the evaluation of fish barriers in the Middle River tributary deltas and sloughs.
NMFS_pp9.12-2_ph7b, USFWS_pp9.12-2_ph4a	*The approved study plan does not describe the methods that will be used to model these hydraulic and physical habitat characteristics (outside of focus areas), or the field data to be collected as model input for sites within the ZHI where barriers are likely to occur (Upper River and Middle River tributaries, beaver dams, railroad crossings).*	AEA has laid out the field and analytical approach that will be used to evaluate barriers in the RSP Section 9.12, the Study 9.12 Implementation Plan (IP), and in ISR. While not all the details of model integration are refined at this time, an approach, similar to that implemented by ADF&G in the 1980s was presented in Section 9.12.4 of the RSP, the study sites were described in Section 7.1 of the IP, models that will be used for predicting future impacts were presented in IP Sections 7.2 and 7.3, and criteria that will be used to evaluate the model have been presented (Section 5.1 of the SIR) and discussed with the technical team and modified with team input (March 19, 2014 and December 2, 2014). AEA has made progress towards meeting the study objectives and as stated in Study 9.12 ISR Part D, Section 8, are at the point of determining how best to integrate the barrier data collected under this study with data collected in

Reference Number	Comment or Study Modification Request	AEA's Response
		Study 6.5, with 1-D and 2-D models developed as part of studies 6.6 and 8.5. AEA has reported that first the barrier data will be integrated with the existing models within Focus Areas and then how best to simulate a similar, but one-dimensional, analysis to tributary deltas that were surveyed outside of Focus Areas will be determined. Field data collected outside of Focus Areas has been presented in the 2012 Upper Susitna River Fish Distribution and Habitat Study Habitat Report, the Study 9.12 ISR, and Study 9.12 SIR. The field data collected within Focus Areas by studies 6.6 and 8.5 are addressed in Study 6.6 ISR Part A, Section 5.1.9, Study 6.6 SIR Section 5.1.2, Study 8.5 ISR Part A, Section 4.6 and Study 8.5 SIR Sections 4.6.1 and 4.6.2.
NMFS_pp9.12-3_ph2, USFWS_pp9.12-2_ph3	*Since this FERC recommendation has not been accomplished, the study has not been implemented as described in the approved plan and is subject to recommended study modifications necessary to meet study objectives.*	The Services incorrectly state that FERC's SPD recommendation has not been accomplished. The quotation the Services refer to was not part of the FERC Staff Recommendation for Study 9.12 and did not pertain the Upper River. As requested by the FERC SPD recommendation, AEA filed a Study 9.12 Implementation Plan on June 15, 2013 that specifically addressed RSP deficiencies, including specification of models that would be used to address velocity and depth barriers. The IP met FERC criteria and is considered part of the FERC-approved Study Plan for Study 9.12. See Section 2.6.8.1 below for additional discussion.
NMFS_pp9.12-3_ph3, USFWS_pp9.12-2_ph4b	*Thalweg surveys of depth and velocity at a single tributary flow at a less than 10m intervals, as shown in the Initial Study Report (ISR) are insufficient for the evaluation of passage criteria for target fish species, and cannot be used to model hydraulic conditions (in two dimensions) and fish passage under variable mainstem water surface elevations and tributary flows.*	AEA disagrees with this comment. The Study Plan (Study 9.12 Implementation Plan Sections 7.1.3, 7.2 and 7.3.1) indicates that 2-D modeling will be used to evaluate off-channel and tributary deltas at intensive study sites within Focus Areas (FAs). Thalweg surveys were conducted outside of FAs, and the data collected from those surveys will be integrated with 1-D models being developed as part of Study 6.5 and Study 6.6 tributary delta task (see Study 6.5 ISR Part A, Section 4.8.2.2 and Study 6.6 ISR Part A, Section 4.1.2.6). Model integration is ongoing (9.12 ISR Part D Section 8). See Section 2.6.8.2 below for additional discussion.
USFWS_pp9.12-2_ph2	*Methods have not been developed to model post-hydraulic conditions necessary to evaluate passage criteria In Upper River tributaries.*	The FERC-approved Study Plan for Study 9.12 did not propose evaluation or modeling of post-hydraulic conditions in Upper River tributaries as the potential for Project effects to Upper River tributaries is limited to within the reservoir ZHI. See Section 2.6.8.1 below for additional discussion.

2.6.8.1. Response to Modification Request to Extend 2-D Modeling to Upper River Tributaries

The NMFS (Modification 1-1; NMFS_pp9.12-1_ph4) and USFWS (Modification 1; USFWS_pp9.12-4_ph1) request AEA collect field data in Upper River tributaries to evaluate fish passage. NMFS states that data needs to be collected at the necessary spatial scale and to model velocity/depth in two dimensions over distance to determine the location of the first migration barrier upstream from the Susitna River for all fish target species and life stages.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" for the modification nor have they demonstrated the plan was not implemented as provided by the approved Study Plan or under anomalous conditions. This modification is inconsistent with the FERC-approved Study Plan and the Services have not demonstrated any new information about potential Project impacts that would justify this request.

Project operation will create a reservoir in the Upper River that will inundate lower reach(es) of existing tributaries. In 2012 and 2013, AEA conducted surveys of 79 Upper River tributaries and existing geologic barriers contained within them. These surveys demonstrated that the reservoir would inundate only one existing barrier. By inundating the lower portion of the tributaries the Project would decrease the velocities dramatically, dropping it to near or at zero. This velocity change would occur only within the inundation zone as the Project has no potential to effect tributary flows. Velocity changes alone would not be expected to impact fishes' abilities to pass upstream. The potential for sediment deposition to occur within the inundation zone and for the channel morphology of tributaries with in the varial zone is being evaluated by the Geomorphology Study, Study 6.5 (see RSP Section 6.5.4.8.2.2, ISR Part C Section 7.2.1.8, and SIR Section 5.8.2).

Two-dimensional modeling of tributaries is not a practical approach to evaluating the current occurrence of depth and velocity barriers over miles of high gradient tributary habitat found in the Upper Susitna River and is unnecessary. Both depth and velocities vary dramatically with flow and change rapidly with bedload movement that occurs with flow events and annually due to ice processes in the Upper River. As boulders move around they create velocity breaks and small pools in different locations. These features facilitate fish passage through otherwise seemingly impassible shallows and/or fast riffles. Even if 2-D modeling were not cost prohibitive, such modeling of depth and velocities over miles of river would not be useful for predicting where on that continuum a barrier might occur. Substrate in these rivers can move and the configuration of the stream bed changes; therefore, many of the depth or velocity barrier determined from a longitudinal survey would be temporary.

The alternative approach suggested by the Services also would not adequately characterize passage barriers. It would result in coarse estimates of velocity that may or may not be passable. However, it would not address the potential edge effects that reduce velocities at channel margins and around in-stream structure that provide passage routes for fish. Examples of this are evident from fish sampling and include the boulder riffles and cascades present in several tributaries upstream of Devils Canyon. AEA contends that a much more reasonable approach for evaluating fish passage barriers in tributaries beyond documenting waterfalls and cascades would be to utilize the fish distribution data collected during Study 9.5 and look for truncation in actual distributions compared to expectation based on available habitat.

The Services disagree with the FERC-approved Study Plan methods (NMFS_pp9.12-2_ph7b and USFWS_pp9.12-1_ph4), and state that the methods were not described for field data collection within the ZHI and modeling hydraulic and physical characteristics outside of Focus Areas. AEA disagrees. Detailed modeling methods are presented in Section 7.3 of the Study 9.12 Implementation Plan as well as RSP Sections 9.12.4.5.1.1.3 and 9.12.4.6 where field methods for field data collection in sloughs and tributary deltas are described. Please note that these sections also indicate the data collected on Study 9.12 will supplement the data collected under the Fluvial Geomorphology Study (Study 6.6).

In their comments, the Services speculate about existing velocity barriers to fish, yet do not demonstrate any potential nexus between such barriers and the Project. While AEA agrees that there are likely areas within many tributaries where velocities exceed fish swimming abilities at times, the 2012 data from Study 9.5 (see HDR 2013, Section 5.2.2.2 and Figure 7) clearly indicate that fish (including Dolly Varden, Arctic Grayling, Sculpin and whitefish) are distributed well upstream of the maximum elevation affected by the inundation zone in all tributaries surveyed. These distribution data demonstrate that the natural variation in flows allow for successful passage conditions to exist even within the high velocity, high gradient Upper River tributaries. Furthermore, regarding the Services' statements that methods have not been developed to model "post-project hydraulic conditions" for evaluating fish passage condition in Upper River tributaries (NMFS_pp9.12-3_ph2, USFWS_pp9.12-2_ph2), that was not part of the FERC-approved Study Plan and AEA has not proposed operations that would affect tributary flow or velocities upstream of the inundation zone; therefore, there is no Project nexus to this proposed modification.

The Services assert that meeting study objectives requires an understanding of the tributary habitats "determined as the distance upstream from the Susitna River to the first barrier". This appears to be related to a mistaken precept that AEA will evaluate Project effects by comparing the currently available fish habitat with the distance fish can migrate into the tributaries under different flow scenarios. This type of analysis has not been proposed by AEA. AEA asserts that a better approach to documenting increased fish use of available habitat is documenting changes in fish distribution and or movements via biotelemetry.

In their comments, the Services incorrectly assert that AEA did not implement FERC's recommendation (NMFS_pp9.12-3_ph2, USFWS_pp9.12-2_ph3) as provided in FERC's Study Plan Determination 4/1/2013 [sic]) pertaining to methods set forth in Section 9.12.4.5 of the RSP. As points of clarification, NMFS confused the date of the FERC study determination on Study 9.12 as being April 1, 2013 instead of February 1, 2013 and the FERC SPD text that the Services quote was taken from FERC's discussion of *Depth Barriers in Sloughs, Side Channels, Tributaries, and Tributary Deltas* (page B-33 of February 1, 2013 Study Plan Determination) not from their Staff Recommendation on pages B-35 and B-36. Additionally, both NMFS and USFWS excerpted only a portion of FERC's recommendation and applied it out of context to the Upper River tributaries. In doing so the Services failed to acknowledge that: 1) FERC's recommendations were specific to additional information on implementation of the study in the *Middle River* study area and 2) as required by the FERC's recommendation, AEA filed a Study 9.12 Implementation Plan on June 15, 2013 that specifically addressed FERC criteria, including documentation of review and comment by the Services, and was incorporated into the Study Plan. While the Services may disagree with FERC's determinations, they have not demonstrated "good cause" to change the FERC-approved Study Plan, or adequately substantiated that AEA has not implemented the Study Plan consistent with the FERC SPD or that AEA has not made sufficient progress toward meeting study objectives at this interim point in the ILP process.

Additional comments the Services submitted under Modification 1 that do not relate to Upper River sampling are addressed above within Table 2.6.8-1.

2.6.8.2. Response to Modification Request to Collect Data in Middle River Tributaries and Model Velocity and Depths in Two Dimensions to Evaluate Fish Passage Criteria

The NMFS (Modification 1-2; NMFS_pp9.12-2_ph1) and USFWS (Modification 2; USFWS_pp9.12-5_ph6) recommend that AEA collect field data in all Middle River tributaries, downstream of and including Portage Creek, at a sufficient spatial scale necessary to support 2-D modeling of water depths and velocities, in order to evaluate passage criteria for target fish species and life stages.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d); this modification is inconsistent with the FERC-approved Study Plan, is not about AEA's implementation of the FERC-approved Study Plan, and the Services have not demonstrated any new information that would justify this request.

Two-dimensional modeling for all Middle River tributaries downstream of Portage Creek was not part of the FERC-approved Study Plan. Methods for tributary selection was described in Section 7.3.1 of the Fish Barriers Implementation Plan for tributaries within Focus Areas. Selection for tributaries outside of Focus Areas was described in Study 6.6 ISR Part C, Section 7.1.1.1.1. Both methods were reported in Attachment 6 to Study 9.12 ISR Meeting Summary filed with the Commission April 2016.

AEA asserts that it is not practical, nor necessary, to collect data and conduct 2-D modeling of all tributaries in the Middle River. First, not all of the tributaries in the Middle River support migratory fish, so evaluating fish passage barriers in these small tributaries would be unnecessary. Second, not all of the tributaries in the Middle River have sufficient sediment production as evidenced by the lack of a fan, so once again evaluating Project impacts on this tributary feature is unnecessary. Third, 2-D modeling requires intensive computer simulation and it would dramatically increase the cost of Study 9.12 to expand the 2-D modeling from the 7 tributaries identified in Study 6.6 ISR Part C, Section 7.1.1.1, Table 7.1-1 up to the 69 tributaries that occur in the Middle River. AEA has selected tributaries in the Middle River for modeling effects consistent with 2-D modeling that was proposed for Focus Area characterization and based on data that suggest the tributaries are used by fish and they have sufficient sediment production that the presence of a ZHI might possibly affect the morphology of the tributary delta. This is the appropriate scale of the study to address the potential to affect fish barriers at tributary deltas, as provided for in the FERC-approved Study Plan.

In addition, 15 tributaries were selected for 1-D model of potential delta formation. In Study 6.6 is was shown that the 1-D procedure provided similar results in evaluating the formation of delta deposits under existing and with-Project condition. This was demonstrated in the FGM Development TM (see Study 6.6 SIR Attachment 1, Sections 5.1.5, 5.2.1, and 5.2.2). The dynamic effects at Skull Creek were demonstrated using the 2-D BEM and compared with fan growth calculations based on 1-D model results. This type of analysis of tributary delta modeling will be conducted for the 15 Middle River Tributaries identified in Table 7.1-1 of the Study 6.6 ISR Part C.

2.6.8.3. Response to Modification Request for Winter Velocity and Depth Surveys in Focus Areas to Identify Current Fish Barriers Under Ice

The NMFS (Modification 2-1; NMFS_pp9.12-2_ph2) and USFWS (Modification 3; USFWS_pp9.12-6_ph1) request that AEA conduct field surveys to measure depths and velocity in all sloughs and side channels within Focus Areas to document locations that are currently barriers to fish migration.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d); this modification is inconsistent with the FERC-approved Study Plan, and the Services have not demonstrated any new information that would justify this request. Because AEA agrees that there are likely velocity, depth and ice barriers to fish passage during winter and that the Project has the potential to affect these conditions, AEA is already including their integrated flow-habitat modeling in Focus Areas as part of the FERC-approved Study Plan (RSP Section 8.5.4.8). Two-dimensional modeling implemented as part of Studies 6.6, 7.6 and 8.5 will be sufficient to address flow conditions under ice in sloughs and additional depth and velocity measurements in sloughs beyond that collected for the 2-D mesh in Study 6.6 is not necessary. As an example, the River 2-D model development and calibration for FA-128 (Slough 8A) was described in Study 7.6 SIR Section 5.3.

2.6.8.4. Response to Modification Request for Installing Water Level Loggers at Middle River Focus Areas and Developing Discharge Rating Curves to Predict Water Velocities During Ice Development

The NMFS (Modification 2-2; NMFS_pp9.12-2_ph3) and USFWS (Modification 4; USFWS_pp9.12-6_ph4) recommend that AEA use two water level loggers in five Focus Areas to develop stage-discharge relationships that can be used to estimate water velocities and fish barriers during winter ice development.

AEA requests that FERC not adopt this proposed Study Plan modification to Study 9.12 because this request does not meet the criteria established in 18 C.F.R. §5.15(d). The Services have not demonstrated why the modeling methods implemented as part of the FERC-approved Study Plan are not sufficient to meet study objectives or why the approved Plan is deficient.

AEA agrees that there are likely velocity, depth and ice barriers to fish passage during winter and that the Project has the potential to affect these conditions. Based upon this recognition, AEA has already included integrated flow-habitat modeling in Focus Areas (RSP Section 8.5.4.8) as part of the FERC-approved Study Plan. This includes 2-dimensional modeling in Focus Areas.

The development of stage-discharge relationships to predict water velocities during ice development in Focus Areas is not necessary and not feasible. AEA is already conducting modeling that will be used to predict velocities in Focus Areas. Two-dimensional modeling implemented as part of Studies 6.6, 7.6 and 8.5 will be sufficient to address flow conditions under ice in sloughs. As an example, the River 2-D model development and calibration for FA-128 (Slough 8A) was described in Study 7.6 SIR Section 5.3. Finally, it is highly unlikely that this modification request would be feasible because once level loggers are covered by ice and under pressure they would no longer accurately record water surface elevation/stage. Any rating curves developed from this data would be subject to an unknown amount of error.

2.6.8.5. Response to Modification Request for 2-D Modeling in Upper River Tributaries

The NMFS (Modification 3-1; NMFS_pp9.12-2_ph4) and USFWS (Modification 5; USFWS_pp9.12-7_ph2) state that locating all velocity, depth and leap barriers for target species is necessary to determine how far these fish can migrate from the reservoir up tributaries and to compare available tributary habitat. Thus, the Services recommend that AEA collect field data and conduct two dimensional modeling to identify all barriers within and upstream from proposed low pool elevation to high pool elevation.

AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as the Services have failed to demonstrate “good cause” for this modification and have not demonstrated Project nexus for studying tributaries upstream of the reservoir varial zone.

As an initial matter, there are contradictions within the Services’ proposed modification. The Services first asks for location of all potential barriers up to the first leap barrier in the Upper River tributaries (NMFS) and to the first barrier “upstream of the high pool elevation” (USFWS), and discuss the need for determining “how far target fish species can migrate from the reservoir up tributaries” (NMFS). However, later in their proposal, the Services request 2-D modeling within the reservoir varial zone. Given the language in this modification, AEA’s interpretation is that Modification 3-1 is to model all potential fish barriers from the low pool elevation to the first leap barrier documented in each Upper River tributary whether it is within or upstream from the reservoir varial zone.

Modeling depth and velocity barriers in the approximately 68 Upper River tributaries that would drain into the reservoir is not part of the FERC-approved Study Plan. The 9.12 Study Plan called for the location and characterization of existing fish barriers such as waterfalls, cascades, beaver dams and road crossings for selected Upper River tributaries. Data collection was implemented by AEA in 2012, 2013 and 2014 and reported in 2012 Upper Susitna River Fish Distribution and Habitat Study Habitat Report (HDR 2013), Study 9.12 ISR Part A, Section 5.1 and Study 9.12 SIR Section 5.2. In addition, the FERC-approved Study Plan for Study 6.5 includes a task to model changes in Upper River tributary deltas with a one dimensional model (RSP Section 6.5.4.8.2.2). Integration between Study 9.12 and the Study 6.5 tributary modeling is presented in the Study 9.12 ISR Part D, Section 8 *Steps to Complete the Study*.

Two-dimensional modeling of tributaries is not a practical approach to evaluating the current occurrence of depth and velocities barriers over miles of high gradient tributary habitat found in the Upper Susitna River and is unnecessary to assess Project effects. Both depth and velocities vary with flow and change rapidly with bed mobilization that occurs with high flow events. Modeling cells would require a resolution on the order of 1 foot on a side to represent boulders and the gaps between boulders. Models at this resolution would require on the order of 100,000 elements per mile for a stream averaging 20 feet in width. Both the modeling and data collection efforts would be excessive to perform this type of analysis. Furthermore, as boulders move around during high flow events, they create velocity breaks and small pools in different locations. These features facilitate fish passage through otherwise seemingly impassible shallows and/or fast riffles.

Even if 2-D modeling were not cost prohibitive, such modeling of depth and velocities over miles of river will have limited usefulness for predicting where on that continuum a barrier might occur. Substrate in these rivers can move and the configuration of the stream bed, any depth or velocity barrier determined from a longitudinal survey would be temporary. AEA contends that a much more reasonable approach for evaluating fish passage barriers in Upper River tributaries beyond documenting waterfalls and cascades would be to utilize the fish distribution data collect during Study 9.5 and look for truncation in actual distributions compared to expectations based on available habitat.

2.6.8.6. Response to Modification Request to Integrate Study Results to Model Tributary Delta Formation, Channel Morphology, Water Depths and Velocities Within the Reservoir Varial Zone

The NMFS (Modification 3-2; NMFS_pp9.12-2_ph5) and USFWS (Modification 6; USFWS_pp9.12-7_ph4) recommend that Study 9.12 incorporate results from the Riparian Instream Flow Study (Study 8.6) and Fluvial Geomorphology Study (Study 6.6) to model post-Project changes in tributary delta formation, tributary channel geometry and ultimately water depths, and water velocities to evaluate fish passage criteria within the reservoir varial zone. NMFS indicated that this is similar to their request for Modification 2.5 of Study 6.6.

AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established “good cause” as required by the ILP regulations, nor have they demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

To clarify, Study 8.6 does not extend into the Upper River and Study 6.6 does not include the modeling of Upper River tributaries, so there are no results to incorporate from these studies. One-dimensional modeling and analysis of the Upper River tributaries is part of Study 6.5 and AEA has already described the incorporation of Study 6.5 results in this study. Model integration is presented in the Next Steps for the Study in ISR 9.12 Part D, Section 8 and in Study 6.5 in the SIR as well as the ISR Part D. Modeling of the tributaries was described in the FERC-approved Study Plan in RSP Section 6.5.4.8 with the final tributary selection documented in the Study 6.5 ISR Part C, Section 7.1.1.8. and Table 7.1-1. Further, 1-D BEM modeling of the mainstem above the reservoir was added by AEA as a proposed modification to the FERC-approved Study Plan as described in SIR 6.5 Section 7.2.3. In all resource areas, AEA has been and will continue to incorporate all relevant data gathered to characterize baseline conditions and complete a comprehensive analysis of Project effects for the License Application. For these reasons, this proposed modification should not be adopted.

While Studies 6.5 (Upper River) and 6.6 (Middle River) will provide the ability to predict the likelihood of Project operations resulting in hanging deltas for selected tributaries with active fan deposition, they will not provide a detailed 2-D mapping of the constantly changing distributary channels formed on the deltas and the associated depths and velocities across the delta. Due to the dynamic nature of these tributary delta habitats and the scale at which the models can operate, producing such a 2-D map would only serve to demonstrate the wide variety of depths and velocities that occur at that moment in time. Naturally occurring channel changes will result from cobbles and boulders moving, sediments being deposited and flow shifts and would negate the utility of such a detailed map. In order to model potential Project effects on barrier creation at Upper River tributary deltas, modeling needs to occur at a scale that would be reproducible over time given the dynamic nature of this habitat.

AEA maintains the methods proposed in the FERC-approved Study Plan for Study 6.5 (RSP Section 6.5.4.8) are the appropriate scale for modeling tributary deltas in the varial zone. In the *2014 Fluvial Geomorphology Model Development Technical Memorandum* (Study 6.6 SIR Attachment 1, Section 6.1.3), it was shown that the 1-D and 2-D modeling approaches for Skull Creek at FA-128 produced similar results in terms of delta formation evaluation under with-Project conditions. In the Middle River, the 2-D modeling approach is being used in the selected tributary deltas within the Focus Area and the 1-D approach in the selected tributary deltas outside of the Focus Areas. It is also noted that the 2-D model cell resolution is on the order of 10 to 20 feet on a side and is not intended to model the changes in small distributary channels on the delta, but rather the overall accumulation of material in the delta area and the extension of the delta as sediment accumulates from the tributary and the retreat of the delta is material is eroded by the main channel. This basic geometry is sufficient to determine whether a conditions exists at the interface between the topset and foreset slope that will create a fish barrier (a hanging delta) during low flows on the mainstem. As indicated in the Study 6.6 SIR Attachment 1, the 1-D modeling approach also was able to provide a similar prediction. The 1-D modeling approach is also what is proposed for the Upper River tributaries in the reservoir inundation zone. Middle River Tributaries experience a range of water surface at their mouths of approximately 10 feet for existing and with-Project conditions as controlled by Susitna River flows. In contrast, the Upper River Tributaries will annually experience a range of water surface elevation of more than a hundred feet. Therefore, hanging deltas are very unlikely to form because the water will not remain at any level for an extended period.

Therefore, AEA concludes that it is not practical, nor necessary, to collect data and conduct 2-D modeling of depth and velocities in 68 Upper River tributaries. First, not all of the tributaries in the Upper River are known to support fish, so evaluating fish passage barriers in these small tributaries is unnecessary. Second, not all of the tributaries in the Upper River have sufficient sediment production as evidence by the lack of a fan (depositional feature) at their confluence with the Susitna, so once again evaluating Project impacts on this tributary feature is unnecessary. Third, while Studies 6.5 and 6.6 will provide the ability to predict the likelihood of Project Operations resulting in hanging deltas, they will not predict changes in velocities and depths at a local scale. Fourth, 2-D modeling requires intensive computer simulation and it would dramatically increase the cost of Study 6.5 to expand the proposed modeling from 6 tributaries

(ISR 6.5 Part C, Section 7.1.1.8) and the mainstem Susitna River (ISR 6.5 Part D, Section 7.2) to all 68 that drain into the inundation zone.

It is not reasonable to incorporate the results from Study 8.6 however, as the reservoir varial zone is located upstream of the proposed dam and the study area for Study 8.6 was limited to downstream of the proposed dam site where riparian effects are anticipated (RSP Section 8.6.2). However, the results of the vegetative mapping study, Study 11.5 will help to inform changes in vegetation in tributary channels within the reservoir varial zone.

2.6.8.7. Response to Modification Request to Expand the Study into the Lower River

The NMFS (Modification Global-1; NMFS_pp9.12-2_ph6) and USFWS (New Study Modification; USFWS_pp9.12-8_ph2) state that they anticipate measurable alteration to the Lower River will occur as a result of the proposed Project operation and, therefore request the study area be extended to include from the Three Rivers Confluence (RM 98.5) to at least Sunshine Station (RM 24.9) to understand Project effects on fish access to main channel, side channel and off channel habitats including beaver ponds.

AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have they demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

To clarify, there is no site called *Sunshine Station* located at *RM 24.9* as stated in the Services' request. In AEA's Susitna-Watana Hydro Project studies, the *Sunshine* site is located at PRM 83.8 while *Susitna Station* is generally located at PRM 29.9. AEA assumes the lower extent of the Services' request refers to Susitna Station at PRM 29.9. That said, AEA disagrees with the Services' assertion regarding changes to the Lower River. AEA has conducted biophysical effects assessments in the Lower River and has concluded that changes in river stage in the Lower River would not materially affect the flow dependent downstream resources (see Section 1.5.3.2). Specifically, the preliminary data collection in Lower River to date indicate a very low potential for barrier creation at tributary deltas (see Section 1.5.3.8 of this document for additional discussion). In addition, the intense dynamic nature of the lateral channels in the Lower River precludes AEA's ability to predict where channel creation or closure may occur under future conditions.

In consideration of any potential for Project impacts in the Lower River, AEA has presented a phased approached for determining if Study 9.12 should extend to the Lower River as presented in the Fish Barriers Implementation Plan, Section 7.5. In addition, AEA established and presented criteria that would trigger expanding this study into the Lower River in Study 9.12 ISR Part C, Section 7.1.1.1. This expansion would be consistent with flow-habitat modeling that has been proposed for the Instream Flow Study (RSP Section 8.5.4.2). Furthermore, AEA is currently studying the potential for depositional barriers to form at tributary mouths (Study 6.6 ISR Part A, Section 5.1.6). As stated in Study 9.12 ISR Part D, Section 8, AEA has agreed to consider the results from the Barrier Study in the Middle River where potential Project impacts on the lower reaches of tributaries would be the greatest, and if there are predicted impacts to barriers in the

Middle River, AEA will extend the study into the Lower River consistent with modeling proposed in Study 8.5.

As part of the decision to extend several studies below PRM 79 in the LR, five tributary mouths were selected for study (R2 2013 and Tetra Tech 2013): Birch Creek (PRM 92.5), Trappers Creek (PRM 94.5), Sheep Creek (PRM 69.5), Caswell Creek (PRM 67.0) and the Deshka River (PRM 45.0). These tributaries were selected for study to identify whether there was potential for fans to form at the tributary mouths as a result of Project induced changes in stage and flows in the adjacent Susitna River mainstem or side channel. The purpose of the tributary mouth studies was to identify whether fan formation could result in barriers that would hinder access for adult salmons attempting to spawn in the tributaries. The five tributaries were visited in 2013 (Study 6.6 ISR Part A, Section 5.1.9.3) and 2014 (Study 6.6 SIR, Section 5.1.2.3) to conduct cross sections surveys and bed material sampling as well as to make general observations.

Though the studies have not been formally completed, based on the site conditions and knowledge of the geomorphology of the Lower River gained from other efforts conducted in the Geomorphology Studies, there is very little potential for barriers to form at the tributary mouths in either the existing condition or with-Project condition. In contrast to the Middle River tributaries, the tributaries to the Lower River discharge to the Susitna River at or across the extensive Susitna River floodplain and thus confluence conditions are inherently adjustable depending on flow and sediment supply from the tributaries and the locations of the receiving Susitna River mainstem or lower order side channels. The west side tributaries (e.g. Trappers Creek, Deshka River) have very low sediment loads due to their contributing drainage basins being primarily underlain by late-Pleistocene-age glacial till and glacio-lacustrine sediments that support extensive areas of muskeg. Therefore, the potential for tributary mouth barriers to form under Project conditions is very low since there is insufficient coarse sediment supply to form fan deposits and the Project will have no effect on either the tributary flows or sediment yields. The smaller east side tributaries (e.g. Birch Creek and Caswell Creek) also drain areas underlain by Late-Pleistocene–age glacial and glacio-lacustrine sediments that support extensive muskeg. Consequently, for the same reasons as for the west side tributaries, there are unlikely to be any tributary mouth barriers under with-Project conditions. The larger east side tributaries drain the Talkeetna Mountains and do carry a substantial sediment load (e.g. Sheep Creek, Willow Creek, and Kashwitna River). However, though both the flows and sediment loads from the larger tributaries are substantial, the lower reaches will be able to adjust both laterally and vertically because their mouths are not fixed by bedrock or other erosion-resistant materials. Consequently, it is highly unlikely that tributary mouth barriers will form under Project conditions in the Lower River.

With respect to side channel and slough habitats, the Lower Susitna River is very dynamic with lateral channel features constantly changing. This is documented in Tetra Tech (2014a) in which a turnover analysis was conducted and showed that in the Lower River conversion of channel to floodplain and floodplain to channel over the past 60 years occurred at rates on the order of 10 times higher than in the Middle Susitna River with the majority of geomorphic reaches in the Middle River experiencing turnover rates of 0 to 10,000 ft^2/yr/mile while the majority of the Lower River geomorphic reaches had turnover rates between 100,000 and 300,000 ft^2/yr/mile . Investigating changes in habitat features specifically, Tetra Tech (2013) compared the areas of aquatic macrohabitat types at similar flows at selected sites in the Middle and Lower Susitna River Segments between the 1983 and 2012 to determine how dynamic these features were under existing hydrological and sedimentological regimes. The macrohabitat types included, main channel, side channels, side sloughs, upland sloughs and tributary mouths, turbid backwaters and secondary side channels. In the Lower River, the analysis of five specific locations (Side Channel IV-4, Willow Creek, Goose Creek, Montana Creek and Sunshine Slough) associated with the lateral tributaries showed that all habitat types were dynamic and most changes were associated with large scale erosion that has resulted in altering the locations and types of connections between the main channel and the lateral habitats or in some cases entirely eroding the geomorphic features associated with the lateral habitat.

The Lower River also displayed dynamic behavior in terms of the relative proportion of habitat in each type present in 1983 versus 2012. For example, the combined clearwater/side slough habitat type either increased or decreased by a factor of nearly two for all five sites with three sites showing an increase and two sites a decrease. Under these types of dynamic conditions in which channels are actively shifting, new channels forming and old channels being eroded, it is extremely unlikely that the Project will impact the potential for the formation of barriers to restrict fish access into and out of lateral habitats. Channel changes continuously occur in the Lower River morphology that alter access to lateral habitats with access increasing due to some features by erosion of bars or shifting of a channel toward the lateral habitat and in other locations, the reverse reduces access. Furthermore, there are locations where the lateral habitats are actually eroded or clearwater habitats are converted to turbid water habitats by the shifting main channel and major side channels. Finally, new lateral habitat may be created as active side channels are completely or partially abandoned.

Given the very dynamic nature of the Lower River habitats under existing conditions, it is reasonable to conclude that they will continue to be dynamic under Project conditions in the Lower River where the flow and sediment regimes are only slightly less than under existing conditions. The attenuation of Project effects on flows and channel morphology in the Lower River compared to the Middle River is a result of the large inflow of water and sediment from the Chulitna and Talkeetna Rivers at the Three Rivers Confluence and then further downstream below the Yentna River confluence. This is documented in Tetra Tech (2014b) which shows a reduction in annual peak flows on the order of 15 to 20 percent at Sunshine (PRM 88.3) and of 5 to 10 percent Susitna Station PRM (29.9) and similar change in the annual sediment load. These changes in peak flows translates into potential for only minor changes in the channel width of 10 percent or less at Sunshine and on the order of 5 percent at Susitna Station. Therefore, there will be little change in the physical processes that restrict access to lateral habitats in some instances and provide access to lateral habitats in other instance in the Lower River for with-Project conditions compared to existing conditions.

2.6.8.8. Response to Comment on Adequacy of Thalweg Survey Data

NMFS (NMFS_pp9.12-3_ph3) and USFWS (USFWS_pp9.12-2_ph4) contend that the thalweg survey data (as reported in the ISR) are insufficient for the evaluation of passage criteria for target fish species, and cannot be used to model hydraulic conditions (in two dimensions) and fish passage under variable flows.

AEA disagrees that the data are insufficient but agrees that they are not suited to conduct 2-D hydraulic modeling, as that was never the intention. As described in the Study 9.12 IP Section

7.3.1 and consistent with FERC SPD recommendations (February 1, 2013), AEA located fish passage barrier intensive sampling sites for both the ice-free and ice-cover periods within the selected Focus Areas. Ice-free data collection includes a larger number and diversity of sample locations at off-channel and tributary deltas. Both ice-cover and ice-free passage data collection sites will be located to overlap with fine mesh 2-D modeling domains. The exact locations of fine mesh sampling domains was determined by the Fluvial Geomorphology Modeling Study, RSP Section 6.6. Focus Area study sites for modeling juvenile passage during the ice-cover period were selected as part of RSP Section 7.6 - Ice Processes in the Susitna River Study and RSP Section 8.5 - Fish and Aquatics Instream Flow Study.

For areas outside of where the 2-D mesh has been applied (outside of Focus Areas), AEA has not proposed and is not planning on conducting 2-D modeling of potential fish barriers. Only one dimensional models are available for making any future predictions. Consequently, the barrier data has been collected to link to 1-D models.

While the specific integration with 1- and 2-D models has not yet been determined (Study 9.12 ISR Part D, Section 8), AEA asserts that the data collected during thalweg surveys on water surface elevation, depth and velocity can be used in combination with habitat data collected within the Middle River ZHI, LiDAR data, and fish distribution data from Study 9.6 can be used to evaluate if current impassable depths and velocities occur in tributary mouths (similar to the analysis recommended by the NMFS and USFWS for Upper River tributaries in their respective Modifications 1-1 and 1 for this study). The models will provide the methods AEA can use to predict if and how tributary channel gradient or morphology may change, and affect the creation of barriers in the future.

2.6.8.9. References Cited

HDR. 2013. 2012 Upper Susitna River Fish Distribution and Habitat Study: Fish Distribution Report. Susitna-Watana Hydroelectric Project (FERC No. 14241) Prepared by HDR for Alaska Energy Authority, April 2013.

R2 Resource Consultants, Inc. (R2). 2013. Selection of Focus Areas and Study Sites in the Middle and Lower Susitna River for Instream Flow and Joint Resource Studies - 2013 and 2014, Susitna-Watana Hydroelectric Project. Prepared for Alaska Energy Authority. Anchorage, Alaska.

Tetra Tech. 2013. Mapping of Aquatic Macrohabitat Types at Selected Sites in the Middle and Lower Susitna River Segments from 1980s and 2012 Aerials. Susitna-Watana Hydroelectric Project. 2012 Study Technical Memorandum. Prepared for the Alaska Energy Authority. Anchorage, Alaska.

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2.6.9. Study 9.13 – Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area

As established in the Study Plan[33] (RSP Section 9.13.1), the goals of this study are to: (1) characterize baseline conditions of the aquatic habitat and fish species composition in the vicinity of the proposed Project's infrastructure including access roads, transmission lines, airports, construction areas, and operation facilities; (2) evaluate the potential for the proposed Project's infrastructure to affect these resources; (3) provide data for determining the least environmentally damaging alternative for purposes of U.S. Army Corps of Engineers issuance of a dredge and fill permit under Section 404(c) of the Clean Water Act; and (4) provide data for developing any necessary PM&E measures, which may include resource management and monitoring plans.

The study objectives established in RSP Section 9.13.1 consist of the following:

- Characterize the aquatic habitats and fish assemblages at potential stream crossings within a 200-meter (650-foot) buffer zone along proposed access road and transmission line alignments.
- Describe aquatic habitats and species present within the construction area for the dam and related hydropower facilities.

To date, no directed field surveys have been conducted for this study. Historical and current fish distribution and abundance data has been compiled for streams intersecting the potential access and transmission corridor alignments (ISR Part A). No reporting has occurred on this study since the June 2014 ISR and the field data collection for this study has been deferred until future implementation of the study. As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes three modifications to Study Plan Section 9.13:

1. Elimination of the Chulitna Corridor from the study area;
2. Addition of the Denali East Option Corridor to the study area; and
3. Conduct 2 sampling events during a single year of study instead of once in each of two years.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement, however licensing participant Ms. Rebecca Long submitted a study modification proposal for Study 9.13. AEA received no

[33] The FERC-approved Revised Study Plan (RSP) Section 9.13 for the Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area (AQTRANS) as approved by FERC's Study Plan Determination (Study 9.13 SPD, February 1, 2013) is referred to as Study Plan Section 9.13.

comments on AEA's proposed modifications to Study 9.13 outlined above. No other comments were filed for Study 9.13.

2.6.9.1. Response to Modification Request to Expand Water Quality Sampling

Ms. Rebecca Long (Long_160620_pp03_ph1) requested the Study Plan be modified to add baseline water quality testing at stream crossings, buffer zones and Project infrastructure to assess turbidity, fine sediments, heavy metals, and hydrocarbons.

AEA requests that FERC not adopt this proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. This request would extend water quality data collection beyond the FERC-approved Study Plan for baseline water quality data collection, without justifying why that is necessary for this study.

Information on water quality, turbidity and fine sediment is being gathered as part of this study as it relates to fish resources, to characterize aquatic habitat. As stated in RSP Section 9.13.4.2.1, during habitat surveys information on substrate compositions will be collected (this will include percent fines). In addition, estimates of water clarity are a component of the habitat characterization protocol. As stated in RSP Section 9.13.4.2.1, water quality field parameters were selected "*to meet permitting requirements (e.g., ADF&G Fish Habitat Title 16 Permit). Several water quality parameters that affect aquatic life will be measured during the aquatic habitat assessment, including field measurements of surface water temperature, pH, dissolved oxygen (DO), and specific conductivity*." The proposed modifications are not necessary to meet the objectives of Study 9.13. The data gathered to characterize the aquatic habitat and fish assemblages present will be used to determine which of the corridor alignments would be the least environmentally damaging to fish resources.

Regarding the study goal referenced by Ms. Long, to provide data to help determine the least environmentally damaging alternative, AEA disagrees that background levels of heavy metals and hydrocarbons are necessary to inform that decision. These streams are in undeveloped areas and all are in nearly pristine condition so water quality would be expected to be very good. AEA sees no reason to anticipate that levels of metals or hydrocarbons would be elevated sufficiently to affect aquatic life, nor was a rationale provided by Ms. Long.

While AEA understands that there may be some level of risk that the Project could impact quantities of hydrocarbons and heavy metals during construction and operation, these will be limited both spatially and temporally through route selection for access and transmission lines along with selecting and implementing best management practices (BMPs) to minimize in-water and near-water construction; clean equipment in designated areas; and minimize runoff from construction areas, roads, airports, and Project facilities. These measures are anticipated to limit potential contamination to very specific locations within the Project area to short periods. AEA will work with Alaska Department of Environmental Conservation (ADEC) to develop a water quality control plan, as appropriate, and implement BMPs consistent with ADEC regulations. Furthermore, wherever the potential exists for AEA to increase contaminants in the water, it will be required by ADEC and ADF&G to obtain permits and likely develop a water quality monitoring plan to demonstrate the Project is in compliance with State water quality standards. These water quality monitoring plans would include: (1) monitoring locations approved by the ADEC and

ADF&G; (2) pre-construction monitoring; and (3) monitoring during (and potentially following) construction. Since the location of Project access and transmission routes and other facilities has yet to be finalized, and heavy metal concentrations may vary spatially, AEA has not included baseline characterization of heavy metals in Study 9.13, but rather believes that such sampling should be deferred until a time when this data collection would be more meaningful to evaluating potential Project impacts, developing protection and mitigation measures, and incorporating them into an evaluation of Project compliance.

The modification proposed by Ms. Long would add extra cost that would exceed any benefit derived from collecting additional water quality data at potential stream crossings. Assuming $3,000 per sample and one sample at each of 90 stream crossings, AEA estimates that this modification would add approximately $300,000 to the study budget—all in an effort to collect data that is not needed to meet Study Plan objectives.

2.6.10. Study 9.14 – Genetic Baseline Study for Selected Fish Species

As established in the Study Plan[34] (RSP Section 9.14.1), the goals of this study are to: (1) acquire genetic material from samples of selected fish species within the Susitna River drainage, (2) characterize the genetic structure of Chinook Salmon in the Susitna River watershed, and (3) assess the use of Lower and Middle River habitat by juvenile Chinook Salmon originating in the Middle and Upper Susitna River.

The objectives for this study were refined after the RSP and during the development of the 2013 Implementation Plan (IP) for Genetics (filed with FERC on April 30, 2013). The study objectives established in the IP consist of the following:

- Develop a repository of genetic samples for target resident fish species captured within the Lower, Middle, and Upper Susitna River drainage.
- Contribute to the development of genetic baselines for Chum, Coho, Pink, and Sockeye salmon spawning in the Middle and Upper Susitna River drainage.
- Characterize the genetic population structure of Chinook Salmon from upper Cook Inlet, with emphasis on spawning ground aggregates in the Middle and Upper Susitna River. As part of this objective, the following three hypotheses regarding Chinook Salmon in the Upper Susitna River will be tested:
- H1a: Chinook Salmon above Devils Canyon represent self-sustaining population(s) that are genetically isolated from Chinook Salmon aggregations below Devils Canyon and potentially locally adapted;

[34] The FERC-approved Revised Study Plan (RSP) Section 9.14 for the Genetic Baseline Study for Selected Fish Species (GENE) as modified by FERC's Study Plan Determination (Study 9.14 SPD, February 1, 2013), the Implementation Plan for 2013, *Regional Operational Plan DF.#R.13-XX Implementation Plan for the Genetic Baseline Study for Selected Fish Species in the Susitna River, Alaska* (Study 9.14 IP, April 30, 2013), and the Implementation Plan for 2014, *Regional Operational Plan ROP.DF#R.14-XX Implementation Plan for the Genetic Baseline Study for Selected Fish Species in the Susitna River Alaska* (Study 9.14 IP in Study 9.14 ISR Part B, Attachment 1, June 3, 2014) is collectively referred to as Study Plan Section 9.14.

- H1b: Chinook Salmon above Devils Canyon represent successful reproduction in the Upper River but also experience a high level of introgression from Chinook Salmon aggregations below Devils Canyon;
- H2: Chinook Salmon above Devils Canyon originate from aggregates below Devils Canyon.
- Examine the genetic variation among Chinook Salmon populations from the Susitna River drainage, with emphasis on Middle and Upper River populations, for mixed-stock analysis (MSA).
- If sufficient genetic variation is found for MSA, estimate the annual percent of juvenile Chinook Salmon in selected Lower River habitats that originate in the Middle and Upper Susitna River in 2013 and 2014.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes two modifications to Study Plan Section 9.14:

1. use of non-lethal buccal swab sampling instead of lethal caudal fin sampling of Chinook Salmon juveniles upstream of Devils Canyon; and
2. increasing the number of markers to include 190 Single Nucleotide Polymorphism (SNP) markers and 12 microsatellite markers to be analyzed for all Chinook Salmon captured in the Middle and Upper River.

Subsequent to the ISR Meeting, AEA held a Study 9.14 Technical Team meeting on April 12, 2016. Geneticists representing the USFWS and NMFS, ADF&G and AEA were present and participated in discussions as well as determinations on several decision points. No objections to recorded decision points were raised at the meeting or during review of the meeting notes. One decision point at this meeting was a proposed modification to omit Objective 5, using MSA analysis to estimate the percent of Upper and Middle River juvenile Chinook Salmon rearing in Lower River habitats (see meeting notes filed April 24, 2016 as Attachment 7 to Transmittal of Meeting Summary and Action Items of Alaska Energy Authority, Project No. 14241-000). Thus, AEA is proposing to omit Objective 5 as a third modification for Study 9.14 based on a high probability that MSA cannot be used appropriately in the Lower River (see Section 2.6.10.5.1 below for a detailed explanation of MSA requirements).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, Ms. Rebecca Long and the Services filed comments for Study 9.14. Ahtna, Incorporated mailed their comments directly to AEA (See Attachment 1). The Services comments were nearly identical, with the exception of NMFS Modifications 3-6, 3-7, 4-2, 5-2; NMFS identified each comment as a modification while the USFWS did not. For simplification and reference, AEA organized its responses by the study objective followed by the comment pertaining to the study objective and AEA's response. While NMFS's comments were called out as "modifications", many do not meet the FERC criteria. AEA's responses to comments and "modifications" submitted to FERC are provided in Table 2.6.10-1 and below, organized by study objective.

Table 2.6.10-1. Study 9.14 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.14-1_ph9	*Modification 1-1: Collect target numbers of resident fish species from the lower, middle and upper Susitna River drainage. Samples from 15 species of resident fish were collected opportunistically and archived at the ADFG Gene Conservation Laboratory. No analyses are planned. Sample sizes were not met; therefore we do not consider the Objective to have been met*.	As explained below in Section 2.6.10.1.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of a directed effort to collect additional genetics samples from the 6 resident species where targets numbers were not previously collected would be $375,000, assuming 25 days of field effort with a boat and helicopter is sufficient to collect these less abundant species.
USFWS_pp9.14-1_ph9	*Samples from 15 species of resident fish were collected opportunistically and archived at the ADF&G Gene Conservation Laboratory. No analyses are planned. Sample sizes were not met, therefore we do not consider the Objective to have been met.*	See Section 2.6.10.1.1 below.
NMFS_pp9.14-2_ph1	*Modification 2-1: Collect genetic samples of Sockeye Salmon from new locations including the Middle River to expand the genetic baseline for this study. Additional baseline samples were collected for the four species. The Chum Salmon, Coho Salmon, and Pink Salmon baselines benefited most from this effort as very few, if any, samples existed prior to the study. The Sockeye Salmon baseline for Cook Inlet was augmented during this study but these new samples were not from new locations.*	As explained below in Section 2.6.10.2.1, AEA requests that FERC not adopt this proposed Study Plan modification. Assigning cost to this modification is challenging, as the desired sample size is unknown, acceptable number of "new locations" are unknown, and the uncertainty of finding Sockeye Salmon is high. In addition, this activity would need to be permitted by ADF&G. In summary, implementing this modification is impractical. For costing purposes, the estimated cost of a 30-day effort with a crew of two and a boat is $300,000.
USFWS_pp9.14-1_ph10	*Additional baseline samples were collected for the four species. The Chum, Coho, and Pink salmon baselines benefited most from this effort as very few, if any, samples existed prior to the study. The Sockeye Salmon baseline for Cook Inlet was augmented during this study but these new samples were not from new locations.*	See Section 2.6.10.2.1 below.
NMFS_pp9.14-2_ph7	*Modification 3-1: NMFS requests that the target number of genetic samples be collected and analyzed. The sample size targets for collections outside the Susitna River drainage were not met. The samples collected did augment existing archived collections. Population structure was evaluated for all upper Cook Inlet collections using 36 single nucleotide polymorphisms (SNP) loci (Document 3). Population structure will be further evaluated using an additional 47 SNP loci*	As explained below in Section 2.6.10.3.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of this modification is $500,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	(Document 2). These additional loci may increase statistical support for the inferred population structure.	
USFWS_pp9.14-2_ph6	*The sample size targets for collections outside the Susitna River drainage were not met. However, the samples did augment existing archived collections. Population structure was evaluated for all upper Cook Inlet collections using 36 SNP loci (Document 3). Population structure will be further evaluated using an additional 47 SNP loci (Document 2). These additional loci may increase statistical support for the inferred population structure.*	See Section 2.6.10.3.1 below.
NMFS_pp9.14-2_ph8	*Modification 3-2: Additional samples of upper river spawning adults and rearing juveniles need to be collected and analyzed, because temporal replicates (inter-annual) are required to confirm the diversity and origin of the putative upper river populations. It will be impossible to test temporal stability of allele frequencies in the upper Susitna River collections because temporal replicates were not collected (Documents 1 and 4). This work needs to be completed. Because no further sampling is planned, it will not be possible to fully evaluate the three hypotheses. We do not agree that sampling is completed as the objective has not been met. Information regarding stock specific habitat usage is necessary to evaluate potential impacts of altered flow in the lower and middle river.*	As explained below in Section 2.6.10.3.2, AEA requests that FERC not adopt this proposed Study Plan modification. The cost of implementing this modification beyond what is already part of the Study 9.5 and Study 9.6 FERC-approved Study Plans is estimated to be $375,000.
USFWS_pp9.14-2_ph7	*It will be impossible to test temporal stability of allele frequencies in the upper Susitna River collections because temporal replicates were not collected (Documents 1 and 4). Because no further sampling is planned, it will not be possible to fully evaluate the three hypotheses. Temporal replicates (interannual) are needed to confirm the diversity and origin of the putative upper river populations. The USFWS recommends the necessary temporal replicates be sampled if the Project continues.*	This recommendation is the same as NMFS Modification 3-2. As explained below in Section 2.6.10.3.2, AEA requests that FERC not adopt this recommendation as a Study Plan modification.
NMFS_pp9.14-3_ph1	*Modification 3-3: Provide the summary report for NMFS[SE1] and other stakeholder's review, including Federal Energy Regulatory Commission (FERC). Defer FERC's study determination for this study until after this report has been reviewed. The Decision Points for further analysis (Document 2, page 3) are appropriate given the samples in hand and the results to date. Further comments on the outcome of this objective should be provided when the final analyses are complete.*	As explained below in Section 2.6.10.3.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of additional interim analyses and reporting is $30,000.
USFWS_pp9.14-2_ph8	*The Decision Points for further analysis (Document 2, page 3) are appropriate given the samples in hand and the results to date. Further comments on the outcome of this objective should be provided when the final analyses are complete. The USFWS looks forward to commenting on the final reporting for this study.*	AEA will provide final reporting for review in the USR.

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.14-3_ph2	*Modification 3-4: The final report should discuss on both caudal fin clips and buccal swabs methods as sources of DNA and whether or not the change to buccal swabs could have influenced genotyping of juveniles. Caudal fin clips can adversely affect juvenile salmon, including causing mortality. Buccal swabs are not likely to be lethal but may not yield as much or as good a quality DNA. The investigators reported low DNA volumes and concentrations resulted in a lack of SNP data for some juvenile collections (Document 2).*	As explained below in Section 2.6.10.3.4, AEA does not object to FERC's adoption of this proposed study modification. There is no additional cost for implementing this modification as AEA will provide this discussion in the USR.
USFWS_pp9.14-2_ph9	*AEA made two modifications to the study plan:* *1) Use of buccal swabs instead of caudal fin to acquire DNA from juveniles. Caudal fin clips can adversely affect juvenile salmon, including causing mortality. Buccal swabs are not likely to be lethal but may not yield as much or as good a quality DNA. We recommend that the final report comment on both methods as a source of DNA and whether or not the change could have influenced genotyping of juveniles. The investigators reported low DNA volumes and concentrations resulted in a lack of SNP data for some juvenile collections.*	As explained below in Section 2.6.10.3.4, AEA does not object to FERC's adoption of this recommendation as a study modification. There is no additional cost for implementing this modification as AEA would provide this discussion in the USR.
NMFS_pp9.14-3_ph3	*Modification 3-5: Increase the number of markers to include 190 SNPs and 12 microsatellites for all Chinook Salmon captured in the Middle and Upper Susitna River. This is a reasonable modification to increase statistical power for identifying population structure. However[SE2], it is unlikely that all samples will be evaluated for 190 SNPs (Document 2 and see modification 1 above). It appears that most samples were successfully analyzed for 12 microsatellites.*	As explained below in Section 2.6.10.3.5, AEA does not object to FERC's adoption of this proposed Study Plan modification provided it is consistent with AEA's proposed modification as indicated in the *Final 2014 Implementation Plan for the Genetic Baseline Study for Selected Fish Species in the Susitna River, Alaska* (Study 9.14 ISR Part B, Attachment 1, Sections 4.4 and 4.6.1). The estimated cost of implementing AEA's proposed modification is $160,000.
USFWS_pp9.14-3_ph2	*AEA made two modifications to the study plan:* *2) Increase the number of markers to include 190 SNPs and 12 microsatellites for all Chinook Salmon captured in the Middle and Upper Susitna River. This is a reasonable modification to increase statistical power for identifying population structure. However, it is unlikely that all samples will be evaluated for 190 SNPs … It appears that most samples were successfully analyzed for 12 microsatellites.*	See Section 2.6.10.3.5 below.
NMFS_pp9.14-3_ph4	*Modification 3-6: Investigate sibling relationships for juvenile Chinook Salmon sampled upstream of Devils Canyon. Document what each sample set represents (whole stream, stream reach, etc.). These analyses can help estimate the number of spawning pairs in the collection and provide insight into how they may be included in the genetic baseline. Of the 363 total Chinook*	As explained below in Section 2.6.10.3.6, AEA does not object to FERC's adoption of this proposed Study Plan modification provided it is consistent with AEA's proposed modification as outlined in the Meeting Summary and Decision

Reference Number	Comment or Study Modification Request	AEA's Response
	Salmon juvenile fish sampled from within or above Devils Canyon, the majority of the 2013 samples (189 fish) have been genotyped for both 13 microsatellite and 48 SNP markers. This is a very good data set to address sibling analysis and stock structure. For juveniles collected in 2014 (174 fish), non-lethal buccal swab sampling was conducted resulting in low concentrations of DNA.	Points for the Technical Meeting of Fish Genetics Study 9.14 on April 12, 2016. The estimated cost of implementing AEA's proposed modification is $10,000 beyond the cost of the FERC-approved Study Plan.
NMFS_pp9.14-3_ph5	*Study Modification 3-7: Continue to non-lethally collect adult and juvenile samples and associated biological data (age, sex, length, habitat associations) from Chinook Salmon upstream of the proposed dam site for three collection years, each with a sufficient number of samples as determined from the requested power analysis (see Study Modification 4-2 below). This is necessary to increase the statistical power of the analysis and enable spatial and temporal analyses within individual streams.*	As explained below in Section 2.6.10.3.7, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is upward of $900,000 (~$300,000 per year).
NMFS_pp9.14-4_ph1	*Modification 4-1: Temporal stability of allele frequencies in the Upper River collection must be determined. The preliminary analyses presented by ADFG at the April 12, 2016 meeting (see Documents 2 and 3) suggests it may not be possible to distinguish Middle River populations from mainstem populations for MSA. In addition, simulations to evaluate the baseline for MSA were not completed at the time of this review. Temporal stability of allele frequencies in Upper River collections has not been tested.*	As explained below in Section 2.6.10.4.1, AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
USFWS_pp9.14-3_ph3	*In addition, temporal stability of allele frequencies in Upper River collections has not been tested. The USFWS recommends that temporal stability of allele frequencies be tested.* *Simulations to evaluate the baseline for MSA were not completed at the time of this review.*	The FERC-approved Study Plan has not yet been completed. AEA will test the temporal stability of allele frequencies in the Upper River collections as part of the FERC-approved Study Plan and will report the results in the USR. See Section 2.6.10.4.1 below.
NMFS_pp9.14-4_ph2	*Modification 4-2: Conduct a power analysis to determine sample size requirements (adults and juveniles) for assessing genetic divergence of Chinook Salmon spawning above the proposed dam site. Results will continue to build upon preliminary genetic analyses outlining the population structure of Chinook Salmon in the Susitna River including samples from at or near the proposed dam site. Insufficient numbers of samples were collected to assess for this genetic divergence, which is very important for NMFS fish passage decision and for developing protection, mitigation and enhancements measures for any license for this project*	As explained below in Section 2.6.10.4.2, AEA requests that FERC not adopt this proposed Study Plan modification. There would be no cost associated with this modification as AEA these efforts are already being conducted under the Study Plan.
NMFS_pp9.14-4_ph3	*Modification 5-1: NMFS recommends that Objective 5 be retained. AEA proposes a study modification to remove this objective (Document 2). Sampling juvenile Chinook Salmon in the lower Susitna River proved to be*	As explained below in Section 2.6.10.5.1, AEA requests that FERC not adopt this proposed Study Plan modification, but to approve AEA's

Reference Number	Comment or Study Modification Request	AEA's Response
	challenging and the number collected was insufficient for MSA. Nevertheless, it is important to determine if and to what extent Upper River fish use the Lower River habitats if the population structure analysis reveals self-sustaining populations in the Upper River. Therefore, we do not agree with the proposed modification to not estimate the annual percent of juvenile Chinook Salmon sampled in lower river habitats that originate in the Middle and Upper Susitna River. Additional sampling effort, or possibly alternative sampling methods (winter sampling, sampling environmental DNA) should be made to meet this important objective.	proposed study modification. The estimated cost of implementing this modification is $500,000 and may yield little if any return.
USFWS_pp9.14-3_ph4	*AEA proposes a study modification to remove this objective [5]. Sampling juvenile Chinook Salmon in the lower Susitna River proved to be challenging and the number collected was insufficient for MSA. Nevertheless, it is important to determine if and to what extent Upper River fish use the Lower River habitats if the population structure analysis reveals self-sustaining populations in the Upper River. Therefore, the USFWS recommends that this Objective be retained. We do not agree with the proposed modification.*	As explained below in Section 2.6.10.5.1, AEA requests FERC to approve AEA's proposed modification to remove this objective from the study as it is unlikely that an MSA analysis can be performed on Chinook Salmon originating above Devils Canyon due to their extremely low abundance.
NMFS_pp9.14-4_ph4	*Modification 5-2: Conduct additional non-lethal collection and analysis of juvenile Chinook Salmon from the lower and middle Susitna to obtain sufficient numbers of Chinook salmon for MSA. NMFS recommends winter sampling with baited minnow traps in suitable Chinook Salmon overwintering habitat (upland sloughs, side channels with sufficient water velocity at the trap location, cover provided by woody debris, macrophytes or submerged shrubs and gravel substrate). NMFS has found this methodology successful in obtaining suitable numbers of juvenile Chinook Salmon provided that fall conditions allow immigration of juvenile Chinook Salmon into the habitat unit and winter flow events do not flush fish from the habitat (Davis and Davis 2015).*	As explained below in Section 2.6.10.5.2, AEA requests that FERC not adopt this proposed Study Plan modification, but to approve AEA's study modification. The estimated cost of implementing this modification is $500,000 and it may yield little if any return.
Long_160620_pp03_ph3	*The 3/22/16 ISR meeting showed that preliminary analysis of population structure of Chinook salmon shows high genetic divergence between the Oshetna and Kosina River collections. Additional analyses are needed to determine if the divergence is stable and indicative of self-perpetuating populations. The divergence could be unstable due to variables such as low study sample size, family effects and other population migrations. For the USR, genetic collections for further purposes of 9.14 should occur as part of future fish study work.*	As explained below in Section 2.6.10.5.3, AEA requests that FERC not adopt this request as a Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved Study Plan as this request is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.

2.6.10.1. Objective 1

Objective 1: Develop a repository of genetic samples for target resident fish species captured within the Lower, Middle, and Upper Susitna River drainage.

2.6.10.1.1. Response to Modification Request to Collect Target Samples

NMFS (NMFS_pp9.14-1_ph9) and USFWS (USFWS_pp9.14-1_ph9) indicate that they do not consider this objective to have been met because the target sample sizes have not been achieved. NMFS (Modification 1-1) requests that AEA collect target numbers of resident fish species from the Lower, Middle, and Upper Susitna River drainage.

In response, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Most importantly, per the Study Plan, these samples were not going to be analyzed as genetic analysis of resident fishes is not necessary to assess Project impacts or develop PM&E's

AEA asserts that this Section of the Study 9.14 was implemented as provided by the FERC-approved Study Plan. The RSP Section 9.14.4.1 clearly stated that targets are not to be confused with a sample size requirement since the abundance of species and stocks were unknown. AEA worked to achieve all targets by sampling 901 Upper, Middle, and Lower River macrohabitats from 2012 to 2014 with directed sampling for genetics samples occurring at 146 of those. Objective 4 of Study 9.14 was designed to take advantage of *opportunistic* sampling by fish crews covering hundreds of miles of the Susitna River basin. The target collection numbers were provided to define the upper limit of samples after which no more tissues were desired. Targets of 50 fish per species may not be met for those species that were not present during sampling, occur in very low numbers, or were not susceptible to the sampling gear. The sample collections were presented in Study 9.14 SIR, Section 4, Table 4-2. A review of this table indicates that 6 of the species not represented with any samples also have never been documented in the Susitna River Basin despite AEA's total fish observations of 105,600 fish. The target of 50 samples was exceeded for 9 resident species and 1-49 samples were gathered for the remaining 6 resident species documented present in the basin. One target species Pacific Lamprey has not been documented in the Sustina River. These remaining five resident species were rare or patchily distributed based on AEA fish distribution studies (Table 2.6.10-2), and collecting "target" numbers for some species, such as Cisco and Ninespine Stickleback, may not be attainable even with a focused effort.

Table 2.6.10-2. AEA 2013 and 2014 collections of select resident species indicating rare or patchy distributions.

Species	Number Collected	Number of Locations
Arctic Lamprey	31	2
Bering Cisco	3	2
Lake Trout	10	3
Ninespine Stickleback	1	1
Northern Pike	62	2

Notes:

Data Sources: Study 9.6 SIR, Section 5, Tables 5.1-2 and 5.2-1; Study 9.6 ISR Part A, Section 5.1, Tables 5.1-1 and 5.1-6; Study 9.5 ISR Part A, Section 5.1, Table 5.1-2.

As indicated in the Study Plan (RSP Section 9.14.1), Objective 1 was to develop a repository of genetic samples for target resident fish species captured within the Susitna River with emphasis on the Middle and Upper River. This was always planned as an opportunistic activity to occur while sampling for other Susitna-Watana Hydro Project licensing studies or other non-related projects (Section 4.2.1 in Study 9.14 ISR Part B, Attachment 1: *Final 2014 Implementation Plan for the Genetic Baseline Study for Selected Fish Species in the Susitna River, Alaska*). Objective 1 (2013 Genetics IP, Section 3) was included in the Study Plan to optimize the value of AEA's comprehensive fish collection effort in the Susitna River basin by opportunistically developing a repository of genetic samples for future ADF&G management purposes (Study 9.14 ISR Part B, Attachment 1, Section 4.2.1). Genetic analysis of resident populations is not needed to support impact analysis or development of PM&E's for the proposed Project. Although no targeted sampling is planned under Study 9.14 other than for Chinook Salmon within and above Devils Canyon, ADF&G will continue to collect tissues from resident fish species opportunistically while working on other projects and additional samples will be collected opportunistically as AEA continues fish sampling associated with other Susitna-Watana fish studies.

2.6.10.2. Objective 2

Objective 2: Contribute to the development of genetic baselines for Chum, Coho, Pink, and Sockeye salmon spawning in the Middle and Upper Susitna River drainage.

2.6.10.2.1. Response to Modification Request to Collect Sockeye Salmon Genetic Samples from New Locations

NMFS (NMFS_pp9.14-2_ph1) and USFWS (USFWS_pp9.14-1_ph10) indicate that the Sockeye Salmon baseline for Cook Inlet was augmented during this study but these new samples were not collected from new locations. NMFS (Modification 2-1) requests that AEA collect genetic samples of Sockeye Salmon from new locations including the Middle River to expand the genetic baseline for this study.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS have not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The Services point out, the Chum Salmon, Coho Salmon, and Pink Salmon baselines benefited most from this effort as very few, if any, samples existed prior to the study. The Sockeye Salmon baseline for the Susitna River has been augmented since the early 1990s (Study 9.14 SIR Table 4-2) and used in mixed-stock analyses since the mid-1990s (i.e., Seeb et al. 2000). As a result, major spawning aggregates were already collected prior to the implementation of this study. This objective was designed to further augment the baseline by *opportunistically* collecting samples (Study 9.14 ISR Part B, Attachment 1, Sections 3, 4.2.1, and 4.2.3) in areas where prior sampling had not succeeded in collecting adequate sample sizes. Likely reasons that the previous baseline did not contain these samples are that the areas do not support, or support small numbers of Sockeye Salmon or that the fish are not vulnerable to sampling. AEA's study team recognized these issues and predicted that the ideal sample sizes were unlikely to be achieved. In fact, focused and extensive effort in 2013 yielded samples from 10 new locations in the Middle River; however, few fish were available to sample (Study 9.14 SIR, Table 4-2). AEA asserts that this data demonstrates that the current baseline of past and current sample collections includes most, if not all, of the vulnerable populations within the Middle River. The Services have not provided any evidence that AEA's effort was not implemented as described in the FERC-approved Study Plan or that populations of Sockeye Salmon were missed by sampling crews. This modification request is unnecessary to meet the study objective and impractical to implement.

2.6.10.3. Objective 3

Objective 3: Characterize the genetic population structure of Chinook Salmon from upper Cook Inlet, with emphasis on spawning ground aggregates in the Middle and Upper Susitna River. As part of this objective, the following three hypotheses regarding Chinook Salmon in the Upper Susitna River will be tested:

- H1a: Chinook Salmon above Devils Canyon represent self-sustaining population(s) that are genetically isolated from Chinook Salmon aggregations below Devils Canyon and potentially locally adapted;
- H1b: Chinook Salmon above Devils Canyon represent successful reproduction in the Upper River but also experience a high level of introgression from Chinook Salmon aggregations below Devils Canyon;
- H2: Chinook Salmon above Devils Canyon originate from aggregates below Devils Canyon.

2.6.10.3.1. Response to Modification Request to Collect and Analyze the Target Number of Samples Outside the Susitna River Drainage

NMFS (NMFS_pp9.14-2_ph7) and USFWS (USFWS_pp9.14-2_ph6) note that the target number of genetic samples *outside* of the Susitna River drainage has not been met. NMFS (Modification 3-1) requests that additional sampling occur to meet the target.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

As is clearly stated in RSP Section 9.14.4.1, target sample collections were not intended as sample size requirements because abundances of species and stocks were unknown. In addition, as stated in Study 9.14 ISR Part B, Attachment 1, Section 4.2, it was anticipated based on uncontrolled variables that these samples targets would sometimes not be met and the Plan included expected values to try and reflect this sampling uncertainty.

Although the "expected sample sizes" for collections outside the Susitna River drainage were not met in all spawning locations, 9 of the 10 populations are represented by at least 50 individuals and 6 of 10 populations are represented by at least 100 fish. The only spawning aggregate not represented by at least 50 fish was Meadow Creek where the "expected sample size" was 12 fish (Study 9.14 SIR, Table 4-1). Meadow Creek is one of two tributaries to Eagle River, a tributary to Knik Arm, located approximately 30 miles east from the mouth of the Susitna River. The baseline has adequate sample size from the South Fork of Eagle River to characterize Eagle River. In addition, the baseline contains adequate sample sizes (>50 fish) from 3 other tributaries to Knik Arm (Matanuska River, Ship Creek, and Little Susitna River) to provide adequate context for genetic structure of populations within the Susitna River basin. As further support of the adequacy of these samples, it should be noted that the Chinook Salmon genetics data have been applied successfully to Cook Inlet Chinook Salmon population structure analyses and MSA applications that were published in separate peer reviewed manuscript series for the State of Alaska (Barclay and Habicht 2015; Eskelin et al. 2013).

Collection of additional samples from Meadow Creek will have no bearing on assessing Project impacts or developing PM&Es. Furthermore, while collections outside of the Susitna River basin are helpful to provide context for the genetic structure of populations within the basin, they are not essential for addressing the hypothesis under Objective 4 or for furthering our understanding of the relationships of Chinook Salmon upstream and downstream of Devils Canyon with respect to potential for Project effects on Susitna River Chinook Salmon.

For the reasons explained above, AEA concludes that NMFS's proposed study plan modification is unnecessary and should not be adopted by FERC.

2.6.10.3.2. Response to Modification Request to Collect and Analyze Additional Samples of Upper River Salmon

Both NMFS (Modification 3-2; NMFS_pp9.14-2_ph8) and USFWS (Recommendation; USFWS_pp9.14-2_ph7) request that AEA collect and analyze additional samples of Upper River spawning adults and rearing juveniles because temporal replicates (inter-annual) were not collected. The Services state that temporal replicates are required to confirm the diversity and origin of the putative Upper River populations, and that without these samples, it will be impossible to test temporal stability of allele frequencies in the Upper Susitna River collections and therefore it will not be possible to fully evaluate the three hypotheses pertinent to evaluating the study objective.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. The Services' assertions that temporal replicates were not collected, that temporal stability cannot be tested, and that no further sampling is planned are inaccurate as stated.

As the Services have noted, the analysis of the samples collected thus far has not been completed. Yet, they incorrectly stated that temporal replicates have not been collected. Genetic samples of Chinook Salmon upstream of Devils Canyon have been successfully collected across three years of AEA studies (2012-2014) and including 3 years of adult samples and two years of juvenile samples. In addition, the Services incorrectly assert that no additional Chinook Salmon samples will be collected in the Upper River. Although no targeted sampling by the genetic study team is planned, additional genetic sampling of Chinook Salmon juveniles is an objective of Study 9.5 and 9.6 and will occur during the future implementation of these studies (Study 9.5 ISR Part D, Section 8 and Study 9.6 ISR Part D, Section 8).

The NMFS also commented that additional sampling is needed to provide temporal replicates. The NMFS statement about the inadequacy of samples in hand is premature. As discussed during the April 12, 2016, Genetics Technical Team meeting, recent preliminary analyses on relatedness among juvenile samples taken upstream from Devils Canyon showed high levels of related individuals (sharing parents) within geographic areas and years. Pedigree analysis also was proposed at the Technical Team meeting and will be implemented to reconstruct parental genotypes. These reconstructed parental genotypes, in combination with sampled adults, may provide enough information to examine adult homing fidelity (or lack thereof), and to estimate effective population size upstream of Devils Canyon. Even if the data on hand are not sufficient, additional collections are planned during future study implementation as discussed above. Specifically, during the April 12, 2016 Technical Team meeting AEA stated that if the results of planned genetic analyses suggest that additional adult samples are necessary for clarification of the genetic populations of Chinook Salmon in the Middle and Upper River, they will be willing to undertaken additional direct sampling for adult salmon in the Upper River.

2.6.10.3.3. Response to Modification Request for an Additional Summary Report and Deferment of Study Determination

Both NMFS (NMFS_pp9.14-3_ph1) and USFWS (USFWS_pp9.14-2_ph8) commented that the Decision Points for further analysis discussed during the April 12, 2016 Technical Team meeting are appropriate given the samples in hand and the results to date. NMFS (Modification 3-3; NMFS_pp9.14-3_ph1) requests a summary report for NMFS and other stakeholders' review, including FERC, and for FERC to defer study determination for this study until after this report has been reviewed.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

Furthermore, this proposed modification is unnecessary because the ILP process includes development of the Updated Study Report specifically for reporting on the results of studies when they are completed. The purpose of the ISR process is to determine AEA's *progress* in carrying out the Study Plan as approved by FERC. The study and the analyses have not yet been completed. A second interim summary report is not necessary to meet the Study Plan objectives. AEA has collected sufficient data which was reported in the ISR, the SIR, and the Meeting Summary and Decision Points for the Technical Meeting of Fish Genetics Study 9.14 on April 12, 2016 to support a determination of whether or not Study 9.14 is on track to meet the study objectives as outlined in the Study Plan. Final analyses will be provided to licensing participants and FERC in the USR.

2.6.10.3.4. Response to Modification Request to Include a Discussion on Buccal Swab Sampling in the Final Report

The Services commented on AEA's Study Modification to use non-lethal buccal swab sampling instead of lethal caudal fin sampling of Chinook Salmon juveniles upstream of Devils Canyon (Study 9.14 ISR Part D, Section 7). NMFS (Modification 3-4; NMFS_pp9.14-3_ph2) and USFWS (Recommendation; USFWS_pp9.14-2_ph9) request that the final report discusses both caudal fin clips and buccal swabs methods as sources of DNA and whether or not the change to buccal swabs could have influenced genotyping of juveniles.

AEA does not object to FERC's adoption of this proposed Study Plan modification. A discussion on the experiences with DNA extracted from both fin tissues and buccal swabs will be included in the USR along with recommendations of the preferred method for future collections of Chinook Salmon within and above Devils Canyon. As discussed in the March 15, 2016 ISR Meetings, although buccal swab collections in this study yielded lower DNA concentrations and higher Polymerase Chain Reaction (PCR) failures than fin clip collection, this method is still appropriate for sampling DNA where lethal sampling is unacceptable. Even with the loss samples for SNPs, sufficient DNA was available for analysis of 12 microsatellite markers and to make progress toward meeting the study objective. However, changes to the buccal swab methods in the field (i.e., additional swipes with additional pressure) and in the laboratory (i.e., pre-amplification of the extracted DNA) have proven effective at increasing DNA quantity and increasing genotype signal at the Gene Conservation Laboratory (GCL) and will be implemented with future buccal swab sampling.

2.6.10.3.5. Response to Modification Request to Increase the Number of Markers for All Chinook Salmon in the Middle and Upper River

The Services commented on AEA's proposed study modification to increase the number of markers to include 190 SNP markers and 12 microsatellite markers to be analyzed for all Chinook Salmon captured in the Middle and Upper River. NMFS (Modification 3-5; NMFS_pp9.14-3_ph3) and USFWS (Comment; USFWS_pp9.14-3_ph2) agreed that AEA's modification is reasonable to increase the statistical power for identifying population structure but noted that while most samples were successfully analyzed for 12 microsatellites, it was unlikely that all would be evaluated for 190 SNPs.

AEA has previously proposed this modification to the Study Plan to increase the number of SNP markers and add microsatellite markers. After consultation with Services' geneticists in March 2014 and as described in Study 9.14 ISR Part B, Attachment 1, Sections 4.4 and 4.6.1, AEA agreed to analyze 190 SNP markers and 12 microsatellite markers (uSATs) for all adult and juvenile Chinook Salmon captured in the Middle and Upper River to test among hypotheses for fish spawning above Devils Canyon.

There are two separate components for this genetic analysis. The first is required for the characterization of the population structure of Chinook Salmon both within Upper Cook Inlet and within the Susitna River. Initially, all samples were screened for 48 SNPs. This dataset provided a preliminary look at population structure and provided insight into how many additional SNPs would be useful to fully characterize the baseline. During the April 12, 2016 meeting with the agencies, it was recommended to screen an additional 47 SNP markers for a total of 95 SNP markers to address this objective. The analysis of 95 SNP markers has been completed in the lab.

The second analysis pertains to understanding the population structure and hypothesis testing for Chinook Salmon in the Susitna River above Talkeetna. In 2013 and 2014, AEA screened for 12 uSATs and 188 SNP markers (maximum number allowable with ADF&G genetics analyzer) for all adults and juveniles. The DNA concentrations for many of the juveniles collected through non-lethal swabbing failed for the SNP marker but provides a fairly complete set of uSAT data. The number of markers successfully screened are presented by location and marker type in Table 4-12 of the Study 9.14 SIR.

AEA anticipates that the 12 uSATs will be sufficient to meet the study objectives and evaluate the three hypotheses. These microsatellite markers are the most powerful for hypothesis testing because of the number of alleles, especially low frequency alleles. These markers also will be more powerful for parentage analysis frequencies. The 190 SNPs would provide additional statistical support. As such, data from the 190 SNPs will only add information if the null hypotheses using the uSAT data cannot be rejected. However, because AEA will not be certain about the power of the uSAT data until the results are complete, at the April 12, 2016 meeting, AEA and the Services agreed to continue to analyze the 190 SNPs and 12 microsatellites into the future.

As described above all genetic samples have been screened for SNPs and microsatellites (no modification to methods), but low quality and quantity of DNA yields from some juvenile collections within and above Devils Canyon resulted in high failure rates for SNP genotyping and a null allele in one uSAT locus resulted in excluding this locus from statistical analyses. As a result, the statistical analyses for the samples in hand will be conducted using data from the successfully analyzed 12 microsatellites. AEA will utilize additional analysis including: pedigree analysis to reconstruct parental genotypes and will employ a battery of tests to develop multiple lines of evidence supporting or debunking the hypothesis. Tests to be evaluated were agreed to during the April 12, 2016 Technical Team meeting and included tests for: allele richness (compare populations below and above Devils Canyon), linkage disequilibrium (signals of multiple contributing populations), assignment (include potentially contributing populations from below Devils Canyon), Garza's M (signal of genetically bottlenecked population(s)), and homogeneity between collections above and below Devils Canyon.

2.6.10.3.6. Response to Modification Request to Investigate Sibling Relationships

NMFS (Modification 3-6; NMFS_pp9.14-3_ph4) recommends that AEA investigate sibling relationships for juvenile Chinook Salmon sampled upstream of Devils Canyon, and to document what each sample set represents (whole stream, stream reach, etc.).

AEA does not object to FERC's adoption of this proposed Study Plan modification provided it is essentially the same as AEA's proposed as a modification to the Study Plan, as outlined in the *Meeting Summary and Decision Points for the Technical Meeting of Fish Genetics Study 9.14* on April 12, 2016. Specifically, AEA proposed to investigate the sibling relationships of the juvenile Chinook Samples collected upstream from Impediment 1 of Devils Canyon. This is part of the statistical analyses identified in Section 8 of Study 9.14 ISR, Part D.

2.6.10.3.7. Response to Modification Request to Continue Sample Collections for Three Collection Years

NMFS (Modification 3-7; NMFS_pp9.14-3_ph5) requests that AEA continue to non-lethally collect adult and juvenile samples and associated biological data (age, sex, length, habitat associations) from Chinook Salmon upstream of the proposed dam site for three collection years, each with a sufficient number of samples as determined from the requested power analysis (see Study Modification 4-2 below, Section 2.6.10.4.2). This is necessary to increase the statistical power of the analysis and enable spatial and temporal analyses within individual streams.

In response, AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established “good cause” as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the FERC-approved Study Plan, or implemented under anomalous environmental conditions.

The requested modification to sample for three additional years is premature at this time in the licensing process. It is has not yet been determined that the samples from the three years of data collection that are in hand are not sufficient to test the hypothesis proposed regarding Upper River Chinook Salmon in Study 9.14.

AEA expects the continued implementation of the Study Plan will result in AEA meeting the study objectives. As NMFS has noted, the analysis of the samples collected thus far has not been completed but will be completed as part of the continued implementation of the Study Plan. Statistical analyses of Chinook Salmon samples from the Middle and Upper Susitna River (ISR Part D, Section 8) may contain adequate statistical power to detect spatial and temporal variation within individual streams from within and above Devils Canyon (if these differences are large). If differences are not detected with samples on hand, a power analysis will be conducted to determine if there was adequate statistical power to detect biologically-significant differences (see response to NMFS Modification 4-2, Section 2.6.10.4.2 below) and to guide AEA on how many additional samples would be necessary. If these analyses indicate that additional samples are required to meet the study objectives, AEA will work to collect these samples during future implementation of Study 9.5 and 9.6, however, not over a period of three years as the first year of study has been completed.

Regarding NMFS’s request for sufficient power to conduct spatial and temporal analyses within individual streams, this was not part of the FERC-approved Study Plan. Further, AEA does not see a nexus between within tributary population structure and potential Project effects nor was one provided by NMFS. The potential Project nexus being addressed by this study is related to determination of whether the presence of a dam affecting Upper River spawning Chinook Salmon will impact a unique genetic component of the Susitna River Chinook Salmon population. There is no reason to expect differential effects of the dam on demes, or localized spawning groups, in Upper River Tributaries.

To clarify, this study objective was designed to investigate population structure and to test hypotheses for spawning aggregates above (and within) and below Devils Canyon, and not population structure for spawning aggregates above the proposed dam site as NMFS is requesting.

Streams above the dam site are a subset of those within and above Devils Canyon. It is also important to note that the initial target collection sizes were established based on literature-based recommendation for baselines used for estimating stock composition (RSP Section 9.14.4.1). Also the initial target size was not considered a "requirement" because the abundance of each species or sub-stock was unknown. Based on all of the data gathered, it is evident that the abundance of the adult Chinook Salmon in the Upper River is very likely less than 100 individuals. While AEA is striving towards the target collection size and multiple years of sampling, the reality that the combination of a small adult population size(s) patchily distributed inconsistently over a large geographic area, poor visibility in spawning tributaries, and high carcass predation will limit the number of samples available for collection. For this reason, AEA is employing a variety of alternate statistical tests that will help address Objective 3, even if the target collection is not attained as discussed in the April 12, 2016 Technical Team meeting.

As previously noted, although no additional targeted sampling by the genetic study team is planned, additional genetics collections are planned as part of Study 9.5 Fish Distribution and Abundance in the Upper River and Study 9.6 Fish Distribution and Abundance in the Middle and Lower River. See response to Modification 3-2, Section 2.6.10.3.2 above.

2.6.10.4. Objective 4

Objective 4: Examine the genetic variation among Chinook Salmon populations from the Susitna River drainage, with emphasis on Middle and Upper River populations, for mixed-stock analysis (MSA).

2.6.10.4.1. Response to Modification Request and Comment Requesting the Testing of Temporal Stability of Allele Frequency

The Services correctly note in their comments that this portion of the study has not yet been completed, including the analysis of the temporal stability of allele frequencies, further stating that a detailed review is not justified at this time. NMFS (Modification 4-1; NMFS_pp9.14-4_ph1) and USFWS (USFWS_pp9.14-3_ph3) recommend that temporal stability of allele frequency be tested.

In response, AEA requests that FERC not adopt NMFS's proposed modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. NMFS has not established "good cause" as required by the ILP regulations, or demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

To clarify, testing the temporal stability of allele frequency is already part of the FERC-approved Study Plan (RSP Section 9.14.4.6.1) and will occur during analysis as described in the 2014 Genetic IP (Study 9.14 ISR Part B, Attachment 1, Section 4.6.4). As part of the analyses to examine potential mixed-stock analysis (MSA) proposed to complete this study (Section 8 of ISR Part D), temporal stability of allele frequencies will be examined for spawning aggregates within and above Devils Canyon. The study has not yet been completed. The analysis will be reported in the USR. See also Section 2.6.10.5.1 below for discussion on other criteria that must be met for successful MSA applications and Section 2.6.10.3.7 above regarding the need for additional sampling.

2.6.10.4.2. Response to Modification Request to Conduct a Power Analysis to Determine Sample Size Requirements

NMFS (Modification 4-2; NMFS_pp9.14-4_ph2) recommends that AEA conduct a power analysis to determine sample size requirements (adults and juveniles) for assessing genetic divergence of Chinook Salmon spawning above the proposed dam site.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" as required by the ILP regulations, nor has NMFS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

As outlined in the 2014 Genetics IP (Section 4.6.9 in Study 9.14 ISR Part B, Attachment 1: *Final 2014 Implementation Plan for the Genetic Baseline Study for Selected Fish Species in the Susitna River, Alaska*), a power analysis will be conducted if divergence is not detected among spawning aggregates upstream and downstream of the proposed dam site. If this power analysis is conducted, it will be used to determine if there was adequate statistical power to detect biologically-significant differences, and if not, to determine the appropriate sample sizes required to adequately test for differences. AEA notes, as discussed in the 2014 Genetics IP (Study 9.14 ISR Part B, Attachment 1, Section 2.1.1) that since this objective was designed to investigate population structure and to test hypotheses for spawning aggregates above (and within) and below Devils Canyon, the power analysis would be conducted specific to this objective. See response in Section 2.6.10.3.7 for discussion of Project nexus for Study 9.14.

Regarding the NMFS's statement on the inadequacy of genetic samples in hand to evaluate genetic divergence, this statement is based on assumptions that have not been confirmed. AEA is in the process of evaluating if the current samples can provide information on genetic divergence between spawning aggregates upstream and within Devils Canyon and downstream of Devils Canyon. See also responses in Sections 2.6.10.3.2 and 2.6.10.3.7 of this document.

2.6.10.5. Objective 5

Objective 5: If sufficient genetic variation is found for MSA, estimate the annual percent of juvenile Chinook Salmon in selected Lower River habitats that originate in the Middle and Upper Susitna River in 2013 and 2014.

2.6.10.5.1. Response to Modification Request and Comment to Retain Objective 5

AEA proposed a modification to the Study Plan to remove Objective 5 as reported in the meeting notes filed April 24, 2016 (Attachment 7 to Transmittal of Meeting Summary and Action Items of Alaska Energy Authority, Project No. 14241-000). Both NMFS (Modification 5-1; NMFS_pp9.14-4_ph3) and USFWS (Comment; USFWS_pp9.14-3_ph4) oppose AEA's proposed modification and request Objective 5 be retained. NMFS noted the difficulty in obtaining samples and suggested additional sampling effort or possibly alternative sampling methods such as winter sampling, or sampling environmental DNA.

AEA proposed the modification to the Study Plan to remove Objective 5 because after a concerted field sampling effort, genetic samples were obtained from only 8 juvenile Chinook Salmon in the Lower River. All of these were sampled from a single habitat type. This 2013 sample size is inadequate for analysis and, based on the extensive field efforts expended by both Study 9.14 and Study 9.6 field crews to obtain it, AEA does not expect that the assumptions of MSA will be met even with additional sampling effort and, therefore, the analysis would not be valid. Thus, AEA is proposing a modification to remove this objective from the FERC-approved Study Plan for Study 9.14 (Attachment 7 to Transmittal of Meeting Summary and Action Items of Alaska Energy Authority, Project No. 14241-000).

AEA's study modification proposal to eliminate this objective was presented, discussed, and agreed upon as a decision point at the Study 9.14 Technical Team meeting in April 2016 (Meeting Summary and Decision Points for the Technical Meeting of Fish Genetics Study 9.14 on April 12, 2016). The paucity of samples collected in the Lower River despite sampling 136 habitats (92 directed sampling and 44 opportunistic) is an indicator that Chinook Salmon may not use the Lower River habitat for rearing during the summer. As outlined in ISR Part A, significant effort was applied to collect juvenile Chinook Salmon in the Lower River in 2013. Despite four dedicated field trips (totaling 9 days, 47 trap sets, and covering all five different types of habitat encountered) to collect juvenile Chinook Salmon in the Lower River, only eight fish were sampled; all of which were from slough habitat on one sampling day (Study 9.14 ISR Part A, Table 4-9). Additionally, in 2013, ADF&G staff with vast experience capturing thousands of juvenile Chinook Salmon annually from Southeast Alaska rivers, participated in four days of fish sampling while training of field crews on how to cure bait and bait traps and how to identify appropriate locations for setting traps and pulling seines following the methods outlined in Magnus et al. (2006). Unfortunately, post-training surveys provided similar results with few or no Chinook Salmon present in what appeared to be suitable habitat. ADF&G biologists attempted an additional 4 days of sampling in 2014, outside of AEA's Susitna-Watana study, and again were unsuccessful collecting juvenile salmon in the Lower River.

More importantly, when the challenge of collecting juvenile Chinook Salmon is viewed in concert with the estimates of the proportion of Upper River Chinook Salmon juveniles could be expected to rear in Lower River habitats, the extremely low fish catch with extensive effort is an indicator that AEA most likely will not meet the criteria for successfully using MSA to detect juveniles from the Upper River. MSA requires temporal stability in allele frequencies within populations, adequate differentiation among reporting groups (groups of populations), and adequate anticipated proportions of reporting groups within mixed-stock samples.

Although temporal stability in allele frequencies within populations and adequate differentiation among reporting groups (groups of populations) has not been tested, an educated guess can be made on whether Chinook Salmon originating from above Devils Canyon will represent adequate proportions of mixed-stock samples collected in the Lower River. For the purpose of illustrating a point, some assumptions can be made and a simple calculation used to quickly calculate the likely proportion of fish from above Devils Canyon in a collection from the Lower River.

Assumptions:

1. 100 percent of juvenile Chinook Salmon rear exclusively in the Lower River,

2. survival to the Lower River rearing habitat is independent of distance travelled, and
3. egg to juvenile rearing survival is uniform throughout the Susitna River.

Calculation:

- Apply the estimated proportion of Upper River Chinook Salmon from Study 9.7 (0.2 percent) to the sample sizes from juvenile rearing collections in the Lower River.

On the order of 500 juveniles would need to be collected per habitat type to average 1 fish from the Upper River. It is important to note that this calculation is likely an over estimate of the proportion of Upper River juveniles in the Lower River because at least two of the assumptions supporting the calculation are likely not valid. It can be assumed that some proportion of the Chinook Salmon juveniles will rear in the Upper and Middle river and based on the literature, the probability of survival from egg to juvenile rearing is not uniform. This exercise, while not precise, demonstrates the challenges of collecting sufficient numbers of juvenile Chinook salmon to apply MSA.

The estimated proportion of Upper River fish falls two orders of magnitude below the proportions adequate for MSA even if adequate sample sizes were available. For large sample sizes (>200), Marlowe and Busack (1995) found that a stock needed to have an estimated contribution of 5 percent or greater for a mixture to have a Coefficient of Variation (CV) less than 50 percent. Simply put, there is a very low probability of collecting a suitable number of Chinook Salmon from the Upper River to support the requirements of using MSA to determine the proportions of Chinook Salmon originating from within and above Devils Canyon (one reporting group) in mixed-stock samples from the Lower River.

As for sampling environmental DNA, this may provide evidence for presence/absence of Chinook Salmon, but would not provide genotypes required for MSA analyses to examine stock-specific habitat use.

2.6.10.5.2. Response to Modification Request to Conduct Additional Non-Lethal Collections of Juvenile Chinook Salmon in the Lower and Middle River for MSA

NMFS (Modification 5-2; NMFS_pp9.14-4_ph4) recommends that AEA conduct additional non-lethal collection and analysis of juvenile Chinook Salmon from the Lower and Middle Susitna to obtain sufficient numbers of Chinook Salmon for MSA. NMFS recommends winter sampling with baited minnow traps in suitable Chinook Salmon overwintering habitat (upland sloughs, side channels with sufficient water velocity at the trap location, cover provided by woody debris, macrophytes or submerged shrubs and gravel substrate). NMFS has found this methodology successful in obtaining suitable numbers of juvenile Chinook Salmon provided that fall conditions allow immigration of juvenile Chinook Salmon into the habitat unit and winter flow events do not flush fish from the habitat (Davis and Davis 2015).

In response, AEA requests that FERC not adopt this recommendation. Objective 5 states that "*if sufficient genetic variation is found for MSA, estimate the annual percent of juvenile Chinook Salmon in selected Lower River habitats that originated in the Middle and Upper Susitna River in 2013 and 2014*." The first part of this objective requires sufficient variation in genetic samples.

As discussed above the new information obtained from Study 9.7 about the relative abundance of Chinook Salmon in the Upper River and the proportional distribution of Chinook Salmon in the Susitna River basin make it very unlikely that AEA will see sufficient genetic variation to support MSA independent of the number of samples they obtain. Without sufficient genetic variation in the Lower River population, it is not realistically feasible to estimate the annual percent of juvenile Chinook Salmon in selected Lower River habitats that originated in the Middle and Upper Susitna River, even with the additional sampling requested in the NMFS modification. As such, NMFS has not established "good cause" for the proposed modification as required by the ILP regulations.

Specific to additional samples being collected in the Middle and Lower River, the second part of Objective 5 is "*to estimate the annual percent of juvenile Chinook Salmon in selected Lower River habitats that originated in the Middle and Upper River*". Sampling of Chinook Salmon juveniles in the Middle River has been sufficient and additional sampling there would not further the ability to use MSA. As discussed above in response to Modification 5-1 (Section 2.6.10.5.1), it is 1) the challenge of collecting sufficient numbers of Chinook Salmon in the *Lower River*, and 2) the unlikely probability that 5 percent of all Lower River collections will be juvenile salmon from the Upper River that are limiting the application of MSA. The requested modification for additional samples and associated biological data without application of MSA would not be useful in testing this hypothesis.

Regarding NMFS reference to Davis and Davis (2015) methods that were "*successful in obtaining suitable numbers of juvenile Chinook Salmon,*" that study reported collections of 62 juvenile Chinook Salmon collected from 17 locations, 14 of which were located in the Middle River (RM 100 to 118) and 3 that were located in the Talkeetna River. Similarly, AEA's winter sampling in this area, FA-104 (Whiskers Slough), resulted in the collection of 144 verified juvenile Chinook Salmon from 12 sites. These data support the notion that collecting fish in this segment of the river in winter is relatively easy. But they do not inform the likelihood of success in the Lower River as Davis and Davis did not sample there. Even if this magnitude of collection was repeatable in the Lower River, the purported suitable collections fall far short of sample sizes that would be required for running MSA, as described above in Section 2.6.10.5.1.

2.6.10.5.3. Response to Modification Request for Additional Analyses

Ms. Rebecca Long (Long_160620_pp03_ph3) states that the March 22, 2016 ISR Meeting presentation of the preliminary analysis of population structure of Chinook Salmon showed high genetic divergence between the Oshetna and Kosina River collections. Ms. Long asserts that additional analyses are needed to determine if the divergence is stable and indicative of self-perpetuating populations. She comments that the divergence could be unstable due to variables such as low sample size, family effects and other population migrations. Ms. Long requests that for the USR, genetic collections for further purposes of Study 9.14 should occur as part of future fish study work.

In response, AEA requests that FERC not adopt this request as a Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, Ms. Long requests additional genetic sample collection and analysis which are already part of the FERC-approved Study Plan and which AEA identified as future Steps to Complete the Study in the ISR Part D, Section 8. Future genetic sample collection of juvenile Chinook Salmon in support of Study 9.14 will be completed as part of the Fish Distribution and Abundance Studies (Study 9.5 Objective 8; and Study 9.6 Objective 7), as described in Section 8 of each respective ISR Part D. The need for future adult sampling will be evaluated after the parental genotyping is completed and AEA has more information about the Upper River samples. If results of genetic analyses indicate that additional adult samples are necessary to understand the genetic structure of the Upper River Chinook Salmon population, AEA has agreed to conduct additional directed sampling under Study 9.14 in the future. This statement by AEA was made during the April 12, 2016 Technical Team meeting. Thus, the proposed modification is not necessary.

Regarding the genetic divergence between the Oshetna River and Kosina Creek collections, AEA agrees that the Oshetna River and Kosina Creek are the most divergent collections, but they likely do not represent independent samples. Lack of independence can upwardly bias Fixation Index-Statistics (FST). Furthermore, preliminary analyses on relatedness among juvenile samples taken above Devils Canyon showed high levels of related individuals (sharing parents) within geographic areas and years. Results of relatedness among juveniles should be taken into account in the interpretation of genetic results. AEA will proceed with analysis of relatedness of samples upstream from Devils Canyon during future study implementation.

2.6.10.6. References Cited

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2.6.11. Study 9.15 – Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area

As established in the Study Plan[35] (RSP Section 9.15.1), the goal of this study is to compile and analyze baseline information on the harvests of resident and anadromous fishes in and downstream of the proposed Project area to understand the potential for Project construction and operation to alter harvest levels and opportunity.

The study objectives are established in RSP Section 9.15.1:

- Describe baseline harvest levels and harvest locations for commercial, sport, personal use, and subsistence fisheries for Susitna-River-origin resident and anadromous fish.
- Describe the potential for the Project to alter harvest levels and opportunities on Susitna-River-origin resident and anadromous fish based on potential Project-induced changes in fish abundance and distribution from flow- and habitat-related changes as estimated from other Project studies.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 22, 2016, AEA proposes no modifications to Study Plan Section 9.15. Study 9.15 ISR Part C Section 7, filed in June 2014, described that the implementation of this study was deferred to 2015. Since that time, AEA has not completed any additional work on this desk top study.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 9.15. AEA received no comments on Study 9.15.

2.6.12. Study 9.16 – Eulachon Run Timing, Distribution, and Spawning in the Susitna River

As established in the Study Plan[36] (RSP Section 9.16.1), the overall goal of this study is to collect baseline information regarding Eulachon (*Thaleichtys pacificus*) run timing, distribution, and habitat use in the Susitna River in two years of study. Eulachon are an important prey species for the endangered Cook Inlet Beluga Whale (CIBW); therefore, this study has been designed to support the CIBW Study (Study 9.17). Together with existing information, data collected as part

[35] The FERC-approved Revised Study Plan (RSP) Section 9.15 for the Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area (FHARV) as approved by FERC's Study Plan Determination (Study 9.15 SPD, February 1, 2013) is referred to as Study Plan Section 9.15.

[36] The FERC-approved Revised Study Plan (RSP) Section 9.16 for the Eulachon Run Timing, Distribution, and Spawning in the Susitna River Study (EUL) as approved by FERC's Study Plan Determination (Study 9.16 SPD, February 1, 2013) is referred to as Study Plan Section 9.16.

of this study will provide necessary baseline information to address issues identified in the Pre-Application Document (PAD) and assess potential Project effects.

The study objectives, as established in RSP Section 9.16.1, are:

- Determine Eulachon run timing and duration in the Susitna River in 2013 and 2014.
- Identify and map Eulachon spawning sites in the Susitna River.
- Characterize Eulachon spawning habitats.
- Describe population characteristics of Eulachon returning in 2013 and 2014.

As described in Study 9.16 ISR Part D, Section 7, AEA has proposed 9 modifications to this study for future implementation and presented them at the October 15, 2014 ISR meeting. In addition, AEA has prepared and filed the *2015 Proposed Eulachon Spawning Habitat Study Modifications Technical Memorandum* with the Commission September 17, 2014.

1. No blocking weir will be used around the sonar unit to exclude fish from the 70-100 centimeter range.
2. The criterion for halting sonar surveys that was implemented in 2013, less than 2 fish per minute, will be repeated going forward to evaluate run timing and duration.
3. AEA will continue sampling with dip nets and/or gillnets both at sonars sites (spawning sites) and non-spawning sites to better support assessment of the sonar data and determination of run timing and duration.
4. AEA will continue with the variance implemented in 2013 to not collect water velocity data at the sonar sites to expand cross-sectional densities to an index of fish passage.
5. AEA will no longer use radio telemetry and will focus on spawning distribution on the intertidal area, where telemetry does not work. The telemetry surveys conducted in 2013 did not provide any new information on spawning distribution than that already known from the 1980s studies.
6. In lieu of radio telemetry, AEA proposes additional visual and sonar surveys to identify potential spawning locations in the lower, intertidal reach of the eulachon spawning distribution (PRM 6-11) that was not surveyed in 2013.
7. AEA proposes to develop a eulachon spawning habitat model, based on transect measurements at known eulachon spawning areas.
8. Transect-specific measurements, including bed, bank, and water surface elevations as well as surficial substrate, will be collected at high, medium, and low flow conditions to cover the range of flows observed during the eulachon spawning period. In addition, pressure transducers will be installed to record stage in 15-minute increments over the length of the field effort.
9. AEA will use the eulachon spawning habitat model to quantify and compare the availability of water depths and spawning-sized substrate under pre- and post-Project conditions. In

addition, the wetted perimeter model will be used to define the flow below which aquatic habitat conditions for spawning eulachon rapidly decline and that will represent the minimum mainstem flow needed to protect suitable spawning habitat.

In comments on the ISR and ISR Meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, NMFS and USFWS submitted four study modification proposals for Study 9.16. AEA received no comments on AEA's proposed modifications to Study 9.16 outlined above. AEA's responses to the comments can be found in Table 2.6.12-1. Responses to the four study modification requests and a common theme regarding the presence of an early under-ice run of Eulachon are further detailed below.

Table 2.6.12-1. Study 9.16 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp9.16-3_ph4b; NMFS_pp9.16-2_ph4b USFWS_pp9.16-4_ph1b; NMFS_pp9.16-2_ph6b USFWS_pp9.16-5_ph4b; NMFS_pp9.16-4_ph4b	*Recognizing that working in water during ice breakup is difficult; implement methods to enumerate each spawning run size in its entirety. Previous investigators have been able to document early under-ice runs (Vincent-Lang and Queral 1984).*	AEA disagrees that an early under-ice run of Eulachon has been documented in the Susitna River. See Section 2.6.12.1.
USFWS_pp9.16-3_ph4; NMFS_pp9.16-2_ph4	*Study Modification Request for Objective 1 (USFWS) and Modification 1 (NMFS): [The Services request] that at least two additional years of data be collected throughout the entirety of Eulachon spawning runs to document the phenology and size of each annual run.*	As explained below in Section 2.6.12.1 and Section 2.6.12.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of two additional years of data collection to implement this modification is $1,800,000.
USFWS_pp9.16-4_ph1; NMFS_pp9.16-2_ph6	*Study Modification Request for Objective 2 (USFWS) and Modification 2 (NMFS): [The Services request] that at least two additional sequential years of data be collected throughout the entirety of the eulachon spawning run to better capture the variability in spawning distribution of Eulachon.*	As explained below in Section 2.6.12.1 and Section 2.6.12.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of two additional years of data collection to implement this modification is $1,800,000.
USFWS_pp9.16-4_ph7; NMFS_pp9.16-3_ph5	*Study Modification Request for Objective 3 (USFWS) and Modification 3 (NMFS): [The Services request] that at least two additional sequential years of data be collected throughout the entirety of the spawning run to evaluate and determine the characteristics of spawning habitat in the Susitna River. In addition, the Services request the following to suitably assess potential Project effects on Eulachon:* *• Extend the water quality investigation to include the lower river and the pre-breakup period.* *• Extend the geomorphology modeling into the lower river.* *• Extend the ice modeling to the lower river or find some other method to access likely Project effects on ice processes in the lower river.* *• Explicitly identify how the assessment of Project effects on Eulachon will be completed.*	As explained below in Section 2.6.12.4, AEA requests that FERC not adopt this proposed Study Plan modification. In addition to requesting two additional years of Eulachon data collection, this study modification request has 4 elements, the first three of which are repeated modification requests from the Services for Water Quality Modeling Study 5.6, Fluvial Geomorphology Modeling Study 6.6, and Ice Processes Study 7.6. AEA's responses to the three modification requests for other studies and the estimated implementation costs can be found in Section 2.2.2.3.4 and Table 2.2.3-1 (Study 5.6 Modification 3-5); Section 2.3.2.2.3 and Table 3.2.2-1 (Study 6.6 Modification 2-4) and Section 2.4.2.6.1 and Table 4.2.6-1 (Study 7.6 Modification G-1), respectively. In addition to the total estimated cost of implementing the first three elements of this modification (from $12,500,00 to $13,800,000), the estimated cost of collecting two additional years of Eulachon data is $1,800,000. There is no cost for implementing the fourth element of the Services' modification request as AEA has already proposed a modification to address potential impacts to Eulachon (Study 9.16 ISR Part D, Sections 7.2 and 8).

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp9.16-5_ph4; NMFS_pp9.16-4_ph4	*Study Modification Request for Objective 4 (USFWS) and Modification 4 (NMFS): [The Services request] that at least two additional sequential years of data be collected throughout the entirety of the Eulachon spawning runs to quantify the population characteristics of Eulachon in this watershed, providing at least some indication of natural variability in run strength.*	As explained below in Section 2.6.12.1 and Section 2.6.12.5, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of two additional years of data collection to implement this modification is $1,800,000.

2.6.12.1. Early Under-Ice Eulachon Run

In several of the Services' modification requests and comments, they assert that an early under-ice run of Eulachon has been documented in the Susitna River, raising concerns regarding the adequacy of the Study Plan to assess impacts of the Project on the entire run of Eulachon because under-ice sampling for Eulachon was not part of the Study Plan. They further conclude that AEA's implementation of the first year of study, as provided in the Study Plan, missed this early run and therefore request two additional years of surveys to capture the "entirety of the Eulachon spawning runs."

Contrary to the Services' assertions, Vincent-Lang and Queral (1984) did not sample under-ice conditions. They employed standard gill nets, dip nets, and electrofishing; and as stated in their report:

> *Earlier sampling both years was precluded due to river ice conditions.*

Since Eulachon were captured on the initial day of sampling, the authors concluded that the actual dates of the beginning of the spawning migration actually preceded the initial day of sampling in 1982 and 1983. The authors also concluded they sampled the majority of the run because peak counts occurred following the start of sampling by a few days and post-spawning Eulachon were not observed until well after sampling had begun.

As described in the *Eulachon White Paper* (Study 9.16 Technical Memorandum [TM] filed with FERC March 22, 2013), researchers have found no clear latitudinal or other pattern in Eulachon spawn timing (Hay and McCarter 2000; Cambria Gordon 2006). The temperature at which Eulachon spawning runs commenced varied by geographic area; however, a clear pattern was not readily discernible (Spangler 2002). While some rivers such as the Copper and Chilkat see small, sporadic, Eulachon spawning runs in winter, the principal runs in these rivers occurs during spring after ice out (Wilson et al. 2006, Moffit et al. 2002). There is no data or existing information to suggest a winter, or under-ice, run has occurred on the Susitna River. Most documented Eulachon spawning migrations in Central and Western Alaska occur from mid-May to early July (Wilson et al. 2006). Documented runs in Cook Inlet rivers, Kenai, Twentymile, and Susitna, all begin in April or May depending on the year. In the 1980s the Susitna River Eulachon run was bimodal with the early part of the run migrating up river in mid-May and the later portion migrating from mid-May to early June. Although the timing of the run varied between years, Barrett et al (1984) concluded that the major movement of Eulachon into the Susitna River occurred after ice out.

Wilson et al. (2006) note that attempts to characterize run timing are often complicated by annual variation in timing. Moody (2008) found that the analysis of spawn timing as a stock identifier in Eulachon was complicated by observed variation in the duration of spawning from year to year, the presence of multiple spawning runs in some rivers, and observations of Eulachon returning earlier in recent years in some systems relative to historical data. In the Susitna River, the 2013 Eulachon migration occurred after breakup, which was very late that year; but, the overall run timing was consistent with study results from the 1980s. The 2013 run was compressed and only one mode was evident; that was also consistent with data reported from the commercial fishery. In 2013, AEA conducted dip net sampling in known spawning locations within the intertidal reach prior to ice out. Sampling occurred on May 9, May 20, and May 22 at one to three different sites each day and no fish were caught. On May 25 sampling in these same locations resulted in one fish. By May 29, dip netting at the sonar station resulted in 66 Eulachon being captured. This data clearly indicates that AEA captured the beginning of the Eulachon run in 2013. Available information from site-specific studies in the early 1980s, and the results of sampling, modeling, and analysis in Study Year 2 as proposed by AEA will support the analysis of Project effects and the identification of protection, mitigation and enhancement measures as appropriate.

2.6.12.2. Response to Modification Request for Additional Years of Study to Document Eulachon Run Size and Phenology

The USFWS (Modification Objective 1; USFWS_pp9.16-3_ph4) and NMFS (Modification 1; NMFS_pp9.16-2_ph4) request that at least two additional years of data be collected throughout the entirety of Eulachon spawning runs, including before ice breakup, to document the phenology and size of each annual run.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not demonstrated that AEA did not follow the FERC-approved Study Plan. Instead, the Services appear to disagree with the study objectives within the approved plan and have created a completely new objective, without any justification as to why run size is important to evaluating Project Effects.

As an initial matter, the FERC-approved Study Plan did not include an objective or a sub-objective to document Eulachon run size. While the Services may disagree with the FERC-approved Study Plan, AEA has made considerable progress toward attaining Objective 1 during the first year of this study. As discussed above in Section 2.4.12.1, AEA disagrees with the Services' assertion that annual estimates of Eulachon run size are necessary to evaluate project effects. Consistent with the proportion of their time spent in the ocean versus freshwater, Eulachon abundance is largely controlled by ocean conditions rather than in-river conditions (Emmett and Brodeur 2000) and their abundance can fluctuate greatly year to year. Furthermore, due to their large abundance, small size, and schooling behaviors, rigorous methods to estimate escapement for this species do not exist (see Hay and McCarter 2000 for a discussion on limitation of abundance estimation for Eulachon).

In addition, this study has not yet been completed. AEA implemented the first year of study following the FERC-approved Study Plan. As described above in Section 2.6.12.1, AEA disagrees with the Services that the entire Eulachon run was not captured during the first year of study implemented in 2013 and the Services do not present any evidence to the contrary. AEA will collect a second year of data per the FERC-approved Study Plan and AEA's proposed Study Plan modifications if approved by FERC. The Services' proposed modification that data collection be extended for two additional years is premature at this stage of the ILP and, based on the data compiled thus far, is not necessary to meet Objective 1 of the Study Plan (see Section 2.6.12.1 for discussion of 2013 versus 1980s run timing). AEA completed Study Year 1, and consistent with the FERC-approved Study Plan Section 9.16, supplemented the 1980s sampling techniques with splitbeam and DIDSON sonars. Dip netting was also employed to sample Eulachon on a limited basis prior to spring ice break-up. Similar to the 1980s results (Barrett et al. 1984), peak counts and the initial sighting of post-spawning Eulachon occurred following the start of sampling.

During Study Year 2, AEA will initiate sampling as soon as river ice conditions allow and will continue to record daily counts and the initial capture of post-spawning Eulachon. This sampling effort should ensure that the majority of the spawning run is sampled, the peak of the run can be identified, and information on Eulachon run timing and duration of spawning will be developed consistent with generally accepted practice.

AEA maintains that estimating Eulachon run size is not necessary to assess Project impacts. The FERC-approved Study Plan and AEA's proposed modifications will provide for the necessary data collection to meet the study objectives and allow for a Project effects analysis.

2.6.12.3. Response to Modification Request for Additional Years of Study to Document Variability in Spawning Distribution

The USFWS (Modification Objective 2; USFWS_pp9.16-4_ph1) and NMFS (Modification 2; NMFS_pp9.16-2_ph6) request that at least two additional sequential years of data be collected throughout the entirety of the Eulachon spawning run, including before ice breakup, to better capture the variability in spawning distribution of Eulachon.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan as the Services have not provided any justification to support their modification and thus have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the plan was either not implemented as provided by the approved Study Plan, or implemented under anomalous conditions.

As an initial matter, the study has not yet been completed. AEA implemented the first year of study following the FERC-approved Study Plan. As described above in Section 2.6.12.1, AEA disagrees with the Services that the entire Eulachon run was not captured during the first year of study implemented in 2013 and the Services do not present any evidence to the contrary. AEA will collect a second year of data per the FERC-approved Study Plan and AEA's proposed Study Plan modifications if approved by FERC. The Services' proposed modification that data collection be extended for two additional years is premature at this stage of the ILP and, based on the data compiled thus far, is not necessary to meet Objective 2 of the Study Plan. The spawning distribution of Eulachon in the non-tidally influenced portion of the mainstem Susitna River is well-established from the 1980s studies as well as 2013 surveys.

During the 2013 study effort, 28 Eulachon spawning sites were documented between PRM 10.5 and PRM 50.3. This distribution was similar to that observed in 1982 and 1983. Eulachon spawning was documented from RM 4.5 to 50.5 in 1983 and up to RM 48.5 in 1982 with the majority of spawning occurring downstream of RM 29 in both years (Barrett et al. 1984). After review of the 2013 spawning distribution data, AEA determined that the radio telemetry results identified potential spawning locations within the known distribution of Eulachon spawning from the 1980s and consistent with visual and sonar observations in 2013. Since radio signals are not detectable in saline environments, and the radio telemetry component of the study did not provide additional information on potential spawning locations, AEA proposes a modification to the FERC-approved Study Plan to eliminate the radio telemetry study component in Study Year 2 (See *2015 Proposed Eulachon Spawning Habitat Study Modifications* filed with the Commission

September 17, 2014). In lieu of radio telemetry, AEA is proposing additional visual and sonar surveys to identify potential spawning locations in the lower, intertidal reach of the Eulachon spawning distribution (PRM 6 to PRM 11) that was not surveyed in Study Year 1. No data are currently available on Eulachon spawning in that stretch of the Lower River. Because Eulachon constitute one component of CIBW PCE prey species, Eulachon activity below PRM 11 is of interest to AEA to assist in evaluating potential Project impacts to the Cook Inlet Beluga Whale PCEs. Sampling results from Study Year 1, available information from site-specific studies in the early 1980s, and the results of proposed sampling in Study Year 2, will support the analysis of Project effects.

As noted above in Section 2.6.12.1, contrary to the Services' assertions, Vincent-Lang and Queral (1984) did not sample under-ice conditions. AEA employed methods used in previous Susitna River investigations (Vincent-Lang and Queral 1984) and, consistent with the FERC-approved Study Plan Section 9.16, supplemented those methods with more modern technology. Radio telemetry and mobile acoustic surveys were used jointly to identify the distribution of spawning locations in the study area and evaluate fish behavior on spawning sites. In both the 1980s and in 2013, these fish moved into the Susitna River at the time of or just following ice out and spawning began within several days as temperatures warm above approximately 5°C (Barrett et al. 1984). Based on available information from the 1980s and 2013, AEA has characterized the existing condition of both the run timing and spawning distribution of Eulachon and will supply even more support for this information during the next year of study implementation.

Finally, the Services do not explain how sampling the few fish that might move in under ice would be likely to affect documenting the spawning distribution, when all available information, in fact, makes a case to the contrary. As stated previously, the spawning distribution was consistent with the distribution historically, showing stability in the spawning distribution over time. Based on the run timing of other Eulachon populations in this part of Alaska, including the Susitna in 1982, 1983, and 2013, the majority of the run moves into rivers after ice out and it is a large group of fish that will be most useful for documenting spawning locations. Thus, it is unlikely that sampling under ice, prior to break up will provide information that materially changes the existing information on distribution.

2.6.12.4. Response to Modification Request for Additional Years of Study to Characterize Eulachon Spawning Habitat, Extension of Riverine Process Models and Description of Project Effects Assessment

The USFWS (Modification Objective 3; USFWS_pp9.16-4_ph7) and NMFS (Modification 3; NMFS_pp9.16-3_ph5) request that at least two additional sequential years of data be collected throughout the entirety of the spawning run, including before ice breakup, to evaluate and determine the characteristics of spawning habitat in the Susitna River. In addition, the Services request the following to suitably assess potential Project effects on Eulachon:

- Extend the water quality investigation to include the Lower River and the pre-breakup period.
- Extend the geomorphology modeling into the Lower River.

- Extend the ice modeling to the Lower River or find some other method to access likely Project effects on ice processes in the Lower River.
- Explicitly identify how the assessment of Project effects on Eulachon will be completed.

AEA requests that FERC not adopt this proposed Study Plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services have not established "good cause" as required by the ILP regulations, nor have the Services demonstrated that the plan was either not implemented as provided by the approved Study Plan, or implemented under anomalous conditions. In addition, AEA has already provided a method for assessing potential Project impacts to Eulachon spawning habitat (*2015 Proposed Eulachon Spawning Habitat Study Modifications Technical Memorandum* filed with the Commission September 17, 2014) to which the Services have not provided any comment.

As described in the ISR, this study has not yet been completed. AEA implemented the first year of study following the FERC-approved Study Plan. As described above in Section 2.6.12.1, AEA disagrees with the Services that the entire Eulachon run was not captured during the first year of study implemented in 2013 and the Services do not present any evidence to the contrary. AEA will collect a second year of data per the FERC-approved Study Plan and AEA's proposed Study Plan modifications if approved by FERC. The Services' proposed modification that data collection be extended for two additional years is premature at this stage of the ILP and, based on the data compiled thus far, is not necessary to meet Objective 3 of the Study Plan.

Sampling and telemetry work in the Lower River conducted in the first year of study met the objectives of the study by documenting that the spawning distribution in 2013 was consistent with 1980s studies (as detailed in Section 2.6.12.3) and provided data toward characterizing spawning habitat as described in Study 9.16 ISR Part A, Section 5.3. Results from the 2013 Eulachon spawning study found the spatial distribution to be similar to those observed in the 1980s. Physical habitat data was collected at 28 spawning sites and included depth, velocity, substrate, water temperature, pH, conductance, dissolved oxygen, and turbidity (ISR Part A, Section 5.3.2). Sampling results from Study Year 1, available information from site-specific studies in the early 1980s, and the results of proposed sampling related to the spawning habitat model in Study Year 2, will support the analysis of Project effects and the identification of protection, mitigation and enhancement measures as appropriate and meet the objective of characterizing Eulachon spawning habitat as specified in Objective 3. USFWS and NMFS have not provided sufficient information to justify why their proposed modification is necessary to meet this objective.

The Services' proposed modification that water quality modeling (Study 5.6), fluvial geomorphology modeling (Study 6.6), and ice processes modeling (Study 7.6) be extended below PRM 29.9 in the Lower River is also not necessary to meet Study Plan Section 9.16 Objective 3. AEA requests that FERC not adopt these elements of the Services' proposed Study Plan modifications because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan and specifically, the Services have not established "good cause" as required by the ILP regulations. The Services' request to extend the riverine process models Study 5.6 (Water Quality Modeling), Study 6.6 (Fluvial Geomorphology Modeling), and Study 7.6 (Ice Processes) models below PRM 29.9 is not supported by any information or justified.

Cook Inlet is host to the one of the largest tidal ranges in North America and Eulachon entering the Lower River successfully contend with a daily tidal range of approximately 30 feet during spring tides and more than 10 feet during neap tides. This tidal range would clearly overwhelm Project-related flow fluctuations in the tidally-influenced zone of the Lower River. Depending on flow and tides, a tidal influence extends upstream to approximately PRM 20 (Study 6.6 TM, September 26, 2014: *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9*).

The proposed dam site is at PRM 187.1, and the Susitna River is joined by the Chulitna, Talkeetna, and Yentna rivers through the 157 miles downstream to the USGS gaging station at PRM 29.9 (USGS Gage Station Susitna River at Susitna Station No. 15294350). During the May to June period (encompassing the Eulachon spawning run), the Susitna River at the proposed dam site contributes 18 percent of the May-June flow at PRM 29.9, with the Yentna River contributing 42 percent, Chulitna River contributing 17 percent, Talkeetna contributing 9 percent, and other tributaries contributing almost 15 percent, respectively. Using Version 2.8 of the Open-water Flow Routing Model (Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*), the average daily range in water level fluctuations in May (open water portion) and June at PRM 29.9 was modeled to be nearly the same between Existing Conditions and operating scenario ILF-1 (i.e., < 0.1 feet).

Although the range of daily fluctuations will be about the same, Project operations will reduce flow and water levels in the Lower River during the early May to mid-June Eulachon spawning period. The daily river water level at PRM 29.9 during May and June of an average year (e.g., 1985) would be about 0.75 feet lower under ILF-1. This calculation is based on a rating curve for PRM 29.9 at a transect with a channel width of 1,850 feet and a maximum channel depth of 37 feet at a flow of 112,000 cfs (Figure 2.6.12-1). For modeling purposes, the USGS gaging station at PRM 29.9 provides a long-term hydrologic record; however, the station is located at an atypical narrowing of the river that is not representative of the river channel below PRM 29.9 (Figure 2.6.12-2). Complete Susitna River transects have not been measured below PRM 29.9, but as shown in Figure 2.6.12-2, the character of the river channel at PRM 36.4 is more representative of the Lower River channel below PRM 29.9 than the USGS gaging site. A transect measured at PRM 36.4 has a channel width of 8,000 feet and a maximum channel depth of about 18 feet at a flow of 112,000 cfs. Using a rating curve developed for the transect at PRM 36.4, the proposed operations under ILF-1 would reduce the water level in the Lower River below PRM 29.9 less than 0.5 feet. See Section 1.5.3 (Response to Requests to Extend Studies to Lower Susitna River) for additional information on Project effects on Lower River water levels.

In order to quantify the effects of Project-related stage changes on potential Eulachon spawning habitat, AEA proposed a Study Plan modification to conduct habitat modeling below PRM 29.9 to quantify the physical effects of the lowering of river water levels during the Eulachon spawning period (Study 9.16 TM, September 17, 2014: *2015 Proposed Eulachon Spawning Habitat Study Modifications*). AEA's proposed modification to conduct Eulachon habitat modeling will involve measuring partial transects at known Eulachon spawning areas to determine whether the streambank geometry and substrate provide acceptable spawning conditions at lower flows in the Lower River. Data for this model will include transect-specific measurements and the installation of pressure transducers to record stage in 15-minute increments. AEA's proposed study modification also includes additional visual and sonar surveys to identify potential spawning locations in the lower reach of the Eulachon spawning distribution that was not previously surveyed. This data and associated model will define and quantify Eulachon spawning habitats and habitat conditions. ADF&G researchers had concluded that under Project operations proposed in the 1980s, acceptable depths and hydraulic conditions persist at Eulachon spawning sites for mainstem discharges between 35,000 and 105,000 cfs (Vincent-Lang and Queral 1984), but since Project operations under operating scenario ILF-1 may include conditions below 35,000 cfs, the proposed habitat modeling study is designed to extend the range of modeling results to these lower flow conditions.

Based on three Water Years of hydrologic modeling output (1985, 1976, and 1981), flows at PRM 29.9 under Existing Conditions are less than 35,000 cfs about 14% of the May-June period. Flows at PRM 29.9 under ILF-1 operations are less than 35,000 cfs about 11% of the May-June period. The frequency of May-June flows below 35,000 cfs are expected to be less under ILF-1 operations because: 1) dam releases under ILF-1 exceed inflows to the Project during early May prior to spring break-up, and 2) following spring break-up, flows from the Talkeetna, Chulitna, and Yentna rivers rapidly increase causing flows at PRM 29.9 to exceed 35,000 cfs even with Project operations.

As described in Section 1.5.3 (Response to Requests to Extend Studies to Lower Susitna River), extending other riverine process modeling below PRM 29.9 is not justified. Water quality modeling was conducted from the proposed dam site at PRM 187.1 downstream to PRM 29.9. Modeling was conducted using operating scenario OS1-b which had lower flows and greater daily flow fluctuations during May and June compared to operating scenario ILF-1. Initial model results comparing Existing Conditions to operating scenario OS-1b indicated that dissolved oxygen concentrations tend to be near saturation in the Lower River and saturation conditions were expected to show no significant change between pre- and post-Project conditions at PRM 29.9. Modeling also indicated that water temperature at PRM 29.9 showed little or no change in temperature patterns over the year (Study 5.5 and 5.6 TM, September 30, 2014: *Water Quality and Lower River Modeling*, Section 6.2). Even under the “worst-case” maximum load-following operating scenario of OS-1b (Study 8.5 ISR Part C, Section 7.41), water temperature differences at PRM 29.9 were small and exhibited a random mode rather than consistently higher or lower differences between pre- and post-Project scenarios. Since effects from Project operations on temperature were calculated to be minimal at PRM 29.9, Project-related temperature effects were expected to be even less farther downstream (Study 5.5 and 5.6 TM, September 30, 2014: *Water Quality and Lower River Modeling*, Section 6.2).

Fluvial Geomorphology Modeling Study 6.6 developed a 1-D bed evolution model from the proposed dam site downstream to PRM 29.9 (Study 6.6 TM, September 26, 2014: *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9*) and concluded that the small amount of relative change between Existing Conditions and operating scenario OS-1b did not warrant extending the model farther downstream. The metrics included hydrology (open-water flow period and monthly flow duration curves), hydraulics (depths and velocities every 2-hours for representative wet, average, and dry years), sediment transport (annual sediment transport of sand and gravel sizes), and channel morphology (bed elevation and channel width change). The changes were small and predominantly within the range of natural variability with operational conditions very similar to Existing Conditions (i.e., without Project). Channel morphology change is the integration of many factors, including hydrology, sediment supply, bed material composition, channel geometry, flow depths and velocities. Because the entire lower Susitna River downstream of the Chulitna River is currently dynamic and aggradational and remains aggradational under operating scenario OS-1b conditions, the character of the river will be unchanged. Minor channel narrowing is expected below PRM 29.9, but the amounts are within natural spatial and temporal variability. Because changes in the geomorphic metrics are small relative to the natural variability, the overall effects on aquatic habitat below PRM 29.9 will also be small. See responses under Fluvial Geomorphology Modeling Study 6.6 Section 2.3.2.2.3 for a more detailed description of geomorphology modeling and the decision to not extend modeling below PRM 29.9.

The analysis of Project effects on ice conditions does not include 2-D modeling in the Lower River because there are currently no accepted models for predicting dynamic ice processes on complex braided channels, such as those found in the Lower River downstream of the Three Rivers Confluence (PRM 102) (RSP Section 7.6.3.4). During the winter period as a result of dam operations, there will be a higher flow rate in the Lower River below PRM 29.9. This increase in flow will result in a slightly higher ice thickness (Study 7.6 ISR Part A, Appendix A: *Detailed Ice Observations and Lower River HEC-RAS Modeling*). However, this ice thickness is expected to be stable over the winter period. During ice breakup, the flows from the dam will be slightly lower, but there will be no change in the breakup flows from all of the other tributaries. Spring ice breakup in the Lower River usually begins near the mouth as the extremely high tidal range results in breakup and flushing of the lowest sections of the river (generally up to PRM 15-20). As spring runoff increases, the ice cover on the Yentna River and lower Susitna River (up to PRM 45) breaks up first, quickly followed by the reach from there upstream to Talkeetna. Initial River1D analysis of operating scenario ILF-1 indicates a range of dam releases of approximately 6,000 to 10,000 cfs during the winter period; and current thinking is that the water release temperature would be closer to 0.5 to 1.0°C. These ranges of discharge would experience some attenuation as they travel downstream, especially in ice covered conditions. Initial modeling of the 1984-85 winter (average winter) with the River1D ice model shows that ice cover progression at these release temperatures would show limited ice above PRM 160, slightly delayed (5-10 days) progression between PRM 120-160, and no detectable effect below the Three Rivers Confluence (PRM 102). The Yentna and Chulitna rivers are the primary ice producers that contribute to the Lower River ice cover and these will be unaffected by changes in the Susitna River discharge (see Section 2.4.2.6.1 for further discussion and AEA's response to the NMFS Study 7.6 Modification 6-1 (NMFS_pp7.6-08_ph2) and USFWS Study 7.6 Modification 7 (USFWS_pp7.6-08_ph3).

The Services' proposed modification that AEA explicitly identify how the assessment of Project effects on Eulachon will be completed is also not necessary to meet Study Plan Section 9.16 Objective 3. AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS and NMFS have not established "good cause" as required by the ILP regulations. The proposed procedures for assessing Project effects on Eulachon are already identified in AEA's proposed modification (Study 9.16 TM, September 17, 2014: *2015 Proposed Eulachon Spawning Habitat Study Modifications*), and summarized in Study 9.16 ISR Part D. The Services do not provide justification for this proposed modification and have not provided any comments on AEA's proposed modification as outlined in the September 2014 TM. Project effects on Eulachon will primarily consider the results of collecting baseline information regarding

Eulachon run timing, distribution, and habitat use in the Susitna River, and modeling the effects of Project-related changes in river flow on Eulachon spawning habitat.

2.6.12.5. Response to Modification Request Regarding Population Characterization

NMFS (Modification 4; NMFS_pp9.16-4_ph4) and USFWS (Objective 4 Modification; USFWS_pp9.16-5_ph4) request that at least two additional sequential years of data be collected throughout the entirety of the Eulachon spawning runs, including before ice break up, to quantify the population characteristics of Eulachon in this watershed, providing at least some indication of natural variability in run strength.

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the Services did not comment on AEA's implementation of FERC-approved Study Plan but are instead raising disagreement with the study objectives as approved and are requesting a new study objective. Furthermore, they have not established "good cause" in support of their newly created study objective as required by the ILP regulations.

First, AEA disagrees that Objective 4 was not clear. RSP Section 9.16.4.4 specifically lists Objective 4 and the three tasks included under this objective: 1) determine present baseline population characteristics, 2) collect baseline genetic samples, 3) document incidental observations of marine fish species. The RSP goes on to state that describing baseline population characteristics was a main focus of 1980s studies; however, subsequent data indicates that population characteristics such as age may have changed since that time so additional data will be collected to establish current baseline biological characteristics. In the subsequent RSP Section 9.16.4.4.1, the population parameters to be collected are clearly described including: sex, spawning condition, fork length, weight, and age. The data proposed to help characterize the eulachon population are provided in 9.16 ISR Part A, Section 5.4.1. AEA collected information on sex, length, weight, and spawning condition on 2,344 Eulachon. Otoliths from 272 Eulachon were analyzed for age and age composition of the sample was provided.

Estimating relative abundance of the population was not part of Objective 4 nor any objective in the FERC-approved Study Plan for Study 9.16. Consistent with the FERC-approved Study Plan Section 9.16.4.1, AEA used fixed sonar station to assess the timing and duration of the spawning migration. Eulachon relative abundance was monitored at that station to help characterize the run timing. Sonar data was presented in 9.16 ISR Part A, Section 5.1.1 and indicated that the preponderance of the Eulachon run past the station between May 28 and June 16, 2013.

AEA also disagrees that a population estimate of Eulachon abundance is necessary to evaluate potential Project effects. Eulachon abundance in a particular river can vary substantially from year to year (Wilson et al 2006) and is dependent on ocean conditions during their marine rearing phase (Emmett and Brodeur 2000). In addition, estimating Eulachon abundance with any precision has proven to be very challenging to fish scientists and the error around the population estimate can be as great as the estimate itself. These two known characteristics about Eulachon run size, make it very unlikely that AEA would be successful at detecting a population level effect based on Eulachon abundance and is one reason why the proposed analysis of Project effects incorporates habitat-based analyses described in *2015 Proposed Eulachon Spawning Habitat Study Modifications* (Study 9.16 TM, September 17, 2014).

Sampling results from Study Year 1, available information from site-specific studies in the early 1980s, and the results of proposed sampling in Study Year 2, will meet the study objectives as described in the FERC-approved Study Plan and will support evaluation of potential Project effects on Eulachon spawning habitat. For discussion of the need for two additional years of study see Sections 2.6.12.2 above.

2.6.12.6. References Cited

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2.6.12.7. Figures

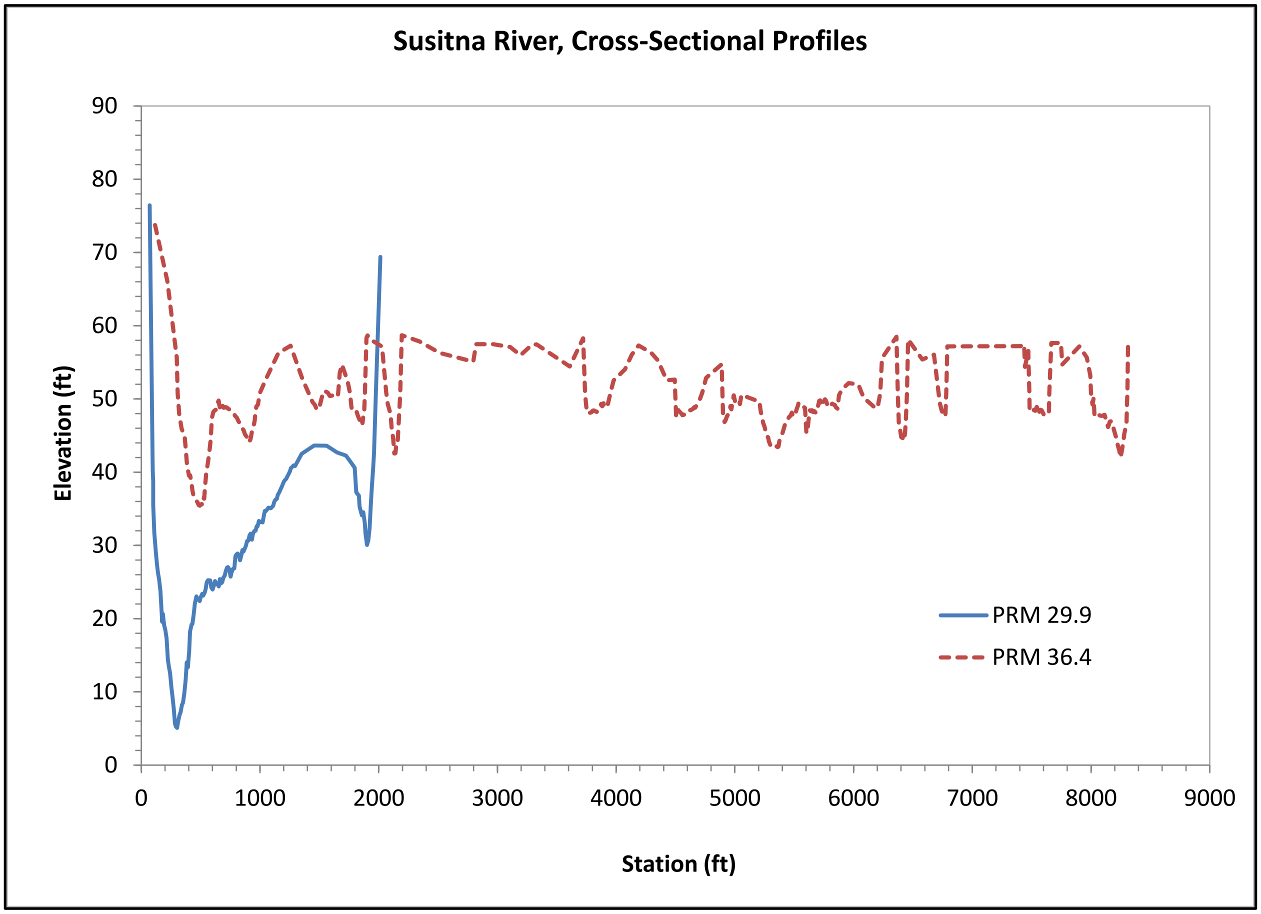

Figure 2.6.12-1. Cross sectional profiles of Susitna River at PRM 29.9 (measured 7/15/2013) and PRM 36.4 (measured 7/12/2013).

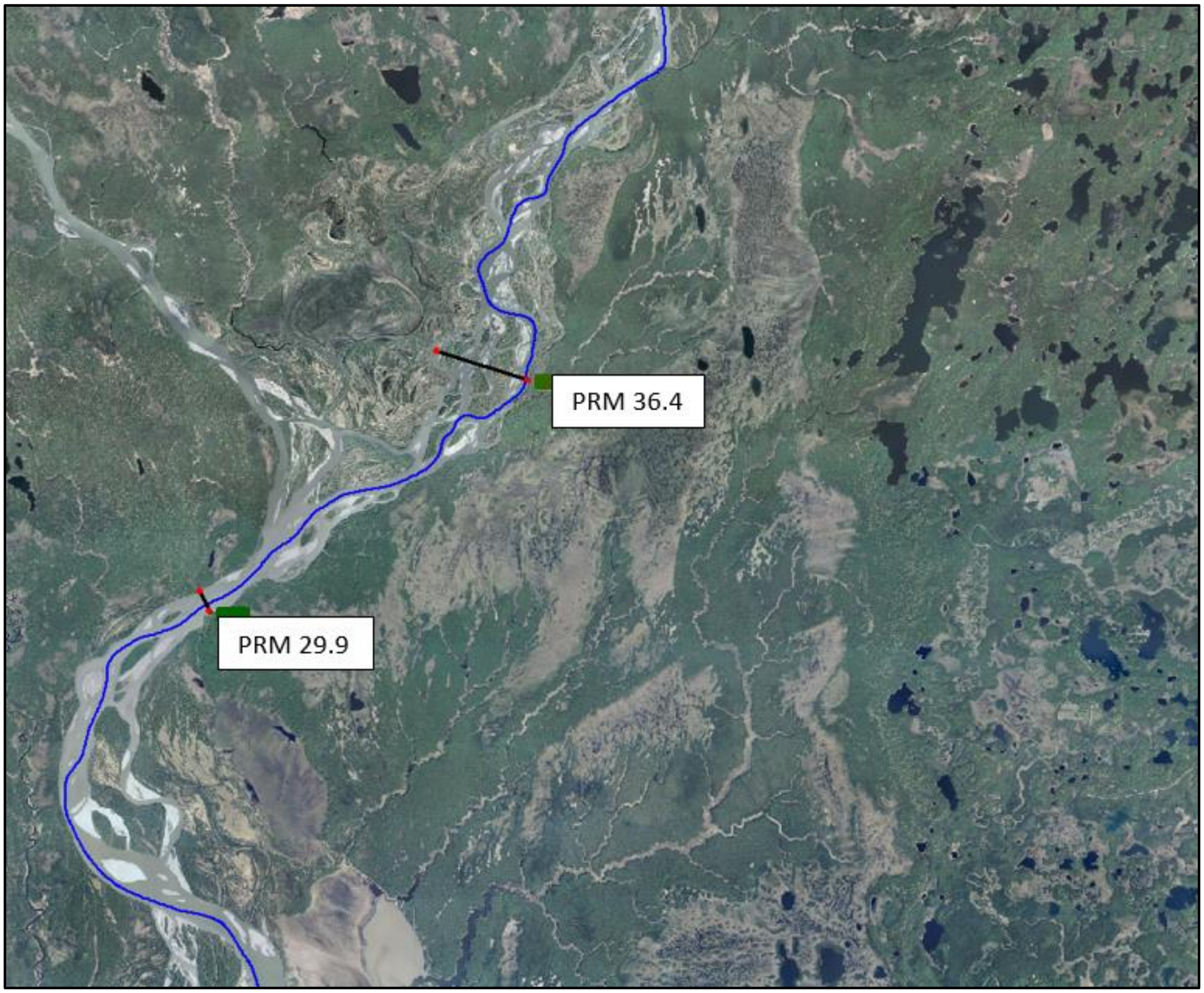

Figure 2.6.12-2. Plan view comparison of Susitna River channel at PRM 29.9 and PRM 36.4 showing difference in Lower River channel type (aerial photo source: 2011 Matanuska-Susitna Borough LiDAR & Imagery Project).

2.6.13. Study 9.17 – Cook Inlet Beluga Whale Study

As established in the Study Plan[37] (RSP Section 9.17.1), this study focuses on understanding the distribution and movements of Cook Inlet Beluga Whale (CIBW) within the Susitna River delta, correlating these data with information on the ecology and habitat parameters of CIBW prey species, and recording incidental observations of all marine mammals sighted during CIBW studies.

As established in RSP Section 9.17.1, the study objectives are:

[37] The FERC-approved Revised Study Plan (RSP) Section 9.17 for the Cook Inlet Beluga Whale Study (CIBW) as approved by FERC's Study Plan Determination (Study 9.17 SPD, February 1, 2013) is referred to as Study Plan Section 9.17.

- Document CIBWs and other marine mammals in the Susitna River delta, focusing on CIBW distribution and upstream extent;
- Document CIBW group size, group composition, and behavior within the Susitna River delta;
- Develop a model to describe the relationships between river flows, water surface elevation, and CIBW foraging habitats in the Susitna River.

Results from the first year of study were presented in the June 3, 2014 ISR. AEA has met with NMFS staff several occasions (May 12, 2014, August 7, 2014, August 26, 2014) to discuss the initial year of implementation and informally consult on modifying the FERC-approved Study Plan to collect data in the subsequent year of study necessary to assess Project impacts to CIBW, CIBW habitat and PCE prey. Given the scale of modifications to the Study Plan, AEA developed a *Modified Revised Study Plan* (MRSP) which was provided as Attachment 1 to ISR Part C. That MRSP and Section 7 of the ISR Part C indicated that an Implementation Plan (IP) for study activities in the next year of study would be provided based on results of the Pilot Study conducted in 2014 which are summarized in *2014 Cook Inlet Beluga Whale Prey Study Implementation Technical Memorandum* filed with the Commission September 26, 2014. Accordingly, an IP which described new methods for study activities in the second year of study compared to those described in the RSP (RSP Section 9.17.1) was filed with the Commission. On August 7 and August 26, 2014, AEA discussed the 2014 activities and plans for the second study year activities with NMFS staff. NMFS provided informal feedback during those discussions and that input has been incorporated into the IP.

Although it was AEA's desire to discuss the results of the 2014 Pilot Study and AEA's Implementation Plan of AEA's *Modified Revised Study Plan* (ISR Part C, Attachment 1) during the October 2014 ISR Meeting, NMFS elected not to participate in discussion of any work beyond that presented in the June 2014 ISR during the October 2014 ISR Meeting (NMFS letter to FERC filed September 22, 2014). In this letter, NMFS did provide some written comment to AEA regarding the vessel based Pilot Study conducted in 2014 and AEA subsequently revised their Implementation Plan and approach for vessel based surveys in part due to NMFS's comments.

As detailed in ISR Part D (November 6, 2015) and presented during the second ISR meeting for this study held on March 22, 2016, AEA proposes three modifications to Study Plan Section 9.17:

1. Aerial surveys would be replaced by vessel-based incidental observations;
2. Camera stations would be replaced by land-based observations; and
3. Water surface elevation model would be replaced by flow-habitat modeling.

In addition, as discussed during the meeting and detailed in the Study 6.6 *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9 Technical Memorandum*, filed September 26, 2014, the potential Project effects would be very minor and within the range of natural variation currently occurring (see Section 1.5.3.6 above), so the decision was made to not extend the fluvial geomorphology model downstream of PRM 29.9.

During the March 22, 2016 ISR Meeting, NMFS indicated that AEA's proposed modifications do not meet the original study objectives at the Susitna River delta, noted that that the WSE modeling was eliminated, and indicated that NMFS would submit comments in writing. Comments to the Study 9.17 ISR were filed with FERC by NMFS on June 22, 2016. Notwithstanding AEA's consultation record with NMFS, it appears that NMFS focused their comments on the ISR Part A and did not comment on significant supporting materials filed with the Commission, including AEA's MRSP (ISR Part C) or the 2015 Implementation Plan (IP) filed on September 30, 2014. Indeed, AEA has yet to receive comments from NMFS on the MRSP, the IP, or any recommendations for modifications to AEA's MRSP.

Instead, as part of its comments on the Study 9.17 ISR, NMFS has proposed 11 modifications, one of which pertains directly to Study 9.17 and 10 of which are for studies that have interdependencies with Study 9.17.

Table 2.6.13-1. Study 9.17 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
NMFS_pp9.17-15_ph10	*Modification 7a: NMFS recommends conducting additional surveys to document the in-river habitats used by CIBW following a study plan developed in coordination with NMFS.*	As explained below in Section 2.6.13.1, AEA requests that FERC not adopt this proposed Study Plan modification as AEA has already developed a plan for additional in-river surveys through consultation with NMFS and filed the plan with the Commission as a proposed modification to the FERC-approved Study Plan. It is not feasible to estimate the cost for implementing NMFS's modification as no study design or details were provided.
NMFS_pp9.17-16_ph4	*Modification 7b: NMFS recommends using an analytical approach to evaluating Project effects on CIBW and their PCEs be developed in coordination with NMFS, be approved by NMFS, and implemented by AEA.*	As explained below in Section 2.6.13.2, AEA requests that FERC not adopt this proposed Study Plan modification. It is not feasible to estimate the cost for implementing NMFS's modification as no study design or details were provided.
NMFS_pp9.17-20_ph8	*Modification 10: NMFS recommends that an approach for addressing potential Project effects on eulachon and CIBW be developed, implemented, and revised as needed, based on NMFS's review (See Additional Modification at the end).*	As explained below in Section 2.6.13.3, AEA requests that FERC not adopt this proposed Study Plan modification. This modification is also redundant. Since Eulachon are a PCE for CIBWs, this modification is fully contained within Modification 7b. In addition, this modification request pertains to the Eulachon Study (Study 9.16) and was also submitted by NMFS within Modification 3 to Study 9.16 (NMFS_pp9.16-3_ph5); see Section 2.6.12.4. It is difficult to estimate a cost for this modification as AEA has already consulted with NMFS and developed and submitted modifications to Study 9.16 to better address potential impacts to Eulachon (Study 9.16 ISR Part D, Sections 7.2 and 8); NMFS has not provided any comments to AEA's proposed modifications nor does it provide any detail describing its request.
NMFS_pp9.17-4_ph8	*Modification 11. All studies with potential to observe belugas should record incidental sightings information; this effort should not be limited to the eulachon studies. NMFS*	AEA does not object to FERC's adoption of this proposed Study Plan modification. AEA understands the importance of incidental sightings of CIBW and has incorporated those into the studies that will be ongoing

	recommends developing and distributing CIBW observation/data collection sheets to all lower Susitna River in-stream and land-based investigators who may observe CIBWs in the river itself, as well as in the river delta area.	in the Lower River. The *CIBW 2015 Implementation Plan Technical Memo*randum specifically calls out vessel-based observations incidental to the Eulachon Study (9.16) because the surveys will occur from approximately PRM 6 to PRM 50, and will take place in May through mid-June. Land-based observations will also occur between approximately PRM 6 and PRM 20. These will occur from breakup until early October. The March 2016 ISR Meeting Notes also indicate that AEA agrees to record incidental sightings during the execution of field work. The estimated cost of implementing this modification is estimated at $10,000.
Study Modification Requests for Studies Interrelated with Study 9.17		
NMFS_pp9.17-3_ph1	*NMFS Study Modification 1. Complete the work associated with the baseline water quality study and water quality modeling study (Study 5.5-Modification 3-1, Study 5.6 –Global modification).*	As described in the response to Modification 3-1 in Section 2.2.1.2.1.1 and Section 2.2.1.3.2.1 and the response to the Global Modification in Section 2.2.1.3.3.5, AEA requests that FERC not adopt these proposed Study Plan modifications because neither of these requests meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. As these "modification" requests are simply to implement the FERC-approved Study Plan as AEA is doing, there is no additional cost for implementing these "modifications." Data from 2013 and 2014 will be used for continued model development and completion of the water quality modeling study will continue to define areas of CIBW prey availability, habitat, and spawning habitat.
NMFS_pp9.17-3_ph1	*NMFS Study Modification 2. Add a mercury bioaccumulation assessment to the mercury assessment and potential for bioaccumulation study which addresses the effects of downstream transport of mercury on biota, including CIBW (Study 5.7, Modification 10-1).*	As explained below in Section 2.6.13.4.1 and previously in Section 2.2.3.10.1 (Study 5.7), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is provided in Table 2.2.3-1 response to NMFS Study 5.7 Modification 10-1.
NMFS_pp9.17-8_ph5	*Modification 3a: NMFS recommends increasing sampling in the lower river to adequately characterize sediment supply and transport in each of the updated reaches (see objective 1) in the lower river. This is described and justified in Study 6.5, Modification 2-1.[sic]*	As previously explained in Section 1.5.3 and Section 2.3.1.1.2 (Study 6.5), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is provided in Table 2.3.1-1 response to NMFS Study 6.5 Modification 3a.
NMFS_pp9.17-8_ph8	*Modification 3b: NMFS recommends determining the range of likely flow release quantities and patterns expected for reservoir operations with the Project in place, and redoing analyses of Project effects on sediment supply and transport as needed to reflect the range of likely operations. This modification is described and justified in Study 6.6, Modification G-1.*	As previously explained in Section 2.3.2.4.1 (Study 6.6), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is provided in Table 2.3.2-1 response to NMFS Study 6.6 Modification G-1.
NMFS_pp9.17-11_ph1	*Modification 3c: NMFS recommends that the modeling of channel morphology be extended to the mouth of the river and that tidal hydrodynamic modeling be completed under a range of likely reservoir operation scenarios*	As previously explained in Section 1.5.3 and Section 2.3.2.2.3 (Study 6.6), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is

	and including an evaluation of changes in ice formation be completed for the lower 29.9 miles of the Susitna River. This is described and justified in Study 6.6, Modification 2-4.	provided in Table 2.3.2-1 response to NMFS Study 6.6 Modification 2-4.
NMFS_pp9.17-12_ph5	*Modification 4a: NMFS recommends modeling of ice build-up in the Lower River…. This modification is further described and justified in Study 7.6 modification 6-1.*	As previously explained in Section 1.5.3 and Section 2.4.2.6.1 (Study 7.6), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is provided in Table 2.4.2-1 response to NMFS Study 7.6 Modification 6-1.
NMFS_pp9.17-3_ph1	*Modification 5: NMFS recommends that the approach used to develop the HSI curves be modified using a more conventional approach that will allow for the assessment of the effects of change in temperature on salmon production. (This is similar to Study 8.5, Modification 4.3). Where there is disagreement the modifications requested in Study 8.5 trump the mods for 8.5 presented here.*	As previously explained in Section 2.5.1.4.2 (Study 8.5), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is provided in Table 2.5.4-1 response to NMFS Study 8.5 Modification 4.3. See also Section 2.5.1.5.4 for further discussion of water temperature and habitat suitability.
NMFS_pp9.17-3_ph1	*Modification 6a: NMFS recommends extending sampling into the Lower River using randomly selected sites, preferably based on a stratified design. This modification is described and justified in Study 9.9, Modification 12).*	As previously explained in Section 2.6.5.3.1 (Study 9.9), AEA requests that FERC not adopt this proposed Study Plan modification as AEA has proposed additional fish and aquatic habitat surveys in the Lower River (see also Section 2.6.2.11.1). The estimated cost of implementing this modification is provided in Table 2.6.5-1 response to NMFS Study 9.9 Modification 12.
NMFS_pp9.17-3_ph1	*Modification 6b: NMFS recommends refining the Aquatic Habitat Maps for approximately the lowest 50 miles of the Susitna River. For this same lowest 50 miles NMFS recommends the geomorphic reaches be redefined to better represent the larger scale geomorphic processes in the river.*	As previously explained in Section 2.3.1.1.2 (Study 6.5) and 2.6.5.3.1 (Study 9.9), AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is provided in Table 2.6.5-1 response to NMFS Study 9.9 Modification 12.
NMFS_pp9.17-4_ph5	*Modification 8. NMFS recommends that a sensitivity analysis be conducted to determine to what extent study results that are used as model input data affect output of those models, identifying those studies that may have pronounced effects upon model output, but for which there is considerable uncertainty surrounding model input parameters. Studies producing results with high levels of uncertainty and that have a high degree of influence over model output should be refined and repeated to reduce uncertainty of model input parameters, especially those parameters that may influence projected effects upon endangered CIBW, CIBW critical habitat and CIBW prey. This modification will be best accomplished in a New Study Request for Model Integration which is included in a separate enclosure.*	As explained in Section 3.4, AEA requests that FERC not adopt this new study request because it does not meet the criteria under C.F.R. 5.15(e). An estimated cost is provided in Section 3.4. Furthermore, it should be noted that the FERC-approved Study Plan already incorporates uncertainty analyses (RSP Sections 8.5.4.5.1 and 8.8.4.7.1.3. An example of such an analysis is provided in *Decision Support System Uncertainty* (Attachment 6).
NMFS_pp9.17-4_ph6	*Modification 9. NMFS recommends that most of the aquatic studies be extended downstream.*	As explained in Section 1.5.3, AEA requests that FERC not adopt this proposed Study Plan modification.

	This has been articulated in modifications in many other studies.	The cost of this modification is estimated to be on the order of $20,000,000.
NMFS_pp9.17-21_ph1	*Modification 11. All studies with potential to observe belugas should record incidental sightings information; this effort should not be limited to the eulachon studies. NMFS recommends developing and distributing CIBW observation/data collection sheets to all lower Susitna River in-stream and land-based investigators who may observe CIBW in the river itself, as well as in the river delta area.*	AEA does not object to FERC's adoption of this proposed Study Plan modification. The estimated cost of implementing this modification is $10,000.

2.6.13.1. Response to Modification Request to Conduct Additional In-river CIBW Surveys

NMFS requests AEA conduct additional surveys to document the in-river habitats used by CIBW following a study plan developed in coordination with NMFS (Modification 7a; NMFS_pp9.17-15_ph10).

AEA agrees with NMFS that additional surveys to document in-river use of habitat by CIBW is warranted and AEA has proposed this as a modification to the FERC-approved Study Plan (June 2014 ISR Part C Attachment 1). However, given that AEA has previously consulted on development and modification of the Study Plan and has provided that plan for NMFS to comment on during informal consultations and has proposed necessary modifications in the ISR within the ILP timeframe, AEA requests FERC not adopt NMFS's proposed Study Plan Modification for developing an additional plan in coordination with NMFS as NMFS has not provided any comments to the plan AEA has already developed and filed with the Commission, following consultation that occurred in 2014.

As explained in the *Modified Revised Study Plan* (MRSP) filed with the Commission in June 2014 (ISR Part C Attachment 1), AEA modified the study to eliminate aerial surveys and is proposing to use vessel-based and land-based observers to survey and document both CIBW presence as well as the distribution of CIBW prey species (Eulachon and adult salmon). AEA consulted with NMFS in developing this proposed modification to the Study Plan (August 7, 2014 and August 24, 2014) and revised the vessel surveys based on comments received from NMFS (September 22, 2014). Notwithstanding, NMFS's modification request seems to disregard the consultation that has already occurred and ignores AEA's proposed modification that was developed through that consultation. NMFS does not address the redundancy in its request or explain whether its proposed modification meets the Study Plan objective more efficiently than what AEA has proposed. In NMFS's request, it did not provide an approach, preliminary design, or any study detail pertaining to its proposed modification that would enable FERC to evaluate how its proposed modification may be similar to, or different from, that proposed by AEA.

As described in Study 9.17 ISR Part D, Section 7.2 (November 6, 2015) and the *2015 Implementation Plan Technical Memorandum* (September 30, 2014), AEA is proposing to conduct surveys to document in-river habitat used by CIBW. The *2015 Implementation Plan Technical Memorandum* includes a proposal for subsequent field studies of CIBW and will allow for further data that can be used to document the habitats utilized by CIBW in the river. The data collected in a subsequent year of field studies will be combined with data collected to date. This combined data will meet 9.17 study objectives. Without specific comments from NMFS regarding AEA's proposed study modifications, AEA respectfully requests that FERC make its determination based on the ISR and supporting documents.

2.6.13.2. Response to Modification Request to Develop an Analytical Approach for Evaluating Project Effects on CIBW and their PCEs

NMFS requests AEA develop an analytical approach for evaluating Project effects on CIBW and their PCEs. NMFS requests the approach be developed in coordination with NMFS, be approved by NMFS, and implemented by AEA (Modification 7b; NMFS_pp9.17-4_ph4). NMFS also requests AEA to develop and implement an approach for addressing potential Project effects on Eulachon and CIBW to be revised as needed, based on NMFS's review (Modification 10).

AEA requests that FERC not adopt this proposed Study Plan modification because NMFS has not established "good cause" for the modification and AEA has already proposed multiple approaches for evaluating Project effects on CIBW and their PCEs.

NMFS's proposed modification to the Study Plan is not necessary to meet Study 9.17 objectives. While AEA agrees that the relationship between discharge and CIBW foraging has not yet been described, AEA maintains that a proposed structured approach to addressing the PCEs is presented in the 2015 IP filed September 30, 2014. NMFS has not provided comments to AEA's approach. Furthermore, Study 9.17 was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit, see Section 1.3).

ISR Part C, Section 7.1.2.4.3 discusses the need for an evaluation of the influence of Project operations on CIBW foraging habitats. As presented in the IP, the 9.17 Study Plan was modified to eliminate the use of a water surface elevation (WSE) model and instead add in a flow-habitat model to address Eulachon spawning as well as use results from the Fluvial Geomorphology Modeling Study (Study 6.6) and Water Quality Modeling Study (Study 5.6) to evaluate potential Project effects on CIBW foraging habitat. It is important to note that the results of the flow routing model have demonstrated significant attenuation of Project effects downstream of Three Rivers Confluence (~PRM 102) and even more so downstream from the Yentna (~PRM 30) to the point where potential Project effects are predicted to be less than naturally occurring variation (see Sections 1.5.3.2 and 1.5.3.6).

Still, as the 2015 IP (September 30, 2014) presents, Study 9.17 will use information provided by related studies to help evaluate potential effects on CIBW during impact analysis. The Salmon Escapement Study (Study 9.7) and Eulachon Run Timing, Distribution and Spawning in the Susitna River Study (Study 9.16) will provide information on the distribution of CIBW prey species in the Lower River while the Water Quality studies (Study 5.5 and 5.6), Geomorphology studies (Studies 6.5 and 6.6), and the Instream Flow Study (Study 8.5) will provide information on physical and chemical processes that may influence riverine habitats and that have possible indirect effects on the distributions of CIBWs and their prey species. Additionally, as a modification to the Eulachon Study (9.16) AEA has proposed a flow-habitat model that will use pressure transducers and stage height information in the Lower River to conduct a wetted perimeter analysis to evaluate potential changes in spawning habitat. As described in Section 2.6.2.11.1 and 2.6.5.3.1 respectively, AEA has also proposed to extend both Study 9.6 Fish Distribution and Abundance Study in the Middle and Lower River and Study 9.9 Characterization and Mapping of Aquatic Habitats within the Lower River. These proposed modifications will provide additional information on juvenile salmon and fish habitat use in the Lower River and, as such will help address the CIBW PCE related to prey species.

The extent and timing of data collection for the collaborative studies that are being used to help determine the relationship between discharge and CIBW PCE prey species in the Susitna River are presented in Table 2.6.13-2. While CIBWs are generally found in and around the Susitna River mouth, their prey species extend further upstream into the Susitna River. While CIBWs have been reported to *occasionally* swim as far as 30-40 mi upstream into the Susitna River (Huntington 2000), they predominantly use the lower five miles of the river and channels in the delta where they time their movement with the tide (Huntington 2000; Rugh et al. 2010). Ezer et al. (2013) also reported that CIBWs generally remain in the vicinity of the Susitna River delta. They spend most of their time transiting between Turnagain Arm and the Susitna River delta, congregating in the mouth of the rivers during salmon and Eulachon runs (NMFS 2015; Rugh et al. 2010; Rugh et al. 2004). In addition, CIBW Type 1 critical habitat extends into the Susitna River an estimated 8.6 nautical miles from mean lower low water. Thus, the focus of Study 9.17 has been on whale observations in the Susitna River delta. Collaborative studies will provide data on prey species and their habitats largely above the intertidal area (PRM 20) because the tidal fluctuation will dominate and diminish any riverine processes that influence hydrology, sedimentation, water quality and fish habitat (Table 2.6.13-2).

Table 2.6.13-2. Location, timing and data relevance of studies associated with CIBW foraging.

Study	River Location (PRM)	Data Collection Window	Relevance to PCEs
CIBW (Study 9.17) IP	0 – 50	May – October	Use of intertidal waters
Eulachon Run Study (9.16)	10 – 60	May – September	Prey species habitat
Salmon Escapement Study (9.7)	30 – 260	July – October	Prey species distribution
Fish Distribution and Abundance (9.6)	30-187	July – October	Prey species distribution and habitat
Baseline Water Quality Study (5.5)	30 – 234	Open-water and Ice-in Periods	Water free of toxins
Water Quality Modeling Study (5.6)	30 – 234	Open-water and Ice-in Periods	Water free of toxins
Geomorphology Study (6.5)	30 – 260	Open-water Period	Channel and stage effects
Fluvial Geomorphology Modeling Study (6.6)	30 – 187	Open-water Period	Sediment supply
Groundwater Study (7.5)	29.9-187	Year round	Prey species habitat
Ice Processes in the Susitna River (7.6)	0- 234	Ice- in Period	Prey species habitat
Instream Flow Study (8.5)	60 – 187	Open-water Period	Prey species habitat
Riparian Instream Flow Study (8.6)	30 - 187	Open-water Period	Prey species habitat

2.6.13.3. Response to Modification Request to Develop an Approach for Addressing Project Effects on Eulachon

NMFS recommends that an approach for addressing potential Project effects on Eulachon and CIBW be developed, implemented, and revised as needed (Modification 10; (NMFS_pp9.17-4_ph7), based on NMFS's review. This modification request is redundant to Study 9.17 Modification 7b, which applies to all of the CIBW PCEs including Eulachon. This modification is also contained within NMFS Modification 3 to the Eulachon Study (Study 9.16) (NMFS_pp9.16-3_ph5); see Section 2.6.12.4.

AEA requests that FERC not adopt this proposed Study Plan modification to Study 9.17 or Study 9.16 because AEA has already developed an approach, informally consulted with NMFS and filed the approach as a proposed modification to the FERC-approved Study Plan for Study 9.16 Eulachon Run Timing, Distribution, and Spawning in the Susitna River (see *2015 Proposed Eulachon Spawning Habitat Study Modifications Technical Memorandum* filed with FERC on September 17, 2014; Study 9.16 ISR Part D, Section 4).

As explained in the MRSP (Study 9.17 ISR Part C Attachment 1), AEA has proposed to modify the CIBW study to eliminate the use of a WSE model and replace it with flow-habitat modeling that is described as a study modification to Study 9.16 Eulachon Run Timing, Distribution, and Spawning in the Susitna River. As a primary prey species for CIBW, Eulachon constitute one component of the primary constituent elements of the prey species deemed essential to the conservation of the CIBWs. AEA's proposed modification to Study 9.16 will address potential effects on Eulachon spawning habitat specifically within the area of overlap between Eulachon spawning and CIBW foraging. AEA's proposed modification and the additional data collection will provide sufficient information to allow AEA to evaluate Project effects on Eulachon and CIBW in the License Application. Although AEA has consulted with NMFS regarding AEA's proposed study modifications, this NMFS modification is redundant as this request disregards the consultation and does not provide sufficient information to evaluate whether its proposed modification meets the Study Plan objective more efficiently than AEA's modification.

This modification request also fails to acknowledge the *2015 Proposed Eulachon Spawning Habitat Study Modifications Technical Memorandum* filed with FERC on September 17, 2014 and listed in Study 9.16 ISR Part D, Section 4. AEA's proposed study modification presents a model that would relate potential stage change in the Lower River to Eulachon spawning habitat. Data for this model will include transect-specific measurements and the installation of pressure transducers to record stage in 15-minute increments. AEA's proposed study modification also includes additional visual and sonar surveys to identify potential spawning locations in the lower reach of the Eulachon spawning distribution that was not previously surveyed. This data and associated model will define and quantify Eulachon spawning habitats and habitat conditions. This will add insight into the availability of prey for CIBW and potential effects on CIBW and their prey. In addition, the additional studies will allow for further incidental observations of CIBW.

2.6.13.4. Responses to Modification Requests for Other Studies Interrelated with Study 9.17

2.6.13.4.1. Response to Modification Request for Study 5.7 to Add a Mercury Bioaccumulation Assessment to Address Effects of Downstream Mercury Transport

NMFS requests the mercury assessment and potential for bioaccumulation study (Study 5.7) be modified to add a mercury bioaccumulation assessment which addresses the effects of downstream transport of mercury on biota, including CIBW (Modification 2; NMFS_pp9.17-3_ph1). NMFS made the same request as Modification 10-1 under Study 5.7 (NMFS_pp5.7-2_ph12). NMFS states that the modification will require additional geological study to provide information needed to model sediment/mercury interactions and will also require addressing exposure to, and bioaccumulation of, mercury in zooplankton, salmon, and Eulachon. NMFS states that modeling accumulation of mercury in predatory species, including CIBW, will likely rely on existing literature relating concentration in water and prey to accumulation in higher trophic level species.

AEA requests that FERC not adopt this proposed Study Plan modification to Study 5.7 because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established "good cause" for the modification. Given the available science on the potential for mercury to be released in the reservoir and the distribution, life history and behavior of CIBW PCE prey species, the potential for consumption of prey by the CIBW that have been contaminated by bioaccumulation of mercury due to the presence and operation of the Project is unmeasurable.

To clarify, as part of Study 5.6, mercury concentrations in dissolved and in methylated form will be modeled in both the EFDC reservoir and riverine water quality models downstream to PRM 29.9 (Susitna Station).

While AEA does not anticipate that mercury bioavailability will be significant based upon the data that has been collected to date, the reservoir is the location, after filling and inundation occur, that represents the most likely source where mercury will become bioavailable. Export of mercury downstream of Watana Dam (~PRM 187) is unlikely since the river downstream of the dam will be relatively shallow and highly oxygenated, especially downstream of Devils Canyon (~PRM 151).

Risk for bioaccumulation in CIBW would be through consumption of prey like salmon that are exposed to mercury as juveniles and later travel to the Lower River where the CIBW feed. However, bioaccumulation of mercury in salmon below the dam would have to occur at a very high rate to result in biomagnification of mercury in the CIBW through consumption of this food base. This is highly unlikely because of: 1) Chinook Salmon being the only salmon that occurs within 30 miles of the dam and with very low abundance of Chinook Salmon spawning upstream of Devils Canyon, 2) the short exposure time of Chinook Salmon offspring rearing in the mainstem for a maximum of potentially 1.5 years, and 3) the very low proportion of these fish that would actually make it to the Lower River and be preyed upon by CIBW either as juveniles or returning adults. Chinook Salmon are the only salmon species that occur within 30 miles of the proposed reservoir and the salmon upstream of Devils Canyon represent a very small fraction of the total Chinook Salmon population in the river, estimated at <0.02 percent (Study 9.7 SCR, Section 6).

Although more salmon are found downstream of Devils Canyon, the risk of mercury exposure to these fish would be reduced. The reservoir water will travel through Devils Canyon where it will be subject to turbulence, oxygenation, and dilution from tributaries. These conditions will offset any toxic exposure and bioaccumulative potential to the salmon located in the Middle River. Eulachon are not found in either the Middle or Upper Susitna River and their time in the river both as adults and juveniles is on the order of weeks; therefore, risk of mercury exposure to Eulachon from the Susitna Reservoir would be unmeasurable.

Zooplankton offer an indirect pathway for mercury contamination in the reservoir; however, since they are not directly consumed by CIBW they would need to be consumed by juvenile Chinook Salmon in the reservoir that subsequently travel to the Lower River where the CIBW forage. Bioaccumulation of mercury by zooplankton in the reservoir may be so small as to be unquantifiable based on the short exposure time to mercury in dissolved form or through consumption of mercury adsorbed to food particles. Even if juvenile salmon overwinter in the reservoir, there would be a very small chance that a miniscule amount of mercury bioaccumulated in the zooplankton foodbase would be transferred to individual migratory fish. Based on current population estimates for Chinook Salmon spawning in the Upper River (<100) annually versus the estimated total annual escapement of all salmon upstream of the Yentna River that is on the order of 660,000 salmon (see Study 9.7 SCR, Section 6 for salmon species abundance estimates), the amount of bioaccumulated mercury in CIBW by consumption of juvenile salmon originating from the reservoir would be so small as to be unmeasurable. Identifying a link between a mercury source from the reservoir and consumption of outmigrating reservoir salmon by CIBW in the Lower River would be confounded by other sources of mercury, especially those that are marine-derived through bioaccumulation in Eulachon.

Finally, the overall risk of exposure of aquatic life to mercury (total and dissolved) is much lower in riverine reaches downstream of dams because factors that promote exposure like low dissolved oxygen, increased temperature, and nutrients are not expected to change with the presence of the dam (Study 5.6 SIR, Section 6). As such, the modification proposed by NMFS is not necessary to meet the CIBW Study Plan objective or assess the potential effects of the Project.

2.6.13.4.2. Response to Modification Request to Extend Multiple Studies Downstream into the Lower River

NMFS recommends that most of the aquatic studies be extended downstream. NMFS articulated this request in modifications in many other studies (Modification 9; NMFS_pp9.17-4_ph6).

AEA requests that FERC not adopt this proposed Study Plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, NMFS has not established “good cause” for the proposed modification.

In its comment letter, NMFS requested that most of the aquatic studies including water quality, geomorphology modeling, and ice modeling be extended below PRM 29.9 in the Lower Susitna River because they relate to CIBW PCEs. However, no specific information is provided to demonstrate that extending the Aquatic Habitat Study (Study 9.9) or riverine process models Study 5.6 (Water Quality Modeling), and Study 6.6 (Fluvial Geomorphology Modeling) below PRM 29.9 will provide additional and necessary information. The proposed dam site is at PRM 187.1

and flow changes at the proposed dam site under Project operations will be reduced through the 157 miles downstream to PRM 29.9. See Section 1.5.3 of this document for a comprehensive discussion of extending studies downstream into the Lower River; the analysis is summarized below.

The Upper Susitna River is joined by major tributaries such as the Chulitna, Talkeetna, and Yentna rivers and the total additional inflow in the 157 miles from the proposed dam site to PRM 29.9 is more than four times the May-June flow of the Upper Susitna River at PRM 187.1 in a representative water year. Using Version 2.8 of the Open-water Flow Routing Model (Study 8.5 ISR; Study 8.5 SIR, Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8)*), the average daily range in water level fluctuations in May and June at PRM 29.9 was modeled to be nearly the same between Existing Conditions and operating scenario ILF-1 (i.e., < 0.1 feet). Although the range of daily fluctuations will be about the same, Project operations will reduce flow and water levels during the Eulachon spawning period. The daily river water level at PRM 29.9 during June of a representative year (e.g., 1985) would be about 0.8 feet lower under ILF-1, but this is in comparison to a maximum channel depth of about 37 feet and an average channel depth of about 13.5 feet at PRM 29.9.

Cook Inlet is host to the one of the largest tidal ranges in North America with a daily tidal range of daily tidal range of approximately 30 feet during spring tides and more than 10 feet during neap tides. This tidal range would overwhelm Project-related flow fluctuations and depending on flow and tides, a tidal influence extends upstream to about PRM 20 (Study 6.6 TM, September 26, 2014: *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9*). While AEA has proposed to conduct habitat modeling below PRM 29.9 to quantify the physical effects of the lowering river water levels during the Eulachon spawning period (Study 9.16 ISR; Study 9.16 TM, September 17, 2014: *2015 Proposed Eulachon Spawning Habitat Study Modifications*), extending other riverine process studies below PRM 29.9 is not justified (see Section 1.5.3).

Water quality modeling was conducted from the proposed dam site at PRM 187.1 downstream to PRM 29.9 and initial model results comparing Existing Conditions to operating scenario OS-1b indicated that dissolved oxygen concentrations tend to be near saturation in the Lower River and saturation conditions were expected to show no significant change between pre- and post-Project conditions at PRM 29.9. Modeling was conducted using operations scenario OS-1b which had lower flows and greater daily flow fluctuations during May and June compared to scenario ILF-1. Modeling also indicated that water temperature at PRM 29.9 showed little or no change in temperature patterns over the year (Study 5.6 TM, September 30, 2014: *Water Quality and Lower River Modeling*, Section 6.2). Even under the "worst-case" operating scenario of OS-1b (Study 8.5 ISR Part C, Section 7.41), water temperature differences at PRM 29.9 were small and exhibited a random mode rather than consistently higher or lower differences between pre- and post-Project scenarios. Since effects from Project operations on temperature were calculated to be minimal at PRM 29.9, temperature was expected to be unchanged further downstream by Project operations (Study 5.6 TM, September 30, 2014: *Water Quality and Lower River Modeling*, Section 6.2).

Study 6.6 (Fluvial Geomorphology Modeling) developed a 1-D bed evolution model from the proposed dam site downstream to PRM 29.9 (Study 6.6 TM, September 26, 2014: *Decision Point on Fluvial GeomorphologyModeling of the Susitna River below PRM 29.9*) and concluded that the small amount of relative change between Existing Conditions and operating scenario OS-1b did not warrant extending the model farther downstream. Bed elevation change is the integration of many factors, including hydrology, sediment supply, bed material composition, channel geometry, flow depths and velocities. Because the Lower River is currently aggradational and remains aggradational under operating scenario OS-1b conditions, the character of the river will be unchanged. Minor channel narrowing is expected below PRM 29.9, but the amounts will be within natural spatial and temporal variability. Modeled Project effects included reductions in flows, sediment supply and transport, channel width, aggradation, velocities and depths in the Lower River in general. The changes were small and the range of variability with operational conditions was very similar to natural variation.

The analysis of Project effects on ice conditions does not include modeling in the lower Susitna River because there are currently no accepted models for predicting dynamic ice processes on complex braided channels, such as those found in the Lower Susitna River downstream of PRM 100.0 (Talkeetna) (RSP Section 7.6.3.4). During the winter period as a result of dam operations, there will be a higher flow rate in the Lower River near PRM 29.9. This increase in flow will result in a slightly greater ice thickness (Study 7.6 ISR, Part A, Appendix A: *Detailed Ice Observations and Lower River HEC-RAS Modeling*). However, this ice thickness is expected to be stable over the winter period. Spring ice break-up in the Lower Susitna River is primarily controlled by the discharge of ice from the Yentna River and the variations in tidal flow so Project operations that affect reservoir release temperatures or flow rates are not expected to affect ice processes in the Lower River (see Section 1.5.3.3).

2.6.13.5. References Cited

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2.7. Wildlife Resources

2.7.1. Study 10.5 – Moose Distribution, Abundance, Movements, Productivity, and Survival

As established in the Study Plan (RSP Section 10.5.1), the overall goal of this study is to obtain sufficient population information and use of the study area to evaluate the potential effects of the Project on moose.

The study objectives are established in RSP Section 10.5.1:

- Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 big-game distribution and movements study.
- Document the moose population and composition in the study area.
- Assess the relative importance of the habitat in the inundation zone, proposed access/transmission corridors, and the riparian area below the Project.
- Document the productivity and calf survival of moose using the study area.
- Document the level of late winter use of adults and calves in the proposed inundation area.
- Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project.
- Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes two modifications to Study Plan Section 10.5:

1. Continuation of telemetry and GPS collar monitoring through March 2016; and
2. Conducting a second late-winter survey in Middle Susitna River in March 2016.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, a group of seven organizations (Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center; collectively referred to herein as SRC et al.) submitted comments, including three study modification proposals for Study 10.5. AEA received no comments on AEA's proposed modifications to Study 10.5 outlined above. Ahtna, Inc. also submitted comments directly to AEA (see Attachment 1). AEA's responses to the comments can be found in Table 2.7.7-1. Responses to the three study modification requests and a common theme on the presence of moose subherds or subpopulations in the study area are further detailed below.

Table 2.7.7-1. Study 10.5 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Ahtna_pp2_ph3	*The browse study conducted in March of 2013 had no report of findings in the presentation. The late winter survey conducted in the reservoir inundation zone in 2012 and 2013 concluded that there were 1.97 moose per square mile in 2012 and 2.06 moose per square mile in 2013. These are good healthy moose population numbers. The GeoSpatial Population Estimator (GSPE) survey that was conducted in November of 2013 for the entire project area reported 0.95 moose per square mile. These numbers seem to indicate that the reservoir inundation zone is likely the most productive habitat for moose within the entire project area.*	Browse survey results will be reported in the USR. It is true that the density in the inundation zone was higher in the winter than the density of the overall study area in the fall during the GSPE. However, because these densities were estimated during different seasons and winter densities were not calculated for other portions of the study area it is not possible to say that the inundation zone is the most productive habitat within the study area. The USR will include browse survey data, inundation survey data, and movement data to assess the importance of the inundation zone to moose in the study area.
Ahtna_pp3_ph2	*Ahtna shareholders in Cantwell and Gulkana hunt in the project area and would like to see their hunting rights protected. The lands within and surrounding the project area are traditional hunting areas used by subsistence hunters. These hunting areas need to be protected.*	AEA recognizes the importance of the area to Ahtna shareholders for subsistence hunting, which is why the communities of Cantwell and Gulkana have been included in the subsistence harvest analysis for the Project (Study 14.5).
SRC_etal_WILDLIFE_pp3_ph1	*I. The Moose Study should be modified to require AEA to collect additional collared moose survey data during winter months when low-elevation moose use the inundation area. ... The approved study plan called for deploying VHF and GPS collars on moose in the project area with "monthly areal [sic] radio-tracking surveys." However, during the 2014–2015 winter, AEA reported that "the study team ceased monthly radio-tracking flights of VHF-collared moose in the winter months of December, January, February, and April." ... We do not believe that AEA can meet the FERC approved study objectives without collecting year round data on moose populations in the vicinity of the inundation zone.*	As explained below in Section 2.7.1.2, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $400,000.
SRC_etal_WILDLIFE_pp3_ph4	*While it is true that moose move less during winter, this modification will result in far fewer locations of the VHS-collared [sic] moose during the season when they are at lowest elevations and in closest proximity to the proposed impoundment. This modification, therefore, will result in a bias against locations of moose at a time when moose are most likely to occur in the area that will be most affected by the proposed impoundment.*	VHF telemetry data will be used to create a separate kernel density analysis (KDE) for each season. Since each seasonal KDE is created separately, having fewer data points in winter will not create a bias against the winter data. The VHF KDE for winter will display 50 percent, 75 percent, and 95 percent utilization distribution contours for the winter locations of radiocollared moose. The contours will be similar if there is one location per moose or five locations per moose, as the moose exhibit little movement in the winter. In addition, data from GPS-collared moose will provide fine-scale movement data throughout the year. See Section 2.7.1.2 below.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WILDLIFE_pp4_ph1	*...by eliminating winter surveys of VHF-collared moose, the sample size of comparative data is greatly reduced, eliminating 62% of the collared moose from the habitat selectivity data.*	Analysis of habitat selection will be based on fine-scale data collected from GPS-collared moose and not data from VHF-collared animals (see RSP 10.5.4.1).
SRC_etal_WILDLIFE_pp4_ph2	*It will also reduce the number of moose available to describe subherds as winter use of habitats by subherds tend to be distinct during winter.*	See Section 2.7.1.1 below.
SRC_etal_WILDLIFE_pp4_ph3	*FERC should modify the Moose Study and require AEA to conduct at least one additional year of year-round moose surveys that includes sampling during the winter months.*	As explained below in Section 2.7.1.2, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $400,000.
SRC_etal_WILDLIFE_pp4_ph4	*II. The Moose Study should be modified to require AEA to collect additional moose browse data on CIRWG lands in close proximity to the dam site.*	As explained below in Section 2.7.1.3, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $90,000.
SRC_etal_WILDLIFE_pp4_ph5	*AEA had not secured access ... to Cook Inlet Regional Working Group (CIRWG) lands. The CIRWG lands are in close proximity to the Susitna River and the dam site. These lands were also identified by AEA as "high" for browse. AEA attempted to work around the problem by replacing these sample plots with others in a different location that had the same moose density classification.*	The study team's use of the term "work around" in Study10.5 ISR Part A Section 4.3.1 simply referred to the fact that alternative cells were available for sampling in place of the few cells on CIRWG lands that could not be sampled in 2013. The browse survey method developed by Seaton (2002) and used subsequently by Paragi et al. (2008) and Seaton et al. (2011) requires overselection of potential sampling sites to accommodate for sites that are unavailable for sampling due to lack of landing sites, lack of vegetation, or absence of browse species. The 2013 browse survey was intended to evaluate broad-scale browse removal across the entire study area. Of the 160 cells that were selected randomly before the survey, 9 were on CIRWG lands. Ultimately, only 70 of those 160 cells were sampled. Because only 63 percent of randomly selected cells were attempted and 31 percent of attempted cells did not meet sampling criteria, the number of cells not sampled because they were on CIRWG lands was minimal (see Study10.5 ISR Part A Section 4.3.1). AEA also completed an additional browse survey in 2016 that focused on the proposed inundation zone and downstream riparian areas, including CIRWG lands. See Section 2.7.1.3 below.
SRC_etal_WILDLIFE_pp5_ph1	*"Doing this assumes that all quadrats within the "high" stratum for browse are equivalent in terms of having more or less browse that the average quadrat within the high stratum. This is not a valid assumption…"*	Cells were stratified into high and low strata based on the relative abundance of moose on the landscape and not on the amount of browse. By collecting a random sample of high and low strata, a broad distribution of browse availability was sampled. The method does not assume that high-stratum quadrats all have equal browse availability (Paragi et al. 2008). See Section 2.7.1.3 below.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WILDLIFE_pp5_ph2	*AEA's study "work around" will likely "result in over-sampling of browse plots distant from the impact areas and under-sampling of plots where impacts of the project will be least and most significant."...FERC should require AEA to collect additional browse data and adopt plot selection and categorization methods that take into account elevation and proximity of the plots to the project area and the Susitna River.*	AEA disagrees with the commenters' assertion. Very few sample units within the larger study area were selected but not sampled in 2013 because the sample site was on CIRWG lands, so the effect over the entire study area was not biased toward areas distant from the Project area. The browse method used (Seaton 2002, Paragi et al. 2008, Seaton et al. 2011) requires sample units to be stratified based on relative moose distribution. This method has been published in the peer-reviewed literature and is currently in practice across the state. The additional browse survey conducted in 2016 did evaluate browse utilization in the proposed inundation zone and downstream riparian areas. Therefore, no additional browse surveys are required to meet the study objective. See Section 2.7.1.3 below.
SRC_etal_WILDLIFE_pp5_ph3	*III. The Moose Study should be modified to require AEA to collect additional survey data to replace the information that was collected under anomalous weather conditions in 2013 and better describe and identify subpopulations.*	As explained below in Section 2.7.1.4, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $400,000.
SRC_etal_WILDLIFE_pp5_ph4	*Some of the moose surveys were conducted during "the unusually late spring in 2013." These abnormal conditions likely affected moose movements, calving area, and survival of the moose in the project area. ... Samples taken during a very unusual year can dramatically skew the data. ... FERC should require AEA to conduct at least one additional year of data collection under normal environmental conditions.*	Although winter lingered for a long time in spring 2013 and snow melt and break-up occurred later than average that year, those conditions were within the range of historical observations. In contrast, other years of study were characterized by light snowfall and early break-up, so study data were collected across a range of environmental conditions. Please see Section 1.5.1 for further discussion of anomalous years. AEA notes that FERC's ILP regulations generally require two years of study. Here, AEA collected data over a four-year period. The study plan noted that collars had been deployed in October 2012 and called for deploying additional collars in March 2013. The GPS collars were expected to have a two-year life span. The study plan indicated that aerial radio-tracking would be done in 2013 and 2014. Twenty additional GPS collars were deployed in March 2015. Monitoring of all collars continued through March 2016. Monitoring of moose movements has already exceeded the ILP standard and the objectives stated in the FERC-approved Study Plan. This work included three (2013, 2014, 2015) full spring seasons. See Section 2.7.1.4 below. Furthermore, late-winter population surveys of the proposed inundation zone were conducted in four years (2012, 2013, 2015, and 2016; Study 10.5 ISR Part D Sections 6.2 and 7.2).

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WILDLIFE_pp6_ph1–2	*...additional surveys should be conducted to identify subpopulations of moose in the study area. … It is critical to identify subpopulations to properly assess impacts on moose populations.*	See Section 2.7.1.1.
SRC_etal_WILDLIFE_ppMOOSE10_ph2	*[Recommendations] 5. Design browse utilization studies so that at least some data will be directly comparable to the results reported by Becker and Steigers (1987). The earlier study focused more on utilization and availability by species whereas the current study focuses on obtaining percent utilization data...*	As explained below in Section 2.7.1.3., the browse survey technique developed by Seaton (2002) and used subsequently by Paragi et al. (2008) and Seaton et al. (2011) was part of the FERC-approved Study Plan (RSP 10.5.4.3). It is an established method to assess browse use at a large scale and has been published in peer-reviewed journals and used across the state (RSP Section 10.5.5). Proportional browse removal is a tool to gauge nutritional condition of moose populations. It is used to calculate per-plot browse production (availability) and removal (utilization) by species. It is not a robust estimate of total production or total removal at the landscape level (Paragi et al. 2008). Carrying-capacity models, such as the one developed by Becker and Steigers (1987), are not practical for free-ranging moose populations and have not been validated at the population or landscape level (Paragi et al. 2008).
SRC_etal_WILDLIFE_ppMOOSE10_ph3	*[Recommendations] 6. ...Ballard and Whitman (1988) estimated moose abundance using the Gasaway et al. (1986) and related techniques. Results from directly comparable techniques proposed for use in this study need to be use [sic] to permit evaluation of any changes that have occurred.*	The GSPE technique (Kellie and DeLong 2006) is a modification of the Gasaway technique and is therefore comparable.
SRC_etal_WILDLIFE_ppMOOSE10_ph4	*[Recommendations] 7. …Post-project studies should be incorporated into the study plan…*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the license application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure, including the post-Project monitoring studies proposed by SRC et al. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
SRC_etal_WILDLIFE_ppMOOSE2_ph2	*A "modification" from the FSP was identified to eliminate monitoring of moose marked with VHS [sic] collars during 4 months of winter 2014 (December–March). … There are 55 VHF-collared*	Please note that the study plan modification described in Study 10.15 ISR Part C Section 7.1.2 was to forego VHF-tracking flights in December, January, February, and April (not March). The

Reference Number	Comment or Study Modification Request	AEA's Response
	moose and 37 GPS-collared moose so this means that approximately 62% of the transmitter-equipped moose cannot be used to estimate habitat selectivity during the time they are closest to the proposed impoundment.	study team has a plethora of telemetry and population survey data on use of the proposed inundation zone by moose in winter. As described in RSP Section 10.5.4.1, analysis of habitat selection will be based on fine-scale data collected from GPS-collared moose, not data from VHF-collared animals. See Section 2.7.1.3 below.
SRC_etal_WILDLIFE_ppMOOSE2_ph3	*...all of the CIRWG lands are in strata subjectively classified as "high" for browse and are in the areas in closest proximity to the Susitna River. ...it appears the way the study team "worked around" not being able to sample the quadrats on CIRWG lands was to select another "high" stratum quadrat to sample. Doing this assumes that all quadrats within the "high" stratum for browse are equivalent... This is not a valid assumption. ... Alternative methods of selecting quadrats to sample based on weighting by elevation and proximity to the Susitna River should have been utilized.*	See responses to SRC_etal_WILDLIFE_pp4_ph5 and SRC_etal_WILDLIFE_pp5_ph1 above.
SRC_etal_WILDLIFE_ppMOOSE3_ph1	*It is important to identify subpopulations of moose in the study area. Ballard and Whitman (1988) identified 11 different subpopulations of moose, all of which had different patterns of movement and habitat use and would have been impacted by the then-proposed impoundment in different ways.*	See Section 2.7.1.1 below.
SRC_etal_WILDLIFE_ppMOOSE3_ph2a	*There are no results reported for Objective 6 and no study mechanisms identified to achieve Objective 6 (mitigation through habitat modification).*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the License Application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
SRC_etal_WILDLIFE_ppMOOSE3_ph2b	*In the current ISR, there is essentially no effort made toward Objective 7 which is to integrate the results of earlier Susitna Dam studies on moose (Ballard and Whitman 1988).*	By design, Objective 7 will be completed later in the implementation of this study. AEA is currently in the initial study reporting phase of the licensing process, and the studies are not intended or expected to be completed at the time of this interim report. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any

Reference Number	Comment or Study Modification Request	AEA's Response
		variance from the study plan and schedule" (18 CFR 5.15(c)(1)). As indicated by the information presented in the Wildlife Data-gap Analysis (ABR 2011), the Preliminary Application Document (AEA 2012), and RSP Section 10.5, the study team is well aware of previous studies. Results from the 1980s studies will be integrated with the current data, as appropriate, and will be reported in the USR.

2.7.1.1. Response to Comments Regarding Moose Subpopulations

Several times in their comments, SRC et al. raised concerns regarding the adequacy of the study to assess impacts of the Project on the moose population because moose subpopulations are not identified (SRC_etal_WILDLIFE_pp4_ph2, SRC_etal_WILDLIFE_pp6_ph1–2, and SRC_etal_WILDLIFE_ppMOOSE3_ph1).

As an initial matter, the purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. Comments related to moose subpopulations address the scope and objectives of the Study Plan itself, and not AEA's implementation. The FERC-approved Study Plan for moose did not include an objective to identify subpopulations, and SRC et al. fail to show any "good cause" (per 18 CFR 5.15(d)) as to why the Study Plan should be modified to identify moose subpopulations.

Although Ballard and Whitman (1988: 47) identified, using periodic tracking of VHF collars, 12 "subpopulations" on the basis of similar winter and summer ranges and generally synchronous movements between those areas, they also recognized that "subpopulations are not discrete and many gradations exist," which calls into question the usefulness of identifying subpopulations for the purpose of Project impact assessment. Furthermore, there is no reason to expect that the existence of subpopulations estimated in this way more than 30 years ago would still persist. GPS collars have provided much finer-scale, year-round data for this study than could be collected in the 1980s, providing a superior data set for examining annual movements of the moose population. Moreover, management by the State of Alaska occurs at the population level rather than at the scale of subpopulations. As part of a larger, unrelated study, ADF&G conducted genetic analyses of blood samples collected from moose collared for this study and from surrounding GMUs, but did not find any evidence that genetically distinct subpopulations inhabit the Project area. Moose sampled throughout the study area and in adjacent GMUs formed one continuous metapopulation with intermediate levels of isolation by distance (K. Colson, ADF&G, unpublished data).

2.7.1.2. Response to Modification Request to Collect Additional VHF Telemetry Data During Winter Months

SRC et al. (Modification 1; SRC_etal_WILDLIFE_pp3_ph1) requested the Moose Study be modified to require AEA to collect additional VHF telemetry data during winter months, when moose tend to occur at lower elevations in the proposed inundation zone, as provided for in the Study Plan.

However, SRC et al. fail to show any "good cause" (per 18 CFR 5.15(d)) as to why the Study Plan should be modified to collect these additional data. The FERC-approved Study Plan required the deployment of VHF and GPS collars on moose in the study area with monthly aerial radio-tracking surveys. However, during the 2014–2015 winters, AEA suspended monthly radio-tracking flights of VHF-collared moose in the winter months of December, January, February, and April (Study 10.5 ISR Part C Section 7.1.2, and SIR 10.5 Section 4.1.1); surveys were conducted in November 2014 and March 2015. In lieu of these surveys, the monitoring period was extended another year and additional animals were collared, providing more valuable data.

AEA maintains that the telemetry information gathered is sufficient to fulfill the Study Plan objectives (RSP Section 10.5.1.1) to assess the relative importance of the habitat in the inundation zone, proposed transportation corridors, and the riparian area below the Project, and to document the level of late-winter use by adults and calves in the proposed inundation area. RSP Section 10.5.4.1 stated that GPS collars would be removed in November of 2014 or March 2015, but AEA exceeded that requirement by deploying 20 additional GPS collars in 2015 and monitoring all active VHF and GPS collars through March 2016 (Study 10.5 ISR Part D Section 7.2, and SIR 10.5, Section 4.1.1).

In addition to GPS collar data and aerial tracking of VHF-collared moose, use of the proposed reservoir inundation area by moose during late winter was documented through multiple aerial surveys. The FERC-approved Study Plan provided for two late-winter population counts of the inundation zone (RSP Section 10.5.4.2). AEA actually completed population counts of moose using the inundation area during late winter in 2012, 2013, 2015, and 2016 (Study 10.5 ISR Part A Section 4.2; SIR 10.5 Section 4.2; and Study 10.5 ISR Part D Section 7.2), thereby exceeding the study plan requirements.

Moreover, contrary to the concerns expressed by SRC et al., reducing the frequency of the VHF winter surveys did not result in a bias against locations of moose at a time when moose are most likely to occur in the proposed inundation zone. VHF data will be used in the USR to create a separate kernel density analysis (KDE; Seaman and Powell 1996) for each season, as was done in Study 10.5 ISR Part A Section 5.1 and Figure 5.1-1. Since each seasonal KDE is created separately, having fewer data points in winter will not create a bias against the winter data. With little movement by moose during the winter months, the analysis still will capture the extent of winter range use from the VHF data collected in March. In the USR, the VHF KDE for winter will display 50 percent, 75 percent, and 95 percent utilization distribution contours for the winter locations of radiocollared moose. The contours will be similar if there is one location per moose or five locations per moose, as the moose exhibit little movement in the winter.

AEA implemented additional variances as a result of comments received from licensing participants during the October 2014 ISR Meeting: 20 additional collars were deployed in the Middle River, a late-winter population survey along the Middle River was conducted in March 2015, and a third late-winter inundation zone survey was conducted in March 2015 (Study 10.5 ISR Part D Sections 3, 6.2, and 7.2).

In addition, data from GPS-collared moose will provide fine-scale movement data throughout the year, including winter months. The FERC-approved Study Plan provided for two years of tracking 40 GPS-collared moose (RSP Section 10.5.4.1). AEA added to the sample size by redeploying refurbished GPS collars. Twenty additional GPS collars were deployed in 2015 and monitored for one year. These additional collars increased the sample size and provided additional information about moose use of the downstream portion of the study area.

As described in RSP Section 10.5.4.3, location data from the VHF-collared animals will not be used in the analysis of habitat selection. Analysis of habitat selection will be based on fine-scale data collected from GPS-collared moose. A browse utilization survey was conducted over the entire study area during 2013 (Study 10.5 ISR Part A Section 4.3) and in the proposed inundation zone and downstream area in late winter 2016 (having been postponed from 2014 and 2015; ISR Part D, Section 8).

In summary, the VHF telemetry data collected during late winter (March), in combination with GPS telemetry data and late-winter population counts in the inundation zone in four different years, provide ample information to accomplish the objectives of the FERC-approved Study Plan.

When coupled with the significant cost that would be required to implement this study plan modification submitted by SRC et al., which AEA estimates to be approximately $400,000, there simply is no justification for adopting the modification. The additional data collected by AEA, which surpasses what was required by the Study Plan, is sufficient to meet Study Plan objectives and evaluate Project-related effects on moose. For these reasons, AEA requests that FERC not adopt this proposed study plan modification.

2.7.1.3. Response to Modification Request to Collect Additional Moose Browse Data on CIRWG Lands

SRC et al. (Modification 2; SRC_etal_WILDLIFE_pp4_ph4) requested the Moose Study be modified to require AEA to collect additional moose browse data on CIRWG lands in close proximity to the dam site.

AEA requests that FERC not adopt this proposed study plan modification because AEA is able to meet the FERC-approved study objectives with the browse survey data collected in 2013 and 2016. SRC et al. fail to show any "good cause" (per 18 CFR 5.15(d)) as to why the Study Plan should be modified to collect these additional data.

As described during the ISR Meeting on March 29, 2016, AEA conducted an additional browse survey in March 2016, which included CIRWG lands in the proposed reservoir inundation zone and riparian areas downstream from the proposed dam. That additional survey addressed the concerns raised by SRC et al. regarding the lack of access to CIRWG lands in 2013.

The browse survey method developed by Seaton (2002) and used subsequently by Paragi et al. (2008) and Seaton et al. (2011) requires overselection of potential sampling sites to accommodate for sites that are unavailable for sampling due to lack of landing sites, lack of vegetation, or absence of browse species (Paragi et al. 2008). The 2013 browse survey was intended to evaluate broad-scale browse removal across the entire study area. Of the 160 cells selected randomly before the survey, nine were on CIRWG land. Only 70 of the 160 randomly selected cells were ultimately sampled. Sampling was attempted at 63 percent (101/160) of the randomly selected cells and 31 percent (31/101) of those cells did not meet sampling criteria (Study 10.5 ISR Part A Section 4.3.1). Since only nine of the randomly selected cells were on CIRWG lands, many of these cells likely would not have been attempted or would not have met sampling criteria even if land access had been permitted that year, so the number of cells unsampled due to the fact that they were on CIRWG land was minimal. Moreover, the 2013 browse survey was meant to assess browse across the entire moose study area and not just in the Project area, which is why the second, more focused browse survey was conducted in 2016.

The browse technique developed by Seaton (2002) and used subsequently by Paragi et al. (2008) and Seaton et al. (2011) was part of the FERC-approved Study Plan (RSP 10.5.4.3). As stated in RSP Section 10.5.5, this is an established method to assess browse use at a large scale and has been published in peer-reviewed journals and used across the state and therefore the most appropriate tool for assessing browse in Alaska. Proportional browse removal is an index to gauge nutritional condition of moose populations. This method is used to calculate per-plot browse production and removal by species. It is not a robust estimate of total production or total removal at the landscape level (Paragi et al. 2008). Carrying-capacity models, like the one developed by Becker and Steigers (1987) and suggested by SRC et al., are not practical for free-ranging moose populations and have not been validated at the population or landscape scales (Paragi et al. 2008).

Browse sample units were stratified into high and low strata based on the relative abundance of moose on the landscape and not on the amount of browse, as suggested by SRC et al. By collecting a random sample of high and low strata, it is expected that a broad distribution of browse availability is sampled (Paragi et al. 2008). The method does not assume that high-stratum quadrats all have equal browse availability.

Finally, the modification proposed by SRC et al. would add extra cost that would exceed any benefit derived from collecting additional moose browse data on CIRWG lands. AEA estimates that this modification would add approximately $90,000 to the study budget—all in an effort to collect data that is unneeded to meet Study Plan objectives.

For these reasons, SRC et al.'s proposed study plan modification is unnecessary and should not be adopted by FERC.

2.7.1.4. Response to Modification Request to Collect Additional Survey Data due to Anomalous Weather Conditions

SRC et al. (Modification 3; SRC_etal_WILDLIFE_pp5_ph3) requested that the Moose Study be modified to require AEA to collect additional survey data to replace the information that was collected under "anomalous" weather conditions in 2013 and to better describe and identify subpopulations.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Although SRC et al. claim that anomalous weather conditions occurred in 2013, as is explained in Section 1.5.1, 2013 did not involve "anomalous environmental conditions" for the purposes of 18 CFR 5.15(d)(2). While it is true that 2013 brought unusually prolonged winter conditions and late arrival of spring conditions, the Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and SRC et al. makes no showing that the meteorological conditions in 2013 impaired the value of the collected data for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of gathering additional years of survey data for moose would be excessive.

Historically, winter conditions and severity vary widely from year to year in Alaska and they can be expected to vary in the future. As indicated by the following observations, conditions encountered during this study were within the range of expected conditions (J. Zufeldt, HDR, Inc., 2016 personal communication):

- 2013 – early freeze-up, average winter overall, late break-up;
- 2014 – average freeze-up, slightly warmer than average winter overall, early break-up;
- 2015 – late freeze-up, warm winter overall, early break-up;
- 2016 – late freeze-up, warm winter overall, early break-up.

Late-winter conditions in 2013 were just within the range of what was recorded in the 67 years of record, with 1964 being very similar but a bit later and colder and 1985 being slightly earlier (J. Zufeldt, HDR, Inc., 2016 personal communication). Specific results contrasting moose movements from year to year will be presented in the USR. Collecting data under conditions that varied from year to year will strengthen inferences over a variety of weather conditions. Collecting data over three to four years and analyzing data on an annual seasonal basis (rather than lumping all data) will prevent skewed results.

The FERC-approved Study Plan required AEA to survey radio-collared moose during 2013 and 2014. Both VHF and GPS collars were deployed on moose in October 2012, prior to FERC's approval of the Study Plan, and aerial surveys of VHF-collared and GPS-collared moose began in October 2012. The GPS collars were expected to have a two-year life span, whereas the VHF collars may have up to a seven-year life span. The Study Plan called for deploying additional collars in March 2013, which was done (see Study 10.5 ISR Part A, Section 4.1). As a modification to the FERC-approved Study Plan (See Study 10.5 ISR Part D Section 6.2), 20 additional GPS collars were deployed in the Middle River in March 2015. Monitoring of all collars continued through March 2016. The requirements of the FERC-approved Study Plan have been exceeded as moose movements were monitored through three full winter and spring seasons (2013, 2014, and 2015). In addition, ADF&G will continue to collect data on the GPS-collared animals until the collar batteries expire. Furthermore, late-winter population surveys of the proposed inundation zone were conducted in four years (2012, 2013, 2015, and 2016; Study 10.5 ISR Part D Sections 6.2 and 7.2).

Finally, the proposed modification to add additional years of moose surveys due to alleged anomalous environmental conditions would add excessive cost to this study. AEA estimates that this modification would add approximately $400,000 to the study budget—even though AEA has already collected data over four years and over a range of environmental conditions.

For these reasons, SRC et al.'s proposed study plan modification is unnecessary and should not be adopted by FERC.

2.7.1.5. References Cited

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2.7.2. Study 10.6 – Caribou Distribution, Abundance, Movements, Productivity, and Survival

As established in the Study Plan (RSP Section 10.6.1), the overall goal of this study is to obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors.

The study objectives are established in RSP Section 10.6.1:

- Document seasonal use of and movement through the Project area by both females and males of the Nelchina Caribou Herd (NCH) and the Delta Caribou Herd (DCH).
- Assess the relative importance of the Project area to both the NCH and DCH.

- Document productivity and survival of caribou using the Project area.
- Analyze data from historical caribou studies and synthesize with recent data for the NCH and DCH, as a continuation of the caribou task of the 2012 study (AEA 2012a).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes four modifications to Study Plan Section 10.6 (two of which were variances continued from the 2013 season):

1. Continue differentiation between the Eastern Migratory Group and the Western Group (Study 10.6 ISR Part A Section 4.1.1, and Study 10.6 ISR Part C Section 7.1.2);
2. Continue increased frequency of telemetry flights to twice weekly during peak calving (Study 10.6 ISR Parts B and Part C Section 7.1.2);
3. Retrieve GPS collars in 2014, refurbish and redeploy spring 2015; and
4. Continue radio-tracking flights through October 2015 (Study 10.6 ISR Part D Sections 6.2 and 8).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, a group of seven organizations (Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center; collectively referred to herein as SRC et al.), plus the Copper Country Alliance (CCA) and three individual licensing participants, submitted comments and proposed study modifications on Study 10.6. Ahtna, Inc. also submitted comments directly to AEA (see Attachment 1). AEA received no comments on AEA's proposed modifications to Study 10.6 outlined above. AEA's responses to the comments can be found in Table 2.7.2-1. Responses to the study modification requests are further detailed below.

Table 2.7.2-1. Study 10.6 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Ahtna_pp3 _ph2	*Ahtna shareholders in Cantwell and Gulkana hunt in the project area and would like to see their hunting rights protected. The lands within and surrounding the project area are traditional hunting areas used by subsistence hunters. These hunting areas need to be protected.*	AEA recognizes the importance of the area to Ahtna shareholders for subsistence hunting, which is why the communities of Cantwell and Gulkana have been included in the subsistence harvest analysis for the Project (Study 14.5).
Ahtna_pp3 _ph4	*Finding of this study show that the inundation zone of the reservoir lies directly in the path of the migration route from the caving [sic] grounds to the summer and fall ranges. Studies have shown that on the North Slope caribou have moved to avoid areas of development and activity. Ahtna, Inc. is concerned that the road development within this area will 1) cause the herd to move to avoid these area, and 2) that the access road constructed to the project area will open the area to new hunters. It appears that all*	AEA notes the concerns expressed by Ahtna. The wildlife study plans, the recreation study plan (Study 12.5), and the subsistence study plan (Study 14.5) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project, both from the Project infrastructure and human activities such as hunting. The impact analysis will be included in the License Application. See Section 1.3 for additional information regarding the relationship between the ISR and impact analysis in the License Application.

Reference Number	Comment or Study Modification Request	AEA's Response
	proposed access routes to the project area will have an impact on the Nelchina Caribou Herd.	
Ahtna_pp3_ph5	*The slide in the presentation labeled Late Spring Movement is of concern. This slide depicts the spring migration movements of 2013 and 2014. During the spring of 2013 there was major flooding and high water throughout the Copper River Basin. The majority of caribou did not migrate back to Northeast of Tok during the winter of 2014, but remained west of the Lake Louise uplands for the winter. There was also an overwintering population in Glennallen. The migration pattern for 2014 is an outlier and should not be included in this study.*	Collecting data under conditions that varied from year to year will strengthen inferences across a range of weather conditions. See Section 1.5.1. The FERC-approved Study Plan required two years of data collection, but AEA actually collected three and a half years of collar location data. In addition, it is important to bear in mind that extensive data collected by ADF&G on range use by the Nelchina and Delta herds over the last several decades is available for comparison, which will be presented in the USR. Please note that Tok, Lake Louise, and Glennallen are outside of the Project area and the caribou study area.
Ahtna_pp4_ph2	*During the presentation it was reported that the final report for this study was not complete. The ADF&G spokesperson stated that it would be completed by July 1st, 2016. This date is after the deadline for the submission of comments on the initial study reports. It is unfortunate that we are not able to review this report to provide further comments.*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The caribou study has not yet been completed. AEA actually extended the duration of the telemetry data collection for the study to gather more complete information. The ADF&G spokesperson was referring to an internal ADF&G reporting schedule that is not part of the FERC process. The final data analysis for the caribou study will be provided in the USR and licensing participants will be provided an opportunity at that time to review the report and provide further comments.
Ahtna_pp4_ph3	*In closing Ahtna, Inc. would like to say that we are not in favor of any development in this area. All proposed road development into this area will disturb the caribou refugia already mentioned. The dam and inundation zone will create a barrier across the annual migration route of the caribou herd.*	AEA notes the concerns expressed by Ahtna. The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the potential effects of the Project. The information generated in these studies will be used to prepare an impact assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures (PM&Es) based on the effects analysis, and all such measures will be presented in the License Application. See Section 1.3 for additional information.
CCA_pp2_ph2	*Because caribou change their migration routes and the areas they use so much from year to year, the three years of research—although done in more detail than previous studies—will not give a complete picture of what caribou do over decades. The 10.6 study maps the public can view...do not even show all of those three years. ... The lack of historic and 2014–2015 information in currently available 10.6 study reports makes it difficult for the public to ask relevant questions.*	AEA is currently in the initial study reporting phase of the licensing process, and the studies are not intended or expected to be completed at the time of this interim report. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The caribou study has not yet been completed. AEA actually extended the duration of the telemetry data collection for the study to gather additional

Reference Number	Comment or Study Modification Request	AEA's Response
		information. Annual migration routes used during the study years will be displayed separately for the Brownian bridge movement models that will be included in the USR, and comparisons with historical information on seasonal range use and migrations also will be included in the USR.
CCA_pp2_ph3–6	*One of our concerns relates to ice shelves and caribou. What happens when the water level beneath the ice falls during drawdowns? Will it break totally free of the shore and drop with the water, or will it form a sloping sheet? ... If these slanted sheets form, how steep will they be, considering the range of drawdown amounts? ... How many sheets will form if there are multiple drawdowns? If ice does break totally free of its pre-drawdown shore attachment, what will the surface of the frozen lake be like? Will it have cracks and ridges? ... ADFG's research has not addressed questions about how caribou respond to crossing slanted ice shelves or jumbled ice… Will the study even address our questions about slanting ice sheets and ice cracks and ridges, or will it just consider the relationship between ice processes and water quality? It appears that there may be significant gaps that should be filled in both studies. The problem of crossing ice needs to be addressed for other mammals as well.*	AEA recognizes the concern about the potential effects of ice shelving and other ice conditions in the proposed reservoir on the movements of caribou and other mammals during winter and spring, which was first discussed for the original Su Hydro studies in the 1980s, as cited in the Wildlife Data-gap Analysis for the Project (ABR 2011) and in Section 4.6.2 of the Pre-Application Document for the Project (AEA 2012b). The deployment of GPS and VHF radio-collars was intended to provide the seasonal movement and range-use data that will be needed to evaluate this impact. The wildlife study plans, the ice processes study (Study 7.6), and the water-quality modeling study (Study 5.6) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. The impact analysis will consider Project-induced changes to ice processes and how those changes would impact caribou as well as other mammals. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). See Section 1.3 for additional information.
Long_160620_pp12_ph1	*7.1 Modification of RSP Objective One — Inclusion of Additional Caribou Groups in Project Area: A permanent Chulitna group in the Chulitna Hills and a migratory group centered in the Cantwell area need to be documented regarding seasonal use and migratory patterns. RSP and the ISR have no recognition of these groups which will be impacted significantly by the project.*	As explained below in Section 2.7.2.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification by extending the telemetry study for another two years is $800,000. The telemetry data collected during this study indicate that caribou using the Cantwell area and Chulitna Mountains in the winter do not exhibit annual or seasonal fidelity to those areas, so they were not considered separate groups for analysis.
Long_160620_pp12_ph3	*7.2 RSP Objective 2 Unfulfilled: The second RSP objective is to "Assess the relative importance of the Project area to both the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH). Because of this objective, ABR's Brian Lawhead and Van Ness Feldman's Chuck Sensiba were incorrect in their statements to licensing participants in the 10/21/14 ISR meeting. They both postulated that 10.6 is not supposed to predict or assess project impacts. But how can objective 2 be met without considering impacts... This objective should be expanded to consider the impacts on the caribou in the Cantwell area and that overwinter in the Chulitna Mountains.*	AEA disagrees with this comenter's interpretation of Objective 2. Objective 2 of the FERC-approved Study Plan is to "Assess the relative importance of the Project area to both the NCH and DCH" (RSP Section 10.6.1). The relative importance of the Project area to these groups of caribou is what the study is designed to assess, and it has been implemented as provided for in the FERC-approved plan. The intent of the study plan was to collect adequate data to address the potential impacts of the proposed Project, as summarized in Section 4.6.4 of the Pre-Application Document (AEA 2012b). The caribou study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit), as Mr.

Reference Number	Comment or Study Modification Request	AEA's Response
		Lawhead and Mr. Sensiba correctly explained. See Section 1.3 for additional information.
Long_160620_pp12_ph5	*7.3 Modification Request to Evaluate Infrastructure Impacts: There is no objective to evaluate impacts of roads and transmission line on the caribou herds specifically during their migrations.*	This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. The impact analysis will appear in the draft license application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impacts assessment in the draft license application, please see Section 1.3.
Long_160620_pp12_ph7	*7.4 Cumulative Impacts: ...The proposed project will open up the Project Area to new human use and development. These have to be considered along with the current uses and their impacts. ... The above projects coupled with the road building, dam construction, inter-tie building that will accompany the project must be part of the data for assessment of the relative importance of the project area to the caribou and for impact assessment.*	AEA acknowledges the importance of evaluating cumulative effects. Under the ILP, wildlife study plans were designed to provide the information needed to assess the potential direct and indirect effects of the Project. Direct, indirect, and cumulative effects will be assessed in the License Application and in FERC's subsequent EIS on the Project, as required by NEPA. See Section 1.3 for additional information.
Rutledge_pp1_ph2	*The graphics clearly show that caribou extensively use the Wantana [sic] area (proposed dam site) in the spring. The area is vital to the Nelchina and Delta Caribou Herds. This is their calving area and where they rear the newborn calves in early life. While caribou are known to change range, this is not the case with calving grounds. ... It must remain intact.*	AEA understands the concern expressed regarding caribou calving grounds. Over the last several decades, the Nelchina Herd generally has shown consistent use of the eastern foothills of the Talkeetna Mountains as a perennial calving ground, with variation among years. The fine-scale telemetry results from this study indicate that some female caribou did not show fidelity to specific calving areas among years, however. When the study is completed, analysis of the multi-year data set will be fully described and discussed in the USR, along with comparisons to the historical data.
Rutledge_pp1_ph3	*ADF&G in their analysis stated the importance of reviewing data of historical use of the area to complete the picture of the caribou's need. These studies are essential. Has the caribou always calved and rear [sic] newborns here?*	The caribou study has not yet been completed. When the study is completed, analysis of the multi-year data set will be fully described and discussed in the USR, along with comparisons to the historical information on seasonal range use, including the location of calving grounds.
SRC_etal_WILDLIFE_pp6_ph5	*I. The Caribou Study should be modified to require AEA to collect additional years of radio collared data to achieve appropriate levels of resolution on all caribou herds using the study area. ...AEA reported one problematic variance in the caribou study. Due to the mixing of the herds within the study area, AEA did not deploy the collars on the individual caribou based on their associated herd. Instead, after collar deployment and monitoring AEA grouped the collared caribou as the "Western Migratory Group" and the "Eastern Migratory Group" based on winter movements. While wildlife expert Sterling Miller noted that the variance is*	As explained below in Section 2.7.2.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification by extending the telemetry study another two years is $800,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	reasonable because AEA's plan to designate herds is sound, he does not believe that adequate herd designations and proper resolution can be accomplished without additional years of study and the recognition of additional caribou groups, specifically the Chulitna group and the Cantwell group.	
SRC_etal_ WILDLIFE_ pp8_ph2	*II. The Caribou Study should be modified to require AEA to collect additional years of information to address data gathered under anomalous environmental conditions during the 2013 study season. ... The heavy and late snows of 2013 as well as the colder weather in April and May of 2013 likely caused Caribou herds to dramatically alter normal migratory movements. It also significantly increased adult and calf mortality. To meet study objectives and assess potential impacts it is imperative that AEA collect accurate baseline data especially when conducting a short term study for a species that has long term trends. For these reasons, FERC should modify the Caribou Study and require AEA to collect additional years of information to address data collected under anomalous environmental conditions to ensure accurate and reliable baseline data.*	As explained below in Section 2.7.2.2, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification by extending the telemetry study another two years is $800,000.
SRC_etal_ WILDLIFE_ ppCARIBO U3_ph1	*[Objective 1.] The study plan calls for deploying 30 VHF collars on bulls and 55–65 GPS collars on cows and bulls. ... This number of collars should be adequate to accomplish this objective if they are appropriately distributed geographically and the ISR reported an appropriate number of telemetry survey locations for these collars that is consistent with the study plan. However, only gross scale analyses of these data were presented in the ISR so it is not possible to evaluate how or whether these data will be appropriately analyzed. At present, there is no reason to believe that available data will not be analyzed appropriately. The inclusion of GPS collars on caribou in this study represents a major advance over the technology available to Pitcher (1987) and should reveal new and meaningful results pertinent to this impact study and, more broadly, to caribou management in the study area. To determine if both kinds of collars (GPS and VHF) were appropriately distributed, it will be necessary, in subsequent reports, to plot the distributions of initial capture locations by date collared, herd, type of collar, and sex of animal collared. The variance reported in the ISR (page 6) with respect to the*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The caribou study has not yet been completed. Seasonal range use by radio-collared animals will be documented using kernel density estimators (KDEs; Seaman and Powell 1996) and migratory movements will be analyzed using Brownian bridge movement models (Horne et al. 2007). Capture locations are protected by state law and regulations under A.S. 16.05.815(d)(D), however, so cannot be plotted as requested by the commenters. The movement data collected throughout the study are sufficient to fulfill the study objectives.

Reference Number	Comment or Study Modification Request	AEA's Response
	distribution of radio-transmitters appears reasonable.	
SRC_etal_ WILDLIFE_ ppCARIBO U3_ph6	*There are additional categories of caribou in the Watana Dam impact area including a permanent Chulitna group. There is also a group of migratory caribou centered in the Cantwell area. … Because of the complicated nature of the herds and groups in the vicinity of the proposed Susitna–Watana Impoundment, many years of study will be necessary to sort out which groups or herds will be most impacted and how these impacts will occur; especially since there is significant year to year variation in movements and areas utilized. It is unlikely that these relations can be adequately sorted out with only 2–3 years of study of radio-marked individuals especially if resolution is lost by recognizing only two groups as is done in the current study (the WG and the NCH). If there are reasons why these groups are lumped in with the EMG and WG individuals, this should be better explained.*	See Section 2.7.2.1 below.
SRC_etal_ WILDLIFE_ ppCARIBO U4_ph2	*[Objective 2.] With multiple years of study, there is no reason to expect that the relationships between these herds cannot be sorted out appropriately but, as noted above, appropriate levels of resolution on all the groups using the study area is unlikely to be obtained with only 2–3 years of study. There are more than NCH and DCH individuals in the Susitna–Watana Dam area and this objective should be expanded to include impacts on individuals from the Cantwell area and...that overwinter in the Chulitna Hills but are not DCH individuals. During the AEA ISR meetings on October 22, 2014, ADF&G researcher Kim Jones said that radio-marked caribou would be followed for a third year. This is an important and necessary change but it is unclear if addition of one additional year will be sufficient to permit identification of subherds and to evaluate impacts on the basis of subherds.*	See Section 2.7.2.1 below.
SRC_etal_ WILDLIFE_ ppCARIBO U4_ph5	*[Objective 3.] ...there was a late spring in 2013 which delayed spring migration and peak calving. A very high proportion of parturient cows lost their calves in 2013 (66%). ... It is very important that anomalous conditions like this (and also winter conditions) continue to be reported in subsequent reports on these caribou studies.*	See Section 2.7.2.2 below, as well as Section 1.5.1.
SRC_etal_ WILDLIFE_	*[Objective 4.] Subsequent reports should include this analysis and synthesis. ... It is important that the current impact assessment studies ultimately*	By design, Objective 4 will be completed later in the implementation of this study. AEA is currently in the initial study reporting phase of the licensing process, and the

Reference Number	Comment or Study Modification Request	AEA's Response
ppCARIBOU4_ph6	*incorporate the status and trends of both herds into an analysis of the proposed project's impacts as identified by this objective. Short term studies under perhaps anomalous conditions cannot adequately evaluate impacts absent the appropriate long term context for species like caribou.*	studies are not intended or expected to be completed at the time of this interim report. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). As described in the FERC-approved Study Plan (RSP Section 10.6.1), data from historical caribou studies will be analyzed and synthesized with the recent data for the NCH and DCH. This analysis will be reported in the USR.
SRC_etal_WILDLIFE_ppCARIBOU5_ph5	*[Recommendations] 1. ...to determine if both VHF and GPS collars were appropriately distributed, subsequent reports must plot distributions of initial capture locations for each individual by date (spring or fall), type of collar (VHF or GPS), and sex of animal. The Watana Dam project area includes a complex set of associations of caribou associated with 4 different groups or herds including the Nelchina herd (the largest group), the Delta herd, a group in the Chulitna Hills, and a Cantwell group. The ISR collapses these into two groups: the Eastern Migratory Group (largely migratory Nelchina Herd that currently calve in the foothills of the Talkeetna Range and overwinter farther east in Unit 13) and the Western Group (animals that winter in the study area supposedly composed of mixed Nelchina and Delta herd individuals)... We suggest that it would be helpful if future reports specifically address how collars were deployed by each of the herds/groups in the study area or clarify the justifications for collapsing these into only 2 categories.*	See Section 2.7.2.1 below.
SRC_etal_WILDLIFE_ppCARIBOU6_ph1	*[Recommendations] 2. Neither the RSP nor the ISR have any objective associated with evaluating impacts of roads and transmission lines that would be built to support the proposed project. ...* *[Recommendations] 3. In addition to impacts on caribou movements, the proposed corridors will provide increased access to hunters in a formerly roadless and relatively isolated area in the heart of the Nelchina Caribou range and the Unit 13 portion of the Delta Caribou herd range.*	The goal of the caribou study plan is to "obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors." That will be accomplished when the study is completed. The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impact assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). See Section 1.3 for additional information.
SRC_etal_WILDLIFE_ppCARIBOU6_ph3	*[Recommendations] 4. Pitcher (1987) provided a list of likely ways caribou would be impacted by the project. The current study shows no indication that it was designed to evaluate the relative importance of these impact mechanisms.*	The goal of the caribou study plan is to "obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors." That will be accomplished when the study is completed. The study team is aware of

Reference Number	Comment or Study Modification Request	AEA's Response
		Pitcher's caribou reports from the 1980s, which were cited in the Wildlife Data-gap Analysis for the Project (ABR 2011), as well as Section 4.6.2 of the Pre-Application Document (AEA 2012b). The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impact assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). For more information related to impact assessment at this point in the licensing process, please see Section 1.3.
SRC_etal_ WILDLIFE_ ppCARIBOU6_ph4	*[Recommendations] 5. The study plan and the ISR fail to evaluate mitigation of project impacts on caribou.*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impact assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the license application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure, including mitigation measures proposed by SRC et al. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
SRC_etal_ WILDLIFE_ ppCARIBOU7_ph2	*[Recommendations] 7. Figures 5.1-1 and 5.1-p2 [sic] showing seasonal utilization of habitats based on kernel home range plotting techniques are useful but should be displayed separately, based on animals from the Eastern Migratory Group (primarily NCH) and the Western Group (mixed NCH and DCH animals). Individuals from other groups—e.g., Chulitna Hills and Cantwell groups—should also be identified as these are likely pertinent grouping categories for evaluating impacts. Mixing these 4 groups/herds together in single plots loses important resolution between groups as acknowledged variances to the Study plan based on the mixing of these herds and groups. VHF and GPS data must continue to be presented separately, as was done for the ISR.*	The Eastern Migratory and Western groups will be displayed separately in the USR using Brownian bridge movement models, as described in RSP Section 10.6.4. In addition, as was done in ISR 10.6 Section 5.2, VHF and GPS data will be displayed separately for seasonal KDEs. As stated below in Section 2.7.2.1, the caribou using the Chulitna Mountains and Cantwell area did not show fidelity to those areas and therefore were not treated as separate groups or subherds for analysis.
SRC_etal_ WILDLIFE_ ppCARIBOU7_ph3	*[Recommendations] 8. Impact assessment studies are inadequate until study plans incorporate (and fund) post-project impact analysis of caribou movements, habitat use, and population and reproductive changes. Post-project studies should be incorporated into the study plan and should use GPS collars to facilitate statistically valid comparisons with ongoing pre-project studies in the actual impoundment area. For documenting river and*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project effects. The information generated in these studies will be used to prepare an impact assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analyses, and all such measures will be presented in the draft license application. Thus, it is premature at this time for AEA (or any other licensing

Reference Number	Comment or Study Modification Request	AEA's Response
	impoundment crossings and seasonal use of seasonal ranges, VHF collars are adequate to document project impacts during post project studies.	participant) to propose or seek any particular license measure, including the post-Project monitoring studies proposed by SRC et al. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
Teich_pp1_ph1b	*Three years of Caribou studies will not give an accurate picture of how caribou migrate over decades.*	The FERC-approved Study Plan required two years of telemetry surveys and AEA's study team (i.e., ADF&G) has actually tracked collared animals for three and a half years. The caribou study is not yet complete. When completed, the study plan will not only evaluate the three and a half years of fine-scale movement data, it will also review and compare those data to the extensive data collected by ADF&G on range use by the Nelchina and Delta herds over the last several decades. Discussion of the comprehensive data on caribou will be provided in the USR. See Section 2.7.2.1.
Teich_pp1_ph1c	*Studies of how ice cracks and ridges on a frozen lake would affect caribou have not been done. (the water level would fall under the ice when water level on the lake would drop).*	AEA recognizes the concern about the potential effects of ice shelving and other ice conditions in the proposed reservoir on the movements of caribou and other mammals during winter and spring, which was first discussed for the original Su Hydro studies in the 1980s, as cited in the Wildlife Data-gap Analysis for the Project (ABR 2011) and in Section 4.6.2 of the Pre-Application Document for the Project (AEA 2012b). The deployment of GPS and VHF radio-collars was intended to provide the seasonal movement and range-use data that will be needed to evaluate this impact. The wildlife study plans, the ice processes study (Study 7.6), and the water-quality modeling study (Study 5.6) were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. The impact analysis will consider Project-induced changes to ice processes and how those changes would impact caribou as well as other mammals. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). See Section 1.3 for additional information.

2.7.2.1. Response to Modification Request Seeking Additional Years of Survey Data for Caribou Herd Designations

SRC et al. (Modification 1; SRC_etal_WILDLIFE_pp6_ph5) request FERC to modify the Caribou Study to require AEA to collect additional years of radio-collar data to achieve appropriate levels of resolution on all caribou herds using the study area because they do not believe that adequate herd designations and proper resolution can be accomplished without additional years of study and the recognition of additional caribou groups, specifically the "Chulitna group" and the "Cantwell group." Similarly, Ms. Long (Modification 7.1; Long_160620_pp12_ph1) requests the Study Plan be modified to recognize additional caribou groups in the Project area, specifically a permanent Chulitna group in the Chulitna Hills and a migratory group centered in the Cantwell area.

As an initial matter, the purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. Comments related to caribou groups or herds address the scope and objectives of the Study Plan itself, and not AEA's implementation. The FERC-approved Study Plan for caribou did not include any objectives to delineate subherds or any objectives related to the Chulitna or Cantwell groups, and SRC et al. and Ms. Long fail to show any "good cause" (per 18 CFR 5.15(d)) as to why the Study Plan should be modified to address these groups. Moreover, neither SRC et al. nor Ms. Long has established that these proposed changes to the FERC-approved study are warranted on the basis that the FERC-approved study was not implemented as provided by the approved study plan or under anomalous conditions (per 18 CFR 5.15(d)). For these reasons, AEA requests that FERC not adopt either of these proposed study plan modifications.

From a technical standpoint, the study modifications requested by SRC et al. and Ms. Long are not needed to effectively evaluate Project-related effects on caribou or otherwise meet Study Plan objectives. The FERC-approved Study Plan required two years of data collection, but AEA actually collected three and a half years of fine-scale location data. The movement data collected during this study are sufficient to fulfill the study objectives.

The commenters assert that four different groups or herds of caribou occur in the study area, based on the work completed in the 1980s (Pitcher 1987): the Nelchina herd (the largest group), the Delta herd, a group in the Chulitna Hills, and a Cantwell group. The FERC-approved Study Plan identifies two herds, both of which use portions of the Project area extensively: the Nelchina caribou herd (NCH), numbering 40,233 caribou in 2011 (ADF&G, unpublished data), and the Delta caribou herd (DCH), numbering 2,985 caribou in 2007 (Seaton 2009).

RSP Section 10.6.2 describes the existing information and identifies the need for additional information. While the caribou study conducted for the Su Hydro project during 1980–1985 identified three resident NCH subherds migrating through the reservoir area, caribou use of the Project area currently is complicated by range expansion and mixing of DCH animals with those from the NCH (Seaton 2009). In addition, since 1985, the number of NCH caribou has increased significantly. A related change since the 1980s has been increased use of summer and winter range in the northwestern portion of the NCH range in GMU subunit 13E, northwest of the Project area. Because the NCH continues to calve in the eastern Talkeetna Mountains in GMU subunit 13A, southeast of the Project area, changes in summer and winter range use may mean that more caribou will cross through the Project area during seasonal migrations to and from the calving grounds. Hence, although the existing information suggests that NCH animals are more likely to cross the inundation zone, it is possible that some DCH animals may do so as well.

The FERC-approved Study Plan was designed to provide additional data on the current movement patterns of both herds, much of it at finer temporal and spatial scales than was previously available or possible (given the collar technology available in the 1980s), to assess potential Project-related impacts and to help identify potential mitigation measures for caribou in the Project area. This information will be supplemented by ADF&G's ongoing monitoring efforts of these herds.

The current multi-year fine scale telemetry data does not support the existence of a permanent Chulitna group in the Chulitna Hills or a migratory group centered in Cantwell, as asserted by SRC et al. and Ms. Long. The GPS collars used in this study provide much finer-scale discrimination of seasonal movements and distribution than can be collected using VHF collars, as was done 30 years ago for the APA Su Hydro study in the 1980s. While the majority of the Nelchina Herd migrates east each winter, a small portion of the herd remains in the Project area near the town of Cantwell and in the Chulitna Mountains (Study 10.6 ISR Part ASection 4.1.1). The three and a half years of fine-scale location data collected during this study indicate that caribou using the Cantwell area and Chulitna Mountains in the winter do not exhibit annual or seasonal fidelity to those areas, however; therefore, they were not considered to be separate subherds for analysis.

As stated in Study 10.6 ISR Part A Section 4.1.1., the designations of the DCH and NCH were collapsed into two ephemeral functional groups of caribou with separate wintering strategies: the Eastern Migratory Group (largely migratory Nelchina Herd animals that calve in the foothills of the Talkeetna Range and overwinter farther east in Unit 13) and the Western Group (animals that winter in the study area, potentially composed of mixed Nelchina and Delta herd individuals). These semantics were used to describe and differentiate the distribution of caribou collars deployed for this study.

In addition to the three and a half years of current fine-scale data on caribou movements, ADF&G has collected extensive data on range use by the Nelchina and Delta herds over the last several decades. The current data gathered under this study will be compared and integrated with the extensive historic data, as appropriate, and discussed in the USR.

Finally, the proposed modification to add additional years of data collection on caribou would add excessive cost to this study. AEA estimates that this modification would add approximately $800,000 to the study budget to extend the telemetry study another two years—even though AEA has already collected data over three and a half years.

For these reasons, AEA concludes that the proposed study plan modifications submitted by SRC et al. and Ms. Long are unnecessary and should not be adopted by FERC.

2.7.2.2. Response to Modification Request to Collect Additional Years of Information due to Anomalous Environmental Conditions

SRC et al. (Modification 2; SRC_etal_WILDLIFE_pp8_ph2) requests FERC to modify the Caribou Study to require AEA to collect additional years of information to address data gathered under anomalous environmental conditions during the 2013 study season, citing "the heavy and late snows of 2013 as well as the colder weather [that occurred] in April and May of 2013."

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Although SRC et al. claims that anomalous weather conditions occurred in 2013, as explained in Section 1.5.1, 2013 did not involve "anomalous environmental conditions" for the purposes of 18 CFR 5.15(d)(2). It is true that 2013 was characterized by prolonged winter conditions and an unusually late arrival of spring conditions. Herd composition data collected in 2013 showed the lowest calf:cow ratio (27 calves per 100 cows) recorded by ADF&G since records began in 1972; this ratio has historically ranged from 31 to 65 calves per 100 cows, averaging 49 calves per 100 cows. However, the Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and SRC et al. makes no showing that the meteorological conditions in 2013 impaired the value of the data collected for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of gathering additional years of survey data for caribou would be high.

Historically, winter conditions and severity vary widely from year to year in Alaska and they can be expected to continue to vary in the future. As indicated by the following observations, conditions encountered during this study were within the range of expected conditions (J. Zufeldt, HDR, Inc., 2016 personal communication):

- 2013 – early freeze-up, average winter overall (not “heavy” snow, as asserted by SRC et al.), late break-up;
- 2014 – average freeze-up, slightly warmer than average winter overall, early break-up;
- 2015 – late freeze-up, warm winter overall, early break-up;
- 2016 – late freeze-up, warm winter overall, early break-up.

Late-winter and spring break-up conditions in 2013 were just within the range recorded in the 67 years of record, with 1964 being very similar but a bit later and colder and 1985 being slightly earlier.

The FERC-approved Study Plan required AEA to survey radio-collared caribou during 2013 and 2014. In fact, AEA collected data over a three-and-a-half-year period, from late April 2012 through October 2015. As FERC has recognized (see Section 1.5.1, above), collecting data under conditions that vary from year to year strengthens inferences across a range of weather conditions that more accurately reflect the natural range of variability. Caribou migration and calving were indeed delayed during the spring of 2013 and calf mortality was high (as described in Study 10.6 ISR Part A Section 5.2.1), but the spring migration routes were similar to other years. Collecting data over three and a half years and analyzing seasonal data on an annual basis (rather than lumping all data among years) will prevent skewed results. In addition to the three and a half years of current fine-scale data on caribou movements, ADF&G has collected extensive data on migration patterns and range use by the Nelchina and Delta herds over the last several decades. The current data gathered under this study will be compared and integrated with the extensive historical data, as appropriate, and discussed in the USR.

Finally, the proposed modification to add additional years of data collection on caribou due to alleged anomalous environmental conditions would add excessive cost to this study. AEA estimates that this modification would add approximately $800,000 to the study budget to extend the telemetry study another two years—even though AEA has already collected data over three and a half years and over a range of environmental conditions.

For these reasons, AEA concludes that SRC et al.’s proposed study plan modification is unnecessary and should not be adopted by FERC. Caribou movement data already collected during this study are sufficient to fulfill the study objectives.

2.7.2.3. References Cited

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2.7.3. Study 10.7 – Dall's Sheep Distribution and Abundance

As established in the Study Plan (RSP Section 10.7.1), the overall goal of the study is to obtain sufficient information on the minimum population size, summer distribution, and current use of mineral licks by Dall's sheep—an important species of big game in the Project area—to use in evaluating potential Project-related effects and identifying measures to avoid, minimize, or otherwise mitigate those effects.

The study objectives are established in RSP Section 10.7.1:

- Estimate the current minimum population size of Dall's sheep in the study area.
- Delineate the summer range of Dall's sheep in the study area.
- Evaluate the current condition of mineral licks in and near the Project area.
- Analyze and synthesize data from historical and current studies of Dall's sheep in the study area, as a continuation of the 2012 study.

As detailed in Study 10.7 ISR Part D Section 7, and presented during the ISR meeting for this study held on March 29, 2016, AEA does not propose any modifications to Study Plan Section 10.7. As detailed in the Study Completion Report, AEA has met the study objectives and this study is considered complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.7. However, representatives from seven organizations (Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center; collectively, SRC et al.) filed six comments on Study 10.7. It should be noted that the comments by SRC et al. reproduced below in Table 2.7.3-1 do not consider the entire record. The comments pertain only to the June 2014 ISR and do not consider the Study Completion Report filed with the Commission on November 6, 2015. AEA's responses to the SRC et al. comments can be found in Table 2.7.3-1.

Table 2.7.3-1. Study 10.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WILDLIFE_pp DALLSHEEP2_ph5	*Recommendation 1. The study should include an evaluation of the composition of the three populations (% adult males, lambs/100 ewes, etc.), their use of mineral licks, and how those factors varied from 1980s observations.*	Table 5.1-2 (ISR Part A) presents composition data for each of the three population groups in the study area. Table 5.3-1 (ISR Part A) shows how the composition has changed since 1968 for the Watana Creek Hills survey area. As was discussed in Section 6.3 (ISR Part A), complete surveys of the Chulitna Mountains and the West Kosina Hills were not conducted for the Su Hydro study in the 1980s, so no composition data are available for comparison. Use of mineral licks by sheep using the survey areas outside of the Watana Creek Hills was beyond the scope of the FERC-approved Study Plan. The FERC-approved Study Plan called for documenting the use of the Jay Creek and Watana Creek mineral licks, which were identified during the 1980s research (Tankersley 1984).
SRC_etal_WILDLIFE_pp DALLSHEEP2_ph6	*Recommendation 2. At the AEA meeting on October 21, we recommended consideration of a new study proposal to evaluate whether the Kosina Hills population was isolated from the Jay Creek–Watana population by the intervening Susitna River. We suggested that this could be done via genetic analysis of shed hair to see if genetic interchange is currently occurring between these populations. We suggested the Kosina Hills sheep might be attracted to the mineral licks on the north side of the river and that when the impoundment is built, such movements would be impossible, thereby increasing the isolation of both populations/herds. We believe this would be a valuable addition to the existing study plan, but acknowledge there is a high likelihood that these populations are currently isolated by the formidable barrier of the Susitna River. At a minimum, a literature review should be conducted to determine if there are data indicating that the distance between these*	In response to this comment, the study team reviewed the data gathered as well existing literature to evaluate the potential for isolation of these sheep populations and has concluded that there is a high likelihood that that these populations are already isolated by the Susitna River. This conclusion is based on the fact that sheep observed leaving the Jay Creek mineral lick in June 2013 moved north toward the Watana Creek Hills, not south across the river toward the West Kosina Hills. Similarly, the detailed observations of mineral lick use in the 1980s summarized by Tankersley (1984) produced no evidence that sheep moved across the Susitna River to and from the Jay Creek lick. Available literature on the genetic structure of Dall's sheep populations (e.g., Worley et al. 2004; Roffler et al. 2014; Roffler et al. 2016) indicates that landscape features such as major river valleys and lowland forests, such as occur in the middle and upper Susitna River valley, pose barriers to sheep movements, contributing to fine-scale genetic differences. Hence, AEA's study team agrees with the commenters that "there is a high likelihood that

Reference Number	Comment or Study Modification Request	AEA's Response
	herds or the presence of the Susitna River between them already prevents interchange between them.	these populations are currently isolated by the formidable barrier of the Susitna River."
SRC_etal_WILDLIFE_pp DALLSHEEP3_ph2	*Recommendation 3. Neither the ISP nor the FSP have any objective associated with evaluating the impacts on sheep of the proposed roads and transmission lines that will be built to support the proposed project.*	The goal of the Dall's sheep study plan is "to obtain sufficient information on the minimum population size, summer distribution, and current use of mineral licks by Dall's sheep to use in evaluating potential Project-related effects and identifying measures to avoid, minimize, or otherwise mitigate those effects." That has been accomplished (See Study 10.7 SCR). The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit).
SRC_etal_WILDLIFE_pp DALLSHEEP3_ph3	*Recommendation 4. There is nothing in the FSP or ISR that is designed to identify appropriate kinds or levels of mitigation for adverse impacts of the project on Dall's sheep. The most likely source of adverse impacts identified by Tankersley (1984) is from disturbance and, possibly loss of connectivity between the Watana Hills and Kosina Hills and/or Chulitna Mountains populations caused by the large impoundment blocking sheep movements.*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the license application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure, including mitigation measures proposed by SRC et al. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
SRC_etal_WILDLIFE_pp DALLSHEEP3_ph5	*Recommendation 6. Impact assessment studies should not be considered adequate unless study plans incorporate (including allocation of funds) post-project studies to determine actual impacts on Dall's sheep movements, use of habitats such as the sheep licks, and changes in numbers and reproductive parameters. It is likely that the proposed impoundment will block movements between the Watana Hills sheep population and the Kosina Creek population. Such movements have not been documented or evaluated.*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the draft license application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure, including the post-Project monitoring studies proposed by SRC et al. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.

2.7.3.1. References Cited

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2.7.4. Study 10.8 – Distribution, Abundance, and Habitat Use by Large Carnivores

As established in the Study Plan (RSP Section 10.8.1), the overall goal of this study is to obtain sufficient information on three species of dominant predators and game animals in the region—brown bear, black bear, and wolf—to use in evaluating Project-related effects and identifying any appropriate protection, mitigation, or enhancement measures.

Four primary objectives have been identified for this study:

- Estimate the current populations of brown bears, black bears, and wolves in the study area, using existing data from ADF&G.
- Evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may be altered by the Project.
- Describe the seasonal distribution of, and habitat use by, wolves in the study area using existing data from ADF&G.
- Synthesize historical and current data on bear movements and seasonal habitat use in the study area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies (Prichard et al. 2013a).

As detailed in ISR 10.8 Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes no modifications to Study Plan Section 10.8 to complete the study and meet the Study Plan objectives.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, a group of seven organizations (Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center; referred to collectively here as SRC et al WILDLIFE.) submitted comments for

Study 10.8, including several study modification proposals. In addition, FERC requested additional information. AEA's responses to the comments can be found below in Table 2.7.4-1, organized first by comments pertaining to bears then followed by wolves. Responses to the study modification requests and the additional information requested by FERC are provided in further detail after the table.

Table 2.7.4-1. Study 10.8 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
	BEARS	
FERC_ppA-7_ph4	*1. ...please provide in the USR additional information related to DSM generation, selection of independent variables used for smoothing functions, model validation, and methods for population estimates from the model results. Please provide tables with the generalized cross validation score, percent deviance explained, and estimated degrees of freedom for each independent variable or interaction included in the final model.*	See Section 2.7.4.10 below for the requested information.
SRC_etal_WILDLIFE_pp10_ph3a	*…we request that FERC require AEA to preform [sic] additional years of hair-snag sampling, including sampling upstream from Devil's Canyon. The effort "should include sample collection times relative to timing of salmon use and bear molting."*	As explained below in Section 2.7.4.2, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $75,000 per year.
SRC_etal_WILDLIFE_pp10_ph3b	*Additionally, to better assess bear use of the project area AEA should redesign the Bear Study to include radio-tracking bears using GPS transmitters to permit determination of bear use of project impact areas, like the studies done for caribou and moose in the project area.*	As explained below in Section 2.7.4.3, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification is $600,000–$750,000, depending on the size of the radio-collared sample and the downstream extent of the study area.
SRC_etal_ WILDLIFE_pp11_ph3	*We propose that the population and density study analysis follow the study area used for the Su-Hydro bear studies in 1987, which "was 1,317 km² centered on the proposed Watana–Susitna dam site."*	As explained below in Section 2.7.4.5, this proposed study plan modification is unnecessary as this request by SRC is already part of the FERC-approved Study Plan. As such, there is no additional cost for implementing this modification.
SRC_etal_ WILDLIFE_pp12_ph4	*To rectify these biases, we urge FERC to require AEA to conduct additional density studies during the summer and fall months, as well as incorporate density estimates from hair-snag studies to accurately estimate the density of bears in the project area.*	As explained below in Section 2.7.4.2, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $75,000 per year. In response to SRC's claims of bias, see Section 2.7.4.4 below regarding the purpose of

Reference Number	Comment or Study Modification Request	AEA's Response
		the hair-snag sampling provided by the FERC-approved Study Plan.
SRC_etal_ WILDLIFE_pp14_ph5	*…we propose AEA be required to conduct additional data analysis using available data from the current study to evaluate abundance and density estimates that can be compared to Su-hydro studies conducted in 1980s.*	As explained below in Section 2.7.4.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $600,000–750,000, depending on the size of the radio-collared sample and the downstream extent of the study area, in addition to the $75,000 annual cost for additional hair-snag sampling and DNA analysis. Moreover, as explained in Section 2.7.4.5 below, the DSM models developed for the FERC-approved Study Plan allow estimation of population density of bears in any portion of the Large Carnivore Study Area.
SRC_etal_p WILDLIFE_p15_ph3	*The possible lack of independence in the mark recapture distance surveys poses a major problem of the assumptions in the bear density and abundance estimations which need to be addressed.*	AEA disagrees with the speculative nature of this comment. See Section 2.7.4.1 below for a discussion of the methods used to develop the density and abundance estimates.
SRC_etal_ WILDLIFE_pp15_ph4	*Recommended Modification* *Bear studies should be redesigned to permit direct estimation of the number of bears in the area likely to be impacted by the proposed impoundment, rather than the current study area which is approximately 20 times larger. The method currently being used does not provide an abundance or a density estimate for either species of bear in the area that will be impacted by the impoundment. CMR, hair-snaring DNA studies, and/or Resource Selection Function studies based on data from radio-marked bears are all appropriate techniques that should be considered to provide useful information for evaluating project impacts on bears. Depending on techniques used, this would require 2–4 years of study with the quickest result from DNA hair snaring studies (e.g., Kendall et al. 2009, Boulanger et al. 2002).*	As explained below in Section 2.7.4.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $600,000–750,000, depending on the size of the radio-collared sample and the downstream extent of the study area, in addition to the $75,000 annual cost for additional hair-snag sampling and DNA analysis. As explained in Section 2.7.4.5 below, the DSM models developed for the FERC-approved Study Plan allow estimation of population density of bears in any portion of the Large Carnivore Study Area.
SRC_etal_ WILDLIFE_pp17_ph4	*IV. The Bear Study should be modified to require AEA to use the CRM method rather than the MRDS method to estimate the density and abundance of bear populations in the study area and assess impacts.*	As explained in Sections 2.7.4.1 and 2.7.4.5 below, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $600,000–750,000, depending on the size of the radio-collared sample and the downstream

Reference Number	Comment or Study Modification Request	AEA's Response
		extent of the study area, in addition to the $75,000 annual cost for additional hair-snag sampling and DNA analysis.
SRC_etal_ WILDLIFE_pp18_ph3	*3. …A more valuable way to use these data than difficult-to-interpret shadings on a map, would be to build tables showing the number of 1-km² cells in different density categories (e.g., 0–4.9/1,000 km², 5–9.9, 10–14.9, 15–19.9, 20–24.9, etc.). This tabular data could be used to derive population and mean density estimates for a subportion of any study area (including a portion of the Large Carnivore Study Area surrounding the proposed impoundment or the 1,317 km² study area where abundance and density was estimated by Miller (1987)). We suggest that the midpoint of each density category could be used to derive these estimates. It may be possible to derive a variance for such estimates based on Coefficient of Variation surface maps such as are displayed in the ISP using the same 1-km² cell approach. We recommend that AEA contract to do something like this for the existing 1-km² data set for some portion of the Large Carnivore Study Area that is geographically pertinent to impact assessment studies for the proposed project. This will also be a useful test of the validity of the results generated by the MRDS approach used in this project and reported in the ISR.*	As explained below in Section 2.7.4.7, AEA requests that FERC not adopt this proposed Study Plan modification. The data requested has already been produced in 1-km² cells as part of the FERC-approved Study Plan. As such, there is no additional cost. No cost estimate was developed for the remainder of the request as the types of data produced by spatial density modeling do not lend themselves to tabular output or interpretation as requested as it would be too large and incomprehensible. The science of statistics has developed graphical methods to display complex data so that scientific results can be comprehended and insights gained from the analysis. For this reason the bear population analysis results are displayed using a density surface map. Further, the commenters' suggestions for creating a variance estimate from tabular data are statistically invalid.
SRC_etal_ WILDLIFE_pp19_ph1	*4. …we recommend that AEA acquire the databases used to generate the results shown in the ISR which generated the density surface and related maps so that they can be independently evaluated for problems that lead to apparent non-credible results.*	AEA disagrees with this comment and the contention that there is an underlying defect in the database used for this analysis. The results are credible and are backed by peer-reviewed scientific literature.
SRC_etal_ WILDLIFE_pp19_ph2	*5. All maps in the ISR should be modified to show geographic features to permit viewers to orient themselves within the Large Carnivore Study area.*	AEA disagrees with the commenters' assertion that the map figures created for the ISR are not sufficiently detailed to allow readers to orient themselves within the study area. Geographic features can be found through comparison with the study area map. The addition of more geographical features to the density surface maps would interfere with the depiction of analytical results.
SRC_etal_ WILDLIFE_pp19_ph3	*6. Regardless of the approach to future bear studies, the project on Wildlife Harvest Analysis (ISR Chapter 10.20) should include analysis of*	This comment is discussed in the portion of this document that addresses Study 10.20, Wildlife

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	kill density by harvest reporting units (UCUs) in the entire Large Carnivore Study Area.	Harvest Analysis; please refer to Section 2.7.16.1 for details.
SRC_etal_ WILDLIFE_pp20_ph1	*8. If the experimental MRDS approach continues to be employed in Susitna Dam impact assessment studies, power analyses must also be conducted to determine what level of change would be detectable utilizing a subsequent application of the approach (e.g., post dam construction) in the same study area.*	As is discussed in detail in Sections 2.7.4.1 and 2.7.4.8, MRDS is not an experimental approach and power analysis is not needed to fulfill the objectives of the Study Plan.
SRC_etal_ WILDLIFE_pp20_ph2	*9. A sensitivity analysis should also be conducted. This will permit evaluating the impact on final results of not observing a subset of randomly selected bear groups on the estimate of bear population size. The same kind of sensitivity analysis should be done to evaluate the impacts of having seen additional groups on the final results.*	As explained below in Section 2.7.4.9, AEA requests that FERC not adopt this proposed Study Plan modification, as it is unnecessary and inappropriate. A cost estimate was not developed for implementing this modification as sensitivity analyses are not done for distance-sampling models, including MRDS models, because all of the relevant information is available from the model results.
SRC_etal_ WILDLIFE_pp20_ph4	*11. Authors must be explicit about the units with which they are estimating bear numbers and bear density. Although it is not explicitly stated, the ISR estimates actually represent bears of all ages. This was based on extrapolations from mean group size observed. Absent explicit description of the units for population or density estimates, they are of little value in making spatial or temporal comparisons with other study areas.*	The estimates produced are for all bears of each species, as described in ISR 10.8 Part A, Sections 4.1.1 and 5.1.1.
SRC_etal_ WILDLIFE_pp21_ph1	*12. Results of the MRDS technique should include search intensity (minutes searched/km²) and associated variability based on covariates (e.g., vegetation type or elevation). This facilitates comparisons with results of other techniques such as the CMR approach.*	AEA disagrees with this comment. It is not reasonable to do this kind of comparison because the MRDS and CMR techniques are not comparable. The variables suggested (minutes searched/km²) do not make sense for MRDS, which employs line-transect sampling.
SRC_etal_ WILDLIFE_pp21_ph2	*13. Tables should be provided based on number of bears seen by group size (including groups of newborn, yearling and 2-year-old cubs) and mean and median group size.*	AEA disagrees with this comment. This information is not useful for assessing the MRDS estimate and has not been provided in the literature reporting other MRDS results.
SRC_etal_ WILDLIFE_pp21_ph3	*14. Tabular data for the MRDS technique should show range and means for detectability based on important covariates, especially group size, distance, snow cover, and vegetation.*	The detection probabilities for any combination of covariates at any specified values can be calculated from the model coefficients. In the USR, AEA will provide graphs that illustrate the effect of the MRDS model covariates.
SRC_etal_ WILDLIFE_pp21_ph4	*15. The authors should display the locations, elevations, and dates of their MRDS transects on a study area map and in tables so that*	The transects were randomly selected, so they are as unbiased as is scientifically possible. In light of the large number of transects (*n* =

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	readers can see where and when transects were flown.	1,238), the law of large numbers suggests that the odds of having severe bias in the transect selection would be astronomically low. It is obvious from the methods presented that this is both infeasible and impractical. There are 1,238 transects for brown bears, with an average length of 34.53 km; this volume of data cannot be interpreted in a table. In addition, only contour transects had a consistent elevation, whereas straight transects were placed randomly on relatively flat terrain. Elevations along the length of these transects can vary by hundreds of feet. Figure 2.7.4-1 below shows the transect locations surveyed each year, supplementing the information provided in ISR Part A, Section 5, Figures 5.1-2 and 5.1-8.
SRC_etal_ WILDLIFE_pp21_ph5	*[Proposed Modifications and Other Recommendations] 16. The analysis of isotopes in bear hair to detect salmon use by bears should include sample collection times relative to timing of salmon use and bear molting.*	As explained below in Section 2.7.4.2, AEA requests that FERC not adopt this proposed Study Plan modification, as AEA has already provided the requested information about collection dates for bear-hair sampling in 2013 and 2015, as presented in Table 5.1-5 in ISR 10.8 Part A and Table 5.1-1 of the SIR for Study 10.8. The timing of bear molting and salmon spawning are presented in Section 2.7.4.2 below and also will be reported in the USR.
SRC_etal_ WILDLIFE_pp21_ph6	*17. Neither the final study plan nor the ISR have any objective associated with evaluating the impacts of proposed roads and transmission lines that will be required to support the proposed project.*	This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including impact assessment in the License Application, please see Section 1.3.
SRC_etal_WILDLIFE_p pBEARS02_ph3	*Density surface maps (ISR 10.8 Figures 5.1-5 and 5.1-11) are based on the incorrect premise that where bears happen to be documented during spring surveys is related to the carrying capacity of the habitat (expressed as density).*	SRC et al. comments repeatedly make this incorrect assertion, but no such assumption was made by the study team. As indicated in the FERC-approved Study Plan (RSP Section 10.8.2.1), the focus of this study component is to estimate bear populations and not the carrying capacity of the habitat. The density surface maps display predicted numbers of black bears and brown bears per km² (ISR 10.8 Part A, Sections 5.1.1.1 and 5.1.1.2).
SRC_etal_WILDLIFE_p pBEARS02_ph3	*In addition, the technique used to generate estimates of bear abundance and density in the entire Large Carnivore Study Area (hereafter*	AEA disagrees with this assertion; refer to Section 2.7.4.1 below for more detailed discussion. MRDS models are a proven and

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	termed the Mark–Recapture Distance Sampling or MRDS technique) has not been described or proved accurate for black or brown bears in any existing publications or reports in Alaska or elsewhere. The data collection and analytical methods used for bears in this study have not been peer reviewed and are correspondingly not "consistent with generally accepted scientific practice" as required for AEA Susitna studies.	well-established method for estimating animal population size (Laake and Borchers 2004, Borchers et. al 2006, Buckland et al. 2015). In a paper that was peer-reviewed by experts, Becker and Christ (2015) obtained a population estimate of black bears in south-central Alaska using MRDS methods.
SRC_etal_WILDLIFE_ppBEARS02_ph3	*For some other species, the person involved in the spatial modeling, Miller et al. (2013:23) described "Density surface modelling from survey data [as] an active area of research" and noted that "we look forward to further improvements and extensions in the near future."*	AEA agrees. Statistical methodology continues to improve, including the subject of Generalized Additive Models (Wood 2006), which are the foundation of Density Surface Modeling. Scientific methods are useful even as they continue to improve. As described above in this table and below in Section 2.7.4.1, MRDS models are a proven and well-established method for estimating animal population size (Laake and Borchers 2004, Borchers et. al 2006, Buckland et al. 2015).
SRC_etal_WILDLIFE_ppBEARS02_ph3	*Distance-sampling techniques have been used to estimate abundance of polar bears in the Barents Sea subpopulation (Aars et al. 2009), but this work did not involve the capture–recapture component of the MRDS technique used for the current Susitna bear studies.*	Aars et al. (2009) thought that the assumption of perfect detection on the transect line from a helicopter flying over sea ice was reasonable; hence, no mark–recapture component was needed. That is not the case for distance-sampling surveys of black and brown bears conducted with small, two-person aircraft.
SRC_etal_WILDLIFE_ppBEARS02_ph4	*The reason there are no previous bear density or population estimates in the western and southern portion of the Large Carnivore Study Area is because much of the bear habitat in this area is forested. It is very difficult to use techniques based on observations in habitats where bears cannot be seen because of overstory vegetation. Regardless of efforts to correct for this problem by covariate analysis in the MRDS method, if any bears present in the study area cannot be detected, then any analytical technique based on observations will underestimate abundance. Although the ISR and Becker and Quang (2009) do not provide location data upon which their analysis is based, we suspect very few bears were seen in forested portions of the study area, openings in the forest, or sedge flats. This means that their abundance estimates and corresponding density surface maps reflect primarily the segment of the population available for observation. This segment is largely between timberline and 5,000 feet for brown bears.*	As long as a theoretical transect could be placed so that the bear could be seen, no bias exists. Generally, if the ground can be seen, this condition can be met. This condition only needs to be met at the apex of detection. Because these surveys were conducted prior to leaf-out in the study area, this condition was met. Black bears use forested habitats heavily in this area; out of the 351 black bear groups detected, 68 were observed in vegetative cover of 50% or higher, 4 observations were in 75% cover, and 4 others were in 80% cover.

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	There is no possibility of calculating a detection probability based on bears observed by only one of two observers if no bears are observed because of overstory vegetation.	
SRC_etal_WILDLIFE_ppBEARS03_ph2	*The brown bear population estimate derived for the Large Carnivore Study Area and published by Becker and Quang (2009) is implicitly acknowledged in the ISR as an underestimate. The ISR reported a brown bear population estimate that was 46% higher than reported (based on exactly the same data for the same study area) by Becker and Quang (2009). This increase resulted from use of new mathematical techniques involving point independence. The estimate increased from 575.9 brown bears to 841 brown bears, and density from 26.3 bears/1,000 km² to approximately 35.8 bears/1,000 km². We suspect that even when point independence is included in the math used to calculate population size, there remains an underestimation bias. Our suspicion is based on the fact that the density surface map for brown bears presented in the ISR (Fig. 5.1-11, page 30) is contrary to expectations. This map indicates lower densities in southern and western portions of the Large Carnivore Study Area where bears have access to multiple runs of salmon, than in interior areas where bears do not have access to salmon. All available studies indicate that where brown bears have access to multiple runs of Pacific salmon, densities are much higher than in interior areas (Miller et al. 1997, Hildebrand [sic] et al. 1998, Table 1 in this document).*	On the contrary, no underestimation is proven by these comments. As described in Study 10.8 ISR Part A, Section 4.1.1, the surveys were conducted in the spring, when adult salmon are completely absent from the area. Adult salmon are only available to bears in mid to late summer and early fall. AEA agrees that the assumption of independence in the Becker and Quang (2009) appears to have caused an underestimate. The current approach used in this study (Becker and Christ 2015) fixed that problem. The results of Laake (1999), summarized in the supplement (Section 2.7.4.11) below, indicate that MRDS methods generated unbiased estimates on a known population.
SRC_etal_WILDLIFE_ppBEARS03_ph3	*We suspect that this underestimation bias most likely resulted from lack of independence between observers in the aircraft during MRDS surveys. Lack of independence between observers would lead to overestimation of detection probabilities which would cause underestimation of bear abundance.*	Comments by SRC et al. repeatedly assert an underestimation bias. There is no bias, nor is there any reported or demonstrated underestimation. Using repeated sampling of a known population, Laake (1999) demonstrated the precision and lack of bias of the MRDS estimator that uses the point-independence assumption (like the one used in this analysis; see supplement in Section 2.7.4.11 below). Point independence eliminates the assumption of full independence between observers.
SRC_etal_WILDLIFE_ppBEARS03_ph3	*We present evidence that is consistent with overestimation bias in the MRDS data. This evidence is based on comparisons of detection probabilities calculated using the MRDS technique with other studies (Capture–Mark–*	The comparison by SRC et al. is not valid, as the probabilities are not comparable. MRDS calculates the probability of seeing a bear within the strip next to the airplane, whereas CMR methods are calculations for the study area.

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	Resight or CMR) where sightability of bears was directly estimated based on number of marked bears known to be present in an area that were observed. The CMR studies used equivalent aircraft and observers but more intensive search techniques. Correspondingly, sightability of bears would be expected to be higher in the CMR estimates than for the detection probabilities calculated using the MRDS technique. This should occur for each set of the MRDS covariates associated with a bear sighting. Based on examination of Figure 5.1-7 (page 26 of the ISR), however, the calculated MRDS detection probabilities were higher than found in the more intensive CRM [CMR] surveys.	Mathematically, it would be trivial to make the detection probabilities larger or smaller by changing the truncation distance (*w*). Making *w* smaller increases the probability of detection and vice versa. Generally, it is desirable to have larger detection probabilities because those estimators are more stable (Marques and Buckland 2003). Selection of the truncation distance for this analysis followed established guidelines. Laake (1999) has demonstrated that the MRDS technique can provide unbiased population estimates (see supplement, Section 2.7.4.11, below).
SRC_etal_WILDLIFE_ppBEARS04_ph1	*It is likely too, that the MRDS application in the current study may not have appropriately identified the correct covariates that influence the likelihood of seeing a bear.*	Relevant covariates affecting the sightability of bears were incorporated in the analysis, including percent vegetative cover, percent snow cover, bear activity, year, group size, various pilot and observer search types, transect type, and search distance (binned). Multiple covariate distance-sampling methods are "pooling robust" and thus unaffected by missing covariates (Burnham et al. 2004). In addition, Buckland et al. (2015) report that MRDS models with high mark–recapture probabilities, such as in this study, are also pooling robust, so this is not an issue with the analysis.
SRC_etal_WILDLIFE_ppBEARS04_ph2	*Based on available information in the ISR, we do not know which covariates were investigated during the current study or used in the final model. The ISR (page 3) mentions explanatory variables (e.g., covariates) such as "elevation, aspect, habitat, and east-west and north-south gradients," and it is clear that some of these were covariates considered. However, it is also clear some of these covariates are not directly correlated with bear abundance including north-south and east-west gradients. These gradients do not directly reflect food availability. The most important factor that influence bear abundance is food availability (Schwartz et al. 2003 and many others). Elevation, aspect, and slope are likely proxy variables for things that affect food availability for bears which, in spring, might be avalanche tracts where bears forage for newly emergent vegetation and tubers. Where a bear is seen in spring might also reflect the presence of a carcass of a winter-killed or wolf-killed ungulate or availability of ungulate calves. A*	The Density Surface Model (DSM) is based on the estimated number of bears, so covariates affecting detection were adjusted for. The study team recognizes that bears key in on food availability, which is indicated in the results. For example, the availability of newly emerged grasses, sedges, and horsetails during the spring is reflected in the black bear DSM (as described in ISR 10.8 Part A, Section 5.1.1.1). The north–south and east–west gradients reflect general bear density gradients that were observed in the data along those axes.

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	springtime southwest-northeast gradient in the Large Carnivore Study area might reflect salmon availability during summer and fall. The most important covariate affecting detection probability for bears (and most other wildlife) is vegetation/canopy coverage.	
SRC_etal_WILDLIFE_ppBEARS06_ph2b	*It is also likely that any salmon use based on hair analysis that is documented by bears upstream from Devils Canyon would be complicated by an inability to distinguish between salmon from the Susitna River and salmon from Prairie Creek (a tributary of the Talkeetna River where Miller 1987 documented use of salmon by some study area brown bears).*	AEA understands that some brown bears above Devils Canyon are likely to feed on salmon spawning in Prairie Creek, a tributary of the Talkeetna River, based on the results of APA's studies in the 1980s. The number of salmon spawning in the Susitna River and tributaries upstream from Devils Canyon is very low, however, and is unrelated to the use of Prairie Creek by salmon and bears. Due to the low number of spawning salmon dispersed over a large area, collection of hair samples was not conducted upstream from Devils Canyon. This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project, which will be included in the draft License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impact assessment in the License Application, please see Section 1.3.
SRC_etal_WILDLIFE_ppBEARS06_ph3	*The MRDS technique used in this study to estimate bear abundance and density are mathematically very complex and difficult to understand.*	MRDS models are a proven and well-established method for estimating animal population size (Laake and Borchers 2004, Borchers et. al 2006, Buckland et al. 2015). Becker and Christ (2015) obtained a population estimate of black bears in south-central Alaska using MRDS methods, and that paper was peer-reviewed by experts. MRDS was the method described in the FERC-approved Study Plan for estimating bear populations.
SRC_etal_WILDLIFE_ppBEARS07_ph2	*…excluding bears above 5,000 feet from density calculations contributes to an underestimation bias.*	Spring habitat for brown bears was delineated based on observations of bears in 1999. Habitats above 5,000 feet in elevation were searched but no brown bears were seen that high (the comparable elevation for black bears was 4,600 feet). The methods were described in RSP Section 10.8.4.1.
SRC_etal_WILDLIFE_ppBEARS09_ph1	*The brown bear density surface map (ISR 10.8 Fig. 5.1-11) appears to overestimate density even though the MRDS approach appears to underestimate bear abundance as discussed above. The darkest areas on this figure*	This perception of the commenters is a matter of scale rather than a "calibration problem." Bears are not evenly distributed across the landscape within any defined study area. It stands to reason that some locations will have

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	represent the highest densities and according to the color index scale, a significant portion of the study area is indicated as having densities near 0.2 bears/km² (or 200/1,000 km²) even in areas where no salmon are present such as in the big bend portion of the Susitna River on the east end of the study area. As displayed in Table 2, all Alaska study areas where brown bear density has been estimated where salmon are not present have densities <50 bears/1,000 km². This suggests a serious calibration problem with the spatial modeling used to derive the density surface map. At best, the density surface map may be characterized as depicting relative (not absolute) densities. A similar calibration problem was found with the density surface map for black bears as discussed below.	higher densities than other locations within a given area. The difference suggests a difference in the scale of inference, not a calibration problem. The large scale and heterogeneity of habitat by elevation, slope, aspect, and access to food resources ensure a heterogeneous bear density on the 1-km² scale.
SRC_etal_WILDLIFE_ppBEARS10_ph3	*Detection probabilities in MRDS surveys are calculated based on bear groups seen by only one observer in the plane and bear groups seen by both observers. This is the mark–resight component of the MRDS technique and is based on the assumption that observations of the two observers are independent (i.e., the sighting of a bear by one observer does not increase the likelihood that the bear will be seen by the other observer). If this critical assumption is incorrect, then the estimates will be biased low and minor violations of this assumption can result in significant underestimation bias (Benson 2010). Sightability of bear groups during CMR surveys, in contrast, does not require any assumptions and is empirically calculated based on the percentage of marked bears (known to be present) that are seen during CMR survey flights.*	As described in RSP Section 10.8.4, an MRDS model under point independence was used; full independence between the two observers was not assumed, as asserted by SRC et al. As is shown in the supplement (Section 2.7.4.11) below, the MRDS model is a superior estimator. Relative to the CMR, there are indeed implicit assumptions about independence of bears when a population estimate is calculated. For example, the mathematical assumption is the bears are independently captured. The calculation of a population estimate (total bears) in the CMR method has not been calculated in a statistically valid fashion. For instance, a radio-collared sow with two cubs is not three radio-collared bears, which is how they are treated in the CMR method to obtain population estimates. One cannot have three radio-collared bears with one radio collar. It is a collared group of three bears, but it is not treated mathematically as such. In addition, the CMR technique cannot model individual capture heterogeneity. Link (2003), in a landmark paper, noted the extreme difficulty that unmodeled heterogeneity creates for obtaining valid population estimates with mark–recapture estimators. The estimates in Study 10.8 are pooling robust and do not suffer from this problem (Buckland et al. 2015). CMR offers no spatially specific information that is critical for determining which access roads would have less impact, whereas the DSM offers an appropriate statistical and spatial framework for such inferences.

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SRC_etal_WILDLIFE_ppBEARS11_ph2	*Comparison of Horowitz[sic]–Thompson detection probabilities from MRDS surveys with average sightability data from CMR surveys shows that the MRDS method overestimates bear detection probabilities and therefore underestimates bear abundance, compared with the CMR method.*	A change in terminology is needed here to correct an error in Study 10.8 ISR Part A: the "estimated Horvitz–Thompson inclusion probabilities" are properly called "corrected detection probabilities." In Section 5.1.1.2 of ISR Part A, these values were reported as ranging from 0.109 to 0.829 for brown bears, whereas for a given study the CMR recapture probabilities are the same for all bears. We point out this distinction to highlight differences in assumptions between the two methods. SRC et al.'s argument that an estimator based on all bears having the same capture probability is superior to one that models heterogeneity in detection is inconsistent with current biometric theory (Link 2003; Buckland et al. 2004, 2015). Statistically, a comparison of corrected detection probabilities (MRDS method) and mark–recapture probabilities (CMR method) makes no sense, because the first estimates the probability of detecting a bear within a strip of land next to the transect and the second is the probability of detecting a bear in the study area.
SRC_etal_WILDLIFE_ppBEARS12_ph2	*We conclude that the density surface map incorrectly depicts black bear density in the Large Carnivore Study area. In contrast, the ISR (Part A Page 7) reported "The study team used the model to predict the number of black bears in 1-km cells (Fig 5.1-5). Model fit diagnostics indicated a good fit. The deviance explained by the model was high (38.1 percent), indicating a good predictive model." We believe if a bear expert had been involved in this research project rather than only biometricians, it would have been recognized that a model predicting black bear densities of >1/km² in any part of Alaska was not a credible model.*	DSMs are increasingly being used to assess development impacts on various animal species throughout the world (e.g., see Bradbury et al. 2014; Winiarski et al. 2013a, 2013b, 2014). As was previously stated, the 1-km² scale used in the DSMs allows for estimates in subareas; this type of inference cannot be made with standard techniques. A previous black bear estimate in a small area in the eastern portion of the Large Carnivore Study Area was half of the density estimated in the central and northern part of GMU 16B (Becker and Christ 2015). Northern GMU 16B is the western section of the Large Carnivore Study Area, so the much higher bear densities there and a small 1-km² scale will result in plausible and defensible localized densities >1 black bear/km².
SRC_etal_WILDLIFE_ppBEARS12_ph2	*The FSP (page 10.8-6) states that "Distance sampling using line transects surveyed from small airplanes (Becker and Quang 2009) is the primary method currently employed by ADF&G to obtain regional estimates of bear population density in southern Alaska." We question this statement.*	The assertion by SRC et al. that the MRDS population and density estimates lack credibility for use by management biologists are unfounded. MRDS methods have been used by ADF&G to estimate bear population size in GMUs 13A, 13B, 13E (this study), 16A, 16B (Becker and Christ 2015), 9B, 9C, and 9D. In addition, the National Park Service and U.S. Fish and Wildlife Service have used this technique to estimate bear population size in GMUs 9A and 17A, respectively. These

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		management units (13A, 13B, 13E, 16A, 16B, 9B, 9C, and 9D) encompass the majority of southern Alaska.
SRC_etal_WILDLIFE_ppBEARS13_ph2	*This objective [Objective 2] would be more precisely stated if it was made clear that bear "use" was not going to be examined during this study but rather the ratio of salmon consumption to consumption of terrestrial plant and animal foods. While more precise wording is always possible, this wording accurately reflects the intent of the study.*	The FERC-approved Study Plan describes the methods to be used in meeting this study objective (RSP Section 10.8.4.1.2). The downstream bear survey collected data on the minimum number of bears using different salmon spawning locations, the sex and species of those bears, and the ratio of different major components in their diet. All of these data provide information on bear use of that portion of the study area.
SRC_etal_WILDLIFE_ppBEARS13_ph5	*It is not clear what the phrase "…current data on bear movements and seasonal habitat use in the study area" refers to. To our knowledge, there are no ongoing studies on these issues for either bear species in any portion of the Large Carnivore Study Area or adjacent to this area. A brown bear study was initiated by management staff in GMU 13A but was terminated and no report is available. Even if a report on this 13A study were available, it is unlikely that it would provide insights on movements and seasonal habitat use in the area of the proposed impoundment. We conclude that the ISR will not provide any new information on bear movements and seasonal habitat use in the study area so this objective [Objective 4] will not be achieved.*	AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). The study has not yet been completed. The USR will summarize the existing bear research in and near the Project area, including other recent studies conducted by ADF&G, such as research on brown bear predation of ungulate calves in GMU 13, which used collar-mounted cameras, GPS telemetry, and stable isotopes, as well as past studies of bear movements and seasonal habitat use from the 1980s APA Project studies and other, more recent studies in southern and interior Alaska.
	WOLVES	
SRC_etal_WILDLIFE_ppWOLVES2_ph1	*...there are no existing data or routinely collected data on wolves for the area that would be impacted by the project on either the number of wolves (Objective 1) or on the seasonal distribution of, and habitat use by wolves (Objective 3)... Completion of this study plan will not result in information that will inform AEA or FERC on the project's impacts on wolves. The ISR states (page 2) that for wolves, the "…study involves office-based analysis of existing ADF&G data on wolves from GMU Subunits 13E and 13A, and from adjacent Subunits 14B, 16A, and 20A, as available". The ISR (page 5) asserts that historical data with be "synthesized" "…with data from other recent and current monitoring by ADF&G... However, no data are "available"*	AEA disagrees with this comment. ADF&G staff conducted an aerial survey on January 26–27, 2015, to enumerate wolves within the survey area as indicated in Figure 4.2-2 in the SIR for Study 10.8. In addition, as the commenters note in the next comment below, other data are available from ADF&G on the wolf population in the region that includes the study area (e.g., Ballard et al. 1981, 1987; Schwanke 2009; ADF&G 2013), as well as the results of the 1980s telemetry study for the APA Project regarding seasonal distribution and habitat use (Ballard et al. 1983, 1984). Moreover, analysis of potential impacts does not occur at this stage of the FERC ILP; rather, it will be conducted for the License Application and subsequent EIS for the Project. For more information related to

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	on project impacts on wolves and there are no data from other recent and current wolf monitoring in any of these subunits. We conclude that these statements in the ISR and RSP/FSP are meaningless and misleading insofar as it implies that such data might be "available" or be in process of being collected.	AEA's approach for including impact assessments in the License Application, please see Section 1.3.
SRC_etal_WILDLIFE_ppWOLVES2_ph2a	*There are routinely collected data on numbers of wolves in Unit 13 and other units. However, these data are collected for a geographic area (Game Management Unit or Subunit) that is too large to be of utility in evaluating project impacts on wolves. A study on a smaller geographic area in the vicinity of the proposed project is needed...*	AEA disagrees that the study area in the FERC-approved Study Plan is too large to be of use in meeting study objectives. By covering the proposed reservoir, associated facilities, and all of the potential access and transmission corridor alternatives, the January 2015 wolf survey was conducted at an appropriate geographical scale (see Figure 4.2-2 in the SIR for Study 10.8).
SRC_etal_WILDLIFE_ppWOLVES2_ph2b	*We are not aware of any new studies involving radio-marked wolves in Unit 13 or the other subunits mentioned since the aborted effort in Units 13A and 13B described by Golden and Rinaldi (1008) [sic]. Given the extremely heavy hunting pressure on wolves throughout GMU 13 (Schwanke 2012), we acknowledge that it would be extremely difficult to conduct a movement or habitat use study for wolves at the appropriate scale to determine project impacts using conventional techniques (radio telemetry) (Golden and Rinaldi 2008).*	AEA agrees that radio-collaring wolves inhabiting areas with high levels of human take is not practical, nor is deploying radio collars in an intensive management area where removal of wolves is a management priority.
SRC_etal_WILDLIFE_ppWOLVES2_ph3	*There are no methods being proposed or used for AEA's current wolf studies that will accomplish Objective 3 ("Describe the seasonal distribution and habitat use by wolves in the study area using existing data").*	The objective was not addressed in the ISR because that study component had not yet been undertaken. Section 10.8.4.2 of the FERC-approved Study Plan stated that the study team will review and synthesize historical reports from the 1980s APA Project study, where possible, with data from other recent and current monitoring by ADF&G of wolves in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A. That review and synthesis will be included in the USR and relevant data will be incorporated in the Evaluation of Wildlife Habitat Use (Study 10.19).
SRC_etal_WILDLIFE_ppWOLVES3_ph2	*[Objective 1.] ...routinely-collected data pertain to the number of wolves in various Subunits of Unit 13 (at best) and will not generate any estimates of the number of wolves in the study area for large carnivores illustrated in Figure 3-1 (page 19 of the ISR, Part A) or—as impact assessment studies should do—in the much smaller area of actual impact of the proposed*	AEA disagrees that the study area in the FERC-approved Study Plan is too large to be of use in meeting study objectives. By covering the proposed reservoir, associated facilities, and all of the potential access and transmission corridor alternatives, the January 2015 wolf survey was conducted at an appropriate geographical scale (see Figure 4.2-2 in the SIR

Reference Number	Comment or Study Modification Request	AEA's Response
	Susitna–Watana Dam and associated corridors. ...the ISR provides no estimates of numbers either for the illustrated Large Carnivore Study Area or for a more pertinently drawn and smaller impact study area for the Susitna–Watana Dam project and associated transportation and transmission corridors. ... There is no indication that future reports will present data at a pertinent scale for project impacts.	for Study 10.8). Section 5.2 of the SIR for Study 10.8 reported that, "Within the GMU 13E survey area, a total of 6 groups of wolves were identified during the January 2015 aerial survey. Most of those groups were small, comprising two or three individuals, with one pack of 16 comprising the majority of the 27 animals directly seen in the subunit." All but two of those wolves were in or adjacent to the Project area.
SRC_etal_WILDLIFE_ppWOLVES3_ph7	*[Objective 1.] By far the largest pack documented by Ballard et al. (1984) was the Watana Pack. This pack, if it still exists, is the pack that would be most impacted by the currently proposed project. The current Study Plan will not be able to document if this pack (or any other pack described by Ballard et al. 1984) still exists or its current size.*	The FERC-approved Study Plan did not require that AEA document the pack organization of the wolf population in the study area. Research in Alaska and elsewhere has demonstrated that wolf pack organization is dynamic, especially in exploited populations, so it is not realistic to expect that pack structures and territories will persist over long-term time scales. Wolves were observed in the vicinity of the historical territory of the 1980s "Watana pack," both during the 2015 survey (see Figure 4.2-2 in the SIR) and incidentally during field work in the following year (K. Colson, ADF&G, pers. obs.). However, given that packs are social structures and are not permanent features of a population or the landscape within which they reside, it is impossible to say if those animals represent the same pack, a pack that has displaced the historic Watana pack from a portion of its territory, or any other of a number of plausible scenarios, particularly in view of the population disruption acknowledged by the commenters in the next comment. Regardless, wolves are managed by ADF&G at the population level rather than at the level of individual packs, which is the relevant scale to consider in the development of protection, mitigation, and enhancement measures for the License Application.
SRC_etal_WILDLIFE_ppWOLVES3_ph8	*[Objective 1.] Since the studies by Ballard et al. (1984), there have been intensive and successful efforts to reduce the numbers of wolves in GMU 13 by increasing harvests (Schwanke 2012). This kind of disruption makes it impossible to assume that the packs, territories or wolf numbers described in earlier studies bear any resemblance to what currently exists... Since there are no ongoing studies to determine this, it appears that Objective 1 for wolves will not be achieved.*	ADF&G staff conducted an aerial survey on January 26–27, 2015, to enumerate wolves within the survey area depicted in Figure 4.2-2 in the SIR for Study 10.8. Therefore, the objective to estimate the current wolf population was met.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WILDLIFE_ppWOLVES4_ph2	*[Objective 3.] No results are reported for this objective. The existing study plan is to use routinely collected wolf management data but these data are not specific to the Large Carnivore Study area illustrated in Figure 3-1 (page 19 of the ISR, Part A) or, as they should be, to the smaller area within which wolves will be impacted by the proposed project ... It may be the case that there is no way Objective 3 could be achieved under the current regulatory system for wolves in GMU 13 and it is puzzling why this objective was included if no effort was going to be made to achieve it. ... Since there are no ongoing studies to "describe seasonal distribution of, and habitat use by wolves", it appears that Objective 3 for wolves will not be achieved.*	The objective was not addressed in the ISR because that study component had not yet been undertaken. Section 10.8.4.2 of the FERC-approved Study Plan stated that the study team will review and synthesize historical reports from the 1980s APA Project study, where possible, with data from other recent and current monitoring by ADF&G of wolves in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A. That review and synthesis will be included in the USR, and will be incorporated in the Evaluation of Wildlife Habitat Use (Study 10.19).
SRC_etal_WILDLIFE_ppWOLVES4_ph6	*[Objective 4.] This objective (synthesis of historical and current data) refers to bears and includes no reference to use of the historical data for wolves in the Susitna Dam impact area reported by Ballard et al. (1984)... There are no analyses of historical wolf data in AEA 2012. Although the historical data is of reduced pertinence given the history of intensive wolf harvest in GMU 13 (Schwanke 2012), some effort to extrapolate from these data to impacts of the current study is potentially pertinent and should be included as an objective.*	Objective 4 of the FERC-approved Study Plan pertained specifically to bears, whereas Objective 3 pertained to wolves. As was explained in Section 4.1 of the 2012 technical memorandum *Big Game Movement and Habitat Use Study* (AEA 2013), "...the telemetry locations and associated data from the SHP [APA Project] wolf and wolverine studies could not be located..., so the reports and publications describing those studies (summarized in ABR 2011) remain as the only sources of project-specific information on those species." Section 10.8.4.2 of the Study Plan stated that the study team will review and synthesize historical reports from the 1980s APA Project study, where possible, with data from other recent and current monitoring by ADF&G of wolves in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A. That review and synthesis will be included in the USR, and will be incorporated in the Evaluation of Wildlife Habitat Use (Study 10.19).
SRC_etal_WILDLIFE_ppWOLVES5_ph1	*...the ISR does not report on either Objective 1 or 3, but instead reports on trends in wolf numbers at much larger geographic scales (GMU or GMU Subunit). Further, the ISR makes no effort to evaluate current use by wolves of the impoundment impact area or the number of wolves in this area.*	The wolf survey flown in January 2015 had not yet been conducted at the time the ISR was prepared. Section 5.2 of the SIR for Study 10.8 reported that, "Within the GMU 13E survey area, a total of 6 groups of wolves were identified during the January 2015 aerial survey. Most of those groups were small, comprising two or three individuals, with one pack of 16 comprising the majority of the 27 animals directly seen in the subunit." All but two of those wolves were in or adjacent to the project area.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_WILDLIFE_ppWOLVES5_ph2	*[Recommendations] 1. Objectives 1 and 3 for wolves should not have been stated in the RSP/FSP if there was going to be no effort made to achieve them. ... We acknowledge that for wolves these objectives would be difficult to achieve given the current heavy hunting pressure on wolves throughout GMU 13. ... We recommend that the AEA acknowledge that Objectives 1 and 3 for wolves as currently stated are unattainable... We further recommend that an appropriately-sized wolf study area centered on the project area be identified and methods proposed to identify ways to determine project impacts on wolves in this area, or to propose some other way to mitigate for adverse project impacts on wolves. This should be identified as a significant variance from the…Study Plan.*	AEA disagrees with these recommendations. The study area is appropriately sized to meet the objectives. Section 5.2 of the SIR for Study 10.8 reported that, "Within the GMU 13E survey area, a total of 6 groups of wolves were identified during the January 2015 aerial survey. Most of those groups were small, comprising two or three individuals, with one pack of 16 comprising the majority of the 27 animals directly seen in the subunit." The survey area is depicted in Figure 4.2-2 of the SIR. Data from other studies, including the 1980s radio-telemetry study for the APA Project (Ballard et al. 1983, 1984), will be used to address Objective 3 in the USR.
SRC_etal_WILDLIFE_ppWOLVES5_ph3	*[Recommendations] 2. The wolf studies should have included an objective to synthesize the historical and current data on wolf movements and seasonal habitat and prey use in the Suitna[sic]–Watana project study area.*	Objective 3 of the FERC-approved Study Plan already incorporates this recommendation. As was explained in Section 4.1 of the 2012 technical memorandum "Big Game Movement and Habitat Use Study" (Prichard et al. 2013a), "...the telemetry locations and associated data from the SHP [APA Project] wolf and wolverine studies could not be located..., so the reports and publications describing those studies (summarized in ABR 2011) remain as the only sources of project-specific information on those species." Section 10.8.4.2 of the Study Plan stated that the study team will review and synthesize historical reports from the 1980s APA Project study, along with data from other recent and current monitoring by ADF&G of wolves in GMU Subunits 13A, 13B, 13E, 14B, 16A, and 20A. That review and synthesis will be included in the USR and will be incorporated in the Evaluation of Wildlife Habitat Use (Study 10.19).
SRC_etal_WILDLIFE_ppWOLVES6_ph2	*[Recommendations] 3. … Future study reports should be more precise about what constitutes a realistic study area for wolf impacts.*	AEA disagrees with this recommendation. The 2015 wolf survey was reported at the appropriate geographic scale to meet study objectives; see Figure 4.2-2 in the SIR for Study 10.8.
SRC_etal_WILDLIFE_ppWOLVES6_ph3	*[Recommendations] 4. ...future reports should include information on the number of wolves harvested in the geographic area that would be impacted by the proposed project and corresponding corridors and transmission lines.*	AEA disagrees with this recommendation. The analysis of wildlife harvest data, which will include wolves, will be reported in the USR for Study 10.20, which will follow the approach used in an earlier analysis conducted for that study, as reported in the 2012 technical memorandum *Past and Current Big Game and*

Reference Number	Comment or Study Modification Request	AEA's Response
		Furbearer Harvest Analysis (Prichard et al. 2013b).
SRC_etal_WILDLIFE_ppWOLVES6_ph4	*[Recommendations] 5. Neither the RSP nor the ISR have any objective associated with evaluating the impacts on wolves of the proposed roads and transmission lines…*	AEA disagrees. The study area includes the alternative corridors. The 2015 wolf survey was reported at the appropriate geographic scale to provide data supporting the evaluation of effects of proposed roads and transmission lines; see Figure 4.2-2 in the SIR for Study 10.8. For more information related to AEA's approach for including impact assessments in the License Application, please see Section 1.3.
SRC_etal_WILDLIFE_ppWOLVES6_ph5	*[Recommendations] 6. Nothing in the RSP or ISR identifies appropriate kinds or levels of mitigation for adverse impacts of the project on wolves.*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the License Application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
SRC_etal_WILDLIFE_ppWOLVES6_ph2	*[Recommendations] 8. Impact assessment studies should not be considered adequate unless study plans incorporate (including allocation of funds) post-project studies…*	The purpose of the licensing studies is to collect information that will be needed for comprehensive analyses of the Project impacts. The information generated in these studies will be used to prepare an impacts assessment, which will appear in the License Application, Exhibit E (Environmental Exhibit). AEA will propose protection, mitigation, and enhancement measures based on the effects analysis, and all such measures will be presented in the license application. Thus, it is premature at this time for AEA (or any other licensing participant) to propose or seek any particular license measure, including the post-Project monitoring studies proposed by SRC et al. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.

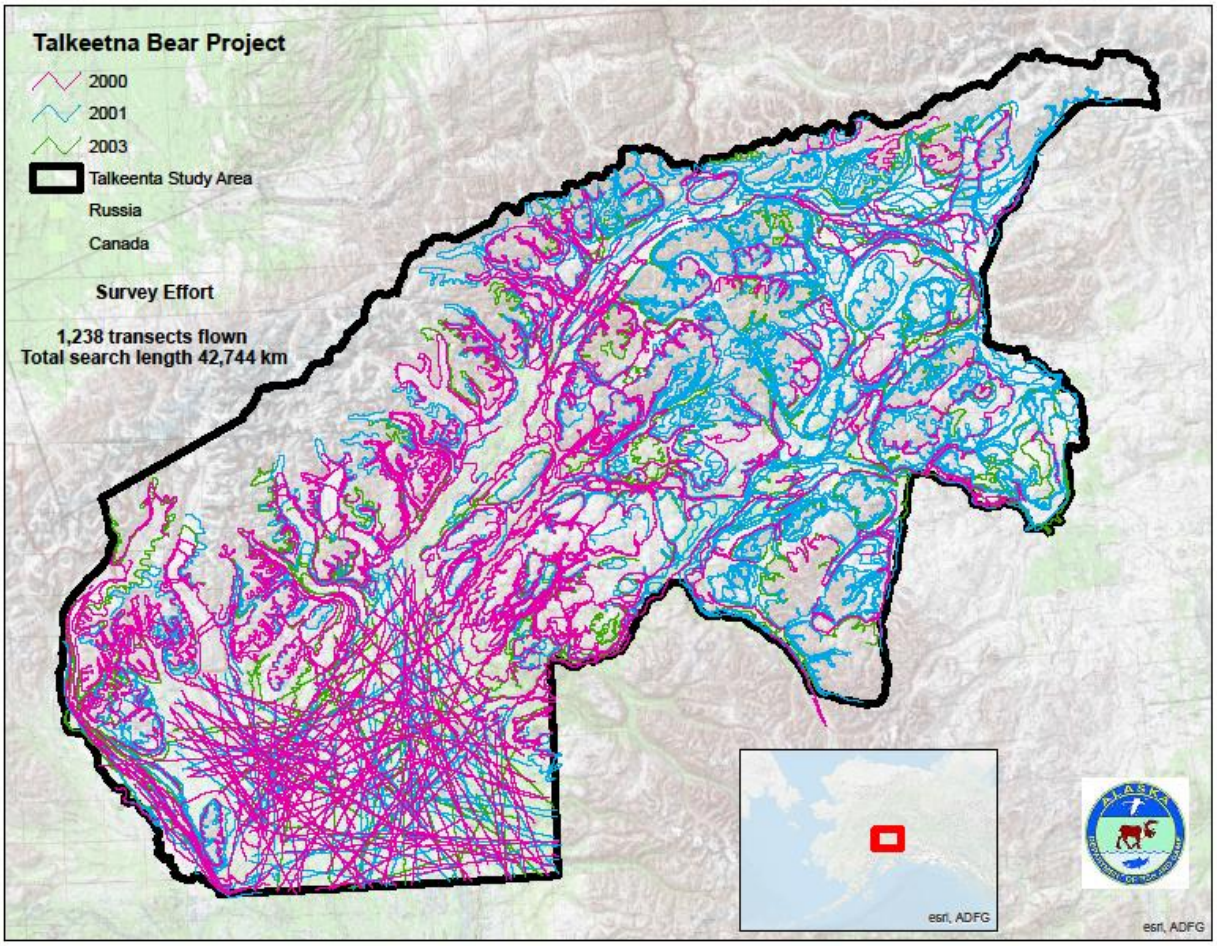


Figure 2.7.4-1 Transects sampled, by year (2000, 2001, 2003), in ADF&G's Talkeetna Study Area. Data from these transects were used to develop the MRDS and DSM models for Study 10.8.

2.7.4.1. Response to Modification Request for Additional Data Analysis

SRC et al. request that FERC require AEA to conduct additional data analysis using available data from the current study to evaluate abundance and density estimates that can be compared to Su-hydro studies conducted in 1980s (Reference Number SRC_etal_ WILDLIFE_pp14_ph5). SRC et al. assert that there are underlying biases and inaccuracies in the mark–recapture distance-sampling (MRDS) analysis, and that MRDS is not "consistent with generally accepted scientific practice." SRC et al. goes on to suggest that capture–mark–recapture (CMR), hair-snaring and DNA analysis, and/or resource selection function (RSF) analyses (based on data from radio-marked bears) are all appropriate techniques that should be considered to provide useful information for evaluating Project impacts on bears. Depending on the techniques used, SRC et al. suggest this modification would require 2–4 additional years of study.

For the reasons explained below, AEA requests that FERC not adopt these proposed Study Plan modifications. FERC approved the MRDS method when approving this Study Plan. SRC et al. have failed to show any "good cause" (per 18 CFR 5.15(d)) as to why the Study Plan should be modified to address these groups, as these commenters have not established that the FERC-approved study was not implemented as provided by the approved Study Plan or under anomalous conditions (per 18 CFR 5.15(d)). As explained in AEA's RSP, the MRDS method is generally accepted in the scientific community and is sufficient for FERC to evaluate Project effects and to identify potential protection, mitigation, and enhancement measures. The methods proposed in this comment are not needed to meet the FERC-approved Study Plan objectives. The estimated cost of implementing these modifications is $600,000–$750,000, depending on the size of the radio-collared sample and the downstream extent of the study area, in addition to the $75,000 annual cost for additional hair-snag sampling and DNA analysis.

MRDS is a statistical modeling technique that combines distance sampling and mark–resight data into a single analysis to obtain a population estimate. The idea is that combining the two methods gets the "best" out of each method to create a superior population estimate. One can think of the MRDS model as having two submodels, a multiple-covariate distance-sampling model (MCDS) and a mark–resight model (MR). The MRDS estimate, when converted to density, is the average bear density in the study area; for spatially explicit inferences, such as estimating the effect of habitat loss and disturbance, an additional density surface model (DSM) is needed.

MRDS modeling is a proven and well-established method for estimating animal population size (Laake and Borchers 2004, Borchers et. al 2006, Buckland et al. 2015). SRC et al. asserts, without offering any proof, that MRDS methods are biased. Laake (1999) conducted tests of several techniques on a known population and concluded that MRDS models with point independence (the model used in this study) were essentially unbiased and outperformed the other estimators (see supplement, Section 2.7.4.11, below). The MRDS model used in this study is "pooling robust" (Buckland et al. 2015) and will give generally unbiased estimates, even if important covariates were to be excluded from the MRDS model. On the other hand, the CMR method will be biased and will suffer from an inability to handle heterogeneity in capture probabilities; the inability of simple mark–recapture estimators, such as CMR, to handle heterogeneous capture probabilities results in major biases (Link 2003).

Obbard et al. (2015) used MRDS methods to estimate the abundance of the southern Hudson Bay population of polar bears. The Alaska Department of Fish and Game has used MRDS methods to estimate black bears in GMU 16B (Becker and Christ 2015), and brown bears in GMUs 10, 9D, 13A, 13B, 26, 9A North, and 9B South (Becker, in prep.).

The comments by SRC et al. repeatedly make the incorrect assertion that the MRDS method is being used to make inferences about carrying capacity. As indicated in the FERC-approved Study Plan (RSP Section 10.8.2.1), the focus of this study component is to estimate bear populations and not the carrying capacity of the habitat. The density surface maps display predicted number of black bears per km^2 (ISR 10.8 Part A, Sections 5.1.1.1 and 5.1.1.2).

As is shown in the supplement (Section 2.7.4.11) below, this model is a superior estimator. Relative to the CMR, there are indeed implicit assumptions about independence of bears when a population estimate is calculated. For example, the mathematical assumption is the bears are independently captured. The calculation of a population estimate (total bears) in the CMR method has not been calculated in a statistically valid fashion. For instance, a radio-collared sow with two cubs is not the same as three radio-collared bears, but that is how they are treated in the CMR method to obtain population estimates. One cannot have three radio-collared bears with one radio collar. It is a collared group of three bears but it is not treated mathematically as such. In addition, the CMR technique cannot model individual capture heterogeneity. Link (2003), in a landmark paper, notes the extreme difficulty that unmodeled heterogeneity creates for obtaining valid population estimates with mark–recapture estimators. The estimates generated for the Large Carnivore Study are pooling robust and do not suffer from this problem (Buckland et al. 2015). CMR offers no spatially specific information that is critical for determining which Project access alternatives would have less impact, whereas the DSM offers an appropriate statistical and spatial framework for these inferences. If future changes in Project design change the impact area, the size of the population potentially being affected can easily be recalculated; in contrast, the other methods (CMR and hair-snaring DNA studies) have fixed study areas and use average density values, so they cannot be adjusted correctly. The use of resource selection functions would not allow for an estimate of the number of bears impacted by the Project, so that technique is inappropriate for this purpose.

The black bear MCDS model (Figure 2.7.4-2) contains the covariates search distance (on the natural log scale; Figure 2.7.4-3) and pilot search type (Figure 2.7.4-4). Search distance is a GPS-measured distance of how far out the observers were searching at the location where the bear was detected. Pilot search type is binary data (0 or 1) and depicts if the pilot had a regular or long search type, respectively; a few of the pilots searched farther out than most, so for them Pilot Search = 1. The black bear MR model contained the following covariates: observer type (0 = pilot, 1 = backseat observer); a cubic spline regression on distance to the bear; percent vegetative cover (percent cover within 10 m of the bear divided by 20, to ensure computational accuracy); percent snow cover (percent snow within 10 m of the bear divided by 20, to ensure computational accuracy); Pilot_2Grp (denoting two groups of pilots [0 or 1], with the second group having higher mark–resight rates); and an interaction term between observer and Pilot_2Grp denoting the outcome of only pilot or observers seeing a bear group, which was a function of the relative abilities of the observers and pilots to detect bears. One would expect the observer recapture rate to be lower if a superior bear-observing pilot was conducting the survey rather than an average pilot.

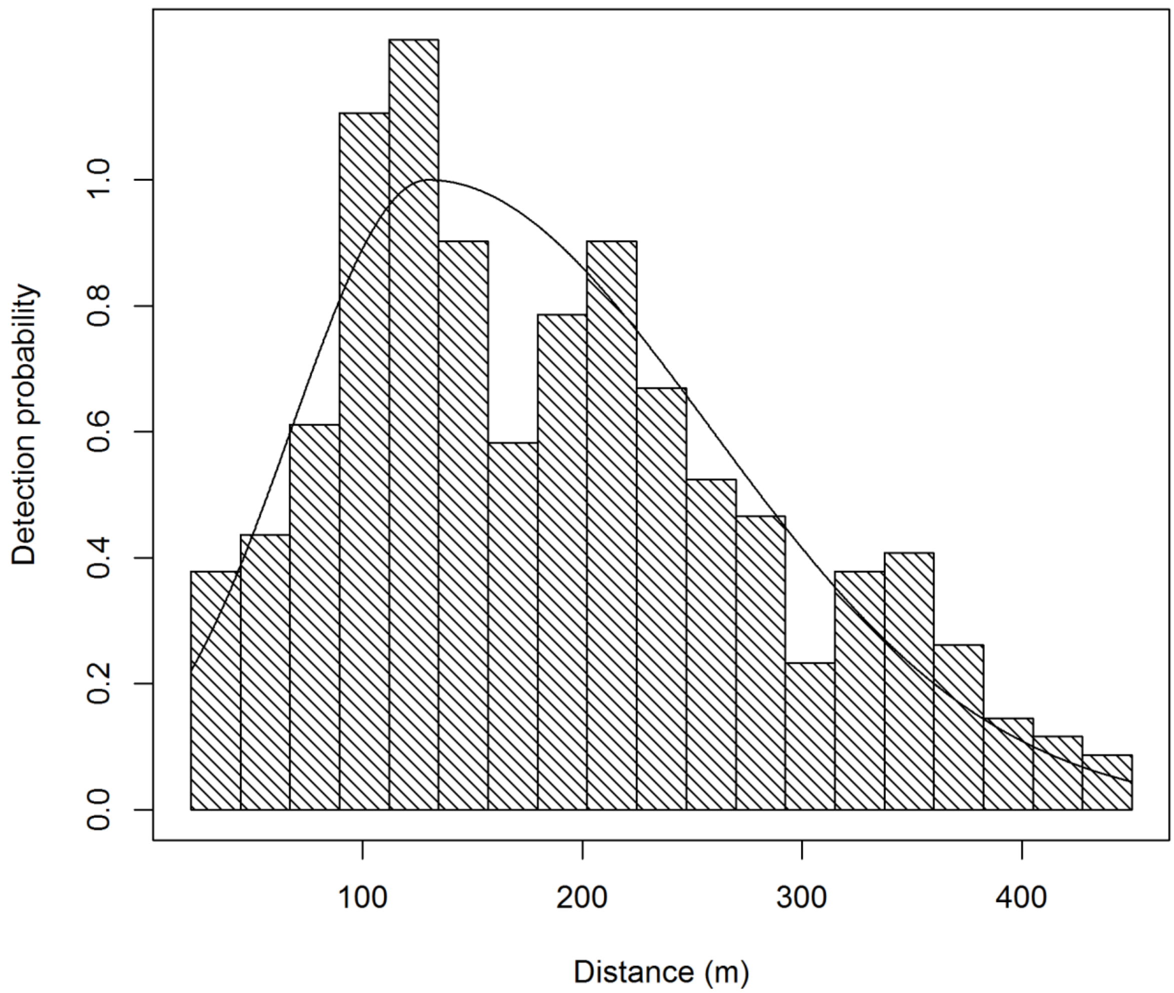


Figure 2.7.4-2 Average black bear detection for ADF&G's Talkeetna Study Area in 2000, 2001, and 2003. This graph uses the mean of the covariate values; i.e., the detection function is plotted using mean (ln(Search Distance)) and mean(Pilot Search Type) in the data set.

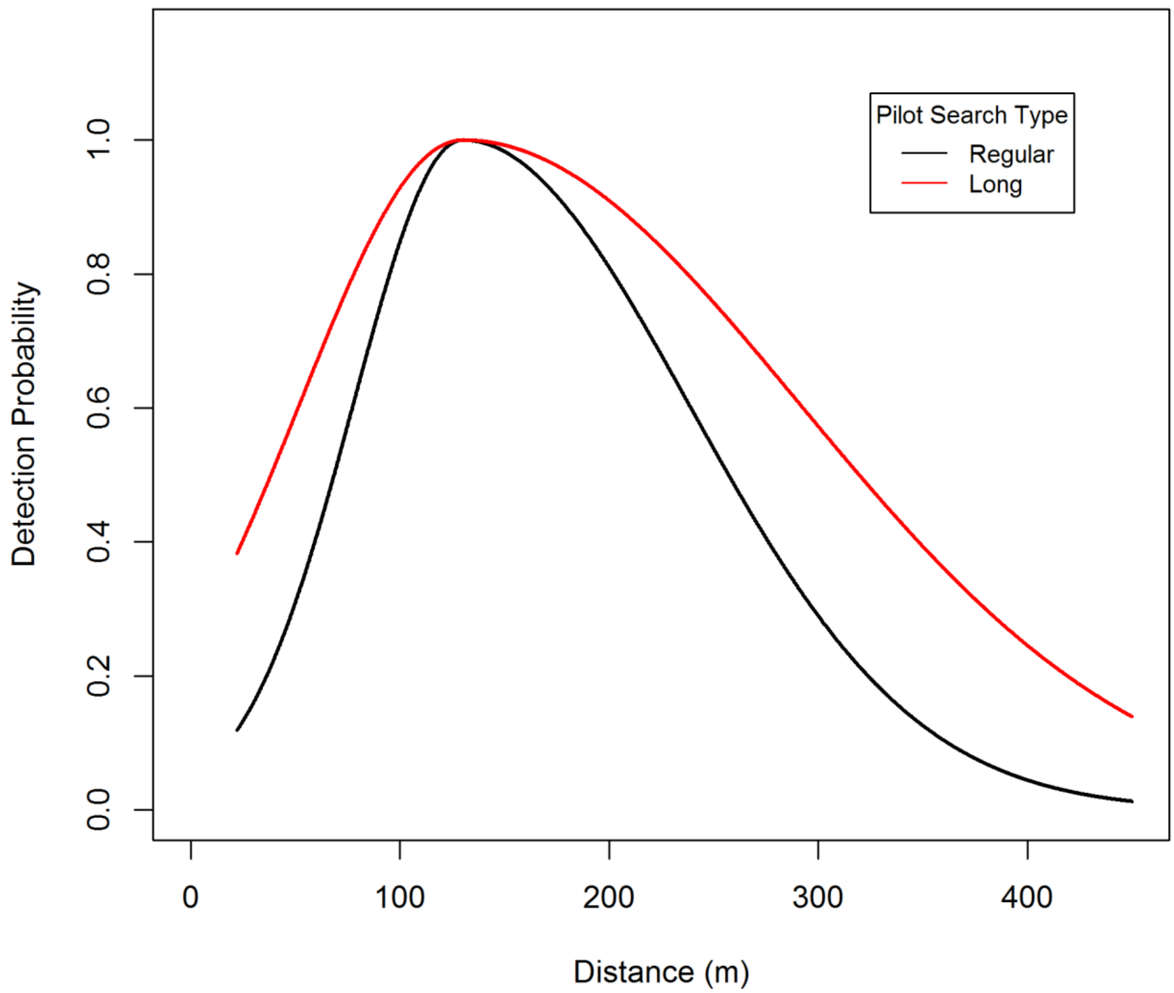


Figure 2.7.4-3 Black bear detection by pilot search type for ADF&G's Talkeetna Study Area in 2000, 2001, and 2003. This graph uses the mean (ln(Search Distance)) and plots the two different Pilot Search Types (0,1).

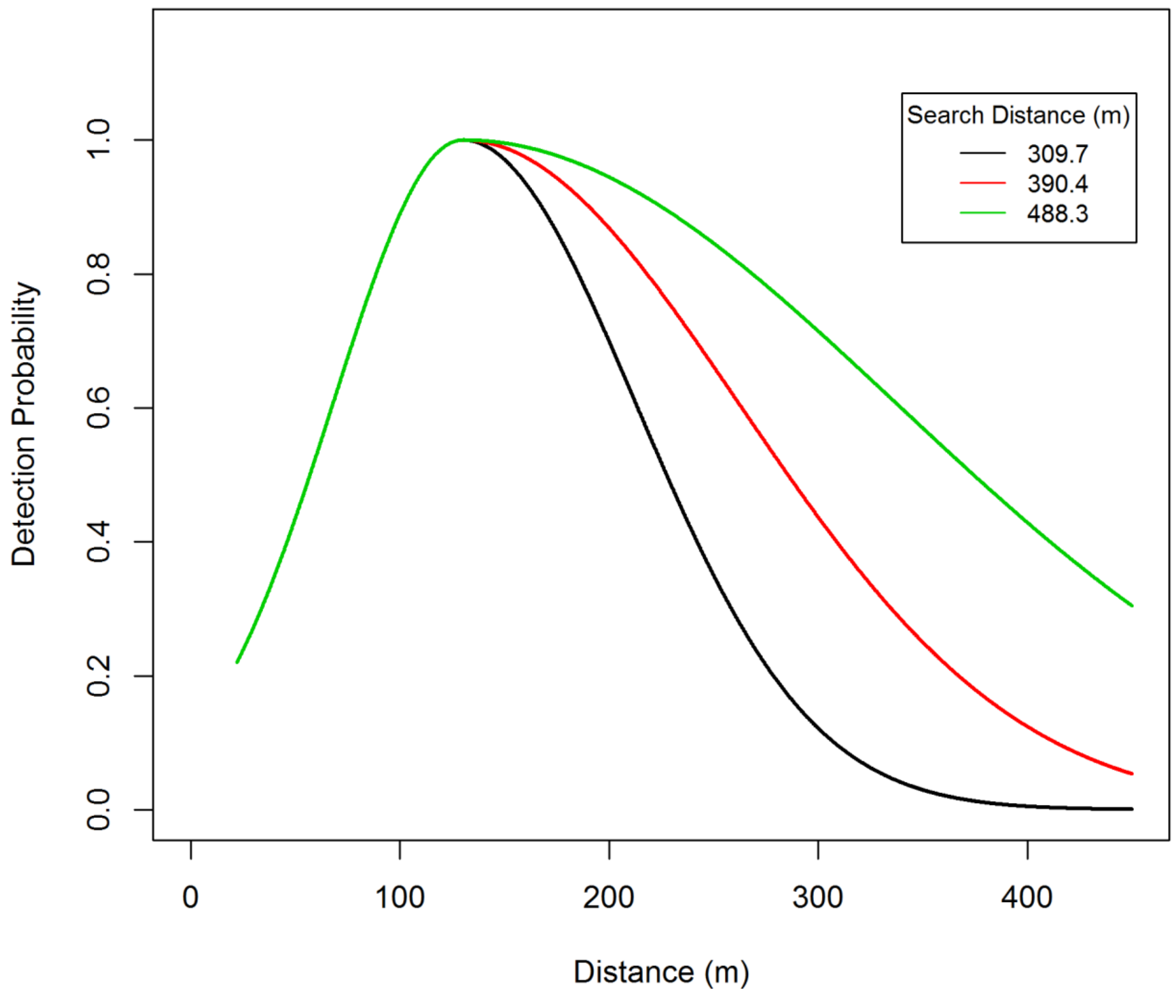


Figure 2.7.4-4 Black bear detection by ln(Search Distance) for ADF&G's Talkeetna Study Area in 2000, 2001, and 2003. This graph uses the mean (Pilot Search Type) and plots the 1st, 2nd, and 3rd quartiles for the observed ln(Search Distance).

The brown bear MCDS model (Figure 2.7.4-5) contains the covariate search distance (on the natural log scale; Figure 2.7.4-6). Search distance is a GPS-measured distance of how far out the observers were searching at the location where the bear was detected. The brown bear MR model contained the covariates observer type (0 = pilot, 1 = backseat observer), Pilot_3Grp (denoting three groups of pilots [0, 1, 3], with the third group having the highest mark–resight rates), and an interaction between observer and Pilot_3Grp, denoting the outcome of only pilot or observers seeing a bear group, which is a function of the relative abilities of the observers and pilots to detect bears. One would expect the observer recapture rate to be lower if a superior bear-observing pilot was the pilot, rather than an average one. The Pilot_3Grp was modeled on an ordinal scale with a single slope parameter, versus a parameter for each setting of the Pilot_3Grp variable.

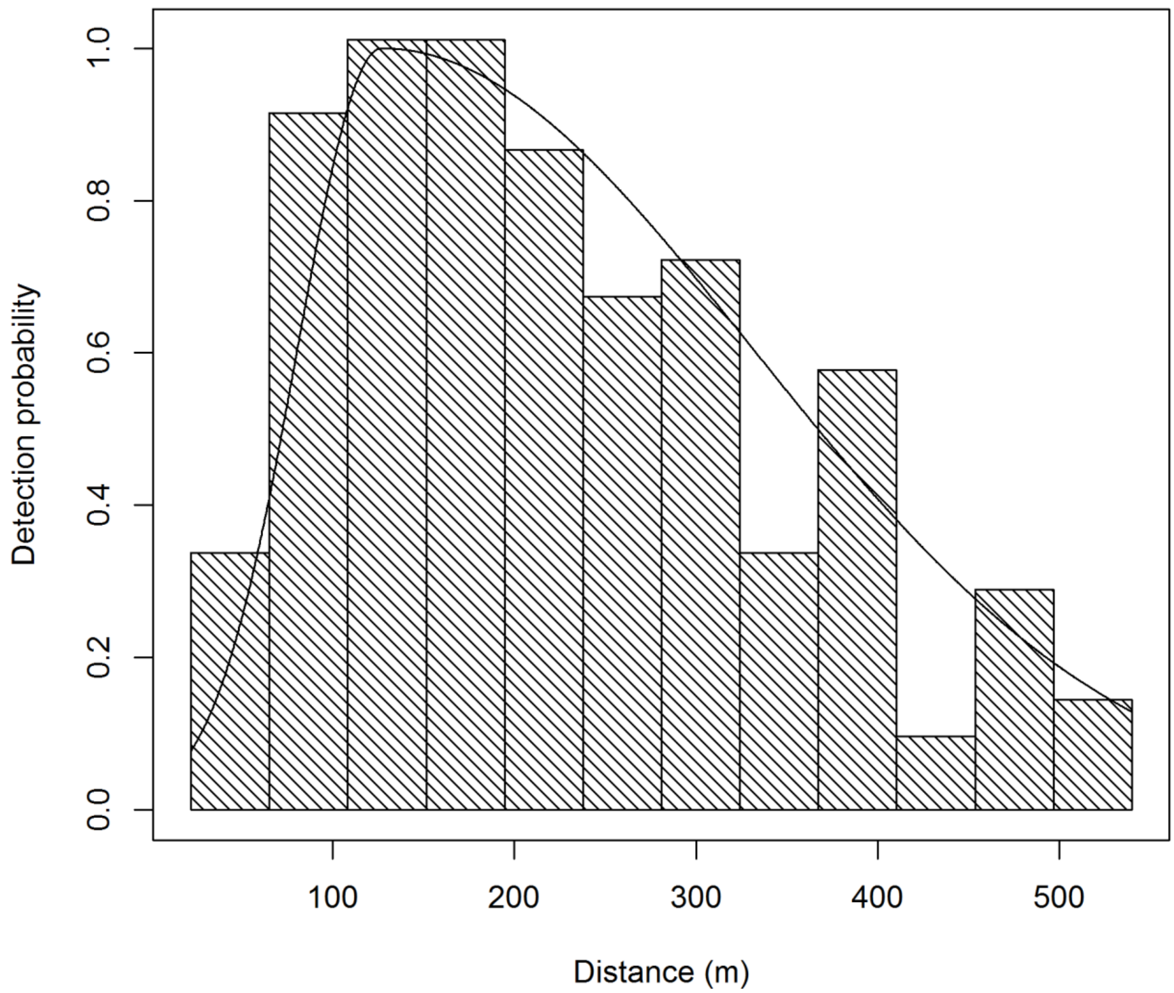


Figure 2.7.4-5 Average brown bear detection for ADF&G's Talkeetna Study Area in 2000, 2001, and 2003. This graph uses the mean of the covariate values; i.e., the detection function is plotted using mean (ln(Search Distance)) and mean(Pilot Search Type) in the data set.

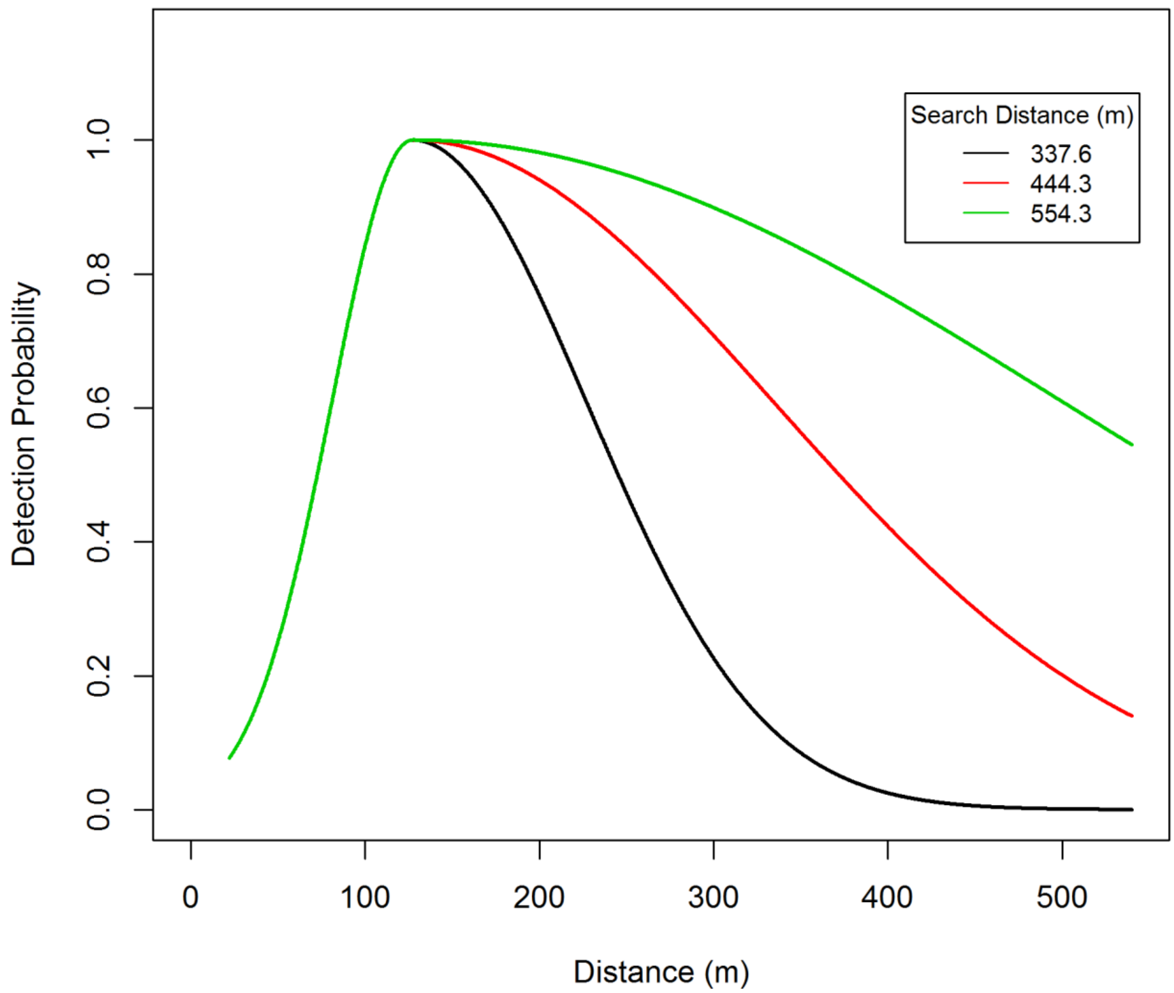


Figure 2.7.4-6 Brown bear detection by ln(Search Distance) for ADF&G's Talkeetna Study Area in 2000, 2001, and 2003. This graph uses the mean(Pilot Search Type) and plots the 1st, 2nd, and 3rd quartile for the observed ln(Search Distance).

The comments by SRC et al. repeatedly assert that there is an underestimation bias in the MRDS model. There is no bias, nor is there any reported or demonstrated underestimation. Laake (1999) demonstrated on repeated sampling of a known population the superior precision and lack of bias of the MRDS estimator that utilizes the point-independence assumption, like the one used in this analysis (see supplement in Section 2.7.4.11 below). Point independence eliminates the assumption of full independence between observers.

There were no "inaccuracies" in the data collection of analysis, nor have any such inaccuracies been documented. The previous black bear estimate (the "midSu" black bear study) was in the eastern part of the Large Carnivore Study Area, which is very low density black bear habitat compared to the western half. The midSu black bear study, using an estimator that did not meet the assumptions of independent data, estimated the density at 88.5 bears/1,000 km², while an

MRDS estimate for mid and northern GMU 16 used an MRDS model assuming point independence and estimated black bear density at 159.6 black bears/1,000 km². The western section of the study area includes northern GMU 16B; hence, the "high bear densities" are the result of better black bear habitat in the western half of this study area. The bivariate smoothing of the estimated black bear densities used in the DSM (ISR 10.8 Part A, Figure 5.1-2) also indicate low black bear densities in the eastern half of the study and much higher densities in the western half. The "calibration problem" alluded to by SRC et al. is in fact a failure of the commenters to account for the differences of scale between inferences over large study areas versus over a square kilometer.

Lack of independence poses an unresolved problem for the CMR method, which SRC et al. recommend, but it is not a problem for the models employed by this study, which used an MRDS model that assumes point independence (independent data observations at the apex of detection). The results of Laake (1999), which are summarized in the supplement below in Section 2.7.4.11, demonstrate that the MRDS method using the point-independence assumption (as was used in this study) generated unbiased estimates on a known population.

2.7.4.2. Response to Modification Request for Additional Bear Hair Sampling

SRC et al. requested that FERC modify the Study Plan to require AEA to complete additional years of hair-snag sampling, including sampling above Devils Canyon, noting that the effort should include the sample collection times relative to the timing of salmon use and bear molting (Reference Number SRC_etal_ WILDLIFE_pp10_ph3a).

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, SRC et al. have not established "good cause" for additional surveys or demonstrated the FERC-approved study objectives were not met by AEA's implementation of the Plan or that it was implemented under anomalous conditions. Moreover, the estimated cost of adding more years of bear-hair sampling for this modification is $75,000 per year, which is a consideration for FERC when evaluating proposed modifications to the Study Plan.

As described in the RSP Section 10.8, the Study 10.8 ISR Part A, and Section 4.1.2 of the SIR for Study 10.8, the hair-snag sampling was designed to obtain samples of bear hair for DNA analysis to quantify the minimum number of black bears and brown bears using the downstream area and for stable-isotope analysis to characterize the diets of those bears.

This study component focused on snagging hair samples at documented salmon spawning locations below the proposed dam site. The study team conducted surveys in 2013 and 2015 of bear use of anadromous fish-spawning areas in the Middle River and associated tributaries downstream from the proposed Watana Dam site to the confluence of the Susitna and Chulitna rivers to assess the use of those resources by bears in the Project area. The collection dates for bear hair sampling in 2013 are provided in Study 10.8 ISR Part A (Table 5.1-5) and the 2015 collection dates are listed in Table 5.1-1 of the SIR.

The timing of hair-snag deployment was designed to overlap with the majority of the salmon spawning that occurs in the study area. Growth of bear hair occurs from May through October but is variable and varies with nutritional status (Jacoby et al. 1999). Based on fishwheels operating near Curry, as reported in the SCR for the Salmon Escapement Study (Study 9.7; LGL and ADF&G 2015), movements of anadromous fish through the Middle River occur from early June to mid-July for Chinook Salmon (SCR Appendix Figure A-13), late July to early September for Chum Salmon (SCR Appendix Figure A-14) and Coho Salmon (SCR Appendix Figure A-15), mid-July to mid-August for pink salmon (SCR Appendix Figure A-16), and late June to early September for Sockeye Salmon (SCR Appendix Figure A-17).

Although not as many locations could be sampled in 2013 as planned, the downstream bear survey in 2015 obtained hair samples at 17 different locations between PRM 105.1 and PRM 152.3, as described in Study 10.8 ISR Part D, Section 6.2, and Sections 4.1.2, 5.1.2, and 6.1.2 of the SIR. In addition, the CIRWG land-access restrictions in 2013 did not cause an undue impact on the extent of sampling because very few salmon spawn above Devils Canyon, where most CIRWG lands are located.

Devils Canyon contains three impediments that may block or delay fish passage, as reported in the SCR for Study 9.7 (LGL and ADF&G 2015). Although small numbers of Sockeye Salmon pass the first impediment in the Canyon, Chinook Salmon are the only Pacific salmon ever documented above the Canyon (LGL and ADF&G 2015). In addition, spawning activity by that species above Devils Canyon is patchy, dispersed across several tributaries (Cheechako Creek, Chinook Creek, Devil Creek, Fog Creek, Tsusena Creek, and Kosina Creek) and with somewhat inconsistent use from year to year. The peak counts of Chinook Salmon observed in these streams during aerial surveys conducted during 2012–2014 were 40 in Cheechako Creek, 5 in Chinook Creek, 25 in Devil Creek, 3 in Fog Creek, 4 in Tsusena Creek, and 16 in Kosina Creek (SCR Table 5.3-5). Radio-tagging studies conducted from 2012 to 2014 showed that few salmon spawn upstream of all three impediments in Devils Canyon. Over the three years, a total of only 17 tagged Chinook Salmon were detected upstream of Devils Canyon (12 in 2012, 3 in 2013, and 2 in 2014; LGL and ADF&G 2015). Because so few salmon spawn above Devils Canyon, and those that do spawn there are widely distributed and inconsistently present from year to year, predictable concentrations of adult salmon are not present to attract bears. Therefore, concentrated use of anadromous stream locations by bears is also unlikely to occur. Potential spawning locations with so little use by salmon were considered unlikely to attract bears. Hence, the anadromous fish-bearing tributaries between Devils Canyon and the proposed dam site (Cheechako Creek, Chinook Creek, Devil Creek, Fog Creek, Tsusena Creek), and Kosina Creek, the only potential spawning location upstream of the dam site, were not sampled for this study.

As SRC et al. correctly noted in their comments (Reference Number SRC_etal_WILDLIFE_ppBEARS8_ph1): "Brown bears in the immediate Susitna Dam impact area have interior diets without access to abundant salmon." Therefore, hair snags were not deployed upstream of Devils Canyon for this study. AEA concludes that the sampling distribution in 2013 and 2015 did provide a good sample of bear use of salmon spawning locations in the Middle River, so the proposed modification is unnecessary. The analytical results of the second year of the hair-snagging component of the study will be reported in the USR for Study 10.8.

2.7.4.3. Response to Modification Request to Include Radio-tracking Bears

SRC et al. have requested AEA to redesign the Large Carnivore Study to include radio-tracking of bears using GPS transmitters to permit determination of bear use of Project impact areas, like the studies conducted for caribou and moose in the Project area (Reference Number SRC_etal_ WILDLIFE_pp10_ph3b).

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. § 5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations, nor have SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Moreover, the cost of implementing this modification is estimated conservatively at $600,000–750,000, depending on the size of the radio-collared sample and the downstream extent of the study area, which is a significant consideration for FERC when evaluating proposed modifications to the Study Plan.

Furthermore, the information sought by SRC et al. will be produced through the other methods already planned in the FERC-approved Study Plan. Habitat use information from the 1980s APA Project studies and other, more recent studies in southern and interior Alaska will be used in the Evaluation of Wildlife Habitat Use (Study 10.19) and during the impact assessment that will be included in the License Application and FERC EIS. The riparian vegetation mapping area, extending from the dam site downstream to PRM 29.5, will also be included in that evaluation. The existence of ample data on bear habitat use and movement and the fact that much of the study area is in an intensive management area with liberalized hunting regulations for large carnivores made it both unnecessary and unfeasible, respectively, to conduct additional radio-collaring of bears for this study.

Finally, this aspect of the study design was discussed with licensing participants during the extensive collaborative process for developing the Study Plan with federal and state resource agencies and other licensing participants. Having demonstrated no good cause for changing course at this juncture after successful implementation of the FERC-approved Study Plan, SRC et al.'s proposed modification should be rejected as untimely as well.

2.7.4.4. Response to Modification Request for Additional Density Studies during the Summer and Fall Months

SRC et al. request FERC to require AEA to conduct additional density studies during the summer and fall months, as well as to incorporate density estimates from the hair-snag study component to accurately estimate the density of bears in the Project area (Reference Number SRC_etal_WILDLIFE_pp12_ph4).

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. § 5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations, nor have SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Moreover, the cost of implementing this modification is estimated at approximately $75,000, which is a consideration for FERC when evaluating proposed modifications to the Study Plan.

The second objective of the FERC-approved Study Plan (RSP Section 10.8.1) was to "evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may be altered by the Project." As described in RSP Section 10.8.4.1.2, the downstream bear survey was designed to estimate the minimum number of bears using salmon spawning locations along the Middle River and to characterize the diets of these bears. This technique detected bears that were using the locations sampled, had hair snagged on snares, and for which hair was successfully analyzed with DNA identification techniques. According to the RSP Section 10.8.4.1.2, downstream sampling was planned to occur in "mid to late summer in 2013 and 2014 to coincide with the timing of spawning runs of salmon." Hair snags would be "deployed along salmon spawning streams in the Susitna River drainage downstream from the dam site and upstream from Talkeetna, extending up tributary drainages that support spawning runs of anadromous fish…," based on the expected densities of bears, logistical considerations for access to the area, and comparison with similar studies in central Alaska."

Because this study component was not designed to obtain an estimate of overall bear density for the Middle River, the data obtained from it are not suitable for comparison with the density estimation produced by the MRDS and DSM modeling exercises to fulfill Objective 1 of the FERC-approved Study Plan (RSP Section 10.8.1). Generating a DNA-based density estimate would have required a much broader study area with more intensive sampling, which was not part of the FERC-approved Study Plan.

2.7.4.5. Response to Modification Request to Redesign Study Area

SRC et al. make several requests for the Large Carnivore Study to be redesigned to permit direct estimation of the number of bears in the area likely to be impacted by the proposed impoundment, rather than the current study area, which is approximately 20 times larger (Reference Number SRC_etal_WILDLIFE_pp15_ph4). SRC et al. assert that the method in the FERC-approved Study Plan (i.e., MRDS) does not provide an abundance or a density estimate for either species of bear in the area that will be impacted by the impoundment.

AEA requests that FERC not adopt this recommendation, as it is unnecessary. SRC et al.'s proposed modification is already part of the FERC-approved Study Plan.

AEA developed a population estimate for brown bears and black bears using the methods described in RSP Section 10.8.4.1 over the study area described in RSP Section 10.8.3. Nonetheless, the comment by SRC et al. shows a lack of understanding of the model output. The Density Surface Model (Miller et al. 2013) allows for the estimation of spring black and brown bear population size on a square-kilometer basis, so for any delineated impact area a population estimate of impacted bears can be calculated. The bear DSM estimates and confidence intervals are adequate for this task. A population estimate can be established using the MRDS technique for any area within the existing study area as access and transmission line alternatives are developed.

2.7.4.6. Response to Modification Request Related to Use of CMR Method Instead of MRDS Method

SRC et al. have requested that FERC require AEA to conduct additional data collection consistent with the capture–mark–resight (CMR) method (Miller et al. 1997), which would use all bear sightings in calculating the population and density of bears in the study area (Reference Number SRC_etal_WILDLIFE_pp17_ph4).

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. § 5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations, nor have SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. In fact, SRC et al.'s proposed modification is not based on AEA's implementation of the study at all, but rather seeks to revisit FERC's original Study Plan determination itself, without any reference to the substantial work AEA has already completed pursuant to the FERC-approved Study Plan, and to supplant the already approved methodologies with a methodology that SRC et al. would prefer. Because the purpose of the ISR process is to evaluate AEA's progress in meeting Study Plan objectives through the methods implemented to date, this proposed study plan modification should be rejected as beyond the scope of the ISR process.

After significant consultation by AEA with federal and state resource agencies and other licensing participants, FERC approved the MRDS method when approving this Study Plan. As explained in RSP Section 10.8 and the SIR for Study 10.8, this method is generally accepted in the scientific community and is sufficient to produce information for FERC to evaluate Project effects and to identify potential protection, mitigation, and enhancement measures. For the record, AEA notes that the lead author of the 1997 CMR monograph was Sterling Miller, whom SRC et al. hired to review and critique the FERC-approved Study Plan and ISRs for several wildlife studies. Although Mr. Miller has an understandable personal interest in applying the method that he was involved in developing, advances in population sampling methods over the two decades since that CMR monograph was published have provided superior statistical techniques—such as MRDS—to use in estimating population density and abundance and in producing DSM models for estimating spatially explicit effects of development projects. In the years since Miller et al. (1997) published their CMR monograph, the MRDS method has largely supplanted the CMR method in Alaska.

The implemented MRDS method for estimating population brown bear and black bear populations was described in RSP Section 10.8.4.1 of the FERC-approved Study Plan. As explained in Section 2.7.4.1 above and shown in the supplement (Section 2.7.4.11) below, this model is a superior estimator to the CMR method. In contrast to the CMR method, the MRDS method has implicit assumptions about independence of bears when a population estimate is calculated. The CMR method offers no spatially explicit information, which is critical for determining which access corridors would have less impact on bears, whereas the DSM developed for this study offers an appropriate statistical and spatial framework for these inferences.

Finally, implementing the modification proposed by SRC et al. would be very costly. Instead of using the existing population survey data that was incorporated in the FERC-approved Study Plan (RSP Sections 10.8.1 and 10.8.4.1.1), implementing the CMR method for this study would require that a large sample of bears of each species would need to be radio-collared and tracked for several years. AEA estimates that implementing this modification—an inferior method as explained herein—would, conservatively, cost $600,000–$750,000. As costs are a significant consideration when FERC evaluates proposed study modifications, there is no basis for approving SRC et al.'s proposal.

For these reasons, the CMR method proposed in this comment is not needed to meet the FERC-approved Study Plan objectives, and FERC should deny SRC et al.'s proposed modification.

2.7.4.7. Response to Modification Request for a Different Presentation of the MRDS Density Estimates

SRC et al. commented that a more valuable way to portray the results of the MRDS and DSM density estimates for black bears and brown bears would be to build tables showing the number of 1-km² cells in different density categories (Reference Number SRC_etal_WILDLIFE_pp18_ph 3). The tabular data could be used to derive density estimates for a subportion of the Large Carnivore Study Area surrounding the proposed impoundment or the 1,317-km² study area in which bear abundance and density were estimated in the 1980s APA study. They contended that this approach would be a useful test of the validity of the results generated by the MRDS technique used in this Project and reported in ISR 10.8 Part A.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. § 5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations, nor have SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The types of data produced by spatial density modeling do not lend themselves to tabular output or interpretation. For example, because the study area was 21,528 km², creating a density estimate for each km² would create a table so large and complex that it would be incomprehensible. The science of statistics has developed graphical methods to display complex data so that scientific results can be comprehended and insights gained from the analysis. For this reason the bear population analysis results are displayed using a density surface map. The commenters' suggestions for creating a variance estimate from tabular data are statistically invalid. AEA agrees that an estimate of the impact area is valuable, and the DSM model can provide a statistically valid estimate for whichever impact areas are delineated for further analysis. By estimating a larger area than any conceivable impact area, statistically valid population estimates can be generated for each bear species. The flexibility of this approach is a useful feature if Project footprints were to change in the future, which would not cause a problem for the approach used in this study.

2.7.4.8. Response to Modification Request to Conduct a Power Analysis

SRC et al. commented that, if the experimental MRDS approach continues to be employed in the Susitna–Watana Project impact assessment studies, power analyses must also be conducted to determine what level of change would be detectable utilizing a subsequent application of the approach (after dam construction) in the same study area (Reference Number SRC_etal_WILDLIFE_pp20_ph 1).

AEA disagrees with this comment. As is explained in Section 2.7.4.1 above, the MRDS method is not an "experimental approach." Power analysis is intended to strengthen one's ability to detect changes through statistical testing. Conducting a power analysis is not necessary to complete the objectives in the FERC-approved Study Plan, however, because post-construction monitoring is not part of the Study Plan. The purpose of this study was to document current bear densities. If the study is repeated in the future and change detection is an objective, then power analysis could be conducted at that time.

2.7.4.9. Response to Modification Request to Conduct a Sensitivity Analysis

SRC et al. have requested that AEA conduct a sensitivity analysis of the MRDS results to evaluate the impact of not observing a subset of randomly selected bear groups on the estimates of bear population sizes (Reference Number SRC_etal_WILDLIFE_pp20_ph 2). The same kind of sensitivity analysis should be done to evaluate the impacts of having seen additional groups.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. § 5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations, nor have SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

This proposed modification by SRC et al. is inappropriate and therefore unnecessary. Sensitivity analyses are not conducted for distance-sampling models, including MRDS models, because all of the relevant information is available from the model results. An estimated Horvitz–Thompson inclusion probability is calculated for each bear group; the contribution of that group to the estimate of the number of bears in the searched area is calculated as group size divided by the estimated inclusion probability. The estimated inclusion probabilities are model outputs, so the effect of removing any single or group of bears can readily be determined. Taking bear group observations out of the dataset in a sensitivity analysis will lower the population estimate, to a very small degree. For instance, removing a group of 2 bears with a detection probability of 0.4 will reduce the number of bears in the search areas (20,996.8 km^2) by 5 bears (2 divided by 0.4), so the density would be reduced by 5 divided by 20.9968 = 0.24 bears/1,000 km^2, which is negligible. This calculation can be done for any bear groups observed.

2.7.4.10. Response to Comment on Bear Density Models

FERC made the following request (Reference Number FERC__ppA-7_ph4):

> *Sections 5.1.1.1 and 5.1.1.2 of the ISR describe smoothing functions generated for environmental variables (elevation and slope/aspect interaction for black bears; x and y coordinates, distance to salmon spawning location, slope, and non-vegetative habitat for brown bears). However, the discussion of the density surface model (DSM) fit diagnostics is limited to the reporting of the deviance explained by the final model (38.1 percent for black bears and 14.6 percent for brown bears). Your discussion of the DSM is not sufficient to evaluate the study results and the validity of the model. For example, it is not clear whether additional variables were considered but excluded from the final models, or whether all listed variables were*

> *included. The discussion of the methods for model generation are also limited and do not indicate whether generation of the DSM used training, testing, and validation data sets or whether the DSM was generated using all available data. It is also not clear how you derived the final population estimates from the model. The model is based on three years of survey data, but the study report does not indicate whether each survey covered the entire study area, or, if not, to what extent the surveys spatially overlapped. Because three years of survey data were incorporated into the model, please clarify how the final population estimates account for potential duplicate observations of bears over the three year survey period. In summary, please provide in the USR additional information related to DSM generation, selection of independent variables used for smoothing functions, model validation, and methods for population estimates from the model results. Please provide tables with the generalized cross validation score, percent deviance explained, and estimated degrees of freedom for each independent variable or interaction included in the final model.*

To clarify, the population estimates were not based on the DSM but rather on the MRDS model. The intended use of the DSM is to estimate impacts on specific portions of the study area from development of the proposed Project. Because exact Project footprints have not yet been finalized and impact buffer zones been not been selected, no DSM-based impacts were calculated for the ISR or SIR. The population estimate is a weighted average of the 2000, 2001, and 2003 surveys; transects were surveyed throughout the study area each year. Counting duplicate bears is not a concern because the population estimates are based on estimated density in the surveyed transect strips. Some transect strips did overlap with those from previously surveyed transects, but that is not a problem because the area was summed and all observed bears were used in the calculations. If the number of bears were knowable within the strips, the correct density value would be to sum up the number of bears in each strip (including supplicates) and divide by the sum of strip areas. The density calculations followed similar logic.

All data were used to fit the DSM, so no cross-validation of the model was done. Many biologists like to reserve some of their data for cross-validation; the advantage of that approach is that a better estimator of the predictive power of the model is obtained. Cross-validation has a hidden cost, however: when one does not use all of the data to fit the model, then the model fit is poorer, as is the predictive ability of the model. The study team concluded that, for this study, it was more important to fit the best model that the data would allow, rather than worrying about potential bias in the estimate of the predictive ability of the model. To fit the best model required all of the data. Biologically, the best estimates of bear abundance and density in portions of the study area are of interest, so the team concluded that it was not worth sacrificing model fit to cross-validation.

DSM modeling for each bear species assumed a negative binomial distribution and a Tweedie distribution (Wood 2006); the negative binomial distribution gave the best fit for both bear species. The potential explanatory variables included the following: x-y univariate coordinate smooth, bivariate x-y coordinate smooth, slope, aspect (cyclic smooth), slope by aspect interaction, elevation, distance to road, distance to salmon stream, distance to salmon spawning site, and vegetation class (dwarf shrubland, herbaceous–forbland, herbaceous–grassland, herbaceous–shrub steppe, non-vegetated, open tree canopy, and shrubland). Model selection was based on Akaike information–theoretic criteria (AIC; Burnham and Anderson 1998). Standard model-fit diagnostics were used, such as normal q-q plots and residual analysis. Model fitting used the R-package ‘dsm’ (Miller et a. 2015). Due to the high incidence of zero bear sightings in transect segments, no data were saved for model validation.

Model outputs for the best DSMs are presented below in Figures 2.7.4-7 (black bears) and 2.7.4-9 (brown bears), and DSM diagnostics are presented in Figures 2.7.4-8 (black bears) and 2.7.4-10 (brown bears).

```
k2 <- 40
bl.dsm.nbopt.nv.xy.te <- dsm(Nhat~ s(x,y,k=k2)+
                      #s(salmon.dist,k=k1)+
                      #s(spawn.dist,k=k1)+
                      #s(slope,k=k1)+
                      s(elev,k=k1)+
                      #s(aspect,k=k1)+
                      te(slope,aspect,k=c(kte,kte),d=c(1,1),bs=c("tp","cc")),
                 bl.ddf, segments, obs.bl,
                 family=negbin(theta=0.005087588),
                 method="REML",select=TRUE,segment.area="area")
summary(bl.dsm.nbopt.nv.xy.te)
```

Figure 2.7.4-7. Model output from the best density surface model for black bears.

```
##
## Family: Negative Binomial(0.005)
## Link function: log
##
## Formula:
## Nhat ~ s(x, y, k = k2) + s(elev, k = k1) + te(slope, aspect,
##     k = c(kte, kte), d = c(1, 1), bs = c("tp", "cc")) + offset(off.set)
## <environment: 0x1360c7240>
##
## Parametric coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)    -18.3        0.2   -91.3   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Approximate significance of smooth terms:
##                    edf Ref.df Chi.sq p-value
## s(x,y)           20.62     39   91.5 7.3e-14 ***
## s(elev)           2.08      9   78.0 < 2e-16 ***
## te(slope,aspect)  6.04     29   44.0 2.9e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## R-sq.(adj) =  -0.0109   Deviance explained = 38.1%
## REML score = 2278.2  Scale est. = 1         n = 43838
```

```
gam.check(bl.dsm.nbopt.nv.xy.te)
```

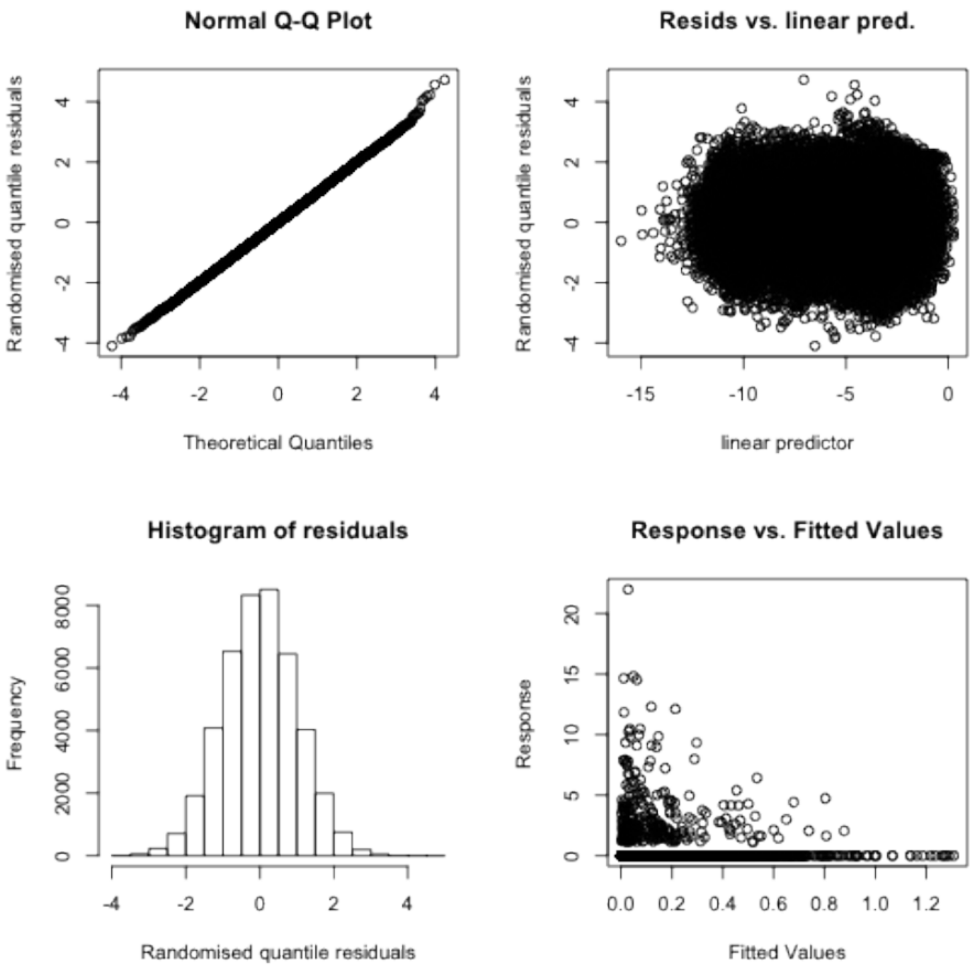
Figure 2.7.4-7 (continued). Model output from the best density surface model for black bears.

Check plots for model `bl.dsm.nbopt.nv.xy.te`

```
##
## Method: REML   Optimizer: outer newton
## full convergence after 13 iterations.
## Gradient range [-0.0008277,0.0002151]
## (score 2278 & scale 1).
## Hessian positive definite, eigenvalue range [7.67e-05,3.596].
##
## Basis dimension (k) checking results. Low p-value (k-index<1) may
## indicate that k is too low, especially if edf is close to k'.
##
##                       k'    edf k-index p-value
## s(x,y)            39.000 20.623   0.529    0.00
## s(elev)            9.000  2.083   0.536    0.00
## te(slope,aspect) 29.000  6.037   0.615    0.38
```

Figure 2.7.4-7 (continued). Model output from the best density surface model for black bears.

```
rqgam.check(bl.dsm.nbopt.nv.xy.te)
```



Randomised quantile check plots for model `bl.dsm.nbopt.nv.xy.te`

Figure 2.7.4-8. Density surface model diagnostics for the best model for black bears.

```
> summary(br.dsm.nb.rv.xy)

Family: Negative Binomial(0.001)
Link function: log

Formula:
Nhat ~ s(x, y, k = k2) + s(spawn.dist, k = k1) + s(slope, k = k1) +
    as.factor(rveg.mode) + offset(off.set)
<environment: 0x000000001762c9b0>

Parametric coefficients:
                              Estimate Std. Error z value Pr(>|z|)
(Intercept)                    -19.637      1.090  -18.01   <2e-16 ***
as.factor(rveg.mode)Vegetated    2.647      1.103    2.40   0.0164 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Approximate significance of smooth terms:
                  edf Ref.df Chi.sq  p-value
s(x,y)        0.01063     29  0.003  0.41905
s(spawn.dist) 2.13231      9 10.612  0.00277 **
s(slope)      3.80772      9 40.020 1.71e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

R-sq.(adj) =  -0.000568   Deviance explained = 14.3%
-REML = 1271.6  Scale est. = 1         n = 43838
>
```

```
> gam.check(br.dsm.nb.rv.xy)

Method: REML   Optimizer: outer newton
step failed after 9 iterations.
Gradient range [-0.003224778,0.0009709785]
(score 1271.574 & scale 1).
Hessian positive definite, eigenvalue range [3.746895e-05,1.279675].
Model rank =  49 / 49

Basis dimension (k) checking results. Low p-value (k-index<1) may
indicate that k is too low, especially if edf is close to k'.

                   k'    edf k-index p-value
s(x,y)        29.0000 0.0106  0.4397    0.96
s(spawn.dist)  9.0000 2.1323  0.3938    0.14
s(slope)       9.0000 3.8077  0.3845    0.03
>
```

Figure 2.7.4-9. Model output from the best density surface model for brown bears.

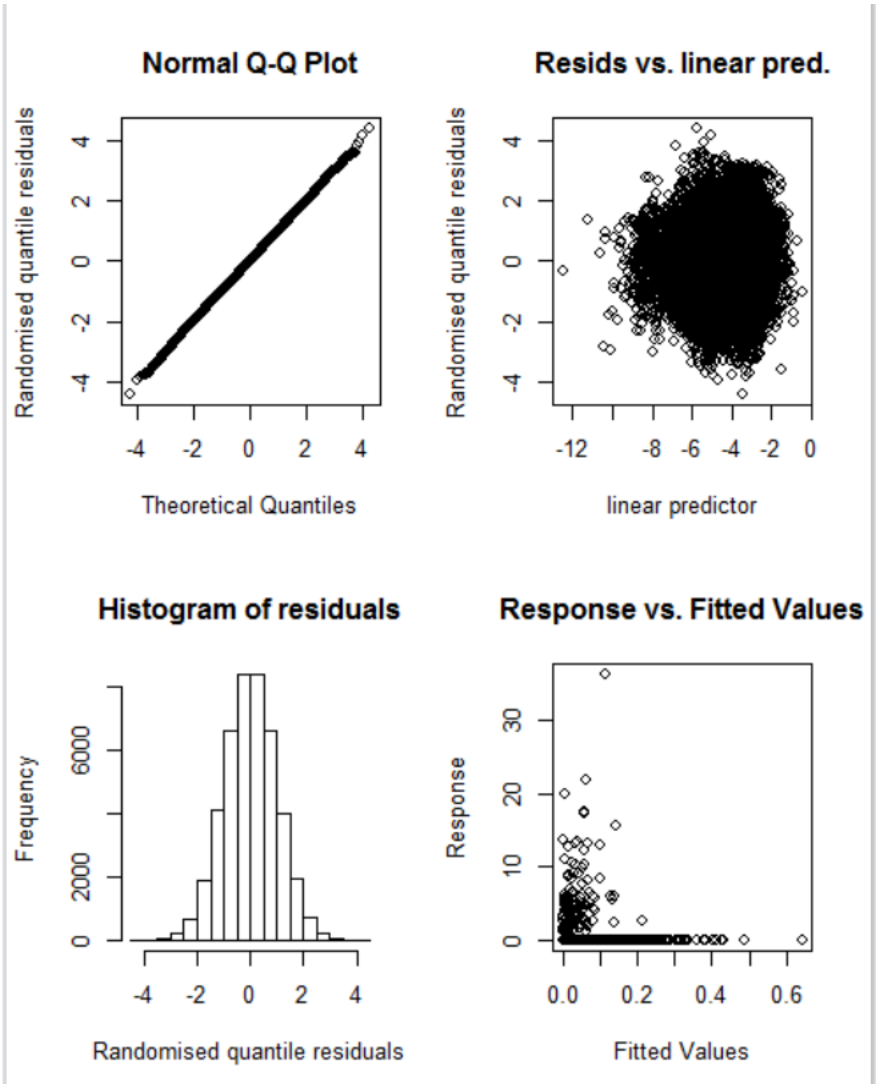


Figure 2.7.4-10. Density surface model diagnostics for the best model for brown bears.

2.7.4.11. Supplement: Evaluation of Three Population Estimators on a Known Population of 150 Wooden Stakes (Laake 1999).

Survey: Eight (8) observers independently surveyed a 1-km long transect and searched a 20-m strip of sagebrush on either side of the transect line for 150 wooden stakes that protruded 30 cm above the ground. The stakes were placed randomly in the 40-m by 1000-m study area.

Estimators: 1) Lincoln–Petersen mark–resight estimator.

2) Distance sampling with mark–resight, assuming full independence between observers.

3) Distance sampling with mark–resight, assuming point independence between observers (used to obtain bear population estimates for Study 10.8).

Note: Models 2 and 3 are MRDS models assuming full and point independence (Becker and Christ 2015), respectively.

Analysis: For 8 observers, 28 two-observer teams can be created. So, 28 point estimates were created with this analysis, and the reported means and standard deviations (SD) are based on these 28 estimates.

Results:

Parameter	1) Mark–Resight	2) MRDS – Full Independence	3) MRDS – Point Independence
True N	150	150	150
Range of N-hat	62–102	76–142	122–163
Mean (N-hat)	87	113	146
SD (N-hat)	10.76	17.85	11.10
CV (100×(SD/N-hat))	12.4%	15.8%	7.6%
Bias	–63 (–42%)	–37 (–24.7%)	–4 (–2.7%)

Conclusion: Distance sampling using mark–resight data and assuming point independence is the superior estimator.

2.7.4.12. References Cited

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2.7.5. Study 10.9 – Wolverine Distribution, Abundance, and Habitat Occupancy

As established in the Study Plan (RSP Section 10.9.1), the overall goal of this study is to collect pre-construction baseline population data on wolverines in the Project area (reservoir impoundment zone; facilities, laydown, and storage areas; access and transmission line routes) to enable assessment of the potential impacts from development of the proposed Project. This information will be used to estimate the number of wolverines that may be affected by the Project and to evaluate impacts on habitats used seasonally by wolverines.

The four study objectives are established in RSP Section 10.9.1:

- Estimate the current population size of wolverines.
- Establish a population index for wolverines.
- Describe the distribution of wolverines in late winter.
- Describe habitat use by wolverines in late winter.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA does not propose any modifications to Study Plan Section 10.9. AEA has met the study objectives and this study is considered complete. A Study Completion Report (SCR) was filed with FERC on November 6, 2015.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, a group of seven organizations (Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild

Salmon Center; referred to collectively herein as SRC et al.) filed comments for Study 10.9, including three identified proposals for study modifications. Of note, the SRC et al. comments included an analysis and recommendations from Sterling Miller which was limited to the June 2014 ISR and did not consider the Study Completion Report filed November 2015 which describes 2014 and 2015 data collection and analysis as provided for in the FERC-approved Study Plan. AEA's responses to these comments are presented below in Table 2.7.5-1, and further details concerning AEA's responses to the study plan modifications proposed by SRC et al. are discussed further in text immediately following the table.

Table 2.7.5-1. Study 10.9 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
SRC_etal_ WILDLIFE_ pp23_ph2	*Modification I. The Wolverine Study should be modified to require AEA to collect additional data to fill the data gap from the first study season. … FERC should require AEA to conduct at least one additional year of data collection to meet the study objectives. ... In the first year of wolverine studies, due to poor weather conditions, AEA was unable to conduct SUPE surveys, instead only conducting occupancy modeling surveys. We…propose that an additional year of SUPE surveys for wolverine be conducted to accomplish these population objectives.*	As explained below in Section 2.7.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification to conduct additional years of sample unit probability estimator (SUPE) surveys would be approximately $150,000 per year.
SRC_etal_ WILDLIFE_ pp24_ph2	*Modification II. The Wolverine Studies should be modified to require additional data collection to fill important data gaps in wolverine population studies. AEA reported two variances for the Wolverine Distribution, Abundance, and Habitat Occupancy studies in the Study Completion Report that limit the sample size of the study, and need to be addressed. Although AEA filed a Study Completion Report for Wolverine Distribution, Abundance and Habitat Occupancy, we propose that FERC require AEA conduct an additional year of SUPE studies to reconcile these variances with the approved study plan and meet the study objectives.*	As explained below in Section 2.7.5.1, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification to conduct an additional year of SUPE surveys would be approximately $150,000.
SRC_etal_ WILDLIFE_ pp24_ph5	*Modification III. The Wolverine Study should be modified to require additional data collection to address biases in the SUPE data and to use the proper model to assess the impacts of the proposed project on wolverine habitat. … We propose that FERC require AEA to conduct additional SUPE surveys to obtain adequate population baseline data for proper impact analyses… Additionally, because the SUPE and OM studies conducted by AEA offer little insight into the habitat use of wolverines outside of a limited number of winter days we propose that FERC require AEA conduct [sic] additional wolverine habitat surveys. .A good model for impact assessment studies for wolverine by ADF&G biologists was available in the ADF&G studies of Lewis et al. (2012) designed to evaluate impacts of a proposed road in southeastern*	As explained below in Section 2.7.5.1 (two consecutive years of SUPE surveys) and Section 2.7.5.2 (additional surveys to model wolverine habitat use), AEA requests that FERC not adopt these proposed study plan modifications. The estimated cost of implementing the modification to conduct additional years of SUPE surveys would be approximately $150,000 per year, for at least two *consecutive* years for additional SUPE surveys. The estimated cost of implementing the modification to undertake a 2–3-year GPS telemetry study of wolverines with accompanying resource selection function model analysis would be approximately $400,000–600,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	Alaska. This model is more appropriate to meet objectives of the current study on Susitna-Watana Dam impacts as it involved GPS-equipped wolverine to evaluate habitat use in the proposed impact area. For the aforementioned reasons, AEA should collect at least two consecutive years of SUPE data to fill important data gaps to ensure reliable baseline data and to evaluate project impacts.	
SRC_etal_ WILDLIFE_ ppWOLVE RINE2_ph4	*…The current study will add no new information on habitat use by wolverine in the project area although this is identified as an objective.*	See Section 2.7.5.2 below.
SRC_etal_ WILDLIFE_ ppWOLVE RINE2_ph5	*In order to evaluate project impacts on wolverine, it is necessary to show where wolverine are found relative to the proposed project.*	The commenters are referred to Figure 4-1 in the SCR for this information. Presentation of fine-scale location data is prohibited by Alaska statute (AS 16.05.815(d)(E)).
SRC_etal_ WILDLIFE_ ppWOLVE RINE3_ph3	*...a population index using OM (presence/absence) data collected during winter may be developed. The ISR does not describe any efforts to establish the relationship of this index to actual population size. Neither does the ISR indicate that power analysis will be used. … It is difficult…to determine how development of an index will inform AEA or FERC on the proposed project's impacts on wolverine. At a minimum, the pertinence of this index to the licensing of the project needs to be explained.*	The use of occupancy modeling to establish a population index was removed from the study; see Study 10.9 SCR Section 4.1.1.
SRC_etal_ WILDLIFE_ ppWOLVE RINE3_ph5	*Absent an explanation of how this objective [#3] will be accomplished with the OM and SUPE techniques described for this project, we conclude that this objective most likely will not be accomplished at a level of resolution that is pertinent to evaluation of impacts on wolverine of the proposed project.*	The use of occupancy modeling to establish a population index was removed from the study; see Study 10.9 SCR Section 4.1.1. The SCR explains that two methods were used to address the objective of describing the distribution of wolverines in late winter: the SUPE survey tracking and the ground tracking conducted for Study 10.10.
SRC_etal_ WILDLIFE_ ppWOLVE RINE4_ph1	*There is no indication of any techniques that will accomplish this objective [#4] in the FSP or ISR. Habitat use can best be described by radio telemetry studies and it is unfortunate that this study did not add to the habitat use data obtained using VHF collars by Whitman and Ballard (1984) by putting out some GPS collars on wolverine in the study area. The goal of the study as described is based on a habitat use evaluation so we conclude that the goal cannot be reached except to the degree that data obtained by Whitman and Ballard (1984) can be used. It is a failure of study design that the stated objectives for the wolverine study did not include integration of the earlier Whitman and Ballard (1984) results.*	Data from the SUPE survey flights allowed the study team to investigate habitat use by wolverines over the course of the movements represented by their tracks, which provided high-resolution habitat-use information, albeit for a relatively brief period of time. The addition of ground-tracking data gathered for the Terrestrial Furbearer Study (10.10) provided longer-term measures of late-winter use. The combination of these sources provides considerable information on habitat use, in addition to that reported for the study area in the 1980s (Whitman and Ballard 1984, Whitman et al. 1986), which was described in RSP Section 10.9.2 and was incorporated in Section 6 of the SCR.
SRC_etal_ WILDLIFE_	*Recommendation 1. Perform a power analysis on any trend index developed as part of these studies.*	The use of occupancy modeling to establish a population index was removed from the study; see Study 10.9 SCR Section 4.1.1.

Reference Number	Comment or Study Modification Request	AEA's Response
ppWOLVE RINE4_ph2		
SRC_etal_ WILDLIFE_ ppWOLVE RINE4_ph3	*Recommendation 2. Abundance estimates should be derived for a study area that is appropriately sized and situated for the area of likely impact of the proposed project on wolverine.*	Wolverines range over large areas and those inhabiting the wolverine study area are likely a high-density component of a larger metapopulation (Kyle and Strobeck 2001). Due to the large home ranges of wolverines in the study area (ranging from <100 to >600 km², averaging 535 km² for males and 105 km² for females; Whitman et al. 1986), the large spatial extent of the study area resulted in a larger sample size for more precise estimation of wolverine abundance and density. If deemed necessary by FERC for the impact analysis in the License Application, the spatially explicit SUPE survey results can be scaled down to an area smaller than the entire study area to derive reliable estimates of population abundance and density accordingly, but there is no compelling reason to do so. The scale of the wolverine study area was appropriate to meet the study plan objective for this wide-ranging carnivore.
SRC_etal_ WILDLIFE_ ppWOLVE RINE4_ph4	*Recommendation 3. It is essential that previous Su-Hydro wolverine studies (e.g., Whitman and Ballard 1984) be incorporated into the current study for the final report.*	AEA agrees; findings of this previous research has been incorporated and is presented in Section 6 of the SCR.
SRC_etal_ WILDLIFE_ ppWOLVE RINE4_ph5	*Recommendation 4. Neither the ISP nor the FSP have any objective associated with evaluating the impacts on wolverines of the proposed roads and transmission lines that will be built to support the proposed project (this is, however, identified as a "goal").*	In addition to the proposed reservoir and Project infrastructure, the study area included all alternative access and transmission corridors. The goal of the wolverine study plan is to "enable assessment of the potential impacts from development of the proposed Project." Completion of this study has met that goal. The wildlife study plans were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project as part of the License Application, which in turn will assist FERC in the preparation of their draft EIS. Although AEA acknowledges that a few objectives in several wildlife studies made reference to impact analysis, the studies themselves were not designed to analyze impacts. That step comes in the next phase of preparing the Project License Application. For more information related to AEA's approach for including impact assessments in the License Application, please see Section 1.3.
SRC_etal_ WILDLIFE_ ppWOLVE RINE4_ph6	*Recommendation 5. There is nothing in the ISR or FSP designed to identify appropriate kinds or levels of mitigation for adverse impacts of the project on wolverine.*	The wildlife study plans were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project as part of the License Application, which in turn will assist FERC in the preparation of their EIS. One of the principal uses of the study results will be to identify potential protection, mitigation, and enhancement (PM&E) measures following the

Reference Number	Comment or Study Modification Request	AEA's Response
		completion of impact analyses. This is another step that comes in the next phase of preparing the Project License Application. For more information related to proposals for mitigation measures at this point in the licensing process, please see Section 1.3.
SRC_etal_WILDLIFE_ppWOLVERINE4_ph7	*Recommendation 6. Persons conducting the investigations and author(s) of the study reports should be identified by name. Anonymous reports do not have the credibility that comes with reports by people willing to identify themselves as responsible for the studies and conclusions.*	SRC et al. wrongly characterize the preparers of reports under the FERC-approved Study Plan as "anonymous." The firms and/or agencies participating as part of AEA's study team are clearly identified on the cover page of each report, and the technical leads for each study have attended each study plan and ISR meeting since the inception of this study phase of the licensing effort. Thus, SRC et al.'s accusation that technical staff are not "willing to identify themselves" is not only false, but distasteful and unprofessional. While AEA, as a matter of convention, determined for reasons of administrative efficiency not to identify by name any of the scores of scientific experts and professionals constituting the study team, the "credibility" of these reports is well established by the high quality of the study team's work itself and the rigor to which it has been reviewed by federal and state resource agencies, other licensing participants, and FERC staff.
SRC_etal_WILDLIFE_ppWOLVERINE5_ph2	*Recommendation 7. Impact assessment studies should not be considered adequate unless study plans incorporate…post-project studies to determine actual impacts on wolverine numbers and movements.*	Under the ILP, FERC-approved Study Plans are not designed or intended to include post-construction monitoring. It is premature for study reports to describe potential protection, mitigation and enhancement measures. See Section 1.3.
SRC_etal_WILDLIFE_ppWOLVERINE5_ph3	*Recommendation 8. The bioclimatic envelope for wolverine was described by Copeland et al. (2010). … The existing bioclimatic envelope for wolverine in the dam impact area should be described and contrasted with this.*	The citation referenced in this comment addressed broad-scale patterns of wolverine habitability, based on an analysis that was performed on a provincial to continental scale. Within that context, the overwhelming majority of mainland Alaska is considered to be within the "bioclimatic envelope" for wolverines (see Figure 2 in the referenced citation). Hence, the scale of the requested analysis is not appropriate for the wolverine study area for this Project.

2.7.5.1. Response to Modification Requests for Additional Year(s) of SUPE Survey(s)

The SRC et al. propose three modifications to the FERC-approved Study Plan, requesting that FERC require AEA to conduct one additional year of SUPE surveys (Modification I [SRC_etal_WILDLIFE_pp23_ph2]; and Modification II [SRC_etal_WILDLIFE_pp24_ph2]) or at least two consecutive years of SUPE surveys (Modification III; SRC_etal_WILDLIFE_pp24_ph5). To support the need for additional year(s) of SUPE surveys, SRC et al. state that additional SUPE surveys should be conducted because a population index could not be established with occupancy modeling (OM) as a reliable monitoring tool and that the two variances implemented during the SUPE survey conducted in 2015 introduced biases that increased the variance estimate and will decrease the reliability of the impact analysis of the Project on wolverines.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved study plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations. SRC et al. has not demonstrated that Study 10.9 was implemented under anomalous environmental conditions, and while it attempts to justify its proposed modifications, in part, based on variances in AEA's implementation, as discussed below these claims are without merit. The objectives for this Study Plan have been fully met, even considering the variances reported by AEA.

As an initial matter, the Study Plan objective of establishing a population index for wolverines using OM was intended to provide a cost-effective means of monitoring the population over multiple years. To estimate the number and density of wolverines in the Project area, an aerial survey using snow-tracking and the SUPE technique (Becker et al. 2004, Golden et al. 2007) was included in the Study Plan. As described in the FERC-approved Study Plan (RSP Section 10.9.4), the SUPE methodology requires suitable weather and snow conditions, consisting of a fresh snowfall followed by several days of suitable flying conditions late in the winter when adequate daylight is available. Because these requirements may not be met every year, OM was included in the Study Plan as a contingency plan that could be used in conjunction with the SUPE. SUPE data also can be used for occupancy modeling. As provided for in the FERC-approved Study Plan, OM surveys were to be flown in both 2013 and 2014 and, if conditions allowed, one of those survey efforts would have been a SUPE survey. As described in the SCR, OM surveys were conducted in 2013 but were discontinued in 2014, based on work by Ellis et al. (2013), which highlighted several difficulties associated with the use of OM for monitoring trends in wolverine abundance. Appropriate environmental conditions for the SUPE survey did not occur in either 2013 or 2014, but did occur in March 2015, at which time a SUPE survey was completed.

In their comments, SRC et al. use the following quote from the SCR—taken out of context—to support their request for an additional SUPE: "the objective of establishing a population index with OM as a reliable monitoring tool in lieu of regular and repeated SUPE surveys was not achieved and future efforts should focus on SUPE surveys." In Section 4.1.1 of the SCR for Study 10.9, the study team concluded that "The objective of establishing a population index with OM as a reliable monitoring tool in lieu of regular and repeated SUPE surveys was not achieved and future efforts should focus on SUPE surveys, as possible, as the superior survey method of aerial tracking for assessing wolverine abundance." This SCR passage pointed out that the SUPE survey method was superior to the OM survey method first envisioned as a population-monitoring tool. The "future efforts" mentioned in the SCR sentence referred to monitoring surveys that may be conducted by ADF&G (or other entities) in the study area in the future for comparison with the results of this study. The FERC-approved Study Plan included only a single SUPE survey, which was accomplished in winter 2015, as reported in the SCR, thereby meeting the study objective.

SCR et al. assert that AEA needs to conduct another SUPE because two variances implemented during the SUPE survey in 2015 reduced the number of preselected sample units available in the study area and therefore impaired AEA's ability to meet the study objectives. AEA disagrees, however, that the 2015 SUPE survey did not meet the objective of the FERC-approved Study Plan. As described in SCR Section 4.1.1, the study area used for the SUPE survey analysis varied from that described in the Study Plan (RSP Section 10.9.4) due to unsuitable tracking conditions from wind scour that removed wolverine tracks (thereby violating SUPE assumptions) in the southwestern corner of the study area and to high winds that created dangerous survey conditions along the northwestern edge of the study area (SCR Figure 4-1). An additional 12 selected sample units in the middle portions of the study area were not surveyed due to pilot error or logistical concerns and were subsequently treated as unselected, unsurveyed units in the analysis. Because those 12 units lacked common characteristics (e.g., common habitat, weather reasons for not surveying, etc.) and because they were interspersed randomly throughout the WSA with successfully surveyed units, their inclusion was unlikely to result in a biased estimate. The primary effect of excluding those 12 selected but unsurveyed units was to lower the proportion of units surveyed, thereby potentially increasing the variance of the abundance estimate in the SUPE calculation. One additional, previously non-selected sample unit was surveyed and included in the analysis as well.

The modified survey area consisted of 281 total sample units (rather than the original 338 units proposed in the Study Plan), of which 173 units (61.6 percent) were sampled. As stated in the methods of the FERC-approved Study Plan, to produce a density estimate with a coefficient of variation (CV) of <10 percent, the sampling goal was 45–50 percent of medium- and low-density sample units and 65–70 percent of high-density sample units. This goal was achieved, as 50.6 percent of the medium/low-density units and 66.0 percent of the high-density units were sampled (see Section 5 of the SCR). Surveying fewer sampling units than planned would be a concern if the estimated variance in the abundance estimate was high, but it was not. The calculated SUPE estimate was 62.81 wolverines (95 percent confidence interval = 53.80–71.81 wolverines), corresponding to a density of 9.48 wolverines/1,000 km² (95 percent confidence interval = 8.12–10.83 wolverines/1,000 km²). The coefficient of variation was 7.13 percent. This estimate represents one of the most precise wolverine abundance estimates ever obtained (see SCR Section 6) and over one of the largest survey areas (6,627 km²). Moreover, wolverines are relatively slow-reproducing furbearers that invest heavily in their offspring (Persson 2005), so interannual variation in wolverine population abundance is expected to be low. Hence, AEA maintains that the objective to “estimate the current population size of wolverines" was achieved as planned.

As was reported in the SCR, wolverines were distributed throughout the study area, so there is no reason to expect that density in the unsampled portions varied appreciably. The comment by SRC et al. that the unsampled high-stratum plots along the southern edge of the study area were the only such plots south of the Susitna River is incorrect, as the SUPE survey included a large swath of high-stratum plots in the Fog Lakes and Kosina Creek areas and surrounding country, which were surveyed successfully (see Figures 3-1 and 4-1 in the SCR). Beyond the weather and snow conditions at the time of the SUPE survey, the differences between the surveyed and unsurveyed portions of the study area were negligible.

The request for at least two consecutive years of SUPE data is not only unwarranted due to the adequacy of the existing baseline estimate, but also likely would be impossible to achieve due to the narrow weather requirements for a SUPE survey, which only occurred in one (2015) of three consecutive winters (2013–2015) in which the survey was attempted.

The estimated cost of conducting an additional year of SUPE surveys as requested under Modification I or II would be approximately $150,000. The cost of conducting two *consecutive* years of surveys as requested within Modification III would exceed $300,000 as it is unlikely that the appropriate restrictive survey conditions would occur in two consecutive years.

For these reasons, coupled with the significant cost of $150,000 to upwards of $300,000 to implement these modifications for additional SUPE surveys, SRC et al. have not established good cause as required by FERC's regulations.

2.7.5.2. Response to Modification Request for Use of a Different Model to Assess Project Impacts on Wolverine Habitat

In the second component of their Modification III (SRC_etal_WILDLIFE_pp24_ph5), SRC et al. request that FERC modify the Study Plan to require AEA to use a specific spatial analytical model to gain more insights into wolverine habitat use and assess impacts of the proposed Project on wolverine habitat. SRC et al. assert that the methods in the FERC-approved Study Plan are inadequate to describe habitat use of wolverines and suggest that the methods applied by Lewis et al. (2012), employing a resource selection function (RSF) model analysis of movement data from GPS-collared wolverines, would be more appropriate to use in evaluating habitat use.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. has not established "good cause" as required by the ILP regulations, nor has SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

Data from the SUPE survey in 2015 allowed the study team to investigate habitat use by wolverines during the course of the movements revealed by their tracks, which provided high-resolution information, albeit for a relatively brief period of time. The additional data gathered for Study 10.10 (Terrestrial Furbearer Abundance and Habitat Use) provided longer-term measures of habitat use in mid- to late winter, as reported in Section 6 of the SCR. The combination of these sources provides considerable information in addition to that reported for VHF radio-collared wolverines tracked in the study area in the 1980s (Whitman and Ballard 1984, Whitman et al. 1986), which also was discussed in Section 6 of the SCR.

In Section 6 of the SCR, the study team identified potential biases inherent in any survey technique based on snow-tracking surveys. Despite those potential limitations, however, the results of the habitat-use portion of this study adequately documented patterns in wolverine habitat association and the results of this study agree strongly with previous findings on wolverine habitat use, including those from the study area in the 1980s (Whitman and Ballard 1984). Lacking any indications of unexpected factors in wolverine habitat use from the existing data, attempting to further improve the spatial resolution is not warranted. An additional SUPE will not provide substantially more habitat information; as the SRC et al. correctly noted, the SUPE provides a snapshot of habitat use in a late-winter window. The SCR et al. summarized habitat-use patterns identified through habitat data gathered during the SUPE survey in 2015, which was supplemented with analysis of two winters of snow-track data gathered for Study 10.10 in 2013 and 2014, as well as the findings of previous research on radio-collared wolverines in the 1980s. Thus, the study team met the objective of describing habitat use by wolverines in late winter.

The estimated cost of implementing this modification to undertake at least a 2-year GPS telemetry study of wolverines with accompanying RSF model analysis would be approximately $400,000–600,000. Undertaking such an expensive and time-consuming study modification is unnecessary because, as is explained in the Section 6 of the SCR, the study objectives have been fulfilled and the information gathered for this species is sufficient to inform the impact analysis for the License Application.

For these reasons, coupled with the significant cost of $400,000–600,000 to complete this proposed modification that is unneeded to meet Study Plan objectives, AEA requests FERC not adopt this SRC et al. study modification.

2.7.5.3. Response to Comments on the Size and Location of the FERC-approved Study Area

In several comments within their attachment ("Wildlife Study Reviews" by consultant Sterling Miller), SRC et al. assert that the wolverine study area is not appropriately sized or situated to meet study objectives and assess Project impacts on wolverines. For instance, Mr. Miller states that the WSA includes "far too much area to the west and north of the proposed project and far too little area to the east and south of the project area. This may be because the goal is to include all 3 access routes under consideration but since only one of these will be selected, it is more appropriate to center the WSA on the proposed project area. We note that none of the other terrestrial mammal studies configured their study areas to encompass all access routes under consideration" (SRC_etal_WILDLIFE_ppWOLVERINE5_ph3).

AEA disagrees with the assertion by SRC et al. that the basis for the study area is flawed. As is necessary to provide adequate information for the License Application and FERC's associated NEPA document, the WSA encompasses all areas potentially affected by the Project, including the proposed reservoir inundation zone, camp and facilities area, all of the potential routes for the access and transmission corridor alternatives, and adjacent areas, as described in RSP Section 10.9.3 and SCR Section 3. The fact that the WSA is larger than the area potentially affected directly by Project infrastructure ensures that a biologically meaningful population estimate of wolverines would be obtained, rather than attempting to subdivide the study area according to an arbitrary assumption about the size of the area of impact; the same approach was taken for other species of large mammals that range over broad areas, such as moose, caribou, Dall's sheep, bears, and wolves. Moreover, the comment is incorrect with regard to the alleged exclusion of all access corridor alternatives from other mammal study plans. In fact, all terrestrial mammal studies—with the exception of Study 10.13 (Bat Distribution and Habitat Use)—included all of the access corridor alternatives in their respective study areas. Mr. Miller appears to use the term "project area" to refer only to the proposed reservoir inundation zone. In fact, by definition, the term "Project area" as used throughout the documents developed by AEA for this Project includes all of the access corridor alternatives.

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2.7.6. Study 10.10 – Terrestrial Furbearers Abundance and Habitat Use

As established in the Study Plan (RSP Section 10.10.1), the overall goal of this study is to provide current information on the abundance and habitat use of four species of terrestrial furbearers (coyote, red fox, lynx, and marten) for use in evaluating potential Project-related impacts and identifying appropriate mitigation.

The study objectives are established in RSP Section 10.10.1:

- Develop population estimates of coyotes and red foxes through fecal genotyping and genetic capture–recapture analyses using scats collected along trails and rivers throughout the study area during winter months (January–March) in 2013 and 2014.
- Develop a population estimate of marten through DNA-based capture–recapture analysis, using hair samples collected in the reservoir inundation zone with hair-snag tubes.
- Develop a population estimate of lynx through DNA-based capture–recapture analysis using hair samples collected throughout the study area with hair-snag plates.
- Assess prey abundance in the study area by conducting snowshoe hare pellet counts and estimating vole density using a mark–recapture framework from live-trapping sessions.

- Compile habitat-use data for the furbearer species being studied, using aerial track surveys.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA does not propose any modifications to Study Plan Section 10.10. AEA has met the study objectives and this study is considered complete. A Study Completion Report was filed with FERC on November 6, 2015.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.10. However, ADF&G and Copper Country Alliance (CCA) each filed one comment for Study 10.10. AEA's responses to these comments can be found in Table 2.7.6-1.

Table 2.7.6-1. Study 10.10 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp15_ph4	*The purpose of this study was to assess the abundance and habitat use of four species of terrestrial furbearers: coyote, red fox, lynx, and marten. As noted in the ISR report, although the two objectives pertaining to population estimates of marten and lynx could not be fulfilled due to laboratory analytical problems, we agree that sufficient data on habitat use, occupancy, and abundance were obtained to assess project impacts and develop potential PME measures. We also agree that the spatially explicit ground-based occupancy surveys that were added to this study provided useful information on the habitat use. Current distribution, and relative abundance of these species. We believe AEA has successfully completed all aspects of this study and has met all FERC-approved study objectives.*	AEA appreciates ADF&G's reviews and support for AEA's implementation of the FERC-approved Study Plan for Study 10.10.
CCA_pp3_ph1	*We are pleased that the researcher included data on all tracks observed, and not just on the four target species. Of the non-target species, all but weasels are target species in other studies. It is disappointing, however, that the study objective did not include weasels. The second highest number of tracks counted in aerial surveys was those of weasels. A discussion of their habitat occupancy and use would have been possible if short-tailed and least weasels had been added as target species. Why have they been omitted?*	The purpose of the ISR process is to determine AEA's progress in carrying out the Study Plan as approved by FERC. This comment raises questions with the Study Plan itself, and not AEA's implementation of the plan. The FERC-approved Study Plan did not include an objective to assess the abundance or habitat use of weasels. The purpose of the Terrestrial Furbearer Study Plan was to assess the abundance and habitat use of four species of terrestrial furbearers: coyote, red fox, lynx, and marten. The Terrestrial Furbearer Study Plan was developed during the course of the ILP process in 2012 through multiple study-planning meetings with federal, state, and local agencies and other licensing participants. During that planning process, none of the licensing participants ever proposed that these two species of weasels be

Reference Number	Comment or Study Modification Request	AEA's Response
		designated as target species for the FERC-approved Study Plan. To the extent that this comment seeks to modify the FERC-approved Study Plan for Study 10.10, AEA asserts that the commenter neither shows "good cause" why the proposal should be approved nor does she demonstrate that the approved study was conducted under anomalous environmental conditions or was not conducted as provided in the approved study plan (18 C.F.R. 5.15(d)). Nevertheless, data on the occurrence and habitat associations of both species (combined, as it is impossible to separate them reliably from aerial tracking) were collected incidentally during the aerial track surveys for this study in both study winters. Hence, Project-specific data were collected incidentally by this study, even though these two weasels were not target species. Those data on occurrence and habitat associations will be incorporated into the evaluation of wildlife habitat use (Study 10.19), which will provide sufficient information to use in assessing potential impacts on these two species of small carnivores.

2.7.7. Study 10.11 – Aquatic Furbearers Abundance and Habitat Use

As established in the Study Plan (RSP Section 10.11.1), the overall goal of this study is to collect baseline data on aquatic furbearers in the study area to enable assessment of potential Project-related impacts. This information will be used to develop appropriate mitigation measures.

The study objectives are established in RSP Section 10.11.1:

- Delineate the distribution and estimate the current population size of beavers.
- Describe the distribution and relative abundance of river otters, mink, and muskrats.
- Describe habitat associations of aquatic furbearers.
- Review available information on food habits and diets of piscivorous furbearers (river otter and mink) as background for the Mercury Assessment and Potential for Bioaccumulation Study (Study 5.7).
- Collect hair samples from river otters and mink to characterize baseline tissue levels of mercury for the Mercury Assessment and Potential for Bioaccumulation Study.

As detailed in ISR 10.11 Part D (Section 7) and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes four modifications to RSP Section 10.11:

1. The Chulitna Corridor has been removed from the study area (ISR Part D Overview, Section 1.3) and the Denali East Option (access road and transmission corridor) has been added to the study area (ISR 10.11 Part C, Section 7.1.2).

2. The 2013 variance of expanding the beaver survey area to include a broader area of the floodplain along the Middle Susitna River than was originally described in the Study Plan will be continued for the remainder of this study.
3. The objectives and methods in this study related to mercury analysis, including the literature review of food habits and diets of river otters and mink and the collection of hair samples, have been consolidated under Study 5.7 (Mercury Assessment and Potential for Bioaccumulation) (ISR 10.11 Part C, Section 7.1.2).
4. Substitute the two seasons of incidental observations of muskrats obtained in 2013 and 2014 in place of the first year of muskrat pushup surveys and the muskrat pushup surveys planned for spring 2016 (ISR 10.11 Part D, Section 7.2) thus will constitute the second year of those surveys, fulfilling the study plan objective (RSP Section 10.11.4.1).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.11. ADF&G filed a comment on AEA's fourth proposed modification to Study 10.11 outlined above. AEA's response to the ADF&G comment can be found in Table 2.7.7-1.

Table 2.7.7-1. Studies 10.11 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp16_ph1	*The purpose of this study was threefold: to evaluate the number and distribution of beaver lodges and assess overwinter survival; locate winter tracks of river otter and mink to assess their relative numbers, distribution, and habitat associations during winter; and identify muskrat pushups to assess muskrat distribution. We agree with the proposed study plan modification to conduct aerial surveys of muskrat pushups in spring 2016 and to substitute two seasons of incidental observations of muskrats obtained in 2013 and 2014 for one year of surveys instead of conducting a second year of muskrat surveys. We believe significant progress has been made and that the study is on track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's review of AEA's progress on implementing Study 10.11 and AEA's proposed modifications to the FERC-approved Study Plan. As proposed in Study 10.11 ISR Part D, Section 8, another snow-tracking survey for river otters and mink was completed in late winter 2016, as were two surveys of muskrat pushups in spring 2016. Final data analyses are underway and will be provided in the USR.

2.7.8. Study 10.12 – Small Mammal Species Composition and Habitat Use

As established in the Study Plan (RSP Section 10.12.1), the overall goal of this study is to synthesize baseline data on small mammals in the Project area to enable habitat-based assessments of the impacts expected to occur from development of the Project.

The study objectives are established in RSP Section 10.12.1:

- Describe the species composition and relative abundance of small mammals in the Project area.
- Describe the habitat associations of small mammals within the Project area.

This desktop study has not yet been initiated.

As detailed in ISR 10.12 Parts C Section 7 and D Section 7.1 and presented during the ISR meeting for this study held on March 29, 2016, AEA does not propose any modifications of the methods for RSP Section 10.12. However, the study area has changed from that described in the Study Plan (RSP Section 10.12.3), with the elimination of the Chulitna Corridor and the addition of the Denali East Option (access road and transmission-line corridor alternative), as described in ISR Part D Overview, Section 1.3.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.12. AEA received no comments on Study 10.12, including its change to the study area outlined above.

2.7.9. Study 10.13 – Bat Distribution and Habitat Use

As established in the Study Plan (RSP Section 10.13.1), the overall goal of this study is to collect baseline data on bats in the Project area to enable the assessment of potential impacts on bats from development of the proposed Project.

The study objectives are established in RSP Section 10.13.1:

- Assess the occurrence of bats and the distribution of habitats used by bats within the proposed reservoir inundation zone and associated infrastructure areas for the Project.
- Review geological and topographical data to assess the potential for roosting, maternity, and hibernacula sites in the study area.
- Examine suitable geological features (caves, crevices) and human-made structures (buildings, mines, bridges) for potential use by bats as roosting sites, maternity colonies, and hibernacula.

A decision point was identified in the final paragraph of RSP Section 10.13.4 regarding continuation of surveys in the second year of study (2014), which was predicated on locating roost sites in the first year of study (2013). Although no roost sites were found in the first year, bats were widespread in the study area and peaks of seasonal activity were found during the maternity (birth and pup-rearing) and prehibernation/migration periods. Hence, survey efforts were continued in 2014 to locate roosts.

As detailed in ISR 10.13 Part D, Section 7.1, and presented during the ISR meeting for this study held on March 29, 2016, AEA proposed two modifications to Study Plan Section 10.13 for the second study year:

1. AEA implemented a modification to the Study Plan, which involved the use of mist nets for bat capture and the use of radio telemetry to locate bat roosts in the study area during the spring and fall seasons. Using telemetry, the study team could identify specific roosting locations of radio-tagged bats in the study area, helping to accomplish the first and third objectives of the Study Plan.

2. In addition, AEA conducted acoustic monitoring in 2014 by deploying six bat detectors at sites with the highest rates of detection in 2013 and deploying four other detectors at sites on CIRWG lands, which were not sampled in 2013.

A cumulative Study Completion Report and ISR Part D were filed in November 2015.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.13. AEA received no comments on Study 10.13, including its proposed modifications, Study Plan decisions, and Study Completion Report, outlined above.

Having met all study objectives and not receiving any comments on Study 10.13, AEA submits that this study is now complete.

2.7.10. Study 10.14 – Surveys of Eagles and Other Raptors

As established in the Study Plan (RSP Section 10.14.1), the overall goal of this study is to characterize the population size, productivity, nesting phenology, habitat use and migratory movements of raptor species in the study area. These data will inform the prediction and quantification of impacts that may result from the proposed Project, and will provide information required for a possible application(s) for federal eagle take (lethal or disturbance take, see below) and/or eagle nest take permits.

The study objectives are established in RSP Section 10.14.2:

- Enumerate and identify the locations and status of raptor nests and territories that could be affected by Project construction and operations. Four specific tasks are associated with this objective:
    - Review and synthesize existing nest data for eagles and other raptors: Identify and assess the status of previously recorded nest locations of various species, including geographic coordinates, annual nest activity, descriptions of nest site characteristics, and general descriptions of cliff habitat in the proximity of each site.
    - Conduct field surveys to locate and characterize nests: Locate and map Bald Eagle and Golden Eagle nests in the Project study area, identifying all active and inactive nests and alternative nest sites. Locate and map active and inactive nests of other tree- and cliff-nesting raptor species (as well as Common Raven, a species whose nests often are used by raptors) in the Project study area.
    - Create a geospatial database of all nests and territories: The database will be used to calculate inter-nest distances, estimate local average territory size, and, with overlays

of Project footprint and habitats, determine the number of nests and territories potentially affected by the Project.

- Calculate local average territory size for Bald Eagles and Golden Eagles: Estimates of average territory sizes (and mean inter-nest distance) are required for the applications for federal eagle nest take permits.

- Estimate Project effects on the productivity of raptors. This objective includes four tasks:
  - Review existing productivity data.
  - Determine the average and range of productivity of nests of each species (e.g., Bald Eagle, Golden Eagle, other raptors).
  - Consider impacts on productivity at the local and larger population level using current and historical data.
  - Establish the framework for comparisons of pre- and post-construction productivity to evaluate whether realized take is consistent with the permitted take, and to ensure that the level of take is compatible with the preservation of eagle populations.
- Estimate effects on nesting and foraging habitats by delineating suitable habitat features in a geospatial database (this work will be conducted in Study 10.19, Evaluation of Wildlife Habitat Use). These characterizations will be used to determine the following:
  - The percentage of local habitat lost.
  - Numbers of breeding pairs and productivity affected by development.
  - Whether or not a partial loss of a territory may functionally result in abandonment of the entire territory.
  - Whether or not habitats adjacent to the Project area may be available for use by displaced nesting birds.
- Conduct field surveys and literature reviews to identify, map, and characterize the habitat-use patterns at fall and winter communal roost sites and foraging sites of Bald and Golden eagles and other raptor species. Describe seasonal habitat use, highlighting areas or conditions that may result in impacts on raptors.
- Assess the extent to which planned overhead transmission lines may pose a collision risk to migrating or nesting raptors and identify migratory corridors (including altitudes of raptor movements) in the Project transmission line corridors.
- Provide information on the distribution, abundance, food habits, and diet of piscivorous (fish-eating) raptors; feather samples for characterization of mercury levels; and information on the effects of methylmercury on piscivorous raptors, for use in Study 5.7, Mercury Assessment and Potential for Bioaccumulation.

As detailed in Study 10.14 ISR Part D, Section 7, and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes four modifications to RSP Section 10.14:

1. In 2014, AEA eliminated the Chulitna Corridor from further consideration (ISR Part D Overview, Section 1.3) and added the Denali East Option road and transmission corridor alternative (ISR Part C, Section 7.1.2) to the study area, including the corresponding 3-mile survey buffer zone around that alignment;
2. The intensity of aerial surveys for woodland raptors (large species using stick nests, in contrast to the smaller species discussed below in Section 2.7.10.2) will be increased within the inundation zone;
3. No further eagle foraging and communal roosting surveys will be conducted (SIR Section 7); and
4. The mercury analysis objectives and methods have been consolidated under Study 5.7, Mercury Assessment and Potential for Bioaccumulation (ISR Part C Section 7.1.2).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, USFWS submitted comments on Study 10.14, including four study modification proposals. AEA received no comments on AEA's proposed modifications to Study 10.14, outlined above. Ahtna, Inc. also submitted comments directly to AEA (see Attachment 1). AEA's responses to all of the comments can be found in Table 2.7.10-1, and more detailed responses to the study modification requests are presented below.

Table 2.7.10-1. Study 10.14 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Ahtna_pp2_ph2	*The Bald and Golden Eagle Protection Act (1940) protects eagles from a "loss in productivity by substantially interfering with normal breeding, feeding or sheltering behavior, or nest abandonment" (US Fish & Wildlife). This study has identified six (6) occupied bald eagle nests within the proposed reservoir site. Federal law prohibits them from being disturbed.*	USFWS regulations provide for the issuance of eagle nest take permits under defined circumstances. Accordingly, AEA will work with the USFWS to obtain the necessary permits before Project construction proceeds.
USFWS_pp10.14-1_ph1b	*[Objective 1.b.] Golden Eagle occupancy survey methodology needs some refinement. We recommend that a methodology employed by Golden Eagle expert Carol McIntyre be implemented, whereby the helicopter returns and sets down near "possibly occupied nests" and observes the nest for an hour or two. This will reduce the number of "possibly occupied" nests.*	As explained below in Section 2.7.10.1, AEA requests that FERC not adopt this proposed study modification. The estimated cost of implementing this modification is $30,000–60,000.
USFWS_pp10.14-1_ph1d	*[Objective 1.d.] Where Golden Eagle nests are concentrated on linear features, such as cliffs, but foraging areas are widespread below, the mean in-nest [sic] distance may not encompass all important parts of the territory.*	AEA recognizes that animal territories are not perfectly circular, but without radio tags or satellite trackers, the boundaries of nesting territories cannot be delineated accurately. For this reason, the mean inter-nest distance described in the 2011 "Draft Eagle Conservation Plan Guidance" by USFWS (since replaced by USFWS 2013) was included in the RSP (Section 10.14.3) and approved by FERC, instead of attempting to capture and

Reference Number	Comment or Study Modification Request	AEA's Response
		track territorial adults (which is extremely difficult to accomplish). In a consultation meeting with USFWS during the study planning phase (April 11, 2012), the use of one-half of the mean inter-nest distance was identified by USFWS staff as a criterion for consideration of potential territory take and a 10-mile buffer around the reservoir inundation zone was proposed by USFWS as an adequate distance to use for describing Golden Eagle territories that may be affected by the reservoir. A 10-mile radius around the reservoir and a 3-mile buffer elsewhere in the Project area was therefore included in the Study Plan approved by FERC. For these reasons, the methods approved by FERC, which follow USFWS guidelines and were discussed with USFWS during study planning consultation, will allow for an adequate assessment of Project-related effects on Golden Eagles and otherwise meet the objectives of this Study Plan.
USFWS_pp10.14-1_ph2b	*[Objective 2.b.] Project effects on raptor productivity may be complicated and long-lasting and not characterized by a simple direct extrapolation of loss of footprint (with current productivity X) into a measure of potential of lost productivity. Such methodology has not yet been proposed or explained, and a framework or model must be established to explain how the study will do this (task d).*	This comment, which appears to refer primarily to Objectives 2c and 2d (rather than 2b) of the FERC-approved Study Plan (RSP 10.14.1), does not address AEA's implementation of the FERC-approved Study Plan. This study was designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project, rather than actually conducting those analyses. Questions concerning potential lost productivity of specific raptor nests and territories will be addressed with USFWS during the process of obtaining eagle take permits, following the final year of surveys and before beginning the analyses of potential impacts. The FERC-approved Study Plan will collect the information needed to conduct impact analyses, which will be included in the License Application, Exhibit E (Environmental Exhibit). For more information related to AEA's approach for including the impact assessment in the draft License Application, please see Section 1.3.
USFWS_pp10.14-1_ph2c	*[Objective 2.c.] To understand impacts on productivity at the local and larger population level, we need to understand and know the raptor population outside of the reservoir inundation site. This project will have a much larger project footprint that will extend many miles downstream. To understand project effects on raptors, habitat availability for displaced raptors should be addressed.*	As explained below in Section 2.7.10.4, AEA requests that FERC not adopt this proposed study modification. The estimated cost of implementing this modification is $100,000–140,000.
USFWS_pp10.14-1_ph3	*[Objective 3.] Has not been started.*	AEA has indeed begun work on Objective 3 of the FERC-approved Study Plan. Nesting habitat features were delineated (see ISR 10.14 Part A, Figures 5.1-2 through 5.1-4). That mapping will be updated in the USR, based on the results of additional surveys in 2014

Reference Number	Comment or Study Modification Request	AEA's Response
		and the final year of study. In addition, the results of the evaluation of wildlife habitat use (Study 10.19) will be used to identify potential foraging areas for raptors. As a general response to this comment, it is worth noting that AEA is currently in the initial study reporting phase of the licensing process. FERC's ILP regulations require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule" (18 CFR 5.15(c)(1)). As reported in the ISR, some work has been done to meet this study objective, however, the study has not yet been completed.
USFWS_pp10.14-2_ph1	*[Objective 4.] It does not appear that this objective has been planned or met. No methodologies are described or implemented yet to identify whether or not habitats adjacent to the project area may be available for use by displaced nesting birds.*	Objective 4, as stated in Section 10.14.1 of the FERC-approved Study Plan, is to "Conduct field surveys and literature reviews to identify, map, and characterize the habitat-use patterns at fall and winter communal roost sites and foraging sites of Bald and Golden eagles and other raptor species. Describe seasonal habitat use, highlighting areas or conditions that may result in impacts on raptors." Hence, Objective 4, as approved by FERC, does not apply to nesting birds, as indicated in the USFWS comment. Rather, Objective 4 focuses on communal roosting and foraging areas used in fall and winter, primarily by Bald Eagles. Moreover, methodologies for meeting Objective 4 have been approved by FERC, following extensive consultation with USFWS and other licensing participants, and these methodologies have been carried out by AEA since their approval. As described in Shook et al. (2013) and ISR 10.14 Part A, Sections 4.2 and 5.2, two seasons of fall and winter surveys were conducted (2012 and 2013) to attempt to locate communal roosting and foraging areas, but none were found. Accordingly, AEA proposed a modification to the FERC-approved Study Plan to discontinue the fall and winter surveys to locate communal roosting and foraging areas (ISR 10.14 Part D, Section 7.2, and SIR 10.14, Section 7.1). Fall and winter communal roosting areas are not common and are normally found at concentrations of food resources (e.g., late-season spawning runs of salmon, waterfowl staging areas, fish-processing facilities, landfills). Because none of these resources were found in the study area, the study team concluded that, after two years of surveys, communal roosting areas did not exist in the study area. If, rather than Objective 4, the USFWS comment was intended to address Objective 3d ("whether or not habitats adjacent to the Project area may be available for use by displaced nesting birds"), then sufficient data to address the objective has been collected. The work

Reference Number	Comment or Study Modification Request	AEA's Response
		needed to fulfill Objective 3d will be completed by using the geospatial nesting habitat data prepared for this study, in combination with the wildlife habitat map prepared for Study 11.5 and riparian habitat map prepared for Study 11.6. This raptor habitat evaluation will be part of the work conducted to complete Study 10.19, Evaluation of Wildlife Habitat Use. Finally, as a more general response to USFWS's comment, AEA again notes that the Project currently is in the initial study reporting phase of the licensing process. The study has not yet been completed; additional information related to Objective 4 will be available in the USR.
USFWS_pp10.14-2_ph2a	*[Objective 5.] We have not yet confirmed that the 18 sites were located at the most optimal points for the migration data collection. Besides optimum detectability, some consideration should be given to sites where there are particular pre-concerns or available alternatives (both landscape-scale and topographically) for transmission line placement.*	AEA agrees with USFWS that other factors in addition to optimum detectability should guide the selection of the observation sites. As provided in the FERC-approved Study Plan (RSP Section 10.14.4.1; also see ISR Part A, Section 4.3), site selection was "determined by focusing on areas judged likely to concentrate migrating raptors (on the basis of topography). Survey efforts will be timed to coincide with times of day when thermal updrafts are most likely to occur (from midday through the afternoon hours)." The study team considered a number of factors, including potential interactions of topography with transmission lines (i.e., how raptors were likely to use the topography near each site), proximity to raptor nesting territories, optimum detectability, adequate spacing between sites, and study area/landscape-scale representation. Based on the application of these factors, the 18 observation sites ultimately selected by the study team accounted for considerations of "pre-concerns and alternatives" raised in USFWS's comment. It is unclear what USFWS is suggesting with this comment. AEA consulted the USFWS in developing the Study Plan, which was approved by FERC. USFWS never requested to be involved in choosing or approving the raptor migration observation sites in its comments on the FERC-approved Study Plan, however, and it is unclear how USFWS proposes to confirm that the sites were optimally located.
USFWS_pp10.14-2_ph2b	*[Objective 5.] Migration surveys should also begin earlier and extend later in the season as it is believed that a potentially significant number of some birds, particularly Golden Eagles were likely missed (Steve Lewis, pers. comm.).*	Section 10.14.6 of the FERC-approved Study Plan specified that the raptor migration surveys would be conducted in "April–May and September–October in 2013 and 2014"; the USFWS agreed to the proposed period of "mid-April to mid-May" in a technical work group meeting on March 1, 2013, which focused on the details of the proposed migration survey methods. The study team attempted to optimize the timing windows within these months to cover the anticipated peak migration/movement periods within the constraints of safety, logistics, and budget. Migration counts in 2013

Reference Number	Comment or Study Modification Request	AEA's Response
		were conducted during April 12–May 11 and September 16–October 15 (Study 10.14 ISR Part A Sections 4.3 and 5.3). The study team considered beginning the spring survey in mid-March to record the earliest-migrating raptors (Golden Eagles), but the effort was postponed due to concerns about the safety of deploying observers in cold, windy, winter conditions in higher-elevation portions of the study area at remote sites that were accessible only by helicopter. AEA agrees with USFWS's comment that some early-migrating raptors (primarily Golden Eagles) may have been missed before April 12, and that it is possible that some late-migrating individuals of some species were missed after May 11. The intent of Objective 5, however, was to sample at suitable observation points along the transmission corridor alternatives to provide sufficient data to use in assessing the potential for collision risk to raptors (especially focused on Bald and Golden eagles), rather than to cover the entire duration of migration and enumerate all raptors passing through the study area. The migration observations in spring and fall 2013 provided adequate samples to address the objective; indeed, Golden Eagles were the most abundant raptors observed in both the spring and fall migration surveys (see ISR Part A, Section 5.3 and Appendix D). Although some early-migrating adult Golden Eagles may have been missed by not beginning the raptor migration surveys before April 12, the protracted winter season and late arrival of spring conditions in 2013 make it unlikely that "a potentially significant number" of other early-migrating raptors were missed. Furthermore, movements of resident Bald and Golden eagles were recorded, which represent the most important species for collision risk in these areas. Only a few raptors were seen from the lower-elevation migration station used for the radar/visual surveys near the dam site after the raptor migration survey period ended in spring or before it started in fall (spring: Boreal Owl, 1; Short-eared Owl, 5; American Kestrel, 1; Osprey, 5; Red-tailed Hawk, 1; fall: Merlin, 13; Northern Goshawk, 3; Red-tailed Hawk, 1; Sharp-shinned Hawk, 13), which do not represent a high collision risk in the study area due to their low numbers. In addition, there is no reason to suspect that individual raptors passing through the study area before April 12 or after May 11 in 2013 would have been subject to a different risk of collision than would later- or earlier-migrating individuals of the same species.
USFWS_pp10.14-2_ph4	*Modification 1 [Objective 1] : Nest surveys have successfully documented cliff nesting raptors, Bald and Golden Eagles, but have not been successful for woodland raptor species,*	As explained below in Section 2.7.10.2, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $150,000–250,000.

Reference Number	Comment or Study Modification Request	AEA's Response
	including owls and smaller raptors. The USFWS recommends developing survey protocols to identify woodland raptors, including owls and smaller raptors that have not been successfully documented in other surveys.	
USFWS_pp10.14-2_ph5	*Modification 2 [Objective 1]: The USFWS recommends at least one, and possibly more, additional years of surveys will be needed to characterize occupancy, productivity, and migration rates of eagles. In the case of Golden Eagles, surveys in years of high prey availability will be necessary. Both surveys that have been completed to this point have been in years of low prey productivity. Additional years of surveys will be required in order to get acceptable estimates of eagle/other raptor migration numbers and rates. This is because of inter-annual variability, which can be particularly high for Golden Eagles, and the fact that 2013 was an extremely anomalous year in Alaska, in terms of spring and summer weather and this likely affected migration timing and perhaps routes (Steve Lewis, pers. comm.).*	As explained below in Section 2.7.10.3, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $300,000–400,000.
USFWS_pp10.14-3_ph2	*Modification 2 [Objective 1]: The Surveys of Eagles and Other Raptors Study has documented the use of the proposed reservoir inundation area by eagles and raptors within a 3-mile buffer area of the reservoir site (10 miles for Golden Eagles). However, it does not address raptor populations downstream of the proposed dam site. The creation and operation of such a large dam structure will alter river flow and hydrology for many miles downstream. Initial results of the open-water flow routing model indicate post Project operations will drastically change the flow hydrograph for the Middle and Lower rivers. Raptor use of the area downstream of the Project was not part of this study; however, it should be considered. As the hydrology of the river system changes the use of the system by raptors will also change. A pre-construction baseline of the raptor use below the proposed dam is necessary to fully understand the effects of the project on raptors.*	As explained below in Section 2.7.10.4, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $100,000–140,000.

2.7.10.1. Response to Modification Request to Change the Golden Eagle Survey Protocol

USFWS (USFWS_pp10.14-1_ph1b) recommends that a methodology employed by Golden Eagle expert Carol McIntyre be implemented, whereby the survey helicopter would return and land near "possibly occupied nests" and the study team would observe the nest for an hour or two. USFWS states that this method would reduce the number of "possibly occupied" nests.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. USFWS's proposal to modify the occupancy survey methodology is not based on AEA's implementation of the study, but rather seeks to question FERC's original Study Plan determination itself, without any reference to the substantial work AEA has already completed pursuant to the FERC-approved Study Plan. Because the purpose of the ISR process is to evaluate AEA's progress in meeting Study Plan objectives through the methods implemented to date, this proposed study plan modification should be rejected as beyond the scope of the ISR process.

USFWS's proposed modification overlooks that it previously agreed to the study methods implemented by AEA. The occupancy survey methods used in this study were developed during the study planning phase in consultation with USFWS staff (including Jordan Muir, Alaska Region eagle permitting biologist) in a meeting on April 11, 2012, and were included in the Study Plan approved by FERC. Moreover, the methodologies approved by FERC and implemented by AEA are consistent with USFWS guidance (Pagel et al. 2010), which states that, for helicopter surveys, accompanying ground observations are not standard practice; rather, they are possible augmentation if deemed more convenient or efficient or in areas with other sensitive wildlife species. Additionally, ground observations are not standard practice for USFWS Golden Eagle surveys (e.g., raptor surveys along the Denali Highway in 2015, in which ABR biologists conducted nesting surveys under contract to USFWS).

Finally, the proposed changes in occupancy survey methodology proposed by USFWS would add to the cost of this study. AEA estimates that this modification would add approximately $30,000–60,000 to the study budget per year—all in an effort to refine a scientifically acceptable employed methodology that USFWS and FERC already have approved, and which AEA has implemented.

While AEA does not believe that the refinements to the occupancy survey methods are warranted to meet the objectives of Study Plan 10.14 and otherwise assess Project-related effects on Golden Eagles for purposes of FERC's licensing of the Project, AEA recognizes that further surveys may be appropriate as part of a future permitting application under the Bald and Golden Eagle Protection Act (BGEPA), as USFWS-preferred survey methods for the BGEPA permitting program may be refined by the time AEA applies for any required BGEPA permit. At that time, AEA looks forward to working with USFWS to develop any additional surveys that may be warranted to address permitting requirements under the BGEPA.

2.7.10.2. Response to Modification Request to Develop a Survey Protocol for Small Woodland Raptors

USFWS (USFWS_pp10.14-2_ph4) recommends developing survey protocols to identify woodland raptors, including owls and smaller raptors, which it asserts have not been successfully documented in other surveys.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established “good cause” as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

USFWS incorrectly asserts that woodland raptors have not been successfully documented in other surveys. Large species of woodland raptors (Red-tailed Hawk, Great Horned Owl, Great Gray Owl) were addressed by aerial transect surveys in the proposed inundation area and in nesting surveys for Bald Eagles. Small species of woodland raptors (Boreal Owl, Northern Hawk Owl, Sharp-shinned Hawk, Merlin, American Kestrel) were addressed by a combination of surveys for landbirds and shorebirds (Study 10.16) and the Evaluation of Wildlife Habitat Use (Study 10.19) (see RSP Section 10.14.4.1). Moreover, USFWS’s proposed modification overlooks that it previously agreed to the study methods implemented by AEA. In a technical work group meeting during study plan development on September 6, 2012, USFWS staff agreed that the latter approach would be acceptable for small species of woodland raptors and that winter surveys for forest owls would not be needed.

One season of intensive aerial transect surveys for large woodland raptors was conducted in the reservoir inundation zone and dam/camp facilities area in 2013, as was reported in Study 10.14 ISR Part A, Sections 4.1, 5.1, and 6.1. Although some nests of large tree-nesting raptors were found, the study team concluded that the survey method could be improved, so the Study Plan was modified accordingly to increase the survey intensity and better evaluate sightability, as described in ISR Part C, Section 7.1.2, and ISR Part D, Section 7.1. Tree-nesting species of large owls (Great Horned Owl, Great Gray Owl) are readily detectable during transect surveys for woodland-nesting raptors, and other tree-nesting raptor surveys (e.g., Bald Eagle) in Interior Alaska because they use similar habitats.

The study team’s reasoning for not conducting targeted surveys of small species of woodland-nesting owls (Northern Hawk Owl, Boreal Owl), falcons (Merlin, American Kestrel), and Sharp-shinned Hawks was explained in wildlife technical working group meetings during the study planning process and was reiterated in the ISR meetings in October 2014 and March 2016. Nesting surveys for the small tree-nesting species of owls (Boreal Owls) need to be done at night in late winter, which presented substantial safety and logistical concerns in this remote study area. It was anticipated that small diurnal raptors (Northern Hawk Owl, small hawks and falcons) were likely to be detected during landbird/shorebird point counts and ground-based transect surveys, which were distributed throughout the study area, and could be addressed further through a review of the literature and incorporation in the evaluation of wildlife habitat use. Therefore, during the study planning process, the USFWS and other members of the wildlife technical working group agreed with AEA that these species would be assumed to be present and would be addressed in Study

10.19 to quantify the spatial distribution and extent of habitats likely to be used by these species. The same approach is being used for ground-nesting species of raptors (Northern Harrier, Short-eared Owl). Extensive aerial surveys of raptors in 2012–2014 and point counts and ground-based transects for landbirds and shorebirds in 2013–2014 detected low numbers of these species, indicating that they are uncommon or rare in the study area.

Vigilant raptor survey teams flew thousands of miles for hundreds of hours over the variety of raptor habitats in the study area; therefore, large woodland raptor nests would have been detected if they were present. Trained landbird/shorebird teams collected data at hundreds of locations throughout the variety of habitats used by small woodland raptors, so they would have been detected if they were present (except for Boreal Owls). AEA's study team biologists have detected nests of large woodland raptor species and small woodland raptor species on other, much smaller studies in the Alaska Interior (e.g., raptor surveys in the Livengood area, along the Tanana River for the Alaska Railroad, Livengood point counts, Pebble point counts, Chuitna point counts). The overall average higher elevation of the Susitna project area may account for the lower densities of woodland raptors detected there, compared with other interior sites.

Finally, the modification proposed by USFWS would add tremendous cost that would exceed any benefit derived from implementing survey protocols to identify woodland raptors, including owls and smaller raptors. AEA estimates that this modification would add approximately $150,000–250,000 to the study budget—all in an effort to largely duplicate the information that has been or will be developed in this study and components of Studies 10.16 and 10.19.

For these reasons, USFWS's proposed Study Plan modification is unnecessary and should not be adopted by FERC.

2.7.10.3. Response to Modification Request for Additional Years of Eagle Surveys, Including During Years of High Prey Availability

USFWS (USFWS_pp10.14-2_ph5) recommends at least one, and possibly more, additional years of surveys to characterize occupancy, productivity, and migration rates of eagles, further requesting that, in the case of Golden Eagles, surveys conducted in years of high prey availability will be necessary.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, USFWS has not established "good cause" for additional surveys as required by the ILP regulations, nor has USFWS or demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous conditions.

Although USFWS claims that anomalous weather conditions occurred in 2013, as explained in Section 1.5.1, 2013 did not involve "anomalous environmental conditions" for purposes of 18 CFR 5.15(d)(2). While it is true that 2013 experienced unusual weather conditions, the Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and USFWS makes no showing that the meteorological conditions in 2013 impaired the value of the collected data for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of conducting additional years of eagle surveys would be considerably high.

USFWS also makes no showing that AEA failed to implement the Study Plan for Study 10.14 "as provided for in the approved study plan," as required under 18 CFR 5.15(d)(1). Rather, USFWS disagrees with the FERC-approved Study Plan itself, stating that additional years of eagle surveys are needed even before the planned years of surveys have been completed. Thus, it is premature for the USFWS to seek additional surveys at this time, before AEA has completed the surveys required in the FERC-approved Study Plan. A final year of nesting surveys and another year of spring and fall migration surveys are planned for this study, as described in Study 10.14 ISR Part D Section 8. It should be noted that three years of nesting surveys have been conducted to date (2012–2014), exceeding the two years required in the FERC-approved Study Plan. In view of the approximately 8–10-year cycle of snowshoe hare abundance in boreal North America, it is seldom practicable to conduct nesting surveys over an entire decade, particularly in view of the tightly prescribed schedule dictated by FERC's ILP.

Finally, the proposed modification to add additional years of eagle surveys would add considerable cost to this study. AEA estimates that this modification would add approximately $300,000–$400,000 to the study budget—even before the results of additional work required by the Study Plan are known.

For these reasons, USFWS's proposed Study Plan modification is unnecessary and should not be adopted by FERC.

2.7.10.4. Response to Modification Request to Extend the Study Area below the Proposed Dam Site

The USFWS (USFWS_pp10.14-3_ph2) requested a study plan modification to "address raptor populations downstream of the proposed dam site," stating that "raptor use of the area downstream of the Project was not part of this study… As the hydrology of the river system changes, the use of the system by raptors will also change. A pre-construction baseline of the raptor use below the proposed dam is necessary to fully understand the effects of the project on raptors." USFWS (USFWS_Study10.14_pp1_ph2c) also asserts that the study area should be expanded to "understand impacts on productivity at the local and larger population level" and to assess habitat availability for raptors that may be displaced following construction of the Project.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

In proposing to extend the study area for Study 10.14, USFWS fails to consider the areas actually surveyed and the interrelated studies for evaluating Project effects in the License Application. USFWS overlooks that the study area for raptors includes an extensive area outside of the proposed reservoir inundation zone, and was developed through consultation with USFWS staff in a series of technical work group meetings during the study planning process (most notably in a meeting on April 11, 2012), culminating in the version described in the FERC-approved Study Plan.

As described in the FERC-approved Study Plan Section 10.14.3, for Golden Eagles, 10 miles is the survey radius typically recommended by the U.S. Fish and Wildlife Service (USFWS) for Golden Eagles (Pagel et al. 2010) in areas that contain suitable nesting habitat. After consultation with AEA, the USFWS agreed to a 10-mile survey radius around the proposed reservoir inundation zone to calculate a mean inter-nest distance for this species and to a 3-mile radius around proposed facilities and potential access road and transmission corridors (M. de Zeeuw and J. Muir, USFWS, pers. comm., April 11, 2012). For Bald Eagles and other raptor species, the radius of 3 miles around the reservoir inundation zone, proposed facilities, and centerlines of the potential access road and transmission line corridors was considered to be sufficient to meet the study needs (M. de Zeeuw and J. Muir, USFWS, pers. comm., April 11, 2012).

Because of the 3-mile radius around the alternative access corridors, all raptor nesting surveys extended across an area 6 miles wide along the Gold Creek alignment, including 44 river miles of the mainstem Susitna River downstream from the proposed dam site to Gold Creek (see Study 10.14 ISR Part A Figure 3-1). Hence, a pre-construction baseline of raptor nesting below the proposed dam has been conducted for a distance of 44 river miles below the proposed dam site.

Furthermore, with regard to the downstream area in the Middle and Lower river reaches, it is relevant to note that raptors will be part of the Evaluation of Wildlife Habitat Use (Study 10.19), which includes the riparian zone extending downstream as far as PRM 30, based on the Riparian Vegetation Mapping (Study 11.6). The riparian instream flow modeling being conducted for the Project will predict post-construction habitat changes that may occur during Project operations, enabling prediction of potential effects on raptor habitats downstream from the proposed dam. That evaluation will address potential changes in nesting habitat (e.g., stands of large spruce and cottonwood) and foraging habitat (e.g., fish habitat) for Bald Eagles and other large species of tree-nesting raptors. Golden Eagle nesting and foraging habitats are mostly removed from the riverine habitats that may be affected by flow alterations. Moreover, modeling and other work conducted to date demonstrate that flow alterations due to Project operations will significantly attenuate the further downstream from the dam site, especially below the Three Rivers Confluence and changes to flows, river stage and sediment will be minimal below the Yentna River confluence. See Section 1.5.3 above.

Finally, the proposed modification to expand the study area would add tremendous cost to this study. AEA estimates that this modification would add approximately $100,000–$140,000 to the study budget—all in an effort to largely duplicate the information that has been or will be developed in this study and components of Studies 10.19, 11.5, and 11.6.

For these reasons, USFWS’s proposed Study Plan modification is unnecessary and should not be adopted by FERC.

2.7.10.5. References Cited

Pagel, J. E., D. M. Whittington, and G. T. Allen. 2010. Interim Golden Eagle technical guidance: Inventory and monitoring protocols and other recommendations in support of eagle management and permit issuance. U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Washington, D.C. 30 pp.

Shook, J. E., J. H. Welch, and R. J. Ritchie. 2013. Surveys of Eagles and Other Raptors; Susitna–Watana Hydroelectric Project (FERC No. 14241). 2012 technical memorandum prepared for the Alaska Energy Authority, Anchorage, by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 32 pp. + appendices.

USFWS. 2013. Eagle Conservation Plan Guidance, Module 1—Land-based wind energy, version 2. Division of Migratory Bird Management, Falls Church, VA. 103 pp.

2.7.11. Study 10.15 – Waterbird Migration, Breeding, and Habitat Use

As established in the Study Plan (RSP Section 10.15.1), the overall goal of this study is to collect baseline data on waterbirds migrating through and breeding in the Project area and surrounding study area to enable assessment of the potential impacts of the Project and to inform the development of appropriate protection, mitigation, and enhancement measures. As used here, "waterbirds" is applied broadly to include swans, geese, ducks, loons, grebes, cranes, cormorants, herons, gulls, and terns. Shorebirds frequently are included in the general category of waterbirds, but they are addressed separately for this Project under Study 10.16 (Landbird and Shorebird Migration, Breeding, and Habitat Use) because the ground-based survey methods for shorebirds are similar to those used for landbirds. The Study Plan for the Waterbird Study includes breeding surveys for the Harlequin Duck, a species of conservation concern that requires specific stream-survey techniques.

The study objectives are established in RSP Section 10.15.1:

- Document the occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds migrating through the Project area in spring and fall.
- Document the occurrence, distribution, abundance, productivity, and habitat use of waterbirds breeding in the Project area.
- Review available information to characterize food habits and diets of piscivorous waterbirds documented in the study area as background for the Mercury Assessment and Potential for Bioaccumulation Study (Study 5.7).

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA does not propose any modifications to Study Plan Section 10.15 other than to consolidate the objective and methods related to mercury analysis of wildlife species under the Mercury Bioaccumulation Study (Study 5.7). The Study Plan (RSP Section 10.15.6) included a decision point to evaluate the results of the ground-based radar and audio-visual migration surveys in the first year of study to determine if a second year of those surveys was necessary. The comprehensive migration surveys completed in 2013 met the study objective to "document the occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds migrating through the Project area in spring and fall". Therefore, no ground-based radar or audio-visual migration surveys were conducted in 2014.

In November 2015, AEA filed with FERC the Study Completion Report (SCR) for Study 10.15. As provided in the SCR, AEA has met the study objectives and this study is now complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, USFWS filed one comment and submitted one study modification proposal for Study 10.15. In addition, USFWS submitted one comment and one study modification to Study 10.16 regarding the ground-based audio-visual and radar migration surveys, which actually were implemented under this study, Study 10.15; these are included here as well. AEA received no comments on AEA's decision point for Study 10.15 outlined above, other than USFWS's request for additional consultation. AEA's responses to the comments can be found in Table 2.7.11-1, with further details in text following the table.

Table 2.7.11-1. Study 10.15 Comments and Responses.

Reference Number	Comment or Study Modification Request	AEA's Response
USFWS_pp10.15-1_ph6	*The low values for migration numbers and rates relative to earlier studies in the area is curious and needs to be more fully explored, especially in light of the anomalous 2013 weather (18 CFR §15.5(d)(2)). The year 2013 has been widely recognized as an extremely anomalous year in Alaska, in terms of spring and summer weather; this likely affected migration timing and perhaps routes (Steve Lewis, pers. comm.). This represents anomalous environmental conditions as described in 18 CFR §15.5(d)(2). No ground-based migration surveys were done in 2014.*	AEA does not agree that spring and summer weather in 2013 amounted to "anomalous environmental conditions" for the purposes of FERC's ILP regulations, 18 CFR § 5.15(d). Please see Section 1.5.1 for further discussion of the conditions in 2013. Moreover, as is explained in more detail below in Section 2.7.11.1, AEA's analysis indicates that the late spring in 2013 did not affect the migration routes or the total numbers and relative composition of species using the study area during migration and the breeding season (see Study 10.15 ISR Part A Appendices B–C and Q–R, and ISR Part B Appendix T). The USFWS does not provide any evidence supporting its assertions, and it is unclear what the USFWS is requesting when it says the migration survey results are "curious and needs to be more fully explored." "Earlier studies in the area" consisted only of those done for the 1980s APA Project and did not collect comparable data on migration numbers and rates, except for aerial surveys of waterbodies, which showed generally comparable data for the same waterbodies sampled in each study (see Tables 5.1-8 through 5.1-10 in the SCR for Study 10.15). AEA also notes that the personal communication from Steve Lewis to Maureen de Zeeuw cited by USFWS (which evidently was in reference specifically to raptor migration rather than waterbirds) is not part of the public record, so it could not be examined for this response.
USFWS_pp10.15-1_ph7	*Modification 1: The Waterbird Migration, Breeding, and Habitat Use Study documented the use of the proposed reservoir area by waterbirds within a 3-mile buffer area of the reservoir. However, it does not address waterbird populations downstream of the proposed dam site. The creation and operation of such a large dam structure will alter river flow and hydrology*	As explained below in Section 2.7.11.2, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification to extend the waterbird aerial surveys during brood-rearing and spring and fall migrations from Gold Creek downstream to PRM 30 is $300,000 per year.

Reference Number	Comment or Study Modification Request	AEA's Response
	for many miles downstream. Initial results of the open-water flow routing model indicate post Project operations will drastically change the flow hydrograph for the Middle and Lower rivers. Post Project operations [sic] Waterbird use of the area downstream was not part of this study; however, it should be considered. As the hydrology of the river system changes the use of the system by waterbirds will also change. A pre-construction baseline of waterbird use below the proposed dam is necessary to fully understand the effects of the project on waterbirds, a USFWS trust resource.	
USFWS_pp10.16-1_bullet6	*Comment submitted regarding Study 10.16:* *[Objective 4 of Study 10.16.] The spring raptor migration survey date range is probably not broad enough to fully account for potential passerine peaks. The spring radar surveys at the dam site may also have been initiated late, given that the peak movement of all birds was recorded just [sic] two days. How much these issues affect passerine, shorebird, or other bird species or group results, or whether this was primarily waterbirds, is not clear from the reporting.*	The raptor migration surveys (Study 10.14) in spring 2013 were not designed or intended to reliably document passerine migration peaks; rather, passerines were recorded incidentally during the raptor migration surveys, providing additional data on that group of species. In contrast, the ground-based audio-visual and radar migration surveys (Study 10.15) in 2013 near the proposed dam site were conducted from April 20 to June 3, as described in the FERC-approved Study Plan Section 10.15.4.1.2. This is a lengthy period that encompassed the peak migration dates in southcentral and interior Alaska of all bird species-groups of interest. See Section 2.7.11.3 below for further detail.
USFWS_pp10.16-2_ph3	*Comment submitted regarding Study 10.16:* *Modification 2: The USFWS recommends further technical discussions regarding the quality and objectives of the migration data, if a second year of radar data collection is not completed, and to explore how more species-specific information may be obtained. First, a single year of data on nocturnal migration patterns cannot provide for an adequate understanding given interannual variation. Also, insofar as potential impacts such as collision risk and reservoir or dam lighting attraction may be species-dependent, a discussion of how more species-specific data may be collected is warranted.*	As explained below in Section 2.7.11.4, AEA requests that FERC not adopt this proposed Study Plan modification. The estimated cost of implementing this modification to conduct another year of ground-based audio-visual and radar surveys of migrating birds at the proposed dam site is $700,000.

2.7.11.1. Response to Comment Regarding Anomalous Winter Conditions in 2013

The USFWS (USFWS_pp10.15-1_ph6) commented that "the low values for migration numbers and rates relative to earlier studies in the area is curious and needs to be more fully explored," especially in light of what it characterizes as an "extremely anomalous year in Alaska" in 2013, in terms of spring and summer weather, and which USFWS states likely affected migration timing and perhaps routes. The USFWS also commented that "no ground-based migration surveys were done in 2014."

It is unclear what the USFWS is requesting when it says the migration survey results are "curious and needs to be more fully explored." "Earlier studies in the area" consisted only of those done for the 1980s APA Project, and those surveys did not collect comparable data on migration numbers and rates, except for aerial surveys of waterbodies, which showed generally similar results for the same waterbodies sampled in both the APA study and this study (see Study 10.15 SCR Tables 5.1-8 through 5.1-10). To sustain a study modification, FERC's ILP regulations require USFWS to file a "proposal to modify" the study (18 C.F.R. §5.15(d)). Simply requesting study results to be "more fully explored" does not meet this requirement, as USFWS has not proposed any changes to the scope, methods, schedule, level of effort, or other aspects of the Study Plan approved by FERC.

As described in RSP Section 10.15.4.1.2 and Study 10.15 ISR Part B, Appendix T, migration numbers and passage rates from the audio-visual and radar migration surveys in the Waterbird Study Area were compared with earlier studies conducted elsewhere in interior and southcentral Alaska (upper Tanana River valley, upper Copper River valley, Tanana Flats, Alaska Range foothills, and upper Cook Inlet), not to earlier studies within the study area (no comparable studies exist for the waterbird study area, except for the aerial survey data presented in the ISR and SCR). These comparisons demonstrated that the study area was not a major migration corridor (see Study 10.15 ISR Part A, Section 6.1.2, and ISR Part B, Appendix T). The continuation of the ground-based audio-visual and radar migration surveys at the dam site in 2014 was a decision point specifically identified in the Study Plan (RSP Sections 10.15.6 and 10.15.8). Because the study area was not a major migration corridor, the decision was made to discontinue the ground-based surveys in 2014.

Although the USFWS claims that anomalous weather conditions occurred in 2013, as explained in Section 1.5.1, 2013 did not involve "anomalous environmental conditions" for the purposes of 18 CFR § 5.15(d)(2). While it is true that 2013 experienced unusually prolonged winter conditions and a delayed spring break-up (although not unusual summer weather, contrary to USFWS's claim), the Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and the USFWS makes no showing that the meteorological conditions in 2013 impaired the value of the collected data for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of conducting additional years of waterbird and migration surveys would be excessive.

Even with the unusual weather conditions in spring 2013, AEA's study team gathered useful data that met the Study Plan objectives. Despite USFWS's claims, there is no indication in the survey data collected by AEA's study team that the late spring of 2013 affected the migration routes or the total numbers and relative composition of species using the study area during migration and the breeding season.

The timing of waterbird migration was approximately 10 days later in the delayed spring of 2013 than in the more "normal" spring of 2014. The time between arrival and dispersal to nesting locations was compressed in 2013, but the total numbers and relative composition of species using the study area during migration and the breeding season were similar between the two years (see Study 10.15 SCR Section 5.1.1.1). The timing of the ground-based migration surveys from April 20 to June 3 in 2013 was broad, intentionally encompassing the known peak migration dates of all species groups of interest, based on the other studies cited (see Study 10.15 ISR Part A, Appendix Q). Hence, the major difference between the late spring in 2013 and in other, more "normal," years was that migration began later in 2013 and was more compressed. Thus, the migration surveys in spring 2013 still sampled the breadth of spring migration.

Contrary to the USFWS comment, it is unlikely that migration routes were altered by the late spring conditions in 2013 (note that the personal communication from Steve Lewis to Maureen de Zeeuw cited in the USFWS request referred to raptors, not waterbirds). Migratory routes typically are related to factors that do not change from year to year, such as the endpoints of migration, the locations of stopover habitats, topographic features that aid in migration, and whether or not the species is a broad-front migrant (e.g., passerines). Thus, while a cold spring may well have delayed species that depend on important stopover habitats for foraging on their way to their breeding areas (or perhaps result in them passing through without stopping), it is unlikely that migrants would change their pathways, particularly in a late spring like 2013 when similar conditions occurred state-wide and not just in the Susitna–Watana study area. In other words, it is unlikely that migrants would have changed their routes during spring 2013 to the north side of the Alaska range or south of the Talkeetna mountains, where conditions were similarly delayed.

Within the study area, the only indication that movement patterns were altered in early spring 2013 was the greater use of the Susitna River that year than in 2014 by waterbirds throughout most of May until waterbodies became ice-free in the surrounding area. It is noteworthy that passage rates measured by the ground-based audio-visual and radar surveys near the proposed dam site were low despite the greater concentration of waterbirds on the river during spring 2013. This result further supports the study conclusion that the area is not a major migration pathway for waterbirds.

2.7.11.2. Response to Modification Request to Extend the Study Area of the FERC-approved Study Plan

Under Modification 1, the USFWS (USFWS_pp10.15-1_ph7) requests that the Waterbird Study Area be extended an unspecified distance below the proposed dam site, presumably along the Susitna River and associated channels and sloughs only and not in adjacent waterbodies away from the river.

AEA requests that FERC not adopt this recommendation because the request does not meet the criteria established in 18 C.F.R. § 5.15(d) for modification of an approved Study Plan. Specifically, USFWS has not established "good cause" as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan or was implemented under anomalous environmental conditions.

As an initial matter, the design of the Waterbird Study Area was developed during consultation with the USFWS and the ADF&G during multiple technical work group meetings during study plan development. Most notable was the Wildlife Technical Working Group meeting on October 4, 2012, in which USFWS staff concurred that the waterbird study area was acceptable; therefore, the agreed-upon study area was included in the RSP and approved by FERC (RSP Section 10.15.3,

Figure 10.15-1). AEA implemented the FERC-approved Study Plan, conducting surveys as described in the RSP.

Furthermore, it is important to clarify that the USFWS incorrectly described the FERC-approved study area in its request as being a "3-mile buffer area of the reservoir." As described in the FERC-approved Study Plan (RSP Section 10.15.3):

> *The study area for waterbirds will encompass lakes, ponds, rivers, streams, and flooded wetlands within a 3-mile buffer area around the Project area (Figure 10.15-1). The 3-mile buffer includes nearly all of the 65 waterbodies surveyed for the original APA Susitna Hydroelectric Project in the 1980s (Kessel et al. 1982), most of which occur in relatively discrete groupings (e.g., see Pre-Application Document [PAD] Figure 4.6-16; AEA 2011). The study area boundary has been extended farther than 3 miles in several places to include waterbodies surveyed by Kessel et al. (1982), such as Stephan Lake, Clarence Lake, and other unnamed waterbodies south of the Susitna River between Kosina Creek and the Oshetna River, but six large lakes surveyed (Kessel's numbers 131–136) between the mouths of the Tyone and Maclaren rivers will be omitted because they are located well upstream from the area that may be affected by the Project.*
>
> *All rivers and streams flowing through the study area buffer will be surveyed for breeding Harlequin Ducks. These stream surveys will extend outside the 3-mile study-area buffer where necessary to cover suitable habitats farther upstream.*

The Project Area includes the inundation zone, the dam and camp facilities, as well as the alternative alignments for the access and transmission corridors. The 3-mile buffer was applied to all components of the Project Area. As depicted in the FERC-approved Study Plan (RSP Section 10.15.3, Figure 10.15-1), the survey area encompassed approximately 44 river miles of the mainstem Susitna River downstream from the proposed dam site to Gold Creek, including adjacent waterbodies and the lower end of tributaries. In addition to the 3-mile buffer around the Gold Creek alignment, aerial surveys specifically examined the Susitna River downstream to Gold Creek during spring until adjacent waterbodies and tributaries became available after break-up and birds moved away from the river into those habitats. Hence, waterbird populations downstream of the proposed dam site were surveyed in the Waterbird Study.

It is important to note that the silty, fast-flowing mainstem of the Susitna River provides low-quality habitat for migrating or breeding waterbirds, in comparison with adjacent waterbodies and wetlands. With regard to the downstream area in the Middle and Lower river reaches, it is also relevant to note that waterbirds will be part of the Evaluation of Wildlife Habitat Use (Study 10.19), which includes the riparian zone extending downstream as far as PRM 30, based on the Riparian Vegetation Mapping (Study 11.6). The riparian instream flow modeling (Study 8.6) will predict post-construction habitat changes that may occur during Project operations, enabling prediction of potential effects on waterbirds downstream from the proposed dam.

The habitat change modeling for Study 8.6 will draw upon data inputs from other aquatic studies. As described in the Instream Flow Study (Study 8.5 RSP Section 8.5.4.6.1.1.5), determining the relationship between mainstem river flow and overtopping or breaching of sensitive off-channel habitats features is necessary to evaluate potential effects of Project operations. Breaching of off-channel habitats due to alteration of flow regime and possibly channel aggradation or degradation is an example of a multiple-resource issue that will be addressed through an integrated riverine process analysis. Changes in sediment transport and associated changes in the morphology of off-channel habitats will be addressed through Fluvial Geomorphology Modeling below Watana Dam (Study 6.6, RSP Section 6.6.4.1.2.1) and the effects of Project operations on aquatic habitat conditions will be evaluated through the Instream Flow Study (Study 8.5 RSP Section 8.5.4.6.1.1.5). One of the steps to complete Studies 6.6 and 8.5 includes measuring inlet elevations at major Middle River side channels and sloughs to calculate breaching flows that affect habitat connectivity. Breaching flows will be analyzed within Middle River Focus Areas and at major side channels and sloughs outside of the Focus Areas to evaluate the representativeness of Focus Area data.

Finally, the proposed modification to expand the study area would add excessive cost to this study. AEA estimates that this modification to extend waterbird surveys farther downstream into the Middle and Lower river reaches would add approximately $300,000 per year to the study budget (more if the study area is widened away from the mainstem Susitna River and sloughs)—all in an effort to largely duplicate the information that has been or will be developed in this study and components of Studies 10.19 and 11.6.

For the reasons explained above, AEA concludes that USFWS's proposed Study Plan modification is unnecessary and should not be adopted by FERC.

2.7.11.3. Response to Comment Regarding the Timing of Migration Surveys

In its comments regarding study Objective 4 for Study 10.16, the USFWS (USFWS_pp10.16-1_bullet6) states that "the spring raptor migration survey date range is probably not broad enough to fully account for potential passerine peaks," further adding that "the spring radar surveys at the dam site may also have been initiated late, given that "the peak movement of all birds was recorded just [*sic*] two days." USFWS adds that it is unclear from the reporting how much these issues affect passerine, shorebird, or other bird species or group results, or whether this was primarily limited to waterbirds.

As an initial matter, the *raptor* migration surveys conducted in spring 2013 as part of Study 10.14 were not designed or intended to reliably document *passerine* migration peaks; rather, passerines were recorded incidentally during the raptor migration surveys, providing additional data on that group of species. In contrast, the ground-based audio-visual and radar migration surveys conducted in 2013 near the proposed dam site as part of this study (Study 10.15) extended from April 20 to June 3, a lengthy period that definitely encompassed the peak migration dates in southcentral and interior Alaska of all bird species-groups of interest, as is demonstrated by the study results presented in Study 10.15 ISR Part A Sections 5.1.2 and 6.1.2, Table 5.1-10, Figures 5.1-3 and 5.1-7, Appendix Q; and the Study 10.15 SCR Section 6.1.1.

AEA does not understand the USFWS comment about "the peak movement of all birds" having been recorded in "just two days"; it definitely was not, as is presented in Study 10.15 ISR Part A, Sections 5.1.2.1.1.1 and 5.1.2.1.2.2, Table 5.1-10, and Figures 5.1-3 and 5.1-7. It is possible that the USFWS reviewer(s) may have misinterpreted the presentation of the migration data, which summarized weekly observations according to the first day of the week (e.g., "Week Starting" column heading in Table 5.1-10); those data show that the highest rates for all birds were recorded during two *weeks* (beginning May 18 and 25, a month or more after the spring sampling began) rather than just two *days*.

The delayed arrival of spring in 2013 makes it highly unlikely that the radar study was initiated too late in the season. For instance, when the radar surveys began in late April, there was nearly complete snow cover in the broad region surrounding the proposed dam site, and fresh snowfall occurred in early May. Because of the late spring in 2013, bird migration was compressed into a shorter period than is typical, and this compression may help to explain the peak movement of birds over a fairly short period in the second half of May.

Some early fall migrants may have been missed by the ground-based audio-visual and radar migration surveys in fall 2013 (as was described in Study 10.15 SCR Section 6.1.2.2.4), but it should be borne in mind that the migration study was not designed to predict the exact amount of bird take that could be expected if the Project were built. Rather, it was designed to evaluate whether or not the area sampled was a major migration corridor and to provide information on migrant species composition, average passage rates, and flight altitudes (RSP Section 10.15.4.1.2)—information that is valuable for a collision risk assessment. Because the ground-based migration surveys targeted passage rates as a primary index of abundance rather than the total number of birds, missing some birds during the course of the study should not affect the ability to assess collision risk and to develop possible protection, mitigation, and enhancement (PM&E) measures in the License Application.

For these reasons, AEA does not agree with USFWS's comments related to the date range of the ground-based audio-visual and radar migration surveys. Rather, AEA maintains that the objectives of the migration study can be met and Project-related effects sufficiently evaluated with the existing data from the radar and audio-visual surveys conducted in 2013, in combination with the aerial survey data collected in 2013 and 2014. No further surveys or other modifications are warranted.

2.7.11.4. Response to Modification Request Regarding the Adequacy of a Single Year of Migration Surveys

The USFWS (Modification 2; USFWS_pp10.16-2_ph3) recommends "further technical discussions regarding the quality and objectives of the migration data, if a second year of radar data collection is not completed, and to explore how more species-specific information may be obtained." USFWS expresses the view that "a single year of data on nocturnal migration patterns cannot provide for an adequate understanding, given interannual variation." USFWS also states that "insofar as potential impacts such as collision risk and reservoir or dam-lighting attraction may be species-dependent, a discussion of how more species-specific data may be collected is warranted."

As an initial matter, it is unclear what the USFWS is seeking in this proposed modification of the FERC-approved Study Plan. Far from submitting a "proposal to modify" the approved plan as required by FERC's ILP regulations in 18 C.F.R. § 5.15(d), USFWS appears to simply be requesting a technical discussion on any future radar data collection; absent from this request is any proposed change to the scope, methods, schedule, level of effort, or other aspects of such a future radar data collection effort. It is relevant to note that characterizing interannual variation in nocturnal migration patterns was not an objective of the FERC-approved Study Plan; the objective pertaining to migration was to "[d]ocument the occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds [and other species, for the audio-visual and radar migration survey] migrating through the Project area in spring and fall," which was accomplished.

Moreover, USFWS has not established "good cause" that a second year of radar data collection is warranted, and it has failed to demonstrate that the radar data collection already completed by AEA in furtherance of this study was either not implemented as provided by the approved Study Plan, or was implemented under anomalous environmental conditions (18 C.F.R. § 5.15). For these reasons, AEA requests that FERC not adopt this recommendation because the request does not meet the required criteria for justifying a modification to the FERC-approved Study Plan under the ILP regulations.

The objectives of the migration study were developed in consultation with the USFWS and are described in the FERC-approved Study Plan. Sections 10.15.6 and 10.15.8 of the approved Study Plan clearly indicate that a decision to conduct a second year of radar and audio-visual sampling would depend on the results obtained in 2013.

During 2013, AEA implemented the methods described in RSP Section 10.15.4.1.2. The Study 10.15 ISR Part A, first released in February 2014, included a summary of the 2013 migration data gathered for this study. Based on the data gathered in 2013, AEA raised the issue of the need for a second year of ground-based and radar migration surveys with the Technical Workgroup on March 6, 2014 (see http://www.susitna-watanahydro.org/wp-content/uploads/ 2014/03/2014-03-06TT_Wildlife_MeetingNotes.pdf) and the topic was discussed with the TWG again on April 9, 2014 (see http://www.susitna-watanahydro.org/wp-content/uploads/2014/05/ Wildlife-Technical-Meeting-Notes_04092014.pdf). In response to those discussions, AEA prepared a supplemental technical memorandum integrating and summarizing the different bird migration survey tasks conducted in 2013 for Study 10.14 and Study 10.15 into a single document (Study 10.15 ISR Part B, Appendix T). This information was prepared specifically to assist the licensing participants in interpreting the migration data collected in 2013 and to compare results with other, similar studies conducted on interior and Southcentral Alaska, as was described and discussed in the Technical Workgroup meetings described above.

As described in Study 10.15 ISR Part C, Section 7.1.1, AEA determined that the data gathered in 2013 met the study objectives and that a second year of audio-visual and radar migration surveys was not warranted. Further rationale for that decision was provided in the Study 10.15 ISR Part C Section 7.1.2, which describes AEA's proposed modifications to the FERC-approved Study Plan:

> *With regard to the first decision point discussed above in Section 7.1.1 (RSP Section 10.15.6), AEA will not conduct a second year of the ground-based migration monitoring effort in 2014 or 2015, based on the results of the radar and visual migration surveys (RSP Section 10.15.4.1.2) conducted in 2013 and reported in Part A and Appendix T of this ISR. The data collected in 2013 for the various avian migration survey tasks (both aerial and ground-based, as reported in ISR 10.14 and this ISR, including Appendix T) corroborate the conclusion of the APA Project*

> *studies in the 1980s (Kessel et al. 1982) that the Project area does not appear to be a major migratory flyway. AEA will continue to work with USFWS, ADF&G, and other licensing participants to ensure that best practices for transmission line siting and infrastructure lighting are incorporated into Project design.*

AEA held two ISR meetings to discuss the progress on AEA's implementation of the Study Plan, including decision points and proposed modifications to the Study Plan. During the October 2014 ISR Meeting, the USFWS indicated that it was not prepared to discuss the avian studies but had written comments to file (http://www.susitna-watanahydro.org/wp-content/uploads/2014/11/Oct21_ISR_Meeting_PartA_Transcripts.pdf). During the ISR Meeting on March 29, 2014, USFWS staff indicated that written comments would be filed, but, citing limited staff resources, were not able to discuss the ISR, the decision point from the FERC-approved Study Plan or AEA's proposed modification (http://www.susitna-watanahydro.org/wp-content/uploads/2016/04/2016_03_29_ISR_Meeting_Summary.pdf).

In its request, the USFWS would like further consultation to discuss the quality of the data, the study objectives, and further collection of species-specific data. However, as supported by the record described above, the USFWS has had more than two years for these discussions and has not provided any technical feedback on the adequacy or "quality" of the data or identified any species that are of concern. Furthermore, the USFWS has not provided any analysis of the data supporting the need for a second year of data to meet the objectives of the FERC-approved Study Plan.

The objectives of the migration surveys were to (1) determine whether or not the proposed dam site was located in a major bird migration corridor and (2) collect information on migrant species composition, average passage rates, and flight altitudes to inform a general risk assessment for collision hazard and to facilitate the development of mitigation measures to minimize collision risk. The study was not designed to assess interannual variation in the number of birds migrating through the area, nor was it intended to estimate the number of bird "takes" that could be expected due to development of the Project. Information on interannual variation in migrant bird numbers and estimates of the number of possible "takes" is not necessary to develop appropriate mitigation measures to minimize bird collision risk. Rather, development of PM&Es will be based on best practices for the siting, design, and construction of transmission lines and on appropriate lighting of Project structures to minimize attraction and collision risk for birds while not compromising human safety. Collecting species-specific migration data in a radar and audio-visual migration study is only possible when simultaneous visual observations or auditory identifications of calling migrant birds can be linked to the radar targets identified on-screen. It is not clear to the study team that additional radar and audio-visual surveys will yield any more specific information on the individual species that migrate past the proposed dam site area over what was collected during the 2013 surveys.

Finally, the proposed modification to add an additional year of ground-based radar and audio-visual migration surveys at the proposed dam site would add excessive cost to this study. AEA estimates that this modification would add approximately $700,000 to the study budget—even though the information gathered to date fulfilled the Study Plan objective and otherwise facilitates evaluation of Project effects on migrating waterbirds.

For these reasons, AEA maintains that the objectives of the migration study can be met with the existing data from the radar and audio-visual surveys conducted in 2013, and therefore that USFWS's proposed study plan modification is unnecessary and should not be adopted by FERC.

2.7.12. Study 10.16 – Landbird and Shorebird Migration, Breeding, and Habitat Use

As established in the Study Plan (RSP Section 10.16.1), the overall goal of this study is to collect baseline data on the occurrence, distribution, abundance, and habitat use of breeding landbirds and shorebirds in the Project area to enable assessments of the direct, indirect, and cumulative impacts on these birds from construction and operation of the proposed Project. This study was designed to provide data on species of conservation concern, both landbirds and shorebirds, that are known or expected to occur in the Project area, as well as numerous other bird species that are protected under the federal Migratory Bird Treaty Act.

The study objectives are established in RSP Section 10.16.1:

- Collect data on the distribution and abundance of landbirds and shorebirds during the summer breeding season.
- Identify habitat associations for landbirds and shorebirds.
- Evaluate changes in distribution, abundance, and habitat use of landbirds and shorebirds through comparison with historical data.
- Characterize the timing, volume, direction, and altitude of landbirds and shorebirds migrating through the dam and camp facilities area (reported in the Study Completion Report for Study 10.15, Waterbird Migration, Breeding, and Habitat Use).
- Review the foraging habits and diet literature, and collect feather samples, if possible, for piscivorous and partly piscivorous landbird and shorebird species to inform Study 5.7, Mercury Assessment and Potential for Bioaccumulation.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes three modifications (beyond those that were previously described and implemented in 2013 or 2014) to Study Plan Section 10.16:

1. For the lacustrine-focused surveys, the original bird abundance metric (birds per unit time) will be replaced with the total number of birds recorded on lacustrine water bodies and in adjacent habitats; this change will be implemented during preparation of the SCR (ISR Part C, Section 7.1.2; ISR Part D, Section 7.1);

2. Comparisons of current (2013 and 2014 data combined) and historical (1980s APA Project) data on the occurrence and abundance of breeding landbirds and shorebirds will be made and the results presented in the SCR (ISR Part C, Section 7.1.2; ISR Part D, Section 7.1); and

3. The possible collection of feathers from Belted Kingfishers for mercury analysis in support of Study 5.7 (Mercury Assessment and Potential for Bioaccumulation) has been consolidated under that study (ISR Part C, Section 7.1.2; ISR Part D, Section 7.1).

In addition, as explained in ISR Part D, Section 7.2, AEA has determined that the current data set is sufficient to meet the study objectives and that an additional year of sampling is not needed. With regard to the point-count survey, the volume of point-count survey data collected in the two study years was well above (70 and 50 percent greater than) the annual sampling goal set forth in the RSP (Section 10.16.8), and all portions of the study area, including CIRWG lands, have now been surveyed. This study likely represents the most intensive and spatially extensive point-count study conducted in a single project area in Alaska, and sufficient point-count data are available to conduct the final habitat-use analyses and density calculations for landbirds and shorebirds in the study area. These data will enable quantitative determinations of the amount of breeding habitat for landbirds and shorebirds that could be lost and altered by development of the proposed Project, and will allow for at least an approximation of the minimum number of landbirds and shorebirds that could be affected. For the riverine- and lacustrine-focused surveys, sufficient data also were collected in the two study years to describe adequately and quantify the use of those habitats and shorebirds in the study areas for those two surveys, and to provide minimum estimates of the numbers of landbirds and shorebirds in riverine and lacustrine habitats that could be affected by the proposed Project. Finally, the study team's implementation of a more efficient survey platform for colonially nesting swallows in the single survey year (2013) facilitated the survey of a larger study area than originally planned in the RSP (10.16.3). The current data are sufficient to quantify the use of the study area by colonially nesting swallows, and will allow for a minimum estimate of the number of nesting swallows that could be affected by development of the proposed Project.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, USFWS filed five comments and submitted two study modification proposals for Study 10.16. One of the comments and one of the modifications pertain to the avian ground-based visual and radar migration study being conducted under Study 10.15; those are provided here but discussed in detail in Section 2.7.11 of this document. USFWS also commented on AEA's proposal to modify the Study Plan not to require an additional year of nesting swallow surveys. ADF&G provided comments on AEA's proposed modifications to Study 10.16 and AEA's decision that additional data collection is not necessary to meet study objectives, as outlined above. AEA's responses to the Study 10.16 comments and study modification proposals can be found in Table 2.7.12-1, with further detail below.

Table 2.7.12-1. Study 10.16 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp16_ph2	*This study characterizes the occurrence, distribution, abundance, and habitat use for breeding landbirds and shorebirds in the project area. We agree with the three proposed study modifications and based on the reasons provided, we believe the additional fieldwork is not necessary to meet study objectives.*	AEA appreciates ADF&G's constructive participation in the development of this study plan and review of study implementation within the context of the FERC ILP. AEA concurs that the FERC-approved study objectives have been met.
USFWS_pp10.16-1_bullet1	*[Objective 1.] The Service has concerns that detectability of songbirds was not corrected for the drop in singing rates that occurs mid-morning, though the final distance analyses may exclude late-morning survey data that*	So as to avoid any possible downward biases in uncorrected abundance estimates and in the density estimates corrected for detectability, and following the recommendations of Handel and Cady 2004 for point-count surveys in

Reference Number	Comment or Study Modification Request	AEA's Response
	could introduce downward biases in density estimates. Point count surveys regularly extended until noon or 1 pm, well past the time when singing rates drop off and standard survey protocol recommends ending (Handel and Cady 2004, Ralph et al. 1993).	Alaska, the final analyses of songbird abundance derived from point-count data will exclude data collected later than 5 hours after local sunrise. AEA simply neglected to make this required correction in the first proof-of-concept distance analyses for the ISR (see Section 2.7.12.1 below for additional discussion).
USFWS_pp10.16-1_bullet2	*[Objective 1.] Colonially nesting swallow surveys in the next study season will provide another year of data to improve the abundance estimates reported in this ISR. As with other landbird species, swallow abundance is likely to fluctuate substantially between years as a result of variability in reproductive success and survivorship. For this reason, a second year of surveys will be helpful in understanding the abundance of breeding swallows in the study area. Additional surveys also will result in a better understanding of swallow nesting activity, habitat use, and colony location changes throughout the study area. The 2013 results in combination with another study year may provide sufficient data to meet the study objectives, provided Service concerns with detectability, survey phenology, and/or habitat selection.*	AEA disagrees that a second year of colonially nesting swallow colonies is necessary to meet study objectives. As explained in Section 2.7.12.2 below, AEA believes that the Commission should accept AEA's proposed modification of the Study Plan to eliminate an additional year of colonially nesting swallow surveys, despite USFWS's stated concerns.
USFWS_pp10.16-1_bullet3	*[Objective 2.] Preliminary habitat associations have been completed; however, the Vegetation and Wildlife Habitat Mapping Study (Study 11.5) will be used as the basis for the final analyses. It has not yet been completed.*	This comment pertains to the data that will be used from an interrelated study (Study 11.5). AEA is currently in the initial study reporting phase of the licensing process and Study 11.5 has not yet been completed. The interrelated studies (Study 10.16 and 11.5) were designed to collect information that will be needed for comprehensive analyses of the potential impacts of the Project across several different study disciplines. Impact analyses will appear in the License Application, Exhibit E (Environmental Exhibit). The final landbird and shorebird habitat associations will be prepared based on the final set of mapped wildlife habitat types prepared for Study 11.5, and will be reported in the USR for Study 10.16.
USFWS_pp10.16-1_bullet6	*[Objective 4.] The spring raptor migration survey date range is probably not broad enough to fully account for potential passerine peaks. The spring radar surveys at the dam site may also have been initiated late, given that the peak movement of all birds was recorded just [sic] two days. How much these issues affect passerine, shorebird, or other bird species or group results, or whether this was*	The migration surveys were conducted under FERC-approved Study Plan 10.15. Please refer to the response under Section 2.7.11.3 of this document.

Reference Number	Comment or Study Modification Request	AEA's Response
	primarily waterbirds, is not clear from the reporting.	
USFWS_pp10.16-2_ph2	*Modification 1: The USFWS recommends additional year(s) of sampling. There are several reasons why additional years of point count and riverine/lacustrine sampling are warranted. For example, additional sampling can be argued based on a stated target for precision of the density of population size estimates (say CV ≤ 0.15). Also, migrants arrived late in both 2013 and 2014 so and the additional year of 2015 is only planned for 27% of the study area. If density estimates are to be calculated by habitat, then additional samples may be needed to fill in poorly sampled habitats. Minimum sample sizes for estimating detection functions are 75–100 detections so additional sampling could be justified.*	As explained below in Section 2.7.12.3, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $650,000 for each additional year of sampling.
USFWS_pp10.16-2_ph3	*Modification 2: The USFWS recommends further technical discussions regarding the quality and objectives of the migration data, if a second year of radar data collection is not completed, and to explore how more species-specific information may be obtained. First, a single year of data on nocturnal migration patterns cannot provide for an adequate understanding given interannual variation. Also, insofar as potential impacts such as collision risk and reservoir or damlighting attraction may be species-dependent, a discussion of how more species-specific data may be collected is warranted.*	The migration surveys were conducted under FERC-approved Study Plan 10.15. Please refer to the response under Section 2.7.11.4 of this document.
USFWS_pp10.16-2_ph4	*Modification 3: The USFWS recommends broadening the scope of the Study to include areas below the Project. Initial results from the open water flow routing model show the post Project flow hydrograph for the Middle and Lower river will drastically change. The Project has the potential to not just impact landbirds and shorebirds within the project footprint, but for many miles downstream.*	As explained below in Section 2.7.12.4, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $300,000–$350,000 for each year of sampling.

2.7.12.1. Response to Comment Regarding the Need to Correct the Songbird Density Calculations

The USFWS (USFWS_pp10.16-1_bullet1) has concerns that detectability of songbirds was not corrected for the drop in singing rates that occurs mid-morning. To avoid any possible downward biases in uncorrected abundance estimates and in the density estimates corrected for detectability, AEA confirms that final analyses of songbird abundance derived from point-count data will exclude data collected later than 5 hours after local sunrise, following the recommendations of Handel and Cady 2004 for point-count surveys in Alaska. AEA simply neglected to make this required correction in the first proof-of-concept distance analyses for the ISR. The corrected abundance analyses will be presented in the USR for Study 10.16. In Section 2.7.12.3 below, AEA presents information indicating that, after removal of point-count data collected beyond 5 hours after sunrise, there are still sufficient data to calculate densities for the common species that occur in the study area and thus meet the study objectives.

The data collected later than 5 hours after sunrise were acquired, in part, to further inform the habitat-association analyses for the landbird-shorebird study. For example, those additional habitat-use data can be used to augment the average occurrence values (calculated for each bird species and wildlife habitat type) and confirm the use of a particular habitat, especially for the less common species for which there are fewer observations. The collection of additional point-count data beyond 5 hours after sunrise also was done to acquire additional data on shorebird species, which can be detected readily throughout the day, and to make efficient use of the time allotted for the field surveys, rather than capping each field survey day at 5 hours. It is important to note as well that it is the habitat association information that can be used to assess impacts for all species recorded in the study area, not just the subset of common species for which density estimates can be calculated (see additional discussion of this point in Section 2.7.12.3 below).

2.7.12.2. Response to Comment Regarding the Need for a Second Year of Colonially Nesting Swallow Surveys

The USFWS (USFWS_pp10.16-1_bullet2) recommends a second year of colonially nesting swallow surveys to improve the abundance estimates reported in this ISR and gain a better understanding of swallow nesting activity, habitat use, and colony location changes throughout the study area, noting that swallow abundance likely fluctuates substantially between years as a result of variability in reproductive success and survivorship.

Although the Study Plan (RSP Section 10.16.4.3) indicates that two years of swallow surveys would be conducted, because the survey coverage and efficiency in 2013 was substantially greater than as described in the Study Plan (see below), AEA only conducted surveys in 2013. The swallow surveys were discussed at the Wildlife Technical Meeting on March 6, 2014, when it was noted that the second survey season, if needed, would be postponed until 2015; there were no licensing participant comments on the swallow surveys at that meeting. The March 6, 2014 meeting notes are available online at the link below:

http://www.susitna-watanahydro.org/meetings/past-meetings/

The objectives of this component of the landbird and shorebird study, as described in RSP Section 10.16.1, were the same as the objectives of the full study: (1) collect data on the distribution and abundance of [colonially nesting swallows] during the summer breeding season, (2) identify habitat associations for [colonially nesting swallows], and (3) evaluate changes in distribution, abundance, and habitat use of [colonially nesting swallows] through comparison with historical data. AEA maintains that the first two objectives have been met with the data collected in 2013 (see below), and disagrees that a second year of colonially nesting swallow surveys is necessary. The third objective, to compare current data with the historical (1980s) data, will be met during preparation of the USR for Study 10.16. AEA notes that the USFWS has not provided any specific information to indicate how the data collected in 2013 are insufficient to meet the study objectives;

rather, the USFWS request is focused simply on obtaining additional information on annual variability in colonially nesting swallow numbers and more information on swallow nesting activity, habitat use, and potential colony location changes in the study area.

AEA understands concerns regarding the variation in swallow abundance across years. AEA maintains, however, that there will be diminishing returns, in terms of the information acquired for the effort expended, in conducting a second field survey for colonially nesting swallows. This is because the suitable habitats for swallow colonies in the study area (steep slopes and cut banks along the Susitna River and the lower stretches of its major tributary streams) were clearly identified and adequately surveyed in 2013. As described in Study 10.16 ISR Part A Section 4.3.1, the colonially nesting swallow surveys in 2013 were conducted using a much more efficient survey platform; a helicopter survey was used to locate swallow nesting colonies rather than the boat-based survey described in the RSP (Section 10.16.4.3). This change allowed greater survey coverage of suitable habitats, and the field team was then able to enlarge the study area substantially. In 2013, the study area for the swallow surveys was expanded to include a 2-mile buffer surrounding the proposed reservoir and dam and infrastructure area (Study 10.16 ISR Part A Section 4.3.1); this compares to the study area proposed in the RSP (Section 10.16.3), which included just the dam and infrastructure area and the innudation zone of the reservoir, with no buffer. These changes allowed the field team to survey all potential swallow nesting habitat in areas that could be directly or indirectly affected by the proposed Project (i.e., with the inclusion of colonies very near to but not expected to be directly inundated by the proposed reservoir).

In this expanded survey area, all areas of suitable habitat in the study area were searched for nesting swallows in 2013 (see Study 10.16 ISR Part A, Section 4.3). It is important to note also that the detectability of swallow colonies is high because of the very visible flights of birds in and out of burrows. The swallow surveys in 2013 also were timed appropriately (delayed) for the late arrival of passerines in the spring of that year (compare RSP Section 10.16.4.3 to Study 10.16 ISR Part A Section 4.3). In 2013, the locations of colonies on high slopes were identified and information also was collected on the establishment of new colonies on lower, freshly exposed cutbanks (see below). AEA expects that the colonies on high slopes are used annually because they are difficult to access by predators and reproductive success at those sites is probably high. Reproductive success in swallows is greater for higher and deeper burrows (Hoogland and Sherman 1976; Cramp et al. 1988; Sieber 1980). At the new colonies established on freshly exposed cutbanks, there is evidence that reproductive success could be low or zero at some colonies (see below), hence these more marginal sites likely are not reused in subsequent nesting seasons. However, because Bank Swallow colonies generally are located in unstable, eroding habitats, it is thought that substantial annual turnover in colony occupancy may occur (Garrison 1999).

The data from 2013 suggest that swallow numbers likely were not abnormally low that year because of the observed use of freshly exposed cut banks for nesting. This indicates that the (presumably preferred) high slope sites, which provide greater isolation from predators, likely were already occupied so that later-arriving swallows were able only to make use of lower and freshly exposed cut banks. Those new and lower cut banks may not have provided a sufficient height above the ground as evidenced by the fact that at least one of those colonies was not successful, likely because of bear predation (Study 10.16 ISR Part A, Section 6.3). Because of this observed use of more marginal sites for nesting colonies, AEA maintains that the nesting swallow numbers were not abnormally low in 2013; rather, the data indicate that there were more swallows in the study area in 2013 than could be accommodated at the most suitable colony sites. Given this, AEA maintains that the data collected in 2013 will provide at least a minimum estimate of the number of colonially nesting swallows that could be affected by the proposed Project. For these reasons, AEA maintains that the objectives of the colonially nesting swallow survey component of Study 10.16 have been met with the existing data collected in 2013.

As described in more detail in Section 2.7.12.3 below, when the impact assessments are conducted for landbirds and shorebirds in the License Application, the impacts will be assessed primarily using quantitative measures of habitat loss and alteration, based on the wildlife habitats mapped in Study 11.5 and the habitat-used evaluation for wildlife species conducted in Study 10.19. This will be done so that similar quantitative habitat information can be used in the preparation of protection, mitigation, and enhancement (PM&E) measures. For colonially nesting swallows, because of the detailed data collected on colonies in 2013, researchers also will be able in include information on the number and locations of the high-slope colonies as well as information on the number and locations of the lower colonies that are more vulnerable to predation; both colony types, depending on their locations, could be innundated by the filling of the proposed reservoir. A minimum number of nesting swallow pairs that could be affected also can be included in the impact assessment from the data collected in 2013. AEA maintains that this combination of habitat-use and abundance data is more than adequate to meet the study objectives and facilitate the preparation of suitable impact assessment and PM&E measures for colonially nesting swallows.

2.7.12.3. Response to Modification Request for Additional Year(s) of Point Count and Riverine/Lacustrine Sampling

The USFWS (USFWS_pp10.16-2_ph2) recommends additional year(s) of point count and riverine/lacustrine sampling.

USFWS asserts that additional sampling can be argued based on a stated target for precision (say a CV ≤ 0.15) in population size estimates based on density calculations. AEA points out that a target level of precision in population size estimates was not stated in the RSP (Section 10.16). Moreover, if used, a target level of precision would, by necessity, apply to the population size estimates for each species separately. With a multi-species study such as Study 10.16, achieving a target level of precision in population size estimates (across all species recorded in the study area) is not a realistic goal within the time frame for collecting baseline data for the Project (see discussion of this point below).

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, USFWS has not established “good cause” as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

Although USFWS claims that anomalous weather conditions occurred in 2013, as explained in Section 1.5.1, 2013 did not involve “anomalous environmental conditions” for purposes of 18 CFR 5.15(d)(2). While it is true that 2013 experienced uncommon weather conditions, the Commission has acknowledged the importance of gathering data over a range of conditions in order to assess Project effects, and USFWS makes no showing that the meteorological conditions in 2013 impaired the value of the collected data for this study. Moreover, when considering anomalous environmental conditions, the Commission considers the cost of producing additional studies, and the cost of gathering additional year(s) of survey data for landbirds and shorebirds would be tremendously high.

Moreover, USFWS does not demonstrate that AEA failed to implement the Study Plan for Study 10.16 “as provided for in the approved study plan,” as required under 18 CFR 5.15(d)(1). Rather, USFWS simply asserts additional years of surveys are needed without providing any basis that the data gathered were inadequate to meet the objectives of the FERC-approved Study Plan.

AEA understands concerns regarding the volume of data required to calculate reasonable density estimates, and for these reasons agreed to conduct intensive point-count surveys for the Project. During the development of the study plan in 2012, the intensity of sampling for this study was discussed in detail and was increased in response to initial USFWS concerns (see Section 8.4 in the Proposed Study Plan). During the field surveys in both 2013 and 2014, the field teams were able to sample far more point-count locations than the annual goal set forth in the FERC-approved Study Plan (RSP Section 10.16.8). In each study year, more than 550 and 400 point counts above the annual Study Plan goal of 800 (over 70 and 50 percent more point counts in each year) were sampled (see Section 7.2.1 in the 2014 Study Implementation Report for Study 10.16). With over 2,500 points sampled over the two study years, this study represents what is likely the most intensive point-count study ever conducted at a local scale for a proposed development in Alaska.

In any effort to try to reduce the variability in density estimates (and achieve a target precision of, say, CV $\leq$ 0.15 in the resulting population estimates for landbirds and shorebirds), there will be diminishing returns for the investment of additional sampling. This is because, with the required random allocation of point-count locations in the study area, most observations during the point-count surveys are of the more common species and generally there already are sufficient data to calculate densities for the common species. For example, in the cumulative data set being used to calculate densities for both study years, and after removal of point counts conducted beyond 5 hours after sunrise, the average number of detections for the 24 species with greater than 75 detections is 412 (range 79 to 1,492). These numbers of detections are sufficient to calculate densities. More sampling certainly would increase the number of detections for these common species, but there are already $\geq$ 100 detections for 22 of those 24 species. In general, more data for common species is not what is needed to reduce the variability in density estimates (across all species) and provide an estimate of the total number of birds that could be affected by the proposed Project.

For the remaining 50 species observed during point counts in the study area, additional sampling likely would increase the number of detections for some species up to the minimum number of observations needed to calculate detection functions, but a minimum number of detections is unlikely to help meet a stringent target level of precision in population estimates. In addition, with additional sampling the process of increasing detection sample sizes for less common species would be slow because there would be fewer detections of less common species amidst the large number of observations of more common species recorded each season. For example, again using the cumulative data set for both study years, and incorporating corrections for point counts conducted beyond 5 hours after sunrise, the data indicate that the average number of annual detections for the remaining 50 species observed during point counts in the study area ranges from

< 1 to 37. Ignoring 27 of those 50 species that have been observed an average of less than 5 times per year—and for which it is unrealistic to obtain a minimum number of 75 detections with less than 17 years of additional sampling—the existing data indicate that, with an average of 5 to 37 detections each year, it could take from 1 to 13 years of additional sampling to obtain a minimum number of 75 detections for the other 23 species. With a single additional survey year, the existing data indicate that a minimum number of 75 detections could possibly be obtained for 5 additional species, depending on the habitats surveyed at randomly allocated point-count locations. After that, with additional years of sampling annual increases in the number of species for which 75 detections could be accrued would remain in the single digits. For these reasons, AEA maintains that the pursuit of significantly reducing the variability in density estimates with increased field sampling will yield only diminishing returns for the investment involved.

It is also important to note how the landbird and shorebird data will be used to assess impacts of the proposed Project and develop PM&E measures in the License Application. In its request for additional year(s) of field sampling to attempt to reduce the variability in density estimates, the USFWS does not demonstrate the need for the additional survey data in assessing Project impacts on landbirds and shorebirds or developing PM&E measures to minimize those impacts. The density calculations, because they will be limited to the common species in the study area (as discussed above), can be used only to provide a rough approximation of the number of birds that could be affected by Project development. The lack of density data for the less common species, including species of conservation concern (which are almost always less common), means that deriving estimates of the numbers of birds, of all landbird and shorebird species, that could be affected by the Project will involve a fair amount of conjecture. Moreover, even with approximate estimates of the number of birds that could be affected by the proposed Project, the fate of birds displaced by a development surrounded by relatively undisturbed habitat is unclear. With the data available, there is no way of knowing how many birds might be lost from the breeding population, because they were unsuccessful in nesting in available habitat nearby, and how many were able to successfully nest elsewhere. Because of these reasons, and because of the need for more accurate quantitative impact information when developing mitigation strategies, the quantitative habitat loss and alteration data (which will be developed for all species, not just the common species) are likely to be more important than density estimates when assessing impacts and developing PM&E measures for landbirds and shorebirds. As noted above, the habitat association data for landbirds and shorebirds will be developed using the wildlife habitat map data from Study 11.5. Then the habitat-use evalution information prepared in Study 10.19, which will rely on the habitat map data from Studies 11.5 and 11.6 and the habitat association data from this study, will be used to calculate the acreages of important breeding habitats for all landbird and shorebird species that would be lost or altered due to Project development (see Section 2.7.12.4 below for more discussion of this process). This impact assessment process, which will be conducted for the License Application, will result in quantitative estimates of habitat effects for all landbird and shorebird species, and will provide the basis for developing quantitative PM&E measures to minimize and offset (via mitigation procedures) the expected habitat impacts to landbird and shorebird species.

AEA maintains that the data collected during the point count and the riverine- and lacustrine-focused surveys over the two planned sampling years—and especially in light of the large volume of point-count data collected (well above the goals set forth in RSP Section 10.16.8) and the extensive sampling periods used in both study years—are more than adequate to meet the objectives of Study 10.16. The existing data will be used (in the License Application) to provide quantitative estimates of the number of acres of important breeding habitats for all species of landbirds and shorebirds, and minimum estimates of the number of birds of the common species of landbirds and shorebirds, that could be affected by the proposed Project.

Also, USFWS asserts that migrant birds arrived late in both 2013 and 2014. AEA is aware that the migration of birds in Southcentral Alaska was delayed in 2013 because of the late spring snow that fell in early May 2013. However, there is no indication that the migration of birds in Southcentral Alaska was late in 2014, and AEA believes the USFWS is mistaken on that point. With regard to the late migration in 2013, and as agreed to with USFWS in the Study Plan process in 2012 (see Section 8.4 in the Proposed Study Plan), the survey timing for Study 10.16 was designed to be flexible to ensure that landbirds and shorebirds would be present in the study area when the field surveys were initiated. In 2013, the study team actively tracked snowmelt in the study area (using information from other researchers working in the area) and delayed the field surveys until snowmelt was evident at the lower elevations. When the point-count surveys were initiated on May 23, 2013, landbirds and shorebirds were present in the study area and some clearly were setting up breeding territories. To ensure that breeding birds would be present at all plots surveyed, the field surveys in early season 2013 were focused on the more snow-free portions of the study area in the east and at lower elevations, and field crews gradually began surveying to the west and at higher elevations as those areas became more snow free. Field surveys in 2014 were started slightly earlier (20 May), but the same pattern in snowmelt in the study area occurred in 2014 as well (lingering snow in the west and at higher elevations). As in 2013, the field surveys in 2014 were conducted by tracking snowmelt in the study area to ensure that breeding birds would be present at all plots surveyed. The survey periods in both 2013 and 2014 extended until the third week in June, a period that encompassed the nest initiation and incubation periods for the migratory shorebirds and landbirds in the study area. The survey period for this study was discussed in detail during the development of the study plan during 2012 and was extended to encompass nearly four weeks of continuous sampling in response to USFWS concerns (see Section 8.4 in the Proposed Study Plan). FERC approved the sampling period and AEA implemented the FERC-approved Study Plan.

USFWS notes that the additional year of sampling in 2015 was only planned for 27 percent of the study area. The 27 percent figure encompasses the areas that were unsurveyed in 2013 (CIRWG lands, the north and westerns portion of the Denali West Option Corridor, and the Denali East Option Corridor). However, the USFWS misinterpreted the ISR on this point. In the ISR (Study 10.16, Part C, Sections 7.1 and 7.2), AEA indicates that it will conduct a second year of point-count and riverine and lacustrine surveys, but the survey year is indicated as 2014, not 2015. Additionally, AEA states that the sampling will occur throughout the full study area and will include CIRWG lands, the north and western portions of the Denali West Option Corridor, and the Denali East Option Corridor. AEA subsequently conducted these surveys as planned in 2014 (see the 2014 Study Implementation Report for Study 10.16). AEA maintains that the two years of data collected for this study, which now includes field surveys in all portions of the study area, are more than adequate to meet the study objectives and will be sufficient to assess impacts from the proposed Project (see discussion of these points above).

USFWS expresses the concern that if density estimates are to be calculated by habitat, then additional samples may be needed to fill in poorly sampled habitats, as minimum sample sizes for estimating detection functions are 75–100 detections. ABR has prepared density estimates by habitat for those species with sufficient numbers of observations (those data will be presented in the USR for Study 10.16). This process involved calculating densities by coarse-scale habitat types so as to minimize the problem of poorly sampled fine-scale habitats. As predicted and discussed during the Study Plan meetings in 2012 (see Section 8.4 in the Proposed Study Plan), even with intensive sampling in two years there are sufficient sample sizes to calculate densities by habitat only for the more common species in the study area; the pursuit of calculating density estimates by habitat for all species in the study area remains an unrealistic goal (see discussion of this point above). Moreover, such density data are not necessary to assess impacts of the proposed project on breeding landbirds and shorebirds, nor are density estimates required to develop PM&E measures for breeding landbirds and shorebirds (see discussion of these points above).

Finally, the proposed modification to add additional year(s) of point count and riverine/lacustrine sampling would add tremendous cost to this study. For *each* additional year of field sampling, AEA estimates that this modification would add approximately $650,000 to the study budget—even though data collected to date are more than sufficient to meet Study Plan objectives.

For these reasons, USFWS's proposed study plan modification is unnecessary and should not be adopted by FERC.

2.7.12.4. Response to Modification Request to Extend the Study Area below the Proposed Dam Site

The USFWS (USFWS_pp10.16-2_ph4) recommends broadening the scope of the Study to include areas below the Project.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, USFWS has not established "good cause" for extending the survey area as required by the ILP regulations, nor has USFWS demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions. Rather, USFWS simply disagrees with the FERC-approved Study Plan itself—claiming that extension of the study area is necessary without considering the actual area surveyed or the interrelated studies for evaluating Project effects in the License Application.

As described in the FERC-approved Study Plan Section 10.16.3, the study area for the breeding landbird and shorebird point-count survey includes a 2-mile buffer zone around the proposed reservoir impoundment zone, dam and camp facilities area, access road and transmission corridor alternatives, and material sites (see RSP Section 10.16, Figure 10.16-1). The FERC-approved Study Plan called for the point-count and linear walking surveys in riparian and lacustrine habitats to be conducted in the primary riparian and lacustrine habitats in the inundation zone, the infrastructure area surrounding the site of the proposed dam, and in riparian habitats along the Susitna River immediately below the location of the proposed dam. This study area was developed in consultation with licensing participants, including the USFWS, during the development of the Study Plan in 2012, and was incorporated into the Study Plan approved by FERC.

AEA understands concerns regarding the potential downstream effects on landbirds and shorebirds from the proposed Project and those concerns will be addressed (in the License Application) when assessing the impacts of the proposed project. This point was made during the March 29, 2016 ISR

Meeting in which AEA outlined for USFWS staff the approach that would be used to assess the effects of riparian habitat change on breeding landbirds and shorebirds downstream of the proposed dam. The approach involves two steps. First, the habitat association information from this study that applies to riparian habitats along the Susitna River and its clearwater tributaries will be used by researchers conducting the Evaluation of Wildlife Habitat Use (Study 10.19). In Study 10.19, habitat use for the existing mapped wildlife habitats in the Project area (both upstream and downstream of the proposed dam) will be evaluated. This will involve categorizing the existing habitats as high-, moderate-, low-, or negligible-value for each bird species known or expected to occur in the Project area, and will be based on the wildlife habitats mapped upstream of the proposed dam site in Study 11.5, and downstream of the dam site in Study 11.6. Second, the expected changes in riparian habitats downstream would be evaluated (in the License Application) for likely changes to breeding birds by evaluating how the extents of high- and moderate-value habitats will change after construction and operation of the dam. This would be done on a species-by-species basis asking, for example, whether high- and moderate-value habitats would decrease in extent and be replaced by low- and/or or negligible-value habitats, or whether high- and moderate-value habitats would increase in extent or remain unchanged. This process was previously described, with examples of possible changes in habitats for both birds and mammals, in the Riparian Modeling Proof of Concept Meeting on April 30, 2014. Both the presentation prepared for that meeting, entitled "Conceptual Approach for Assessing Post-development Changes in Riparian Wildlife Habitats," and the meeting notes are available online at the link below:

http://www.susitna-watanahydro.org/meetings/past-meetings/

AEA understands the desire to collect additional landbird and shorebird abundance data downstream of the proposed dam site, but with the approach described above, the expected changes in habitats supporting breeding landbirds and shorebirds can be quantitatively evaluated for downstream areas. In the License Application, the data from a number of interrelated studies will be used to predict the habitat changes downstream of the proposed dam site, including studies of instream flow (Study 8.5), riparian instream flow (Study 8.6), groundwater (Study 7.5), riparian vegetation (Study 11.6), riverine geomorphology (Study 6.6), river productivity (Study 9.8), fish habitats (Study 9.9), water quality (Studies 5.5 and 5.6), and ice processes (Study 7.6). When the modeling of riparian habitat change post-development has been completed, those data will be used to assess how the predicted changes in riparian vegetation and riverine habitats will affect breeding habitats for landbirds and shorebirds downstream of the proposed dam site.

As described above in Section 2.7.12.3, developing accurate population estimates from point-count data and density calculations for all breeding landbird and shorebird species that were found to occur in the upstream study area, is a goal that is not attainable within a reasonable time frame to collect baseline data for the proposed Project. Even with intensive survey efforts in two study seasons, population estimates from density calculations can be made only for the common species, and this would almost certainly be the case for areas downstream of the proposed dam site as well. This means that, if field surveys were conducted in downstream areas, the estimates, corrected for detectability, of the number of landbirds and shorebirds of all species that could be affected by the Project downstream of the proposed dam site are likely to be approximate at best and subject to conjecture. Because of this, the assessment of potential impacts on landbirds and shorebirds downstream of the proposed dam site (to be prepared in the License Application) will rely on the habitat association data prepared for this study and the subsequent value ranking of the mapped wildlife habitat types in Study 10.19. This information will yield more accurate quantitative data to use to assess habitat impacts from the proposed Project and to develop quantitative PM&E measures to try to minimize those impacts.

Finally, the proposed modification to extend the study area below the dam site to include areas below the Project would add tremendous cost to this study. For *each* year of field sampling, AEA estimates that this modification would add approximately $300,000–$350,000 to the study budget—even though the analysis of data from interrelated studies will meet the USFWS objective of analyzing Project-related effects to breeding landbirds and shorebirds downstream of the Project and provide the basis for developing any appropriate PM&E measures.

For these reasons, USFWS's proposed Study Plan modification is unnecessary and should not be adopted by FERC.

2.7.12.5. References Cited

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2.7.13. Study 10.17 – Population Ecology of Willow Ptarmigan in Game Management Unit 13

As established in the Study Plan (RSP Section 10.17.1), the overall goal of this study is to provide the necessary data to evaluate the potential effects of the proposed Project on Willow Ptarmigan, the predominant species of upland game bird in the Project area and surrounding areas. The area of interest consists of GMU subunits 13A and 13E.

The study objectives are established in RSP Section 10.17.1:

- Determine the seasonal distribution of Willow Ptarmigan in the Project area.
- Determine the seasonal migratory patterns of Willow Ptarmigan that occur in the Project area.
- Estimate the abundance of Willow Ptarmigan in the Project area during the breeding season and during the fall.
- Estimate seasonal survival of Willow Ptarmigan.

As presented during the ISR meeting for this study held on March 29, 2016 (and providing clarification to the information in ISR Part D), AEA proposes three modifications to Study Plan Section 10.17:

1. Aerial transect flights were canceled, but more telemetry flights added to improve the precision of space-use inferences and allow better predictions about distribution of ptarmigan across the study area;
2. Butte Creek site was added in 2014 as an alternative capture site (ISR Part A, Figure 4.1-1, and ISR Part C, Section 7.1.2); and
3. Deadman Lake site was added in 2014 as another alternative capture site because the upper Jay Creek site was not accessible.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.17. AEA received no comments on Study 10.17, including its proposed modifications outlined above.

2.7.14. Study 10.18 – Wood Frog Occupancy and Habitat Use

As established in the Study Plan (RSP Section 10.18.1), the overall goal of this study is to characterize the use of the Project area by breeding wood frogs to facilitate an assessment of potential impacts on wood frogs from development of the proposed Project.

The study objectives are established in RSP Section 10.18.1:

- Review existing data on habitat use and distribution of breeding wood frogs in a broad region surrounding the study area.
- Estimate the current occupancy rate for breeding wood frogs in suitable habitats in the study area through a combination of field surveys and habitat-occupancy modeling.
- Use information on current habitat occupancy and habitat use to estimate the habitat loss and alteration expected to occur from development of the Project.
- Sample frogs opportunistically for the presence of the chytrid fungus that has been linked to amphibian population declines. (At the request of state and federal management agencies, AEA agreed to sample for the chytrid fungus to opportunistically take advantage of planned fieldwork and thereby provide some baseline information on the potential occurrence of the fungus in the study area before development.)

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA did not propose any modifications (beyond those that were previously described and implemented in 2013 or 2014) to Study Plan Section 10.18.

In November 2015, AEA filed with FERC the Study Completion Report (SCR) for Study 10.18. As provided in the SCR, AEA has met the study objectives, and this study is now complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.18. AEA received no comments on Study 10.18.

2.7.15. Study 10.19 – Evaluation of Wildlife Habitat Use

As established in the Study Plan (RSP Section 10.19.1), the overall goal of this study is to provide Project-specific habitat evaluation information for birds, mammals, and amphibians to facilitate quantitative assessments of the impacts on wildlife habitats from development of the proposed Project.

The study objectives are established in RSP Section 10.19.1:

- Use Project-specific survey data and the scientific literature to determine local habitat associations for those wildlife species occurring in the Project area that are of conservation, management, cultural, or ecological concern and that are specific to the wildlife habitat types to be mapped in the Project area.
- Categorically rank habitat values for each wildlife species of concern for each of the wildlife habitat types that will be mapped in the Project area.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes three modifications to Study Plan Section 10.19:

1. The 4-mile study area buffer surrounding the proposed Project areas and access road/transmission alignments has been reduced to a 2-mile buffer, which corresponds directly to the reduction of the study area buffer for Study 11.5 (Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin) because the habitat data for the Project area used in this study will come from the habitat map prepared for Study 11.5;
2. AEA removed the Chulitna Corridor and added the alternative Denali East Option (access road and transmission line corridor) to the study area; for this study, the new corridor includes a 2-mile buffer surrounding the road and transmission line alignments for the Denali East Option; and
3. In contrast to a selected set of bird Species of Concern for analysis, as described in the RSP, each bird species recorded in the study area will be ranked for habitat values for each mapped wildlife habitat type.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.19. AEA received no comments on AEA's proposed modifications to Study 10.19 outlined above. However, the NPS filed one comment for Study 10.19. AEA's response to the NPS comment can be found in Table 2.7.12-2.

Table 2.7.12-2. Study 10.19 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
NPS_pp2_ph 4	*Riparian vegetation modeling is incomplete in the ISR, so the wildlife habitat use study (10.19) upon which several other studies rely has not started. Wildlife habitat models cannot be validated until the wetland and riparian vegetation mapping and modeling supports the habitat use estimation models.*	The NPS comment is correct; all mapping of wildlife habitats for the Project must be completed before Study 10.19 can be initiated.

2.7.16. Study 10.20 – Wildlife Harvest Analysis

As established in the Study Plan (RSP Section 10.20.1), the overall goals of this study are to compile and analyze information on the distribution of big game, furbearers, and small game (including both small mammals and upland gamebirds, assuming data are available) and to understand patterns of hunting effort and harvest in the study area. These data will provide information on identification of past and current trends in hunter access modes, hunting locations, and harvest locations, and identify potential Project-induced changes that are likely to alter hunter access or harvest patterns. These findings will help predict the impacts of those changes on wildlife harvests. This study is a multi-year effort that began with the 2012 Technical Memorandum, *Past and Current Big Game and Furbearer Harvest Analysis*.

The study objectives are established in RSP Section 10.20.1:

- Identify past and current harvest effort for large and small game including furbearers, harvest locations, access modes and routes.
- Compare current harvest locations of large and small game, including furbearers, with data on the seasonal distribution, abundance, and movements of harvested species, using the results of other, concurrent Project studies on big game and furbearers (RSP Sections 10.5–10.11).
- Provide harvest data for use in the analyses to be conducted for the recreation and subsistence resource studies (RSP Sections 12.5 and 14.5, respectively).

The information developed in this study will be used to help develop measures determined necessary to address Project impacts on hunting opportunities, hunter distribution, and impacts on game species abundance.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA does not propose any modifications to Study Plan Section 10.20.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 10.20. However, AEA received a total of four comments on Study 10.20 from the Copper Country Alliance (CCA), a group of seven other organizations (Susitna

River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center; collectively referred to here as SRC et al.), and Cathy Teich. AEA's responses to the comments are in Table 2.7.16-1.

Table 2.7.16-1. Study 10.20 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
CCA_pp3_ph3	*The Wildlife Harvest study—essentially a desktop study—has not been done yet. When it is written, we request that it make clear two difficulties and limitations in estimating the trapping harvest: 1) In the transcript of the April 25, 2016 meeting, there was passing reference to the fact that only certain species are required to be taken to an authorized sealer for sealing ... furthermore, there is no limit on how many individuals of each species a trapper may harvest in Unit 13, so a maximum number cannot be derived from the number of licensed trappers. There are voluntary trapper questionaires [sic]. ADFG combines these into an annual report. The most recent report (2012–2013) posted online observes that because not all species are required to be sealed, "...information on the numbers, distribution, and harvest of many furbearers is limited."*	AEA agrees and is aware of these limitations. The USR for the Wildlife Harvest Analysis will clearly describe the limitations associated with acquiring accurate harvest numbers for species that are not required to be sealed.
CCA_pp4_ph4	*The ADFG Alaska Wildlife Action Plan (draft revision) states, "Although legal take [by hunters and trappers] can be regulated, illegal take cannot; and illegal take may approach legal take in magnitude (Person and Russell 2008)."*	AEA agrees and is aware of this limitation. The USR for the Wildlife Harvest Analysis will clearly state that the data only summarize legal take and that some unknown level of illegal take also occurs.
SRC_etal_WILDLIFE_ppHARVEST1_ph4	*… we recommend that the Wildlife Harvest Analysis Study include an analysis of the number of brown bears killed by hunters in the Large Carnivore Study Area ... determine the number of brown bears killed by hunters in each Uniform Coding Unit (UCU) in the Large Carnivore Study Area ... it would be most informative to compile harvest data fro [sic] both spring and fall seasons combined ... Plot or report kill densities for UCUs or groups of adjacent UCUs from these bear harvest data that can be compared to the density surface map in Figure 5.1-11 in the Large Carnivore ISR ... If UCUs for brown bear kills are grouped for this analysis, the groups of UCUs should be based on whether or not salmon are present in the groupings ... Do the same thing for black bears as a way of evaluating the accuracy of the black bear density surface map presented in Figure 5.1-6 of the Large Carnivore ISR. If groups of UCUs are used for analysis of black bear kill density, the groups should be based on whether the habitat is forested ... for the above recommendations to be accomplished, the study*	As explained below in Section 2.7.16.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $3,500.

Reference Number	Comment or Study Modification Request	AEA's Response
	area for wildlife harvest analsyis [sic] will have to be expanded to the south and west to include all the Large Carnivore Study Area (especially the northern part of GMU 16B).	
Teich_pp1_ph1a	*…Some studies have not been done: i.e., Wildlife Harvest.*	Although Study 10.20 has not yet been conducted, an analysis of state wildlife harvest data for the years 2003–2011 and federal subsistence data for moose and caribou for 1994–2011 was conducted in 2012 (Prichard et al. 2013). That analysis formed the basis for Study 10.20, which will use a similar approach to analyze comparable wildlife harvest data obtained since 2011 when it is completed and reported in the USR.

2.7.16.1. Response to Modification Request to Expand the Study Area of the Wildlife Harvest Analysis Study for Bears to Match that of the Large Carnivore Study Area

SRC et al. (Modification; SRC_etal_WILDLIFE_ppHARVEST1_ph4) have recommended that the Wildlife Harvest Analysis Study include an analysis of the number of brown bears and black bears killed by hunters in each Uniform Coding Unit (UCU) in the Large Carnivore Study Area (Study 10.8) as a way of evaluating the accuracy of the bear density surface maps presented in Figures 5.1-5 and 5.1-11 of ISR 10.8 Part A. The study area for the wildlife harvest analysis would have to be expanded to the south and west to include all of the Large Carnivore Study Area, especially the northern part of Game Management Unit (GMU) Subunit 16B.

AEA requests that FERC not adopt this proposed study plan modification because the request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, SRC et al. have not established "good cause" as required by the ILP regulations, nor have SRC et al. demonstrated that the study was either not implemented as provided by the approved Study Plan, or implemented under anomalous environmental conditions.

The study objectives and the appropriate study area to meet those objectives were established during the development of the study plan in consultation with licensing participants and were subsequently approved by FERC. As described in the FERC-approved Study Plan (RSP Section 10.20.3), the study area (RSP Section 10.20, Figure 10.20-1) includes GMU Subunits 13A, 13B, 13E, 14B, 16A, and portions of 20A. These GMUs and subunits were selected because hunting and trapping activities in portions of each of these GMUs and subunits may be influenced directly or indirectly by Project construction and operations, including the reservoir inundation zone, associated facility sites, laydown/storage areas, and access road and power transmission corridors. The study area is based on reporting units conforming with the harvest data available (which is recorded by GMU, subunit, and for most data, Uniform Coding Unit) and because hunting and trapping in the region of the Project is managed by ADF&G for each GMU and subunit.

Furthermore, this modification requested by SRC et al. to expand the study area of the Wildlife Harvest Study (Study 10.20) to that of the Large Carnivore Study Area (Study 10.8) is in direct contradiction to another modification request by SRC et al. to reduce the size of the Large Carnivore Study Area. Specifically, SRC et al. stated that the Large Carnivore Study Area "greatly exceeds the size of the area within which bears conceivably could be impacted by the proposed Susitna Dam project," as is discussed in Section 2.7.4.5 of this document.

As described in the FERC-approved Study Plan, the information developed in Study 10.20 will be used to help develop measures to address Project impacts on hunting opportunities, hunter distribution, and impacts on game species abundance. The FERC-approved study was not intended to use bear harvest data to support or refute bear density patterns reported in Study 10.8, as SRC et al. ask to be done with this modification request. Additionally, the effort described by SRC et al. would be of limited value in evaluating the accuracy of the bear density maps from Study 10.8. Bear harvest numbers are influenced by many factors in addition to bear density, including ease of access, method of transportation, bear distribution and areas of concentration, bear seasonal movements, human population distribution, guiding services, game harvest regulations, distribution and regulations for other species leading to incidental harvest of bears, and habitat variables (e.g., open versus forested habitat). The addition of this study component would, therefore, only provide limited information on the accuracy of the bear density maps from Study 10.8.

Completing the analysis that SRC et al. requests would require the number of brown bears and black bears killed by hunters in each Uniform Coding Unit (UCU) to be plotted for both spring and fall seasons, and for kill densities to be plotted by individual UCU or groups of UCUs, combined with consideration of the presence of anadromous fish-bearing streams (brown bears) or forested habitats (black bears). This analysis cannot be presented explicitly by UCU because UCU harvest data are considered sensitive, confidential information by ADF&G. As explained in the Study Plan, the study area is based on GMUs conforming with the harvest data available (which is recorded by GMU, subunits, or groups of UCUs) and because hunting and trapping in the region of the Project is managed according to GMU and subunit boundaries.

The addition of this study objective is not warranted and SRC et al. does not provide sufficient justification for expanding the study area for the Wildlife Harvest Analysis, as approved by FERC. As is explained in Section 2.7.4.5 of this document, the method used to model the population density of both bear species is robust enough to provide the information needed to estimate how many bears are likely to be affected by Project infrastructure and activities in specific portions of the Large Carnivore Study Area for Study 10.8, and to allow development of PM&Es, so further modification of the study area for Study 10.20 is unnecessary.

Finally, the modification proposed by SRC et al. would add additional cost that would exceed any benefit derived from expanding the study area for bears in this study to match that of the Large Carnivore Study Area (Study 10.8). AEA estimates that this modification would add approximately $3,500 to the study budget—all in an effort to produce information that would be of limited value.

For these reasons, SRC et al. proposed study plan modification is unnecessary and should not be adopted by FERC.

2.7.16.2. References Cited

Prichard, A.K., N.A. Schwab, and B.E. Lawhead. 2013. Past and current big game and furbearer harvest analysis. Susitna–Watana Hydroelectric Project [FERC No. 14241], 2012 Technical Memorandum prepared for the Alaska Energy Authority, Anchorage, by ABR, Inc.—Environmental Research & Services, Fairbanks. 31 pp.

2.8. Botanical Resources

2.8.1. Study 11.5 – Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin

As established in the Study Plan (RSP Section 11.5.1), the overall goals of this study are to classify and prepare maps of the existing vegetation and wildlife habitats in the Upper and Middle Susitna River Basin (including the proposed Project dam and camp sites, the proposed reservoir, and the alternative Project transmission line and access road corridors). This multi-year study was initiated in 2012; work continued in 2013–2015 and is ongoing with final data analyses and preparation of the Study Completion Report (SCR). The mapping information from this study will be used to assess the potential impacts to both vegetation and wildlife habitat resources from development of the proposed Project, and to prepare any necessary protection, mitigation, and enhancement (PM&E) measures to minimize impacts to those resources. When completed, the wildlife habitat mapping will be used to evaluate habitat use by birds, mammals, and amphibians (in Study 10.19, Evaluation of Wildlife Habitat Use), and to estimate quantitatively the impacts of habitat loss and alteration for birds, mammals, and amphibians. The wildlife habitat mapping prepared in this study will be one of the primary pieces of information used to evaluate impacts to wildlife species from the proposed Project.

This study is being conducted in close coordination with the Wetland Mapping Study in the Upper and Middle Susitna Basin (Study 11.7). In the field, data were collected for both studies at each sampling plot, and the mapping efforts for both studies were performed concurrently (i.e., each map polygon was coded with the attributes needed to map vegetation, wildlife habitats, and wetlands).

The specific objectives of the Vegetation and Wildlife Habitat Mapping Study, as described in the RSP (Section 11.5.1), are to classify, delineate, and map vegetation and wildlife habitat types in the Upper and Middle Susitna River Basin based on current aerial imagery for the study area.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes two modifications to Study Plan Section 11.5:

1. AEA proposes to change the study area by eliminating the Chulitna Corridor from the study area (ISR Part D Overview, Section 1.3) and adding the Denali East Corridor Option as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (Study 11.5 ISR Part C, Section 7.1.2).

2. AEA proposes to reduce the original study area buffer of 4 miles to a 2-mile buffer to match the study areas for two closely related studies (Study 11.7, wetlands mapping, and Study 10.16, landbirds and shorebirds) (Study 11.5 ISR Part C, Section 7.1.2).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 11.5. AEA received no comments on Study 11.5, including its proposed modifications outlined above.

2.8.2. Study 11.6 – Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam

As established in the Study Plan (RSP Section 11.6.1), the overall goals of this study are to: (1) prepare maps of existing, local-scale riparian ecosystems (riparian ecotypes), wetlands, and wildlife habitat types in areas downstream from the proposed Project dam site; (2) characterize sedimentation, vegetation succession, and vegetation-soil-landscape relationships; and (3) coordinate with the Riparian Instream Flow Study (Riparian IFS, Study 8.6) and other closely related studies to support the development of a spatially-explicit model to predict potential changes to downstream riparian floodplain vegetation due to expected Project effects. The mapping prepared in this study will be used to assess the impacts to riparian ecotypes, wetlands, and wildlife habitats (see ISR Part D for Study 10.19, Evaluation of Wildlife Habitat Use) in areas downstream from the proposed Project dam site, and to develop possible protection, mitigation, and enhancement (PM&E) measures to address any identified effects.

The study objectives are established in RSP Section 11.6.1:

- Classify, delineate, and map riparian ecotypes, wetlands, and wildlife habitats downstream from the Watana Dam site;
- Characterize the role of erosion and sediment deposition in the formation of floodplain surfaces, soils, and vegetation using a combination of soil stratigraphic descriptions, sieve analysis, and several complimentary sediment dating techniques;
- Quantify and describe Susitna River riparian vegetation communities using a combination of basic statistical summaries (e.g., basal area, density, stand age) and multivariate statistical techniques (e.g., cluster analysis, ordination, sorted tables), which will be used to develop a series of conceptual models of floodplain vegetation succession building from models developed for the Susitna River by researchers working in the 1990s; and
- Coordinate closely in the implementation of the Riparian IFS (Study 8.6), Groundwater Study (Study 7.5), Ice Processes in the Susitna River Study (Study 7.6), and Fluvial Geomorphology Modeling below Watana Dam Study (Study 6.6) to provide necessary and complementary data, including vegetation successional models and mapping in support of a spatially-explicit model (to be developed in the Riparian IFS; see ISR Part D for Study 8.6) to predict potential impacts to downstream riparian floodplain vegetation due to Project alterations of flow, sedimentation, groundwater, geomorphology, and ice processes.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 24, 2016, AEA proposes one modification (which was not previously described and implemented as a variance in 2013) to Study Plan Section 11.6:

1. AEA will conduct additional sampling of rapid vegetation transects (RVTs) to be established in three Focus Areas and one satellite area in the Middle River and along four riparian transects in the Lower River where there are groundwater/surface water transects and groundwater wells. Detailed RVT methods are provided in Appendix A of the SIR for Study 8.6.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 11.6. AEA received no comments on Study 11.6, including its proposed modifications outlined above.

2.8.3. Study 11.7 – Wetland Mapping Study in the Upper and Middle Susitna Basin

As established in the Study Plan (RSP Section 11.7.1), the overall goal of this study is to prepare a map of existing wetland habitats in the Upper and Middle Susitna River (including the proposed Project dam and camp sites, the proposed reservoir, and the alternative Project transmission line and access road corridors). This multi-year study was initiated in 2012; work has continued in 2013–2015 and is on-going with final data analyses and preparation of the Study Completion Report (SCR). The mapping information from this study eventually will be used to assess the potential impacts to wetland resources from development of the proposed Project, and to prepare protection, mitigation, and enhancement (PM&E) measures, as appropriate, to minimize impacts to wetland resources.

This study is being conducted in close coordination with the Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (Study 11.5). In the field, data were collected for both studies at each sampling plot, and the mapping efforts for both studies were performed concurrently (i.e., each map polygon was coded with the attributes needed to map wetlands, vegetation, and wildlife habitats).

As described in the RSP (Section 11.7.1), the study objectives are to:

- Classify, delineate, and map wetlands in the Upper and Middle Susitna River Basin based on current aerial imagery for the study area; and
- Determine and evaluate the ecological functions of the mapped wetland types to facilitate an assessment of the relative value of each wetland type in the study area.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes one modification to Study Plan Section 11.7:

1. AEA proposes to change the study area by eliminating the Chulitna Corridor from the study area (ISR Part D Overview, Section 1.3) and adding the Denali East Corridor Option as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (Study 11.7 ISR Part C, Section 7.1.2).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on

December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 11.7. AEA received no comments on AEA's proposed modification to Study 11.7 outlined above. However, the USACE filed two comments for Study 11.7. AEA's responses to the USACE comments can be found in Table 2.8.3-1 and below.

At the time of the ISR Meetings in March 2016, all of the field work and digitizing and attributing of wetland polygons had been completed and senior-level QA/QC of the mapping was underway. The mapping QA/QC work has since been completed. The GIS data, wetland determination forms, and the field plot photos for Study 11.7 are available at: http://gis.suhydro.org/SIR/11-Botanical/11.7-Wetland_Mapping/.

Table 2.8.3-1. Study 11.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
USACE_pp1_ph2	*The Corps understands that wetland mapping field work was completed in 2015, and review/revision of the potential wetland boundaries are being revised by the applicant currently. We requests that we be provided data and the proposed delineated boundaries as soon as that information is available for review to ensure the final products are suitable and appropriate for the Corps' potential future use and consideration.*	The mapping of wetland boundaries in the study area has been completed. As requested, AEA posted the mapping and field data to the Project website (http://gis.suhydro.org/SIR/11-Botanical/11.7-Wetland_Mapping/) on August 9, 2016. The data consists of the wetland map polygons and field plot locations (in an ArcGIS geodatabase), standard USACE data forms for each wetland determination plot, and field plot and soil pit photos; the USACE data forms and field photos are linked to sample plot locations in an Access database, which is also included in the data available for review. Note that there are nearly 65,000 map polygons in the wetland mapping for the 513,117-acre study area and, with the inclusion of the field photos, the full data set is quite large.
USACE_pp1_ph3	*The Corps understands that the functional assessment for wetlands in this project's area will be assessed using the 1988 Magee Functional Assessment as stated within the February 2013 Wetlands Final Technical Memorandum. The Corps would like an opportunity to review any aquatic site assessment methodology, including any proposed modifications to the method, intended for use on this project prior to implementation.*	As detailed in Section 2.8.3.1 below, AEA will continue to consult with the USACE regarding the wetland functional assessment methods.

2.8.3.1. Response to Comment Regarding Continued Consultation on Wetland Functional Assessment Methods

The USACE (USACE_pp1_ph3) requested an opportunity to review any aquatic site assessment methodology, including any proposed modifications to the method, intended for use on the Project prior to implementation.

AEA appreciates the interest of the USACE in the wetland functional assessment methods to be used for the Project, and will continue to consult with the USACE on the wetland functional assessment methods.

To provide some background, during development of the Study Plan for the wetland mapping study, the methods proposed for the wetland functional assessment were discussed in detail with several agencies (the EPA, USFWS, and USACE in particular) in a series of meetings in April and May 2012 (see Section 9.4 in the Proposed Study Plan [PSP]). As a result of those meetings, the methods proposed for the wetland functional assessment were adjusted based on the recommendations of the EPA, USFWS, and USACE before preparation of the Revised Study Plan (RSP). As described in Section 11.7.4.3 of the RSP, the adjusted functional assessment methods to be used in Study 11.7 were discussed and agreed upon by the EPA, USFWS, USACE, and AEA. In addition to the specific consultation on the methods for this study, stakeholder comments on Study 11.7 also were received during preparation of the PSP (see Attachment 9.1 in the PSP). When evaluating the proposed methods for Study 11.7, FERC considered the agency consultation regarding those methods and the comments provided on the proposed study before approving the methods for Study 11.7 with no modifications (see Section 1 in the ISR for Study 11.7).

The specifics of the FERC-approved methodology for the wetland functional assessment are described in Section 11.7.4.3 of the RSP and in greater detail in Section 4.3 in the ISR for Study 11.7. The methods do not rely solely on Magee's (1998) procedures, which were developed primarily for wetlands in temperate regions in the lower 48 states where wetland systems can be different than in boreal forest areas and where wetlands often have also been altered by development. Rather, the methods employ Magee's procedures only as a starting point. The goal in using Magee’s procedures as a starting point in the analysis was to ensure that the functional assessment methods are based on hydrogeomorphic principles, as agreed to by the EPA, USFWS, and USACE during the consultation meetings in 2012. As described in Section 11.7 of the RSP and the ISR, the methods for Study 11.7, including the methods for the wetland functional assessment, are adequate to meet the study’s objectives.

In the ongoing FERC-approved functional assessment analyses, as described in Section 11.7.4.3 of the RSP, many of the Magee models for wetland functions and the variables used in those models are being altered substantially or replaced entirely with additional information to ensure that the results are appropriate for the specific wetlands occurring in the study area. For example, because the study area occurs within a region of discontinuous permafrost, the wetland study team will be incorporating the likelihood of the presence or absence of permafrost into the assessment of wetland function. This will result in substantial alterations to two Magee models (Modification of Groundwater Discharge and Modification of Groundwater Recharge) because permafrost acts a restrictive layer inhibiting groundwater discharge and recharge.

For the wildlife- and fish-habitat support functions of wetlands, the poorly defined Magee variable (Contribution to Abundance and Diversity of Wetland Fauna)—which relies only on generalized habitat structure variables not the actual occurrence of wildlife and fish species—will be replaced with project-specific and spatially referenced field survey data on the use of wetlands by birds, mammals, amphibians, and fish (from Studies 10.5 through 10.18 and Studies 9.5, 9.6, and 9.9). This will result in a much more focused and study-area-specific assessment of the wildlife- and fish-habitat support functions of wetlands.

Additionally, there are no Magee models that address the consumptive uses (by humans) and uniqueness functions of wetlands, which will be evaluated in this study. Project-specific and spatially referenced data from the recreation and subsistence studies (Studies 12.5 and 14.5, respectively) will be used to assess the consumptive uses function of the mapped wetlands in the study area. The uniqueness of the wetlands in the study area will be assessed at a regional geographic scale by identifying those mapped wetland types that are regionally scarce relative to other more common wetland types (e.g., by comparing to broad-scale NWI wetland mapping data in the region of the proposed project).

2.8.3.2. References Cited

Magee, D. W. 1998. A rapid procedure for assessing wetland functional capacity based on hydrogeomorphic (HGM) classification. Bedford, NH.

2.8.4. Study 11.8 – Rare Plant Study

As established in the Study Plan (RSP Section 11.8.1), the overall goal of this study is to locate populations of rare vascular plant species that may occur in the Project area in the Upper and Middle Susitna River Basin (the proposed Project dam and camp sites, the proposed reservoir, and the alternative Project transmission line and access road corridors) and which could be affected by the proposed development.

The study objectives are established in RSP Section 11.8.1:

- Identify habitats in the Project area that may harbor rare vascular plant species previously found within a broad region surrounding the Project area.
- Locate populations of rare vascular plant species that may occur in those portions of the Project area that would be disturbed by Project construction and operations activities.
- Estimate population sizes for any rare species found and map their locations.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes one modification to Study Plan Section 11.8:

1. AEA proposes to change the study area by eliminating the Chulitna Corridor from the study area (ISR Part D Overview, Section 1.3) and adding the Denali East Corridor Option as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (Study 11.8 ISR Part C, Section 7.1.2).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 11.8. AEA received no comments on AEA's proposed modification to Study 11.8 outlined above. However, FERC staff filed two comments for Study 11.8. AEA's responses to the FERC comments can be found in Table 2.8.4-1 and below.

Table 2.8.4-1. Study 11.8 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA-8_ph2	*In Appendix A of the ISR, the spp./var. information for the plants Arnica lessingii and Mertensia paniculata is not provided, and therefore it is unclear as to whether they are the same species as those listed in table 4.1-2 of the ISR (i.e., Arnica lessingii ssp. norbergii and Mertensia paniculata var. alaskense). If the spp./var. information is known for those plants populations documented in 2013, please provide it in the USR.*	During the sampling in 2013, the rare plant study team recorded the common forms of the two taxa in question (*Arnica lessingii* ssp. *lessingii* and *Mertensia paniculata* var. *paniculata*), not the rare subspecies and variety, respectively, that were on the list of possible rare taxa that could occur in the study area. Information on the occurrence of the common subspecies and variety for these two taxa found during the 2013 surveys will be included in the USR, as well as any documentation of the rare forms (if found during future surveys).
FERC_ppA-8_ph3	*Figure 3-1 of the ISR shows both past and planned transects for rare plants. For the reservoir area, it appears that much of the past and proposed sampling focuses on the northern shore. The report does not explain why that is the case. We suspect that other habitat mapping exercises have provided evidence that these areas likely have a moderate or high potential for supporting rare plants. Please explain why the survey effort you propose along the south shore of the proposed reservoir is sufficient to achieve the study objectives, considering habitat needs of the species in question.*	See Section 2.8.4.1 below.

2.8.4.1. Response to Comment on Survey Transect Distribution

In its comments, FERC (FERC_ppA-8_ph3) staff noted the greater allocation of survey transects along the northern shore of the proposed reservoir compared to the southern shore and requested an explanation of why AEA's proposed survey effort along the southern shore is sufficient to achieve the study objectives, considering habitat needs of the species in question.

AEA acknowledges that the rare plant transects sampled in the reservoir area during 2013 and the future planned transects were predominantly located along the north side of the Susitna River.

The primary reason for the greater number of transects allocated north of the Susitna River in the proposed reservoir area is that there is more acreage of potential rare plant habitat that would be inundated and greater habitat diversity in the proposed reservoir area on the north side of the river than on the south side. This assessment was made in 2013 by reviewing the aerial imagery in the proposed reservoir inundation zone because the mapping of vegetation and landscape features in the reservoir area, which was being conducted in Study 11.5 (Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin), was not yet complete.

Additional reasons for the focus on sampling the north side of the Susitna River (in 2013) include the fact that Cook Inlet Region Working Group (CIRWG) lands on the south side of the river were not available for sampling in 2013, and (for future survey transects) the portion of the proposed inundation zone in the reservoir on the south side of the river is more narrow than on the north side. Because of the narrowness of the proposed inundation zone on the south side of the river and the greater uniformity in the habitats there, survey transects would have to be much longer there than on the north side of the river and would still not sample the same habitat diversity that occurs on the north side of the river. This would mean more field time sampling on the south side of the Susitna River in areas of relatively low habitat diversity at the expense of sampling other regions in the study area that have greater habitat diversity.

Overall, the study team sought to sample the greatest habitat diversity throughout the study area in the most efficient manner, following the sampling methods designed for the survey of rare vascular plant species (Carlson et al. 2006; modified from Catling and Reznicek 2003). Those methods emphasize the sampling of regional or locally unique geological features (see below), suitable habitats for the species of interest, areas with high environmental gradients and habitat diversity, and logistical feasibility. Because rare plant populations are patchy in their occurrence across the landscape, the greatest probability of success in locating those populations involves sampling as many occurrences of suitable habitats for rare species as possible, and this is most efficiently done by focusing the field sampling on areas with a greater diversity of habitat types. Because of the greater land area, greater habitat diversity, and more efficient survey opportunities on the north side of the Susitna River in the proposed reservoir, the study team allocated more survey transects there than on the south side of the river. For these reasons, the study team maintains that the allocation of transects in the reservoir area, and throughout the full study area, is sufficient to achieve the study objectives.

The rare plants that have the potential to occur in the study area could occur in a wide range of habitats, including the most common vegetation types. For the 14 plants with the more rare rankings (S1 or S2), the suitable habitats include conifer forests, alder thickets, moist meadows and marshes, shallow ponds, stream banks, low-elevation dry bluffs, dry scree slopes, sand dunes, dry grasslands, disturbed areas, rocky crevices, and alpine meadows. This made it important to focus on habitat diversity in selecting transect locations so as to sample as wide a range of habitats (regions in the study area categorized as having a moderate or high potential to harbor rare plants were defined as those with greater habitat diversity over the distances that typically could be sampled in a day). Aside from habitat, the most important criterion in selecting transect locations was geology, and the study team made sure that the only known area of unique geology (calcareous bedrock in the northwest corner of the study area) was sampled, and that the full range of other bedrock types was sampled as well. In the USR for Study 11.8, the procedures used in selecting survey transect locations within the study area will be fully described.

With full access to the entire study area now authorized, the study team will evaluate the possibility of allocating more rare plant transects on the south side of the Susitna River in the proposed reservoir area during the next year of study, following the procedures outlined above. This will be assessed in terms of the time available for the survey work and the opportunities to sample as many occurrences of suitable habitats for rare plant species as possible, throughout the full study area, including the unsampled areas in the new Denali East Option Corridor.

2.8.4.2. References Cited

Carlson M., R. Lipkin, H. Cortes-Burns, I.V. Lapina. 2006. Stewart River training area rare plant survey 2006. Prepared for the Alaska Army National Guard, Fort Richardson, AK, by Alaska Natural Heritage Program, Anchorage, AK. 26 pp.

Catling, P.M., and A.A. Reznicek. 2003. Basic requirements for comprehensive botanical inventories. Botanical Electronic News No. 317.

2.8.5. Study 11.9 – Invasive Plant Study

As established in the Study Plan (RSP Section 11.9.1), the overall goals of this study are to determine the current prevalence of invasive vascular plants in the Project area and nearby disturbed areas, and to assess the risk of the continued spread of invasive species as a result of Project development.

The study objectives are established in RSP Section 11.9.1:

- Identify the locations at which invasive plant species have already become established in the Project area and in nearby disturbed areas;
- Estimate population sizes for invasive species and map their current distributions; and
- Determine whether any of the species found could pose a substantial ecological threat if populations were to spread into the Project area.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 29, 2016, AEA proposes one modification to Study Plan Section 11.9:

1. AEA proposes to change the study area by eliminating the Chulitna Corridor from the study area (ISR Part D Overview, Section 1.3) and adding the Denali East Corridor Option as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (Study 11.9 ISR Part C, Section 7.1.2).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 11.9. AEA received no comments on Study 11.9, including its proposed modification outlined above.

2.9. Recreation Resources

2.9.1. Study 12.5 – Recreation Resources Study

As established in the Study Plan (RSP Section 12.5.1), the overall goal of this study is to identify recreation resources and activities (by both visitors to Alaska and Alaska residents) that may be affected by the construction and operation of the proposed Project, and to help assess the potential impacts of Project construction and operation on those resources and activities.

The study objectives are established in RSP Section 12.5.1:

1. Identify and document recreation resources and facilities that support commercial and non-commercial recreation in the Project area.
2. Identify the types and levels of current recreational uses and future reasonably foreseeable future uses based on surveys and interviews, consultation with licensing participants, regional and statewide plans, and other data.
3. Evaluate potential impacts of Project construction and operation on recreation resources, needs, and uses in the Project area.
4. Develop data to inform AEA's future development of a Recreation Management Plan for the Project.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA has two modifications to Study Plan Section 12.5, both the addition of the Denali East Option road and transmission corridor and inclusion of State-issued registration (Tier I) and Tier II subsistence permits for analysis of hunting use (see Study 12.5 ISR Part D, Section 7.1).

A 2014 Study Implementation Report (SIR) was filed with FERC on November 4, 2015. There was a decision point in the Study Plan regarding the extension of the study area in to the Lower Susitna River. Based on current recreational use and the potential Project impacts to those uses from changes to instream flow, ice processes, geomorphology, and aesthetics, AEA in the SIR determined to not extend the recreation study area any further downstream based on recreation and other study results from water resources and geomorphic study areas. As explained in the SIR, executive interviews with user groups and informal consultations have indicated low levels of flow-dependent recreation use between the Parks Highway Bridge (PRM 88.9) and Susitna Landing (PRM 61). Summer users and operators cited the lack of access, safety considerations, cost, and availability of fish and game resources as reasons for low levels of flow-based recreation. Log books provided by Susitna Landing managers indicate that winter recreation users (primarily snowmachiners) were mostly crossing the Susitna River to travel to lands west of the river. Winter trails that cross the Lower Susitna River include: Rabideaux Trail (PRM 89), Trapper Lake Trail (PRM 82.5), Deshka-Su Trail (PRM 82.5) and these crossings have been noted but no further study is needed to characterize the potential effects, if any from the Project.

In accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, AEA received comments and proposed study plan modifications for Study 12.5 from licensing participants, including Rebecca Long, ADF&G, NPS, TCCI, CCA, and WACO AEA's responses to these comments and proposed modifications can be found in Table 2.9.1-1 and below.

Table 2.9.1-1. Study 12.5 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp16_ph3	*We believe significant progress has been made and that the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's constructive participation in the development of this Study Plan and review of study implementation within the context of the FERC ILP. AEA concurs that the study is

Reference Number	Comment or Study Modification Request	AEA's Response
		on track to meet the FERC-approved study objectives.
NPS_pp3_ph6	*We agree with AEA's Study Implementation Report summary and remaining tasks to complete the approved study plan.*	AEA appreciates NPS's constructive participation in the development of this Study Plan and review of study implementation within the context of the FERC ILP. AEA concurs that the SIR provides the remaining tasks to meet the FERC-approved study objectives.
NPS_pp4_ph2	*If the Lower River is not added to the geographic scope for these three studies* [12.5, 12.6 and 12.7] *prior to the USR, and one or more of the other biophysical studies indicates that there will be changes to the river, floodplain, riparian vegetation or fish and wildlife, the applicant will have to extend the three recreation and aesthetics studies to include field work in this area in at least one additional year of study.*	As explained below in Section 2.9.1.1, AEA requests that FERC not adopt the NPS's inferred Study Plan modification request to extend the recreation study below PRM 79. AEA maintains that adequate data has been gathered thus far and will be continue to be gathered under the various FERC-approved Study Plans to evaluate potential impacts to recreation resources.The estimated cost of implementing this modification for additional recreation study beyond what has already been completed below PRM 79 is $1,600,000.
NPS_pp4_ph3	*AEA's assertion that Lower River studies of recreation resources are not need because post-project biophysical conditions will be "within range of existing variability" only accounts for the magnitude of with-dam flows. Flow dependent biophysical resources, upon which recreation and aesthetics resources depend, will be affected by not only flow magnitudes but by the frequency, duration, seasonality and rate of change of with-dam flows. It is too early to state that the with-dam flow regime for the entire Susitna River, including the segment between river mile 79 and 29.9, will result in no changes to any of the biological resources or physical conditions upon which users ranging from moose hunters to birdwatchers, anglers, trappers, snow machiners, fat bikers and more rely.*	AEA disagrees that the decision to not extend recreation studies further downstream only considered the magnitude of with-Project flow. As explained in Section 1.5.3, comparison of the daily flows and water levels in the Lower River between baseline and ILF-1 conditions shows that the frequency, duration, seasonality, rate of change, and timing mirror one another (see Figure 1.5.3-1 and 1.5.3-2). Therefore, AEA concludes that changes in river stage in the Lower River would not materially affect the flow-dependent downstream resources. See Sections 1.5.3 and 2.9.1.1, particularly the discussions related to biological resources in 2.9.1.1.2, 2.9.1.1.4, 2.9.1.1.5, and 2.9.1.1.8.
NPS_pp4_ph4	*In its Study Plan Determination, FERC stated with respect to the Fish Barrier Study that there was "no information in the record to definitively determine that project-related effects from winter load-following operations would be attenuated below three rivers confluence" (p. B-30 of Study Plan determination). Based on this absence of evidence of no effect, FERC required the fish barrier study to include the Lower River. NPS questions why a different rationale was used for the three recreation and aesthetics studies.*	While there may not have been information on the record to definitively determine if Project-related effects were attenuated below the Three Rivers Confluence at the time of FERC's SPD in early 2013, AEA has provided quantitative evidence of the attenuation on the record through implementation of

Reference Number	Comment or Study Modification Request	AEA's Response
		the FERC-approved Study Plans thus far. See Sections 1.5.3 and 2.9.1.1.
NPS_pp4_ph5	*There is no evidence in the record to definitively determine that project-related effects from winter load-following operations would be attenuated below the three rivers confluence. To the contrary, we heard during the ISR meetings, that the Lower River channel may narrow by as much as 10% (Fluvial Geomorphology Study 6.6, ISR transcript p. 304), that aggradation in the Lower River will be reduced (ISR transcript p. 278), that the floodplain will likely narrow (an area highly important for moose habitat and other huntable and watchable wildlife), and that not enough is known about tributary mouths to say whether fish barriers may develop post-project, in these segments in the Middle River which were not studied (Study 9.12: Fish Passage in Upper and Middle River).*	See Sections 1.5.3 and 2.9.1.1, particularly the discussions related to channel width (Section 2.9.1.1.3), riparian vegetation (Section 2.9.1.1.4), and fish barriers tributary mouths (Section 2.9.1.1.5), and wildlife resources (Section 2.9.1.1.9).
NPS_pp5_ph1	*Barriers would exclude migratory fish that are associated with sport fishing and (indirectly, as sources of food) associated with huntable and watchable wildlife from this important habitat, and would decrease the availability of prime sport-fishing sites at tributary mouths.*	See Sections 1.5.3 and 2.9.1.1, particularly the discussions related to fish barriers and sportfishing (Section 2.9.1.1.5) and wildlife resources (Section 2.9.1.1.9).
NPS_pp5_ph2	*Locations such as Deshka Landing, which provides a major point of access to the Susitna River and its tributaries for the general public for subsistence, recreation and transportation, and Willow, where winter snow machine and mushing use is concentrated and spreads across the Susitna Valley to roadless areas on the western side, are of prime importance to the region and beyond. Baseline recreational use and access at these locations should be studied in order to make the assessment of project effects.*	See Sections 1.5.3 and 2.9.1.1, particularly the discussions related to water levels and ice stability (Section 2.9.1.1.1).
NPS_pp5_ph3	*Seasonal trails in the Lower River area including trails within the existing floodplain (which may narrow due to the project) should be mapped using the same methods and standards as trails in the existing study area.*	See Sections 1.5.3 and 2.9.1.1, particularly the discussions related to channel width (Section 2.9.1.1.3) and riparian vegetation (Section 2.9.1.1.4).
NPS_pp4_ph1	*There are numerous species of wildlife important to sport hunting, trapping and non-consumptive viewing that could be affected by changes in the availability or access to habitat along the entire river, including the Lower River. Groundwater changes that affect sportfish egg incubation or rearing habitat and fish barriers that cut off access to tributary habitat or eliminate sport fishing opportunities at tributary mouths, would in turn affect recreation.*	Based on information collected and analyzed in the FERC-approved Study Plan, AEA does not concur that extending the Recreation Resources study to the lower Susitna River is needed to evaluate Project effects on sport hunting, trapping, and viewing wildlife resources. See Sections 1.5.3 and 2.9.1.1.8. AEA also does not concur that Project operations could affect sportfishing recreation in the lower Susitna River. See Sections 1.5.3, 2.9.1.1.2, and 2.9.1.1.5.
TNC_pp23_ph2	*In Part A, the ISR notes that "with respect to current use benefits generated by ecosystem services occurring in the Susitna River corridor and upper watershed, the Recreation Resources Study (Study 12.5) is providing a description of the*	To clarify, AEA has modeled both the maximum load-following and intermediate load-following scenarios down to PRM 29.9 for the open water flow routing

Reference Number	Comment or Study Modification Request	AEA's Response
	recreation resources and facilities that currently support both commercial and non-commercial recreation in the Susitna River watershed and estimates of current levels of recreational use in the region." Yet in the March 30, 2016, meeting, AEA reiterated that there is no need to study the lower river in that study. Without having proposed operating scenarios, AEA cannot know the effects on the Lower River, which provides an active recreation area, including fishing, and the annual Iditarod sled dog race.	model, the 1-D bed evolution model and the temperature component of the EFDC model. These model runs, as well as data gathered in the Lower River in other resource areas, form the basis for AEA's decisions on study extent for various studies. As detailed in Sections 1.5.3 and 2.9.1.1, Project operations are not expected to adversely affect recreation in the lower Susitna River, and this analysis is based upon various potential operating scenarios of the Project.
TCCI_pp10_ph 3	*Addition of Willow to the Rec Resources Study would entail additional data collection. (It's unfortunate that AEA's Rec Use study team did not collect relevant lower river / Yentna data while surveying at Deshka landing. Instead they only sought data for those heading to recreate above the Parks Highway bridge into the existing study area - contrary to the common local uses. The existing study would have costs for expenses occurred by having reps at the Deshka Landing site for the prior study season. One surveyor could collect both recreational and transportation data as they are at the same Deshka facility.*	While the intercept surveys conducted at Deshka Landing specifically asked if people were recreating in the defined study area, these were supplemented with executive interviews with the operators of Deshka and Susitna Landing. See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to water levels and ice stability (Section 2.9.1.1.1).
TCCI_pp6_ph5	*TCCI request Willow be added to the following studies: Recreational Resources*	See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to water levels and ice stability (Section 2.9.1.1.1).
TCCI_pp8_ph1	*AEA and its contractors have taken the hard position that they have determined any changes below the Parks Hwy Bridge (RM 88.9) to be "insignificant" or within environmental acceptance. This premise is not confirmed through completed models or finalized data. It is a hypothesis which still requires ample proof and should not dictate the omission of baseline data. Only the comparison of baseline data to projected conditions with the project can conclude whether impacts are significant or not. AEA's decision point to negate extension of the Rec Resources study are based primarily on data derived from an alternative transect below the Parks Hwy bridge. During the fall 2014 ISR meetings, licensing participants were alarmed to find out that the operation flow tables used for all other studies were no longer applicable for this decision -but that a new gauge was being utilized which generated flows with less stage difference than those at the historic bridge gauge. These new figures were buried in the elusive appendix K in the Open Water Hydrology Data Collection and Flow Routing Model, ISR Part C / Study Implementation Report. (?!!) They have since been replaced with another Appendix B. This new transect gauge has none of the historical data of the prior gauge used by all the other interrelated studies. While AEA asserts this gauge more accurately reflects the lower braided river, it feels unorthodox from a licensing participant*	See Sections 1.5.3 and 2.9.1.1. A discussion of gauge adequacy appears in Section 2.9.1.1.6.

Reference Number	Comment or Study Modification Request	AEA's Response
	point of view. to "change gauges in mid stream" to favor a decision point outcome.	
TCCI_pp8_ph2	*The study areas within 12.5 are varied ie. Recreational Effects analysis area, Recreational Use Study Area, and Recreational Facilities Study Area. a Willow component could be added to the Recreational Use Study rea which currently stops at the Parks Hwy "Y" at Talkeetna (mile 99) This extension would take into account several heavily used sport fisheries at Montana Creek, Goose Creek, Sheep Creek. It would capture all of the Willow dog mushing and snow machine trails (attached in WACO filing) including the Iditarod Trail and others dependent on consistent ice and frozen river conditions. Finally, the Susitna and Deshka Landings would be incorporated for both recreational boating and snow machining access. (currently, the study includes facilities from the Richardson Hwy Corridor, and Glenn Hwy facilities from Glennallen to Chickaloon - but does not include recreation currently occurring on the Susitna River at Willow!) A Willow component modification to the Recreation Use study area could be pared down without the broad intercept or mail surveys of the main study. Interviews with key recreational groups and facilities could provide a cost effective and basic overview.*	See Sections 1.5.3 and 2.9.1.1.
WACO_pp1_ph2	*WACO believes that the ISR Overview entirely overlooked the high levels of winter and summer recreational use on the lower Susitna River, from the mouth of Willow Creek, located at river mile (RM) 50, to the mouth of the Yetna River (RM 29.9). While FERC found there to be low levels of flow-dependent recreation on the Susitna River from the Parks Highway bridge (RM 88.9) to Susitna Landing (RM 61), this conclusion ignores the significantly greater flow-dependent recreation and accompanying social/economic farther downstream.*	See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to water levels and ice stability (Section 2.9.1.1.1).
WACO_pp1_ph3	*The Susitna River near Willow serves as a highway for oudoor enthusiasts. It is the main method of land travel from Willow westward, to the area of Skwentna and to the many lodges and private cabins scattered throughtout the Susitna basin Deshka Landing Outdoor Association, LLC in Willow estimates there are 10,000 recreational days enjoyed annually by its clients, all of whom use the Deshka Landing at RM 45.5 for boating and snowmaching onto the river. Other adventurers utilize the many trails weaving through and around Willow for river access. These trails, including the Corral Hill, Rolly Creek and Luck Shot Trails, are all heavily managed and funded from both public and private sources. The Susitna River also serves as the stage upon which the world-famous events take place. The Iditarod Trail Sled Dog Race begins in Willow, and the first portion of race takes place on the Susitna River. The Iron Dog, a snowmachine race, begins in nearby Big Lake and covers a portion of the river as well. All of these river travelers, whether serious competitors, freight haulers or weekend explorers, depend on consistent*	See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to water levels and ice stability (Section 2.9.1.1.1).

Reference Number	Comment or Study Modification Request	AEA's Response
	water levels and stable ice conditions for their safety. When weather variations change the conditions of the ice, river travel can become treacherous or non existent. Large fluctuations of discharge from the dam during the winter months and low flow rates during the summer could have the potential to seriously and adversely affect river travel conditions.	
Long_160608__pp1_ph 1	*This licensing participant contends that 12.5 and 12.7 should be extended past Willow to PRM (Project River Mile) 29.9 which is Susitna Station.*	As explained below in Section 2.9.1.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $1,600,000.
Long_160608_pp1_ph3	*WACO correctly states that the studies in the Initial Study Review (ISR) entirely overlooked the high levels of winter and summer recreation use on the lower Susitna River from the Willow Creek mouth PRM 50 to the Yentna River mouth PRM 29.9 (Susitna Station). The applicant focused on the flow dependent recreation from the Sunshine bridge area (PRM 88.9) to the Susitna Landing (PRM 61) which showed a low level of use. The applicant ignored the significantly larger flow dependent recreation going down river from Susitna Landing with the accompanying socio-economic impacts further downstream. WACO estimates that there are 10,000 recreation days annually around the Willow area. Year round access at Deshka Landing PRM 45.5 has high traditional use. This includes more than commercial and individual recreational use. Freight hauling and transportation are a big part of the river use accessed at Deshka Landing.*	AEA did not ignore winter and summer recreation use in the Lower Susitna River. To clarify, winter and summer use patterns were documented by both the intercept survey and the recreational use mail surveys. As explained below, the FERC-approved Study Plan included a decision point as to whether to extend the recreation study to the Lower River after information on water levels, ice processes, riparian vegetation, and other resources is collected and analyzed. As detailed in Sections 1.5.3 and 2.9.1.1, AEA has decided not to extend the recreation study further into the Lower River because Project-related influences in the Lower Susitna River are not expected to affect recreation and recreational resources in the Lower River.
Long_160608_pp4_ph2	*1.5 National Park Service Mandate. Furthermore, there is a question about the study fulfillment of the NPS mandate. NPS might not be able to develop section 10(a) licensing recommendations adequately to mitigate impacts on recreation and aesthetics without Lower River baseline data. The recreational study outputs feed into the socio-economic study inputs. Comprehensive lower river baseline data is necessary for accuracy in other studies.*	AEA does not agree that recreational data gathered to date will prevent NPS from developing section 10(a) licensing recommendations to mitigate Project effects on recreation and aesthetic resources. As explained in Sections 1.5.3 and 2.9.1.1, extensive information collected and analyzed during AEA's implementation of the FERC-approved Study Plan demonstrate that Project-related influences in the Lower Susitna River are not expected to affect recreational and aesthetic resources in the Lower Susitna River.
CCA_pp3_ph2	*We are puzzled by the statement in the ISR Part A for Study 12.5 that "The Wildlife Harvest Analysis (Study 10.20) provided baseline wildlife harvest data which was used to characterize existing hunting opportunities and hunter distribution." How can this be, when Study 10.20 has not been done?*	Although Study 10.20 has not yet been conducted, an analysis of state wildlife harvest data for the years 2003–2011 and federal subsistence data for moose and caribou for 1994–2011 was conducted by AEA in 2012 (Prichard et al. 2013). This

Reference Number	Comment or Study Modification Request	AEA's Response
		data was used by the recreation study team, as well as other resource study teams. The analysis completed in 2012 also formed the basis for Study 10.20, which will use a similar approach to analyze comparable wildlife harvest data obtained since 2011 when it is completed and reported in the USR. A comprehensive analysis of the data gathered for all relevant resource areas will be completed to assess Project impacts, to be presented in the License Application.

2.9.1.1. Response to Modification Request to Extend Study Area below Parks Highway Bridge

A number of commenters (NPS, TCCI, WACO, and Ms. Long,) seek a modification to the FERC-approved studies for the Recreation Resources Study (Study 12.5), Aesthetic Resources Study (Study 12.6), and Recreation River Flow Study (Study 12.7) to extend the study area downstream of the Parks Highway Bridge.

AEA requests that FERC not adopt this proposed study plan modification because this request does not meet the criteria established in 18 C.F.R. §5.15(d) for modification of an approved Study Plan. Specifically, the commenters have not established "good cause" for the modification nor have they demonstrated the study was not implemented as provided by the approved Study Plan.

Then FERC-approved Study Plan provided that if study results indicated that the Project may affect recreation activities and river flows in a way that recreationists currently use the reach of the river downstream of the Parks Highway Bridge (PRM 88.9), AEA would make a decision regarding extending the study effort further downstream. In the June 2014 ISR Part C (Section 7.1.1) and November 2015 SIR (Section 7.1), AEA reviewed results from applicable studies and made the determination that the Project would not affect recreation or river flows in a way that would appreciably impact flow-dependent and non-flow-dependent recreation uses of the Lower River. As a result, AEA decided not to extend the study effort for studies 12.5, 12.6, and 12.7 further downstream of the Parks Highway Bridge. Moreover, AEA estimates that the cost of implementing these proposed modifications would exceed $1,600,000 for the recreation study, another $130,000 for the aesthetics study and between $400,000 and $500,000 for the river recreation study. For these reasons, described in detail below, commenters have not established that "good cause" warrants modification of these three studies to extend the study areas below the Parks Highway Bridge.

2.9.1.1.1. Water Levels and Stable Ice Conditions

The commenters expressed concern that river travelers depend on consistent water levels and stable ice conditions for their safety and assertthat large fluctuations of discharge from the dam during the winter months and low flow rates during the summer could have the potential to seriously and adversely affect river travel conditions. (See Long_160608_pp4_ph2, NPS_pp4_ph3, NPS_pp4_ph5, NPS_pp5_ph2, NPS_pp5_ph3, TCCI_pp7-ph5, TCCI_pp6-ph5, TCCI_pp7-ph4, TCCI_pp8-ph1, TCCI_pp7-ph6, TCCI_pp8-ph2, WACO_pp1_ph2, WACO_pp1_ph3.)

2.9.1.1.1.1. Flow-Dependent Recreation

Data collected to date under the Study Plan establish that flow-dependent recreation in the lower Susitna River will be unaffected by Project operations. Section 1.5.3 describes in detail the comparison of mainstem river water levels, or river stage elevations under existing conditions and post-Project operational scenario ILF-1 and the results have found that the range of daily stage does not change substantially post-Project scenario ILF-1. Therefore, under post-Project conditions, flow based recreation uses and experience of the Lower River, including motorized and non-motorized boating, would not appreciably be affected in a way that would be noticeable to users.

As noted in the June 2014 ISR Part C (Section 7.1.1), estimated recreation use levels downstream of the Parks Highway Bridge (PRM 88.9) varies along the length of the river. The area downstream of the Parks Highway is addressed in the study through the existing information such as that found in the Alaska Statewide Comprehensive Outdoor Recreation Plan and other borough planning documents. Between the Parks Highway Bridge and Susitna Landing (PRM 65), recreation use was determined to be limited due to a lack of access, user preferences for other recreation access locations, safety considerations, cost, and availability of fish and game resources. Operators of Susitna Landing and Deshka Landing (PRM 47.5) confirmed these findings and indicated that the majority of summer flow based recreation users (motorized and non-motorized boating and sport fishing) traveled downstream of Susitna Landing to access sport fishing opportunities, primarily at tributary mouths. Therefore, for the segment of the Lower River between Parks Highway Bridge and Susitna Landing, any potential effects to flow-based recreation users are expected to be negligible due to the extremely low levels of recreation use coupled with the fact that flow changes would be within the range of normal variation currently utilized for flow-dependent recreation.

Downstream of Susitna Landing (PRM 65), higher levels of flow-dependent recreation use were identified and tended to be focused on sport fishing opportunities at the tributary mouths and recreational boating associated with remote properties. Recreation use is higher for this portion of the Lower River, but the Project is expected to have a negligible effect on these activities. For Lower River access points, the range of daily flow fluctuations (daily maximum river level – daily minimum river level) shows little change (i.e., less than 0.1 ft) between existing conditions and operating scenario ILF-1. While daily river level fluctuations show little change, under the ILF-1 operating scenario the river level would be lower (i.e., 0.7 ft) during summer months of representative dry, average, and wet years at PRM 64.6 near Susitna Landing (Section 1.5.3). These stage changes would be within the range of normal variation currently experienced by flow-dependent recreation under existing baseline conditions. Therefore, changes in river stage, as detailed above, would not affect the ability of recreation boaters or anglers to travel on the Lower River and would not adversely affect the overall experience or use patterns of flow-dependent recreation in portions of the Lower River outside the Recreation Use Study Area.

2.9.1.1.1.2. Ice-Dependent Recreation

Executive interviews with winter users groups, as indicated in the June 2014 ISR Part C (Section 7.1.1), indicated that several winter trails cross Susitna River between Susitna Landing and Deshka Landing and are used by snowmachiners and dog mushers to access recreation resources in the western Sustina River Valley. Winter trails include the Iditarod Trail and those identified by WACO in comments. These trails are used for recreation events such as the Iditarod Sled Dog Race and the Iron Dog Race.

Section 1.5.3.3 describes in detail the analysis of ice cover in this reach, the discharge ranges, and corresponding river stages. The modeling indicates that even if proposed operational scenarios increase the discharge (during freeze-up and throughout the winter), the resulting stages would only be increased by a maximum of about 1 ft. over the naturally occurring stage range just prior to freeze-up. At Susitna Station (PRM 29.9), at the beginning of freeze-up, the natural discharge ranges from 11,000 to 58,000 cfs with a corresponding representative stage of 32.7 to 39.0 ft., respectively. Similar to Sunshine, the Susitna Station model indicates that even if the proposed operational scenarios increase the discharge (during freeze-up and throughout the winter), the resulting stages would only be increased by a maximum of about 1 ft. over the naturally occurring maximum stage range just prior to freeze-up. The complete first year results of the Ice Processes Study (Study 7.6) are provided in the Study 7.6 ISR.

Results from the above analysis do not indicate that the Project would affect winter ice-dependent recreators (snowmachiners, dog mushers, fatbikers and other winter recreators) using the reach of the Susitna River downstream of the Parks Highway Bridge (PRM 88.9). Changes in ice formation and ice break-up in the Lower River due to Project induced changes would not appreciably affect ice stability, safety, or alter winter recreators ability to use trails that utilize the Lower River, including the Iditarod Trail. As a result, ice processes under post-Project conditions would be within the range of normal variation currently experienced by winter recreationists under existing, baseline conditions, and therefore would not adversely affect the overall experience or use patterns of recreationists in portions of the Lower River outside the Recreation Use Study Area.

2.9.1.1.2. Groundwater Changes that Affect Recreation Activities

The NPS (NPS_pp4_ph1, NPS_pp4_ph3) stated that groundwater changes that affect sportfish egg incubation or rearing habitat would in turn affect recreation.

As noted in the June 2014 ISR, Part C (Section 7.1.1), operators of Susitna Landing and Deshka Landing (PRM 47.5) indicated that the majority of flow based recreation occurred downriver of the Deshka and Susitna landings, particularly in downriver tributaries. Executive interviews indicated that in the Lower River sport fishing activities are primarily focused at the mouth of tributaries (Yentna River, Deshka River, Willow Creek, and Sheep Creek) where anglers pursue migratory fish species, such as Chinook and Coho salmon, that enter tributaries for spawning habitat. Therefore, if there was a link between egg incubation or rearing habitat quality and the Project it still would not change recreation fishing opportunities or success. Sportfishermen essentially use the Susitna mainstem as a travel corridor to arrive at their fishing destination. Given the low levels of sport fishing that occur in the Lower River mainstem, the changes in river stage under Project conditions, as outlined above, would have a minimal impact to recreation sport fishing activities in the Lower River.

2.9.1.1.3. Changes in Channel Forming Discharge and Potential for Channel Width Change

The NPS (NPS_pp4_ph1) stated that there are numerous species of wildlife that are important to sport hunting, trapping and non-consumptive viewing that could be affected by changes in the availability or access to habitat along the entire river, including the Lower River.

In the 2014 Technical Memorandum *Decision Point on Fluvial Geomorphology Modeling of the Susitna River below PRM 29.9*, potential channel width change in the Lower River was reevaluated based on updated estimates of the Project effects on peak flow hydrology under MAX LF OS-1b using a version of the 1-D BEM that extended to Susitna Station. The reductions of peak flow in the channel forming range (about 1.5- to 5-year return period) were 17 to 19 percent at Sunshine Station (PRM 87.9) and 11 to 9 percent at Susitna Station (PRM 29.9). These translated to estimated bankfull width reductions of approximately 9 to 10 percent between the Three Rivers Confluence and the Yentna River confluence. Downstream of the Yentna River confluence, due to the further moderating effect of Yentna River water and sediment inflow, only a 5 to 6 percent width reduction was predicted.

In the same 2014 Technical Memorandum, the results of the 50-year simulations using the 1-D BEM indicated that the Lower River tends to be aggradational for both existing and Max LF OS-1b conditions, but slightly less so under the with-Project condition. In the Lower River, reach-average bed elevation change over 50-years ranged from 0.65 to 3.5 feet for existing conditions and from 0.43 to 3.2 feet for Max LF OS-1b conditions. This information, combined with the prediction of 10 percent or less adjustment of the channel width under the with-Project condition resulted in a conclusion that the basic channel form and character of the Susitna River will remain the same, but with slightly narrower channels. The changes would not affect the ability of motorized or non-motorized recreation boaters to travel on the Lower River nor would it adversely affect the overall experience or use patterns of recreationists in the Lower River.

2.9.1.1.4. Change in Extent of Riparian Vegetation

The NPS (NPS_pp4_ph3, NPS_pp4_ph5) and Ms. Long (Long_160608_pp3_ph6) stated that there is no evidence in the record to definitively determine that Project-related effects from winter load-following operations would be attenuated below the Three Rivers Confluence and with-dam flow regime for the entire Susitna River, including the segment between PRM 79 and 29.9, or would not result in changes to any of the biological resources or physical conditions relied upon by users ranging from moose hunters to birdwatchers, anglers, trappers, snow machiners, fat bikers and more.

Section 1.5.3.7 above describes in detail the expected extent of changes in riparian vegetation. As described in that section, the valley in which the floodplain and channels of the Lower River are contained will not be changed by the Project, and the area of the floodplain will increase by the amount that the channels decrease. Thus, riparian vegetation will expand slightly in some areas as the channel adjusts to a narrower width.

The expansion of vegetation in the Lower River is a process that was determined to have occurred over the past 60 years in the Geomorphology Study (6.5) from analysis of aerial photography. The turnover analysis in the 2014 Technical Memorandum *Mapping of Geomorphic Features and Turnover within the Middle and Lower Susitna River Segments from 1950s, 1980s, and Current Aerials*, which quantifies the amount of floodplain converted to channel and the amount of channel converted to floodplain, indicated that in the period from the 1950s to 2012, 5 of the 6 Lower River geomorphic reaches (Reaches LR-1, LR-2, LR-3, LR-4 and LR-6) experienced net increases in the amount of floodplain (which represents a corresponding net decrease in channel area) with the average annual rate of increase in floodplain area within these reaches ranging from about 20,000 sq. ft. per mile to 60,000 sq. ft. per mile (or 4 to 11 ft. per year) (Figures 6.1-5 and 6.1-6). This trend was most pronounced in the period from the early 1980s to 2012 with the same five reaches showing an average annual rate of net increase in floodplain area ranging from 20,000 ft. sq. per mi. to 100,000 sq. ft. per mi. (or 4 to 19 ft. per year). In contrast, the only reach in which floodplain area decreased and thus channel area increased was Lower River Geomorphic Reach LR-5, which experienced an average annual rate of increase in channel area of 25,000 sq. ft per mi. (or 5 ft. per year) from the 1950s to 2012 and 10,000 sq. ft. per mi. from the 1980s to 2012 (or 2 ft. per year). The results of the turnover analysis indicate that the relationship between the channel area and the vegetated floodplain is dynamic and varies over time.

These results indicate that Project-induced changes to riparian habitat utilized by wildlife and sport hunters, trappers, and non-consumptive uses such as bird and wildlife watching would be very limited and occur within a dynamic floodplain environment. As the channel slightly narrows in width the riparian vegetation habitat would expand in some areas. This change in habitat would be small relative to the larger habitat areas that exist in the Lower River for species important to recreation activities. Furthermore, an increase in riparian vegetation could potentially increase habitat and be slightly beneficial for some species. Overall changes to riparian vegetation habitat and wildlife resources important to recreation activities would be extremely limited and would not adversely affect the overall experience or use patterns of recreationists in the Lower River.

2.9.1.1.5. Fish Barriers and Sport Fishing

The NPS asserts that not enough is known about tributary mouths to say whether fish barriers may develop post-Project (NPS_pp4_ph5) and that fish barriers would exclude migratory fish that are associated with sport fishing and (indirectly, as sources of food) associated with huntable and watchable wildlife from this important habitat, and would decrease the availability of prime sport-fishing sites at tributary mouths (NPS_pp5_ph1).

As part of the decision of whether to extend the several studies below PRM 79, five tributary mouths were selected for study (R2 2013 and Tetra Tech 2013c): Birch Creek (PRM 92.5), Trappers Creek (PRM 94.5), Sheep Creek (PRM 69.5), Caswell Creek (PRM 67.0) and the Deshka River (PRM 45.0). These tributaries were selected for study to identify whether there was potential for fans to form at the tributary mouths as a result of Project-induced changes in stage and flows in the adjacent Susitna River mainstem or side channel. The purpose of the tributary mouth studies was to identify whether fan formation could result in barriers that would hinder access for adult salmon attempting to spawn in the tributaries. The five tributaries were visited in 2013 and/or 2014 to conduct cross section surveys and bed material sampling as well as to make general observations.

Based on the site conditions and knowledge of the geomorphology of the Lower River gained from other efforts conducted in the Geomorphology Studies, there is very little potential for barriers to form at the tributary mouths in either the existing condition or with-Project condition. In contrast to the Middle River tributaries, the tributaries to the Lower River discharge to the Susitna River at or across the extensive Susitna River floodplain and thus confluence conditions are inherently adjustable depending on flow and sediment supply from the tributaries and the locations of the receiving Susitna River mainstem or lower order side channels. The west side tributaries (e.g. Trappers Creek, Deshka River) have very low sediment loads due to their contributing drainage basins being primarily underlain by Late-Pleistocene-age glacial till and glacio-lacustrine sediments that support extensive areas of muskeg. Therefore, the potential for tributary mouth barriers to form under with-Project conditions is very low since there is insufficient coarse sediment supply to form fan deposits, and the Project will have no effect on either the tributary flows or sediment yields. The smaller east side tributaries (e.g., Birch Creek and Caswell Creek) also drain areas underlain by Late-Pleistocene-age glacial and glacio-lacustrine sediments that support extensive muskeg. Consequently, for the same reasons as for the west side tributaries, there are unlikely to be any tributary mouth barriers under with-Project conditions. The larger east side tributaries drain the Talkeetna Mountains and do carry a substantial sediment load (e.g. Sheep Creek, Willow Creek, and Kashwitna River). However, though both the flows and sediment loads from the larger tributaries are substantial, the lower reaches will be able to adjust both laterally and vertically because their mouths are not fixed by bedrock or other erosion-resistant materials. Consequently, it is highly unlikely that tributary mouth barriers will form under with-Project conditions and cut off access to tributary habitat for migratory fish associated with sport fishing. Furthermore, there is expected to be no decrease in availability of migratory fish or sport fishing opportunities at tributary mouths due to fish barriers and no adverse effect to the overall experience or use patterns of sport fishing recreationists in the Lower River.

2.9.1.1.6. Gauge Data Adequacy

TCCI stated (TCCI_pp8_ph1) that it was not appropriate to base the decision not to extend the Recreation Resources study on data derived from an alternative transect below the Parks Highway Bridge.

The June 2014 ISR Part C (Section 7.1.1) and 2014 Study Implementation Report (Section 7.1), did not rely on discharge data from a new gauge. The PRM 87.1 transect referenced in the report is a surveyed cross-section of the Susitna River at PRM 87.1. Discharge measures from the long-term gauge at PRM 88.0 were used to model what the water level height (stage height) would be at PRM 87.1. This transect at PRM 87.1 was selected to determine potential Project effects on flow-dependent recreation in the Lower River because the channel shape was more representative of conditions in the Lower River than PRM 88.0. Applying long-term discharge measures recorded at PRM 88.0 to the transect at PRM 87.1 allowed recreation specialists to better assess potential Project effects on flow-dependent recreation.

2.9.1.1.7. Modeling Data and Study Extension

NPS stated (NPS_pp4_4) that the same rationale FERC used for the Lower River Fish Barrier Study determination, in that "*no information in the record to definitively determine that project-*

related effects from winter load-following operations would be attenuated below three rivers confluence," should also be used for recreation and aesthetics studies in the Lower River.

AEA has completed 1-D modeling for the Lower River and continues analysis of the 1-D transect hydraulic data sets collected in Trapper Creek and Birch Creek, and mainstem transects located at PRM 95, PRM 96 and PRM 97. Field data collection methods and initial analyses were presented in Study 8.5 ISR Part C, Appendix O: *Fish Habitat Modeling in the Lower River* (R2 2014l) and as well presented during the Proof of Concept meeting held April 15-17, 2014 (Study 8.5 ISR Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept* [R2 et al. 2014]). Data are being analyzed using the 1-D HEC-RAS hydraulic model (Version 4.1) to simulate water levels at the respective transect locations. (Study 8.5 SIR, 5.6.5: Continued analysis and calibration of 1-D Hydraulic Models – Lower River Segment). Additionally, Version 2.8 of the OWFRM is available and documented in Study 8.5 SIR Appendix B: *Open-water Hydrology Data Collection and Open-water Flow Routing Model* (Version 2.8).

2.9.1.1.8. Impacts on Wildlife Resources

The NPS (NPS_pp4_ph1) stated that there are numerous species of wildlife that are important to sport hunting, trapping and non-consumptive viewing that could be affected by changes in the availability or access to habitat along the entire river, including the Lower River.

Collection of ecological data and the associated modeling needed to evaluate potential Project effects on wildlife resources in the riparian zone of the Lower River is already part of the FERC-approved Study Plan. Specifically, for Study 11.6 (Riparian Vegetation Study Downstream of the Proposed Susitna–Watana Dam), wildlife habitats have been mapped in the entire area currently influenced by riverine processes as far downstream as PRM 29.5 (see Study 11.6 ISR Part A, Section 3, Figure 3-1). That habitat map information is being incorporated into Study 10.19 (Evaluation of Wildlife Habitat Use, which uses the identical study area as Study 11.6) to identify the wildlife species using each habitat type and to assess the relative importance of those habitats to the wildlife species that occur in the area, as described in RSP Section 10.19. The predictive habitat-change model developed for Study 8.6 (Riparian Instream Flow Study; see RSP Section 8.6.3.7) will be used to evaluate post-development Project-related changes in riparian habitats and, by extension, in the use of those habitats by all wildlife species that occur in the study area. This integration of results from multiple studies is explained in RSP Section 11.6.7. Hence, no further modifications of the Study Plan are needed to address potential impacts on wildlife resources in the Lower River.

2.9.2. Study 12.6 – Aesthetic Resources Study

As established in the Study Plan (RSP Section 12.6.1), the overall goals of this study are to inventory and document baseline aesthetic (e.g., visual, auditory) conditions within the Aesthetic Resources Study area and evaluate the potential effects to aesthetic resources that may result from construction and operation of the proposed Project. The analysis will focus on assessing these potential impacts and will help identify potential design and other mitigation options.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA does not propose any modifications to Study Plan Section 12.6.

There have been three variances from the FERC-approved Study Plan discussed in the ISR Part D. Additionally, the Study Plan included a decision point regarding the extension of the study area into the Lower Susitna River. As described in the June 2014 ISR, it was determined to not extend the Aesthetic Resources study area down river below Talkeetna. Though changes to river flow, stage, sediment load, and ice cover in the Lower River would occur with the Project, they are considered to be within the normal range of variability. The Lower River is expected to remain a wide, low-gradient, braided, and turbid river. Since river uses are not expected to change, there would be no shift in predominant viewer groups.

No modifications to the Study Plan methods are needed to complete the study and meet the Study Plan objectives. However, the study area has changed from that described in the RSP (Section 12.6.3): AEA removed the Chulitna Corridor (ISR Part D Overview Section 1.3) and added the alternative Denali East Option (access road and transmission line corridor) to the study area.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, comments were filed by FERC, NPS, and Rebecca Long for Study 12.6. AEA's responses to the comments can be found in Table 2.9.2-1 and below.

Table 2.9.2-1. Study 12.6 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA8_ph4	*The ISR (Part C) indicates that access restrictions prevented visiting previously identified analysis locations (ALs). Please clarify whether you intend to access any of these ALs during future studies, or if alternative sites have been identified that would be sufficiently representative to complete the visual resource analysis. In the latter case, did you consult with stakeholders to select the alternate analysis locations, what were their concerns with the proposed sites, and how did you address their comments?*	As provided in RSP Section 12.6.4, baseline data collection includes visiting ALs, but as indicated in the ISR Part D, Section 8, baseline data collection of basic landscape components remains an ongoing action to complete the study plan. ALs not accessible during the first study year will be visited at a future date.
NPS_pp5_ph4	*The omission of the Lower River from the scope of the study makes it difficult to appropriately assess project-related effects and seek measures to avoid, minimize, mitigate or compensate for such effects. A narrowed river channel, narrowed floodplain, or increased encroachment of forest into riparian areas would change the Lower River's aesthetics. Baseline data, in the form of soundscape measurements and key observation points and routes (e.g. Iditarod trail route) should be collected and assessed using similar methods as have been used in the existing study area.*	As explained above in Sections 1.5.3 and 2.9.1.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $130,000. As described in the June 2014 ISR, it was determined to not extend the Aesthetic Resources study area down river below Talkeetna. Though changes to river flow, stage, sediment load, and ice cover in the Lower River would occur with the Project, they are considered to be within the normal range of variability. The Lower River is expected to remain a wide, low-gradient, braided, and turbid river. Since river uses are not expected to

Reference Number	Comment or Study Modification Request	AEA's Response
		change, there would be no shift in predominant viewer groups.
Long_160608_pp1_ph2	*The Aesthetics Resource Study 12.6 should … be extended to PRM 29.9.*	As explained above in Section 2.9.1.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this this modification is $130,000.

2.9.2.1. Aesthetic Impacts of Narrowed Channel

The NPS stated (NPS_pp5_ph4) that a *"narrowed river channel, narrowed floodplain, or increased encroachment of forest into riparian areas would change the Lower River's aesthetic and requested that baseline data, in the form of soundscape measurements and key observation points and routes (e.g. lditarod trail route) should be collected and assessed using similar methods as have been used in the existing study area."*

As outlined previously and detailed in Sections 1.5.3 and 2.9.1.1 above, since the valley in which the floodplain and channels of the Lower River are contained will not be changed by the Project, the area of the floodplain will increase by the amount that the channels decrease. Thus, riparian vegetation will expand slightly in some areas as the channel adjusts to a narrower width. The results of the turnover analysis also indicate that the relationship between the channel area and the vegetated floodplain is dynamic and varies over time. The stage changes identified above indicate that Project operations would minimally influence river flows and that flows would be within the range of normal variation currently experienced by recreationists under existing, baseline conditions. This information resulted in a conclusion that the basic channel form and character of the Susitna River will remain the same, but with slightly narrower channels. As a result, under post-Project conditions, the aesthetic attributes of the Lower River and experience of recreationalists in the Lower River, including motorized and non-motorized boating, would not be appreciably affected in any measurable way noticeable to users.

2.9.3. Study 12.7 – Recreation River Flow and Access Study

As established in the Study Plan (RSP Section 12.7.1), the overall goal of this study is to contribute data to the Recreation Resource Study (Study 12.5) concerning the relationship between river flows and river recreation opportunities and uses.

The study objectives are established in RSP Section 12.7.1:

- Document river recreation use and experience for the respective river recreation and transportation opportunities on three mainstem Susitna river reaches.
- Describe potential effects of altered river flows on existing and potential boating activity and other river recreational uses of the Susitna River.

- Understand river ice preferences for the respective river ice dependent winter recreation and transportation on the Susitna River.
- Describe new boating or other flow-dependent recreational opportunities that may be created by Project construction and operation.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA does not propose any modifications to Study Plan Section 12.7.

A 2014 Study Implementation Report was filed with FERC on November 4, 2015. There was a decision point in the Study Plan regarding the extension of the study area in to the Lower Susitna River. Based on current recreational use and the potential Project impacts to those uses from changes to instream flow, ice processes, geomorphology, and aesthetics, it was determined to not extend the recreation study area any further downstream. Executive interviews with user groups and informal consultations have indicated low levels of flow-dependent recreation use between the Parks Highway Bridge (PRM 88.9) and Susitna Landing. Summer users and operators cited the lack of access, safety considerations, cost, and availability of fish and game resources as reasons for low levels of flow-based recreation. Log books provided by Susitna Landing managers indicate that winter recreation users (primarily snowmachiners) were crossing the Susitna River to travel to Trapper Lake, Neil Lake, Lisa Lake, and Florine Lake.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015. Comments were filed by FERC, ADF&G, TCCI, WACO, and Rebecca Long for Study 12.7. AEA's responses to the comments can be found in Table 2.9.3-1 and below.

Table 2.9.3-1. Study 12.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
FERC_ppA8_ph5	*The ISR notes that you intend to gather additional information on ice dependent winter travel and recreation on the river in coordination with the Transportation Resources Study. Given the overlap between the two studies, we recommend that future focus group discussions be closely coordinated to provide a thorough understanding of desired ice conditions needed for winter travel or recreational purposes, as well as how project operation may affect such use.*	AEA agrees and will closely coordinate future focus group discussions undertaken to address both Studies 12.7 and 15.7.
ADNR_ADFG_pp16_ph4	*We believe significant progress has been made and that the study is on-track to meet FERC-approved study objectives.*	AEA appreciates ADF&G's constructive participation in the development of this study plan and review of study implementation within the context of the FERC ILP. AEA concurs that the study is on track to meet the FERC-approved study objectives.
Long_160608_pp1_ph2	*Furthermore, this licensing participant contends that 12.5 and 12.7 should be extended past Willow to PRM (Project River Mile) 29.9 which is Susitna Station.*	As explained above in Sections 1.5.3 and 2.9.1.1, AEA requests that FERC not adopt this proposed study plan modification. This request does not

Reference Number	Comment or Study Modification Request	AEA's Response
		meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. The estimated cost of implementing this modification is \$400,000 - \$500,000.
Long_160608_pp1_ph4	*WACO correctly states that the studies in the Initial Study Review (ISR) entirely overlooked the high levels of winter and summer recreation use on the lower Susitna River from the Willow Creek mouth PRM 50 to the Yentna River mouth PRM 29.9 (Susitna Station). The applicant focused on the flow dependent recreation from the Sunshine bridge area (PRM 88.9) to the Susitna Landing (PRM 61) which showed a low level of use. The applicant ignored the significantly larger flow dependent recreation going down river from Susitna Landing with the accompanying socio-economic impacts further downstream. WACO estimates that there are 10,000 recreation days annually around the Willow area. Year round access at Deshka Landing PRM 45.5 has high traditional use. This includes more than commercial and individual recreational use. Freight hauling and transportation are a big part of the river use accessed at Deshka Landing.*	AEA did not ignore winter and summer recreation use in the lower Susitna River. Rather, as explained above, the FERC-approved Study Plan contained a decision point as to whether to extend the recreation study to the Lower River after information on water levels, ice processes, riparian vegetation, and other resources is collected and analyzed. As detailed in Sections 1.5.3 and 2.9.1.1, AEA has decided not to propose to extend the recreation study to the Lower River because Project-related influences in the lower Susitna River are not expected to affect recreation and recreational resources in the Lower River.
Long_160608_pp2_ph6	*But the applicant is making the assumption that project changes in stage and flow are undetectable and considered insignificant at Sunshine gage and below. The 12.7 Part A ISR report concludes that modeled changes in stage and flow at the end of Reach 3 are actually exaggerated at Sunshine Gage because it is an unusually narrow channel at that location. Applicant states PRM 87.1 transect measurements show the channel there is twice as wide as the Sunshine gage channel. They state PRM 87.1 is a more typical channel. Comparison of results between 87.1 and 88 under pre and post OS-1 resulted in a 12-19% less stage change at 87.1 than 88. So using the data from 87.1, it was stated that the results of the 1/31/13 Open-Water HEC-RAS Flow Routing does not support increasing the longitudinal scope of the river recreation studies below the Sunshine gage bridge. They are saying a 12%-19% stage change is insignificant and indiscernible. This assumption is questionable. In this instance, using the transect data at 87.1 skews the results. This enables false assumptions upon which decision points for study extensions were made. This seems flimsy reasoning especially since every other modeling effort is using the data from the sunshine gage at PRM 88 which has 61 years of data. This is both actual data and modeled data. The case has not been made to not extend.*	AEA maintains that the wealth of data collected and analyzed to date demonstrates the lack of any "good cause" to extend the recreational boating study to the lower Susitna River. See Sections 1.5.3 and 2.9.1.1. A discussion of gauge adequacy appears in Section 2.9.1.1.6.

Reference Number	Comment or Study Modification Request	AEA's Response
Long_160608_pp3_ph2	*1.2 Fluvial Geomorphology Below Watana Dam Study 6.6 Data Considerations. The 3/22/16 ISR Meeting Summary stated for 6.6 that the Bed Elevation Model was extended to PRM 29.9 based on stream flow assessment. So if the decision was made for 6.6 to extend to 29.9 should this not be extended for the recreation and aesthetics study? According to the September 2014 Technical Memorandum The Decision Point on Fluvial Geomorphology Modeling below PRM 29.9, the open water flow project operation- induced changes modeling results showed generally reduced flows, sediment transport, water surface elevation, flow depth and velocities. The Lower River under existing conditions is generally aggradational. Post project will maintain aggradational trends at slightly reduced rate. The Susitna River channel is expected to narrow slightly. The 6.6 Tetra Tech, Inc. September 2014 Technical Memorandum stated that there was an early decision to extend from Sunshine to PRM 29.9 because appreciable changes were occurring at Sunshine and potential for future changes. So it was extended to 29.9.*	See Sections 1.5.3 and 2.9.1.1, particularly the discussions related to channel width (Section 2.9.1.1.3).
Long_160608_pp3_ph4	*1.3 Riparian Instream Flow Study 8.6 Data Consideration. In the 3/23/16 ISR meeting, AEA consultant Kevin Featherston of 8.6 Riparian Instream Flow Study stated they don't have the results of the 1D open water modeling of the entire river. They do not know what would change in the Lower River down to Willow or the Yentna River in terms of surface water. They do not know what stage changes would occur longitudinally through-out the Lower River with the project. Currently, this is unknown because they have not finished the modeling. Without this data, how can there be a decision to not extend the recreation and aesthetic studies?*	See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to 1-D modeling data (Section 2.9.1.1.7). Ms. Long incorrectly states that stage changes in the Lower River are not known. Results from the 1-D open water modeling for the entire river, including the Lower River to PRM 29.9, have been completed and presented in Study 8.5 ISR Part C, Appendix O: Fish Habitat Modeling in the Lower River. Additionally, Version 2.8 of the OWFRM is available and documented in SIR Appendix B: Open-water Hydrology Data Collection and Open-water Flow Routing Model (Version 2.8).
TCCI_pp7_ph1	*TCCI request Willow be added to the following studies: River Rec Flows and Access Study*	As explained above in Section 2.9.1.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $400,000 - $500,000.
TCCI_pp7_ph5	*In light of the extension of the 6.6 Geomorphology study to RM 29.9, and multiple aquatic studies extending to this RM, one can assume there will be changes to the lower Susitna River south of the Parks Hwy Bridge RM 88.9. The objectives of a Willow / Lower Su River Use component would include an overview of social conditions, transportation, and recreational uses from the RM 88.9 to 29.9.*	See Sections 1.5.3 and 2.9.1.1.

Reference Number	Comment or Study Modification Request	AEA's Response
TCCI_pp10_ph8	*Additional data would be required for adding a fourth reach (88.9 - 29.9) to study 12.7 but methodologies could be altered and simplified to accommodate a more regional use pattern.*	As explained below in Section 2.9.1.1, AEA requests that FERC not adopt this proposed study plan modification. The estimated cost of implementing this modification is $400,000 - $500,000.
TCCI_pp8_ph1	*AEA and its contractors have taken the hard position that they have determined any changes below the Parks Hwy Bridge (RM 88.9) to be "insignificant" or within environmental acceptance. This premise is not confirmed through completed models or finalized data. It is a hypothesis which still requires ample proof and should not dictate the omission of baseline data. Only the comparison of baseline data to projected conditions with the project can conclude whether impacts are significant or not. AEA's decision point to negate extension of the Rec Resources study are based primarily on data derived from an alternative transect below the Parks Hwy bridge. During the fall 2014 ISR meetings, licensing participants were alarmed to find out that the operation flow tables used for all other studies were no longer applicable for this decision -but that a new gauge was being utilized which generated flows with less stage difference than those at the historic bridge gauge. These new figures were buried in the elusive appendix K in the Open Water Hydrology Data Collection and Flow Routing Model , ISR Part C / Study Implementation Report. (?!!) They have since been replaced with another Appendix B. This new transect gauge has none of the historical data of the prior gauge used by all the other interrelated studies. While AEA asserts this gauge more accurately reflects the lower braided river, it feels unorthodox from a licensing participant point of view to "change gauges in midstream" to favor a decision point outcome.*	See Sections 1.5.3 and 2.9.1.1. A discussion of gauge adequacy appears in Section 2.9.1.1.6.
WACO_pp1_ph2	*WACO believes that the ISR Overview entirely overlooked the high levels of winter and summer recreational use on the lower Susitna River, from the mouth of Willow Creek, located at river mile (RM) 50, to the mouth of the Yetna River (RM 29.9). While FERC found there to be low levels of flow-dependent recreation on the Susitna River from the Parks Highway bridge (RM 88.9) to Susitna Landing (RM 61), this conclusion ignores the significantly greater flow-dependent recreation and accompanying social/economic farther downstream.*	AEA did not ignore winter and summer recreation use in the lower Susitna River. Rather, as explained above, the FERC-approved Study Plan contained a decision point as to whether to extend the recreation study to the Lower River after information on water levels, ice processes, riparian vegetation, and other resources is collected and analyzed. As detailed in Sections 1.5.3 and 2.9.1.1, AEA has decided not to propose to extend the recreation study to the Lower River because Project-related influences in the lower Susitna River are not expected to affect recreation and recreational resources in the Lower River.

Reference Number	Comment or Study Modification Request	AEA's Response
WACO_pp1_ph3	*The Susitna River near Willow serves as a highway for outdoor enthusiasts. It is the main method of land travel from Willow westward, to the area of Skwentna and to the many lodges and private cabins scattered throughtout the Susitna basin Deshka Landing Outdoor Association, LLC in Willow estimates there are 10,000 recreational days enjoyed annually by its clients, all of whom use the Deshka Landing at RM 45.5 for boating and snowmaching onto the river. Other adventurers utilize the many trails weaving through and around Willow for river access. These trails, including the Corral Hill, Rolly Creek and Luck Shot Trails, are all heavily managed and funded from both public and private sources. The Susitna River also serves as the stage upon which the world-famous events take place. The Iditarod Trail Sled Dog Race begins in Willow, and the first portion of race takes place on the Susitna River. The Iron Dog, a snowmachine race, begins in nearby Big Lake and covers a portion of the river as well. All of these river travelers, whether serious competitors, freight haulers or weekend explorers, depend on consistent water levels and stable ice conditions for their safety. When weather variations change the conditions of the ice, river travel can become treacherous or non existent. Large fluctuations of discharge from the dam during the winter months and low flow rates during the summer could have the potential to seriously and adversely affect river travel conditions.*	See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to water levels and ice stability (Section 2.9.1.1.1).

2.10. Cultural and Paleontological Resources

2.10.1. Study 13.5 – Cultural Resources Study

As established in the Study Plan (RSP Section 13.5.1), the overall goals of this study are to systematically inventory cultural resources within the Area of Potential Effects (APE), evaluate the inventoried cultural resources within the APE that may be affected by the Project for National Register of Historic Places (NRHP) eligibility, and assess Project-related effects on National Register-eligible historic properties (NRHP) within the APE (36 CFR § 800.5).

The Cultural Resources Study has three components:

- Inventory and Evaluation: Systematic inventory of archaeological and built cultural resources within the APE and NRHP evaluation of those that may be affected by the Project.
- Ethnogeography: Assembly of ethnographic and linguistic information to help inventory and evaluate historic properties—particularly Traditional Cultural Properties—that may be affected by the Project.

- Paleoenvironmental: A lake-coring effort to obtain environmental information for evaluating the prehistoric cultural resources in their temporal and ecological context.

The May 2016 Study Implementation Report completed for this study describes the methods, results and discussion for the latter two components as Attachment 1, *Holocene Landscape and Paleoenvironments Technical Memorandum* and Attachment 2, *Report on Ahtna Ethnogeography Investigation,* respectively.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA proposes one modification to Study Plan Section 13.5:

1. To eliminate the Chulitna Corridor from the study area (Study 13.5 ISR Part D Section 7.2) and to add the Denali East Corridor Option to the study area as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (Study 13.5 ISR Part D, Section 7.1).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, FERC staff and the Alaska Department of Natural Resources (ADNR) provided comments on Study 13.5, including comments related to its proposed modification outlined above. AEA's responses to the comments can be found in Table 2.10.1-1 and below.

Table 2.10.1-1. Study 13.5 Comments and Responses

Reference Number	*Comment or Study Modification Request*	AEA's Response
FERC_ppA-9_ph1	*According to the 2014 ISR, a location model developed for the project identified 262 "high-potential test areas" in the direct Area of Potential Effects (APE). These are areas considered to contain a high potential for the presence of archaeological sites. Only 26 of these areas were tested in 2013 due to logistical challenges. We cannot tell from the information provided which of the 262 high potential test areas have been surveyed and which remain to be studied and when they would be studied. Please provide a map or table providing this information. If you do not intend to study certain high-potential test areas, please explain why and how you would achieve the study objectives without this information.*	See Section 2.10.1.1 below.
ADNR_OHA/SHPO_pp 5_ph1	*The State of Alaska Office of History and Archeology (OHA) and Alaska State Historic Preservation Office (SHPO) staff have engaged in consultation with the AEA and FERC since this project's inception. This includes regulatory review of actions and documents connected to the development of both the 2012 Revised Study Plan (RSP) and a comprehensive review of ISR Part A – D for the 13.5 Cultural Resources Study. We have also reviewed selected portions of other ISR studies with a direct relationship to evaluating cultural resources potential, including some habitat and subsistence studies. We believe*	AEA appreciates OHA/SHPO's constructive participation in the development of this Study Plan and review of study implementation to date within the context of the FERC ILP. AEA concurs that the study is on track to meet the FERC-approved study objectives.

Reference Number	Comment or Study Modification Request	AEA's Response
	significant progress has been made and the study is on-track to meet FERC-approved study objectives.	
ADNR_OHA/SHPO_pp5_ph2	*OHA regards the cultural resources studies commissioned by AEA for both the RSP and ISR to be well conceived and well executed. AEA and its cultural resources contractor, Northern Land Use Research Alaska (NLURA), have consulted regularly with OHA regarding compliance with the Alaska Historic Preservation Act (AS. 41. 35. 070) and Section 106 of the National Historic Preservation Act (54 U.S.C. 306108) during the ISR process. These consultations have been timely and effective. Permit applications made to perform field research on State lands were similarly well-coordinated. NLURA also provided ample opportunity for the State Archeologist to observe field operations and to review annual reports. Through its website, AEA has given the public appropriate access to ISR cultural resources documents, redacted to protect sensitive site location data. OHA access to the unredacted versions has been equally good.*	AEA appreciates OHA/SHPO's review of study implementation to date within the context of the FERC ILP. AEA will continue to carry out the remainder of the study in consultation with OHA, compliant with State statutes and federal law, for the protection and management of sensitive cultural resources.
ADNR_OHA/SHPO_pp6_ph1	*OHA/SHPO has some concerns regarding the effects of modifications and variances to the ISR, as identified in the Cultural Resources Study Plan Section 13.5, Part D (November, 2015). The addition of the Denali East Option to the direct Area of Potential Effects may have affected the sequence of Phase I site inventory and Phase II NRHP evaluation in portions of the study area. The FERC-approved Study Plan indicated that Phase I inventory should be conducted before Phase II NRHP evaluation. Addition of the Denali East Option created the need for additional archaeological inventory. In light of this modification and other variances, Part D identified additional steps necessary to complete the ISR. These included completion of systematic inventory and evaluation of archaeological and historic cultural resources within the APE. Also identified was assembly of ethnographic and linguistic information, particularly as related to Traditional Cultural Properties. NLURA reported some progress in these aspects of the study during the March 30, 2016 meeting, but it is not clear whether a formal report has been produced. If not yet addressed, these data gaps should be remediated in the near term.*	The Denali Corridor West, which partially overlaps with the Denali East Corridor option, has been surveyed once. As described in the ISR Part D, Section 7.1, the additional Denali East Corridor Option lands that have not yet been surveyed may require a Phase I inventory and Phase II NRHP evaluation within the same season to avoid an additional study season. AEA recognizes the effort that would be required and will allocate the necessary resources as available to achieve the goal of the study. With respect to evaluation of Traditional Cultural Properties, AEA has compiled ethnographic and linguistic information for the Ahtna people of the area (see 2014-2015 Study Implementation Report Attachment 2, Report on Ahtna Ethnogeography Investigations filed with FERC on May 17, 2016). A similar effort will be completed for the Dena'ina of the area in the next year of study. Together, this information will be used in identifying and evaluating Traditional Cultural Properties in the study area.
ADNR_OHA/SHPO_pp6_ph1	*A second concern is that archaeological survey of the indirect Area of Potential Effects was not completed, including some areas that may be of high archaeological potential.*	In implementing the study thus far, AEA prioritized surveying the direct APE as accessible. A complete survey of the direct APE and the indirect APE, including areas of high archaeological potential, and as

Reference Number	Comment or Study Modification Request	AEA's Response
		described in the Study Plan will be completed during the next year of study.

2.10.1.1. Response to Comment Regarding High Potential Test Areas

FERC staff requested a breakdown on what high potential test areas have been surveyed and which remain to be studied (FERC _ppA-9_ph1).

The number of high potential test areas referred to in the 2014 ISR (262) was subsequently modified in 2014 and 2015. The sensitivity model that defines high and low probability areas is iterative and continuously updated. Increases to the total number of high potential test areas and acreages have occurred since the 2014 ISR based on field observations (ground truthing the model) and changes to the survey area (e.g., change in the alternative transmission and access corridors and refined APE boundaries).

It is estimated that approximately 28,500 acres of high potential ground has been surveyed, leaving roughly 35,000 acres with high potential remaining to be surveyed. Subsurface test areas within the high potential areas were identified during the survey, but only limited shovel testing has been done. The survey to date has included subsurface testing at 27 locations that fall within the high probability acreage (test areas). These locations are scattered throughout the APE, and represent random sampling completed during helicopter surveys conducted between 2012 and 2013.

In addition to the remaining high probability acreage, an estimated 828 test areas remain to be shovel tested within areas already surveyed within the direct APE. The 2013 and 2014 field seasons focused on the recording and updating of known sites in the study area with limited to no shovel testing, resulting in the number of acres and test areas remaining to be surveyed. See Table 2.10.1-2 for details.

Table 2.10.1-2. Summary of Cultural Resource Survey Status in the Direct and Indirect APE

APE Components	Total Acreage	High Probability Acreage Surveyed (Pedestrian)	High Probability Acreage Remaining (Pedestrian)[1]	Approximate Number of Remaining Test Areas (Acreage)[2]	Total Acreage Remaining
Direct APE					
Denali (East and West) Corridor	45,024	9,403	17,687	399 (358)	17,687
Gold Creek Corridor	18,490	931	16,568	23 (10)	16,578
Dam and Camp	23,528	2,094	135	135 (63)	2,506
Impoundment	9,573	3,632	0	271 (101)	101
Indirect APE					
Indirect APE[3]	146,988	1,660	N/A	N/A	N/A
No longer in Current Project Area					

Chulitna Corridor	36,088	10,746	N/A	N/A	N/A
Totals	**279,691**	**28,466**	**34,390**	**828 (532)**	**36,872**

Notes:

1 There are an undetermined amount of test areas within this acreage (it has not been surveyed and test areas have not been defined).

2 These represent high potential areas that were identified during pedestrian survey, but have not been tested yet.

3 The number of remaining high probability acreage has not been calculated at this time. Given that a different survey strategy will be applied to the indirect APE, the total acreage remaining does not include the unsurveyed portions of the indirect APE.

As indicated in the ISR Part D, Section 8 Steps to Complete the Study, AEA will complete the systematic inventory and evaluation of both the archaeological and built cultural resources within the APE, including the survey and testing of high potential test areas in the next year of study.

2.10.2. Study 13.6 – Paleontological Resources Study

As established in the Study Plan (RSP Section 13.6.2), the overall goal of this study is to determine the effects of the proposed Project on paleontological resources by locating, documenting, and evaluating paleontological resources within the study area.

The study components for this study are summarized as follows:

- Identify potential impacts to paleontological resources by determining the geologic units that may be impacted by the proposed Project and the associated Potential Fossil Yield Classification (PFYC) classes.
- Determine the need for field surveys and monitoring efforts.
- Undertake field surveys.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA proposes one modification to Study Plan Section 13.6:

1. Eliminate the Chulitna Corridor from the study area (Study 13.6 ISR Part D Section 7.2) and to add the Denali East Corridor Option to the study area as an additional, alternative north-south corridor alignment for transmission line and road access from the dam site to the Denali Highway (Study 13.6 ISR Part D Section 7.1).

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participants raised any disagreement or submitted a study modification proposal for Study 13.6. AEA received no comments on Study 13.6, including its proposed modification outlined above.

2.11. Subsistence

2.11.1. Study 14.5 – Subsistence Resources

As established in the Study Plan (RSP Section 14.5.1), the overall goal of this study is to demonstrate whether and, if so, the extent to which communities harvest and use subsistence resources within or near the Project area, use Project area lands to access other lands for subsistence harvest and use, and/or harvest and use resources that migrate through the Project area and are later harvested in other areas.

The study objectives are established in RSP Section 14.5.1:

- Document whether and, if so, the extent to which communities within the Susitna River watershed, as well as communities outside the Susitna River watershed that have subsistence use areas in the watershed, use areas that are within the Project area for subsistence harvests.
- Document whether and, if so, the extent to which communities within the Susitna River watershed, as well as communities outside the Susitna River watershed that have subsistence use areas in the watershed, use Project area lands to access other lands or waters for subsistence harvest.
- Document whether and, if so, the extent to which communities within the Susitna River watershed, as well as communities outside the Susitna River watershed that have subsistence use areas in the watershed, use resources that migrate through the Project area and are harvested in other areas.
- Collect and document traditional and local knowledge of communities within the Susitna River watershed, or who have subsistence use areas within the watershed, to assist in assessing the potential impacts of construction and operation of the proposed Project on subsistence harvest and use. This information will be directly shared with the program leads for other resources, as appropriate.
- Evaluate Project development plans to identify likely sources of potential impacts on identified subsistence uses.
- Provide the necessary information needed to support preparation of an ANILCA 810 evaluation.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA proposes one modification to Study Plan Section 14.5:

1. As indicated in the ISR Part C, Section 7.1.2, AEA proposes a modification to the Study Plan to add the Knik Tribe, a federally recognized tribe with ties to the Susitna River watershed, to the Traditional and Local Knowledge interviews. During the ISR Meeting, Brian Davis, ADF&G Subsistence Program Manager, requested household harvest surveys to be conducted in two additional communities with a nexus to the Project, Chickaloon and Susitna North (the area east of Parks Highway between Willow Creek and the Talkeetna Access Road), as the last surveys were conducted in 1984. As a modification to the Study Plan, AEA agrees to consider these two communities. If the household harvest surveys are conducted for a project other than the Susitna-Watana Hydro Project, AEA will include that data in the impact assessment. If household surveys are not conducted for some other purpose, AEA will gather the necessary baseline data at these two communities.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on

December 2, 2015, no licensing participant raised any disagreement for Study 14.5. AEA received supporting comments for AEA's proposed modification to Study 14.5 outlined above. Ahtna, Inc. filed a comment for Study 14.5, and ADF&G submitted a written request to modify Study 14.5, as discussed in the March 30 ISR meeting. AEA's responses to the comment and study modification can be found in Table 2.11.1-1.

Table 2.11.1-1. Study 14.5 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_ADFG_pp17_ph2	*Research was completed in the enclaves of Talkeetna and Trapper Creek, but the remainder of the Talkeetna Area was not surveyed, an area south of the Talkeetna Spur Highway known as "Susitna North". In addition, although the community of Chickaloon was left off the initial list of 13 study communities, it became apparent during tribal, public and agency working group discussions that Chickaloon should also be surveyed….We propose additional survey work for those two communities.*	AEA agrees to add Susitna North and Chickaloon to communities for future household harvest surveys. AEA does not object to FERC's adoption this proposed Study Plan modification. If household harvest surveys are conducted in these two communities for a project other than the Susitna-Watana Hydro Project, AEA will include that data in the impact assessment. If household surveys are not conducted for some other purpose, AEA will gather the necessary baseline data at these two communities. The estimated cost of implementing this modification is $200,000 - $250,000.

2.12. Socioeconomics, Air, and Transportation

2.12.1. Study 15.5 – Regional Economic Evaluation Study

As established in the Study Plan (RSP Section 15.5.1), the overall goal of this study is to assess potential changes in regional economic conditions in the study area resulting from the operation of the proposed Project and the power generated by the Project.

The study objectives are established in RSP Section 15.5.1:

- Describe the effects of the Project on the regional economy resulting from improvements in the reliability of the electrical power grid.
- Describe the effects of the Project on the stability of electric prices over time.
- Determine the economic effects of the Project's power over time.

Although ISR Part D, Section 7 indicated that AEA planned no modifications to the methods for the study, AEA has since proposed one modification to Study Plan Section 15.5 as presented during the ISR meeting for this study held on March 30, 2016:

1. Utilize the IMPLAN model to complete the study instead of the REMI model and report the results in the USR. A critical component of the REMI model is having a reasonable assumption of the economic future. Because oil prices have drastically dropped since the Study Plan was approved and the economic future of Alaska is too uncertain to predict at this time, a static model such as the IMPLAN is more applicable than REMI. Separate

IMPLAN models will be built to reflect the with-Project and without-Project scenarios. The IMPLAN model is standard practice for economic modeling, but with less specificity than REMI. Later in the process, the REMI model will be used during AEA's development of the License Application, if needed.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, the NPS and TNC filed comments for Study 15.5. The NPS commented on AEA's proposed modification to Study 15.5 outlined above. AEA's responses to the comments can be found in Table 2.12.1-1.

Table 2.12.1-1. Study 15.5 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
NPS_pp3_ph3	*Given the pause in pre-licensing studies for this project, we request a study modification for a collaborative decision between the applicant, FERC, resource agencies and stakeholders on which model (IMPLAN, REMI, or other) is best suited to achieve the goals of the study prior to its resumption. The reason for this is that economic conditions in Alaska are changing rapidly.*	AEA concurs that economic conditions in Alaska are changing rapidly. Due to the economic uncertainty at this time, it is not appropriate to use REMI as provided in the FERC-approved Study Plan. Accordingly, AEA appreciates the NPS's recommendation for licensing participants to consult on which model would be appropriate once the licensing process resumes. AEA concurs with the NPS on this recommendation.
TNC_pp21_ph2	*Scale of Economic Analysis In the introductory paragraph, the December 2013 memorandum in Appendix A notes that the study is looking at long-term assumptions about the Alaska economy. We suggest that the local economy of the Mat-Su Borough will be the most impacted by the dam and that a scaled analysis should consider how inriver changes and effects to Cook Inlet fisheries will affect the local economy. The assumptions about Tourism (section 14 of the memo) hint at the more local effects that can be expected. As written in the ISR, the assumptions imply no negative impacts from changes to the river, including lack of flows for river running, lack of stable ice for snow machining and holding the Iditarod sled dog race, or reduced sport fish opportunity. Similarly, looking at all of the Mat-Su Borough may overlook community-level impacts to river communities like Talkeetna, Chase, Willow, and Skwentna. For those reasons, a scaled analysis should consider impacts to economies at the state, borough, and community level.*	The goal of Section 15.5 has always been to look at community, regional, and state-level effects which is why AEA includes community and borough level data in the baseline analysis. AEA agrees to add Willow to the existing tables. The IMPLAN model runs at the state and borough levels, while community level effects will have to be interpolated based on quantitative and qualitative data gathered during the study. The estimated cost for adding Willow is less than $10,000.
TNC_pp21_ph3	*Power Need Determination Section 6 notes that the power generation data used for the REMI model is current through 2012. Several of the railbelt utilities are in the process of building new power generating plants. These new additions to the power grid must be included in this analysis. Power use across southcentral Alaska has steadily declined over the last decade. AEA needs to*	The regional economic evaluation under Study 15.5 includes new power plants and those under construction. AEA acknowledges the long-term trend towards greater efficiency and its effects on demand and has included these trends in its projections.

Reference Number	Comment or Study Modification Request	AEA's Response
	consider how reduced power usage will affect the long-term power needs of Alaska.	
TNC_pp21_ph3	*Executive Interviews The development of the Regional Economic Models, Inc. (REMI) model appears to be based in large extent on 'executive interviews.' The list of interviews (Part A Appendix B) does not seem comprehensive of the Mat-Su's economy. It only includes one representative of the tourism industry (i.e. ATIA). Tourism (i.e. leisure and tourism sector) supplied 17% of the jobs in the Mat-Su according to a February 2013 report by state economist Neal Fried. We suggest that interviews be conducted with local chambers of commerce, Mat-Su Convention and Visitors Bureau, major industrial tourism operators (e.g. Princess, Holland America), and the Mat-Su Borough Department of Community Development.*	As a modification to the FERC-approved Study Plan, AEA has proposed to use the IMPLAN model to complete the study for purposes of the USR instead of REMI due to the uncertainty in Alaska's economic future. AEA has proposed to delay implementation of the REMI model until development of the License Application. Given the rapid changes occurring in Alaska's economy the key informant interviews will need to be conducted again when developing the License Application. At that time, AEA will confer with licensing participants on appropriate interviewees.

2.12.2. Study 15.6 – Social Conditions and Public Goods and Services Study

As established in the Study Plan (RSP Section 15.6.1), the overall goal of this study is to assess potential changes in population, housing, public goods and services, and other quality of life factors resulting from the construction and operation of the Project and potential changes in regional economic conditions resulting from the non-power effects of the Project.

The study objectives are established in RSP Section 15.6.1:

- Describe, using text and appropriate tables and graphics, existing socioeconomic conditions within the study area.
- Evaluate the effects of on-site manpower requirements, including the number of construction personnel who currently reside within the study area, who would commute to the site from outside the study area, or who would relocate temporarily within the study area.
- Estimate total worker payroll and material purchases during construction and operation.
- Evaluate the impact of any substantial immigration of people on governmental facilities and services, and describe plans to address the impact on local infrastructure.
- Determine whether existing housing within the study area is sufficient to meet the needs of the additional population.
- Describe the number and types of residences and businesses that might be displaced by the Project access road and transmission corridors.
- Describe, based on other studies, what bio-physical attributes of the Susitna River system may change as a result of the Project and what those changes might mean to commercial opportunities related to fishing, logging, agriculture, mining, and recreational activities,

recreation and subsistence use values, quality of life, community use patterns, non-use environmental values, and social conditions of the area.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA proposes two modifications to Study Plan Section 15.6:

1. Both the RUM modeling and the Quality of Life survey require information from studies which have yet to be completed and policy decisions regarding the level of public access. As such, AEA proposes moving these analyses from the USR to the License Application.
2. Use IMPLAN results from Study 15.5 instead of REMI results (as described in AEA's proposed modifications to Study 15.5) for the analysis to complete Study 15.6.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, Rebecca Long, TCCI, TNC, and WACO filed comments for Study 15.6. AEA's responses to the comments can be found in Table 2.12.2-1. AEA received no comments on AEA's proposed modification to Study 15.6 outlined above.

Table 2.12.2-1. Study 15.6 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Long_160620_pp4_ph1	*A survey to establish the value the American public places on an undeveloped river is necessary to determine project effects on non-use values.*	AEA disagrees. As an initial matter, a national online survey would be unlikely to produce statistically valid and unbiased non-use estimates (Hausman 2012). Further, FERC addressed assessing non-use values in its February 1, 2013 Study Plan Determination; see Section 3.1. The value of the free-flowing Susitna River will be adequately assessed through the existing studies already approved by FERC. There are significant challenges and obstacles to the quantification of environmental values of river systems in dollar terms and these quantitative economic valuations of environmental goods and services are not required in order for the positive value of the environmental assets of the Susitna River system to be given full and equal consideration. AEA's environmental review will incorporate a variety of qualitative and quantitative measures of impacts to the physical, biological, recreational, cultural and socioeconomic environment through the data gathered under the Commission-approved Study Plan. AEA's analyses in Study 15.6 will address both market (e.g., jobs, revenue) and non-market (e.g., recreation, aesthetics) values.
HRC_pp1_ph6	Specifically, we believe that new information is necessary to determine the Project's effect on non-use environmental values.	See AEA's response above to comment Long_160620_pp4_ph1 and Section 3.1.

Reference Number	Comment or Study Modification Request	AEA's Response
TNC_pp25_ph3	*…we think the value of one of the last free-flowing rivers in the country needs to be studied to fully understand the non-use benefit of the Susitna River*.	See AEA's response above to comment Long_160620_pp4_ph1 and Section 3.1.
TNC_pp25_ph5	*Interviews should also be conducted with local chambers of commerce, Mat-Su Convention and Visitors Bureau, major industrial tourism operators (e.g. Princess, Holland America), and the Mat-Su Borough Department of Community Development.*	This comment pertains to both Study 15.5 and Study 15.6. As a modification to the FERC-approved Study Plan for Study 15.5, AEA has proposed to use the IMPLAN model to complete the study for purposes of the USR instead of REMI due to the uncertainty in Alaska's economic future, although it will consult with licensing participants on this issue once the process resumes. Given the rapid changes occurring in Alaska's economy the key informant interviews will need to be conducted again when developing the License Application. At that time, AEA will confer with licensing participants on appropriate interviewees.
Long_160608_pp4_ph4	*The Social Conditions and Public Goods and Services Study (15.6) should be modified to include Willow in Potentially Affected Communities (PACs).*	While this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan, AEA does not object to FERC adopting this request as a modification to the Study Plan. AEA agrees to add Willow to the study area, consistent with the addition of Houston, Whitter and other communities.
TCCI_pp6_ph4	*TCCI requests Willow be added to the following studies: Social Conditions/Public Goods and Services*	While this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan, AEA does not object to FERC adopting this request as a modification to the Study Plan. AEA agrees to add Willow to the study area, consistent with the addition of Houston, Whitter and other communities.
WACO_pp1_ph1	WACO *requests the inclusion of Willow in the Social Conditions and Public Goods/Services (15.6)* [study].	While this request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan, AEA does not object to FERC adopting this request as a modification to the Study Plan. AEA agrees to add Willow to the study area, consistent with the addition of Houston, Whitter and other communities.
TNC_pp22_ph4	For these additional reasons, Willow and the community of Skwentna should be included in this study.	While AEA agrees to add Willow to the analysis, AEA requests FERC not adopt this request to add Skwenta as the request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan. Specifically, Skwentna does not lay on the Parks Highway or the ARRC line and is therefore unlikely to experience construction and transportation related impacts associated with the Project. Changes that the other PACs may experience during and after construction would be non-detectable in Skwentna.

2.12.2.1. References Cited

Hausman, Jerry. 2012. "Contingent Valuation: From Dubious to Hopeless." Journal of Economic Perspectives, 26(4): 43-56.

2.12.3. Study 15.7 – Transportation Resources Study

As established in the Study Plan (RSP Section 15.7.1), the overall goal of this study is to assess current transportation conditions in the Project area and evaluate potential Project demands relative to current capacity limits and safety requirements for road, railroad, aviation, port, and river traffic. The study will assess the short-term (construction) and long-term (operational) direct and indirect impacts of the Project, as well as of the cumulative impacts of the Project. The transportation effects of the Project (with-Project) will be compared to a without-Project scenario.

AEA will use information from this study to identify and coordinate needed transportation infrastructure improvements with the Alaska Department of Transportation & Public Facilities, Alaska Railroad Corporation (ARRC), the Matanuska-Susitna Borough, the Denali Borough, and others. This report will also provide valuable information for the multidisciplinary analysis of the Project required under the National Environmental Policy Act.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA proposes two modifications to Study Plan Section 15.7, in addition to carrying forward the variances reported in the ISR:

1. Forecasts for existing highway facilities were documented from existing traffic demand models or developed using historic growth rates. Aviation forecasts were documented using published aviation data. Forecasts for various modes may be updated if new data is available. River use forecasts will be qualitatively evaluated based on data obtained through interviews with knowledgeable persons; and
2. Project effects on all transportation modes will be qualitatively evaluated based on the level of Project information available, professional judgment, and interviews with knowledgeable individuals. This differs from RSP Section 15.7.4.5, which implied that effects would be quantified for highway and rail modes.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, FERC, Rebecca Long, TCCI, and WACO filed several comments for Study 15.7. AEA's responses to the comments can be found in Table 2.12.3-1.

Table 2.12.3-1. Study 15.7 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Long_160608_pp1_ph1	*Willow should be considered a Potentially Affected Community (PAC) in 15.6, 15.7, and 15.8.*	AEA requests FERC not adopt this proposed Study Plan modification. This request does not meet the criteria established in 18 CFR 5.15(d) for modification of an approved study plan as this request is already part of the FERC-approved Study Plan Section 15.7. As such, there is no additional cost for implementing this modification. The transportation study area includes facilities from the Port of Whittier to the Denali Highway. Willow is within the study area, and the Willow airport was addressed in the ISR/SIR. The variety of transportation uses of

Reference Number	Comment or Study Modification Request	AEA's Response
		the river will be addressed through interviews with key knowledgeable individuals.
Long_160608_pp1_ph4	*Freight hauling and transportation are a big part of the river use accessed at Deshka Landing.*	AEA will address freight use of the river through interviews with key knowledgeable individuals in the next year of study.
Long_160608_pp5_ph1	*In general 5.3.5 of 15.7 has no robust overview of all the lodge and homestead barging.*	AEA will address the variety of transportation uses of the river through interviews with key knowledgeable individuals.
FERC_ppA-8_ph5	*…[W]e recommend that future focus group discussions be closely coordinated to provide a thorough understanding of desired ice conditions needed for winter travel or recreational purposes, as well as how project operation may affect such use.*	AEA agrees to closely coordinate future focus group discussions undertaken to address both Studies 12.7 and 15.7.
TCCI_pp7_ph4	*Seek to characterize existing conditions in the Willow area including but not limited to those addressed in the other "potentially affected communities". Specific attention should be payed to the remote Yentna communities and their dependance on river barging for supplies,*	See Sections 1.5.3 and 2.9.1.1, particularly the discussion related to water levels and ice stability (Section 2.9.1.1.1). The transportation study area includes facilities from the Port of Whittier to the Denali Highway. Willow is within the study area, and the Willow airport was addressed in the ISR/SIR. The variety of transportation uses of the river will be addressed through interviews with key knowledgeable individuals.
TCCI_pp10_ph1	*Methodologies for the Willow overview could include:… A summer and winter field season of data from Deshka Landing facility to quantify use of both summer river boat / barge and winter snow machine transportation uses and traditional corridors supporting owners of remote properties. (Winter oil/gas frozen river roads should also be included in this transportation overview.)*	To clarify, Willow is already included within the study area of the FERC-approved Study 15.7. As provided in the FERC-approved methodologies for this study, information on summer and winter transportation use by boats, barges and snowmachines will be collected through interviews with key knowledgeable individuals. This will include information on oil and gas ice roads and traditional trails.
TCCI_pp11_ph2	*Willow is not currently included in the approved study so effects are not being thoroughly captured.*	To clarify, Willow is already included within the study area of the FERC-approved Study 15.7. The transportation study area includes facilities from the Port of Whittier to the Denali Highway, including Willow, and the Willow airport was addressed in the ISR and SIR. Potential Project effects on Willow will be captured through analysis of information received via interviews with key knowledgeable individuals.
TCCI_pp6_ph4	*Transportation - the ISR covers all methods of transportation potentially affected by the SuWa project except river transportation which will be conducted "qualitatively" vs. quantitatively. This is unacceptable that AEA did not conduct a comprehensive study of river transportation and does not intend to. The Susitna River hosts transportation barges at the Willow area*	To clarify, AEA proposes to qualitatively evaluate river use forecasts based on data obtained through interviews with knowledgeable persons and maintains that will be sufficient to meet study objectives and evaluate potential Project effects. A quantitative analysis is not possible given the lack of consistently collected or reported data

Reference Number	Comment or Study Modification Request	AEA's Response
	servicing the Yentna and lower Su Rivers. These uses should be documented quantitatively.	on river transportation uses, which include private transportation, as well as commercial transportation. The transportation study area includes facilities from the Port of Whittier to the Denali Highway, including Willow, which was addressed in the ISR and SIR.
WACO_pp1_ph1	*[WACO] requests the inclusion of Willow with the…Transportation Resources (15.7)…stud[y].*	To clarify, Willow is already included within the study area of the FERC-approved Study 15.7. The transportation study area includes facilities from the Port of Whittier to the Denali Highway, including Willow, and the Willow airport was addressed in the ISR and SIR.
WACO_pp2_ph1	*Large fluctuations of discharge from the dam during the winter months and low flow rates during the summer could have the potential to seriously and adversely affect river travel conditions.*	The transportation, recreation, and ice processes (Study 7.6) studies were designed to collect current information that will be needed for comprehensive analyses of the potential impacts of the Project. The variety of transportation uses and the water and ice conditions needed for these transportation uses will be addressed through interviews with key knowledgeable individuals. The impact analysis will consider Project-induced changes to ice processes and how those changes would impact transportation. This analysis will appear in the License Application, Exhibit E (Environmental Exhibit). However, AEA disagrees that there would be large changes in flows or stage levels or ice processes in the Lower River, as explained in Section 1.5.3.

2.12.4. Study 15.8 – Health Impact Assessment Study

As established in the Study Plan (RSP Section 15.8.1), the overall goal of this study is to analyze the potential positive and negative impacts of the Project on the health of residents in the impacted community.

The study objectives are established in RSP Section 15.8.1.1:

- Identify potentially affected communities (PACs) and establish a community engagement plan (where relevant).
- Through a review of the FERC scoping meetings and ongoing community engagement, identify public issues and concerns about how community health might be affected during construction and operation of the Project.
- Collect baseline health data at the state level, borough, or census area level, tribal level, and at the potentially affected community level, as possible.

- Identify data gaps and determine the most efficient method to fill those gaps, through community consultation and coordination with other studies, such as the Subsistence Resources Study (Study 14.5), Regional Economic Evaluation Study (Study 15.5), Social Conditions and Public Goods and Services Study (Study 15.6), and Recreation Resources Study (Study 12.5).
- Evaluate the baseline data against the Project description to initially determine the nature and extent of potential impact pathways, both positive and negative.
- Prepare a Health Impact Assessment report that is transparent, scientifically rigorous, and understandable to the public.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA proposes two modifications to Study Plan Section 15.8:

1. The HIA analysis to be provided in the Updated Study Report (USR) will not serve as a final HIA for the Project. The analysis included in the USR will serve as a template that can be updated and included in the FERC License Application once the AEA Project proposal is finalized. The USR, therefore, will not describe specific impacts or include a ranking and rating, but will include a high-level overview of potential impact mechanisms and effects; and
2. AEA will update baseline health data to the most current available to perform the HIA.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 15.8. AEA received no comments on AEA's proposed modification to Study 15.8 outlined above. However, Rebecca Long, TCCI, Alaska Department of Health and Social Services (DHSS), and WACO submitted comments for Study 15.8. AEA's responses to the comments can be found in Table 2.12.4-1 and below.

Table 2.12.4-1. Study 15.8 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
ADNR_DHSS_pp7_ph2	*The Alaska Department of Health and Social Services (DHSS) agrees with AEA's summary of work performed to date and remaining tasks to complete the Health Impact Assessment (HIA; Study 15.8). These additional tasks include providing the baseline data to describe and rate potential health impacts. DHSS finds the initial work was conducted according to the study plan objectives and did not include any variances. While the HIA is not yet completed, DHSS did collect a large amount of baseline health data, including local and traditional knowledge related to health. The baseline data was extremely useful to the HIA and to DHSS.*	AEA appreciates DHSS's review and support for AEA's implementation of the FERC-approved Study Plan.
Long_160608_pp5_ph5	*The Subsistence Study is collecting data from Willow.15.8 data needs to be collected in the Willow area.* *Consultation with the Willow community needs to happen.*	To clarify, Willow is not one of the communities within the Subsistence (Study 14.5) study area. The community of Willow lies within the Transportation Study area (Study 15.7) and could potentially experience some influx due to transportation effects and indirect growth resulting from the Project. All of the health effects categories will be evaluated for inclusion in the HIA, including transportation changes, and key informant interviews conducted. As per the approved HIA study methods, the baseline data collection will be evaluated again against the Project description to determine the nature and extent of potential impacts, both positive and negative. Therefore, it is premature to conclude whether additional information needs to be collected for the Willow community to complete the HIA.
TCCI_pp11_ph4	*Willow meets the PAC criteria…. Willow should be included but is not in the approved study.*	See response above to comment Long_160608_pp5_ph5.
WACO_pp1_ph1	*[WACO] requests the inclusion of Willow with the…Health Impact Assessment (15.8) stud[y].*	See response above to comment Long_160608_pp5_ph5.

2.12.5. Study 15.9 – Air Quality Study

As established in the Study Plan (RSP Section 15.9.1), the overall goal of this study is to ensure that the proposed Project does not violate National Ambient Air Quality Standards (NAAQS) per 40 CFR Part 50 and state air quality standards in Alaska Administrative Code (AAC) 18 AAC 50 (under the authority of Alaska Statutes [AS] 46.03 and 46.14).

The study objectives are established in RSP Section 15.9.1:

- Assess the current conditions of the area against applicable state and national air quality standards.
- Review and summarize existing air monitoring data in the area.
- Determine attainment status of the study area (i.e., unclassifiable/attainment, non-attainment, maintenance).
- Quantify short-term (construction) and long-term (operational) emissions.
- If applicable, analyze ground-level impacts using air dispersion models.
- If applicable, evaluate indirect mobile source emissions from additional traffic generated.
- Compare Project emissions to the Without-Project alternative.
- Evaluate potential emission reductions from Railbelt fossil-fuel utility plants if the Project is operating.
- Develop information to be used in the identification of potential mitigation measures, if necessary, to reduce emissions during construction.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA does not propose any modifications to Study Plan Section 15.9.

A 2014 Study Completion Report (SCR) was filed with FERC on November 4, 2015. As provided in the SCR, AEA has met the study objectives, and this study is now complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, Rebecca Long filed comments for Study 15.9. AEA's responses to the comments can be found below in Table 2.12.5-1.

Table 2.12.5-1. Study 15.9 Comments and Responses

Reference Number	Comment or Study Modification Request	AEA's Response
Long_160620_pp8_ph1	*Reservoir GHG calculation should be done in this study.*	As noted in the October 23, 2014 ISR meeting, AEA will include information on greenhouse gas emissions and other factors in the License Application.
Long_160620_pp9_ph1	*The development in permafrost areas that causes melting and emissions along with an increased warming climate that causes permafrost degradation needs to be quantified as an air quality emission for the USR.*	Permafrost has been considered in Study 7.7, Glacial and Runoff Changes as well as 4.5 Geology and Soils. These results do not suggest the air quality study analysis would change because of permafrost considerations.
Long_160620_pp9_ph5	*[Cement manufacturing Emissions] should be quantitatively analyzed in 15.9 in order for the study to adequately describe both the short and long term air emissions from the proposed project.*	As stated in the October 24, 2014 ISR meeting, the FERC license application will address quantified emissions from the concrete batch plant operations, if one is proposed. Study 15.9 addresses indirect impacts of the Project from the

Reference Number	Comment or Study Modification Request	AEA's Response
		offsetting of existing fossil-fuel electricity generators in the area but does not attempt to quantify emissions from the manufacturing or shipping industry which will provide materials and goods to construct the Project as these facilities are assumed to generate similar effects with or without the Project.
Long_160620_pp9_ph7	*The Baseline Fossil Fuel Generation Emissions are based on old information and thus inaccurate.*	AEA disagrees that the baseline fossil fuel generation emission analysis is inaccurate as the analysis looks at the long-term trends in fuel generation emissions. Changes in generation emissions do not change quickly because of the large investments made in major power generation infrastructure. Therefore, the Project must look at long-term trends versus short-term variations in power demand.
Long_160620_pp10_ph2	*I do not agree with the conclusion that the primary goal and objective of the air quality analysis was met. Violations of the National Ambient air Quality Standards and state air quality standards in the Alaska Administrative Code could occur With-Project. This conclusion does not consider quantitative project emissions nor quantitative reservoir or melting permafrost emissions.*	The objectives of the FERC-approved Study Plan were to: assess current conditions (done); review and summarize existing air monitoring in area (done); determine attainment status (done); assess construction and operational emissions (done qualitatively); compare emissions with and without Project (done qualitatively); and develop information to help identify potential mitigation measures (done). The objectives were achieved, with variances for qualitative analysis versus quantitative analysis.

2.13. Project Safety

2.13.1. Study 16.5 – Probable Maximum Flood (PMF)

As established in the Study Plan (RSP Section 16.5.1), the overall goal of this study is to develop the inflow design flood (the PMF) for Watana Dam.

The specific objectives of the Probable Maximum Flood Study, as described in the RSP Section 16.5.1, are to:

- develop a site-specific PMP to be used for the derivation of the PMF including both a temporal and spatial distribution of rainfall;
- model the runoff through the project drainage basin to produce the PMF inflow, including snowmelt considerations for the Project reservoir;
- route the PMF inflow through the Project to obtain the PMF outflow and maximum flood elevation at the dam;
- determine the required outlet capacity to safely route the PMF through the reservoir;
- determine the freeboard allowance; and

- use the Board of Consultants (BOC) for technical review during development and performance of the site-specific studies.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA did not propose any modifications to Study Plan Section 16.5.

ISR Part C Section 7, filed in June 2014, described the PMF Study as complete, subject to inclusion of any additional responses to potential comments from the BOC and others, which would be addressed in the USR and meet the objectives of the RSP. The primary purpose of the ISR Part D, filed in November 2015, is to confirm that no comments had been received. As provided in the ISR, AEA has met the study objectives, and this study is now complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 16.5. AEA received no comments on Study 16.5.

2.13.2. Study 16.6 – Site Specific Seismic Hazard Study

As established in the Study Plan (RSP Section 16.6.1), the overall goals of this study are to conduct deterministic and probabilistic seismic hazard evaluations to estimate earthquake ground motion parameters at the Project site, assess the risk at the site and the loads that the Project facilities would be subject to during and following seismic events, and propose design criteria for Project facilities and structures considering the risk level.

The specific objectives of the Site Specific Seismic Hazard Study, as described in the RSP (Section 16.6.1) are to:

- identify the seismic sources along which future earthquakes are likely to occur, including the potential for reservoir-triggered seismicity;
- characterize the degree of activity, style of faulting, maximum magnitudes, and recurrence information of each fault;
- develop maps and tables depicting the spatial and geometric relations of the faults and seismic source zones together with specific distance parameters to evaluate ground motion parameters from each source;
- assemble available historical and instrumental seismicity data for the region, including maximum and minimum depth of events;
- determine the distance and orientation of each fault with respect to the site; estimate the earthquake ground motions at the proposed dam site, updating previous studies to include changes in practice and methodology since the 1980s;
- propose the seismic design criteria for the site;
- prepare a supporting design report that includes the seismic criteria and results of dam stability analysis under seismic loading (this will be addressed as part of the dam analysis, not as part of the initial seismic characterization); and

- use of the Board of Consultants for independent technical review and guidance during development of site-specific studies.

As detailed in ISR Part D and presented during the ISR meeting for this study held on March 30, 2016, AEA did not propose any modifications to Study Plan Section 16.6

In November 2015, AEA filed with FERC the Study Completion Report (SCR) for Study 16.6. As provided in the SCR, AEA has met the study objectives, and this study is now complete.

In comments on the ISR and ISR meeting filed by licensing participants in accordance with the ILP regulations (18 CFR 5.15(c)(4)) and FERC's ILP process plan and schedule issued on December 2, 2015, no licensing participant raised any disagreement or submitted a study modification proposal for Study 16.6. AEA received no comments on Study 16.6.

3. RESPONSE TO NEW STUDY REQUESTS

As discussed in Section 1.3 above, FERC's ILP regulations establish a high threshold for licensing participants to justify new studies at this point in the licensing process. Under 18 C.F.R. § 5.15(e), a new study request must not only demonstrate "good cause," but the requestor must also include a statement explaining the following:

1. any material changes in the law or regulations applicable to the information request;
2. why the goals and objectives of any approved study could not be met with the approved study methodology;
3. why the request was not made earlier;
4. significant changes in the project proposal or that significant new information material to the study objectives has become available; and
5. why the new study request satisfies the study criteria in 18 C.F.R. § 5.9(b).

In total, there were four study requests filed with FERC in response to AEA's ISR. As described in more detail below, none of these new study requests are warranted, and the requestors have not met their burden to justify the need for additional studies, as their requests do not meet each of the five elements above. Moreover, from a technical standpoint, these requested new studies are either irrelevant to the licensing of the Project or already accommodated in other studies under the FERC-approved Study Plan. As such, requesters have not demonstrated "good cause," and AEA requests the Commission to reject all new study requests.

3.1. Social Conditions and Public Goods and Services Study

The Hydropower Reform Coalition (HRC) has requested the Social Conditions and Public Goods and Services Study as an extension of the current AEA led study with the same title (Study 15.6). The Nature Conservancy in its comments also recommended adding components of the HRC's study request to Study 15.6.

3.1.1. Rationale and Establishment of Good Cause

In advancing this proposed new study, the HRC states that new information needs to be developed in the Social Conditions and Public Goods and Services Study to determine the Project's effect on non-use environmental values. The HRC goes on to note that economists have long recognized that the mere existences of natural resources have values, or existence values now often referred to as non-use or passive values. Furthermore, the HRC notes that the "*seminal issue of this license proceeding is whether the Susitna River and its watershed is more valuable to the nation left undeveloped."*

Although advancing these reasons for the proposed study, the HRC makes no attempt to meet the required criteria under 18 C.F.R. § 5.15(e). Absent from its study request is any identification of any material changes in law or regulation that apply to its new study request. The HRC makes no showing that the goals and objectives of its proposed new study cannot be met with the studies already approved by FERC, nor does HRC identify any significant changes in the Project proposal or that significant new information material to the study objectives has become available.

3.1.2. AEA's Rationale for Not Adopting the Proposed Study

AEA requests that FERC not adopt this proposed new study because the request does not meet the criteria established in 18 C.F.R. § 5.15(e) for adoption of a new study proposal. First, HRC has failed to identify any material changes in the law or regulations applicable to this study request since the Commission approved the Study Plan for this Project in 2013, and AEA is unaware of any such change. Second, HRC has not established that the goals and objectives of this study cannot be met with the studies and methodologies already approved by the Commission. As detailed below, in fact, the goals and objectives advanced by HRC can be met through studies that FERC has approved and which are currently underway. Third, while HRC correctly notes that it did advance this study request earlier in the ILP, that prior request was rejected by the Commission, and this latest version is just a re-packaged and pared-down version of that prior request that already has been considered and rejected in this proceeding. Finally, HRC does not identify any significant changes in the Project proposal or that significant new information is available—and there is none.

With regard to the criteria under 18 C.F.R. § 5.9(b), the Commission already determined that this type of analysis sought by HRC fails to meet these study plan criteria. In response to HRC's prior study request, FERC in its February 1, 2013 Study Plan Determination provided the following discussion, which continues to be applicable to this study request:

> *As stated in Commission staff's scoping document 2, while section 4(e) of the FPA requires the Commission to give "equal consideration" to the purposes of energy conservation, the protection, mitigation of damages to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of environmental quality," "equal consideration" is not the same as "equal treatment." Nothing in the statute requires the Commission to place a dollar value on non-power resources. Nor does the fact that because the Commission assigns dollar figures to the licensee's economic costs require that the Commission do the same for non-power resources.*

> *Further, we do not dispute that the existence of a free-flowing Susitna River that supports salmon and other resources have intrinsic value to Alaskans and potentially others nationally and that various methods have been developed and used in an attempt to express existence values in dollars. However, we also recognize that the balancing of environmental and economic impacts cannot be done with mathematical precision. Where the dollar cost of enhancement measures, such as diminished power production, or for resource uses such as recreation, can be reasonably ascertained, we will do so using the information gathered from the various studies being conducted. However, for nonpower resources such as aquatic habitat, fish and wildlife, and cultural and aesthetic values, their value will be assessed more qualitatively.*

Thus, consistent with FERC's prior analysis, HRC's study request fails to meet study criterion 5.9(b)(7), as well as criterion 5.15(e)(2). Existing studies are sufficient to address the information sought by HRC in this study request. AEA's analyses in Study 15.6 address both market (e.g., jobs, revenue) and non-market (e.g., recreation, aesthetics) values. However, economic (i.e., monetary) valuations of environmental goods and services are not required in order for the positive value of the environmental assets of the Susitna River system to be given full and equal consideration in the licensing decision making process for the proposed Project.

There are significant challenges and obstacles to the quantification of environmental values of river systems in dollar terms. Consequently, the environmental review will incorporate a variety of qualitative and quantitative measures of impacts to the physical, biological, and socioeconomic environment. These multiple measures will be obtained through an array of biological, physical, socioeconomic, transportation, recreational, aesthetics, subsistence and cultural studies that already are part of the Commission-approved Study Plan.

By contrast, the HRC requests that AEA conduct an additional Social Conditions and Public Goods and Services study involving the development of new information as it is "necessary to determine the Project's effect on non-use environmental values." Supported by the Commission's prior Study Plan Determination, AEA disagrees with HRC's conclusion that such a study is justified. AEA's Social Conditions and Public Goods and Services Study is more than adequate, and the value of the free-flowing Susitna River will be adequately assessed through the existing studies already approved by FERC.

In fact, baseline conditions include a free flowing Susitna River, thus the recreation data collected for the 15.6 Random Utility Models (RUM) includes the information necessary to estimate recreation utility under free flowing conditions. The very purpose of the RUM is to allow estimation of changes in recreational utility between free flowing (baseline) and with Project conditions. The mailed recreation survey conducted for the RUM models detected recreation levels at many sites of interest including the Deshka River, the Susitna mainstem, the Talkeetna River, Montana Creek, etc. To the extent that other studies are able to inform changes in recreation associated with Project conditions, the RUM model will be able to compare changes, both positive and negative, in recreation utility values. It is AEA's intent to estimate these changes in value later in the licensing phase when other study results are available to inform Study 15.6 about possible changes in recreation levels. As noted in the Project's FERC-approved Study Plans, the

Project will not be quantifying non-use values associated with either free flowing or with-Project conditions.

Moreover, HRC's request fails to meet study criterion 5.9(b)(6), which requires study requests to be "consistent with generally accepted practice[s] in the scientific community . . . ." Requiring economic valuation of non-developmental values is not generally accepted within the scientific community. FERC has consistently found that the monetization of non-market goods and services is inadequate in the context of assessing non-power values under Sections 4(e) and 10(a)(1) of the FPA. As explained by the Commission in *Great Northern Paper, Inc.*

> *The public-interest balancing of environmental and economic impacts cannot be done with mathematical precision, nor do we think our statutory obligation to weigh and balance all public interest considerations is served by trying to reduce it to a mere mathematical exercise. Where the dollar cost of enhancement measures, such as diminished power production, can be reasonably ascertained, we will do so. However, for non-power resources such as aquatic habitat, fish and wildlife, recreation, and cultural and aesthetic values, to name just a few, the public interest cannot be evaluated adequately only by dollars and cents.*[38]

And as stated in *City of Tacoma, Washington*:

> *In the context of public interest balancing for long-term authorizations, it is inappropriate to rely too heavily on the accuracy of current dollar estimates of nonpower resource values, calculated using any number of reasonably disputable assumptions and methods.*[39]

Finally, the HRC has not demonstrated that this expensive study—which HRC itself estimates to cost up to $1 million—meets study criterion 5.9(a)(7); when evaluating cost considerations, non-developmental values can be sufficiently analyzed through the studies already approved by FERC and underway in this licensing process, such as aesthetics, cultural resources, recreation, and socioeconomic resources, among others. A costly additional study, which is unlikely to produce results that are any more reliable than what is already planned and underway, does not meet the cost consideration of study criterion 5.9(a)(7).

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[38] 85 FERC ¶ 61,316 at p. 62,244-45 (1998), *reconsideration denied*, 86 FERC ¶ 61,184 (1999*), aff'd*, *Conservation Law Foundation v. FERC*, 216 F.3d 41 (D.C. Cir. 2000) (nothing in the FPA requires the Commission to place a dollar value on nonpower benefits; nor does the fact that the Commission assigned dollar figures to the licensee's economic costs require it to do the same for nonpower benefits.). *See also*, *Namekegon Hydro Co.*, 12 FPC 203, 206 (1953), *aff'd*, *Namekegon Hydro Co. v. FPC*, 216 F.2d 509 (7th Cir. 1954) (when unique recreational or other environmental values are present such as here, the public interest cannot be evaluated adequately only by dollars and cents); and *Eugene Water & Electric Board*, 81 FERC ¶ 61,270 (1997)*, aff'd*, *American Rivers v. FERC*, 187 F.3d 1007 (9th Cir. 1999) (rejecting request for economic valuation of environmental resources that were the subject of 10(j) recommendations).

[39] 84 FERC ¶ 61,107 at p. 61,571-72 (1998), *order on reh'g*, 86 FERC ¶ 61,311 (1999), *City of Tacoma v. FERC*, 460 F.3d 53 (D.C. Cir. 2006).

For all these reasons, the Commission should not adopt the HRC's proposed new study. When submitting this new study request, the HRC failed to meet its burden to show "good cause," nor did it include an explanation of each of the criteria set forth in 18 CFR 5.15(e) for justifying a new study at this interim phase of the licensing process. While the HRC did include a discussion of the elements under 18 CFR 5.9(b) in making its request, as discussed above standards (6) and (7) are not met. The goals and objectives of this study will be met through the existing FERC-approved studies, and the HRC fails to explain why FERC's decision should not be any different than its prior determination not to require this study.

3.2. Impacts of Climate Change in the Susitna River Basin

The Natural Resources Defense Council (NRDC) has requested further study of the impacts of climate change in the Susitna River Basin for the Susitna-Watana Hydropower Project. NRDC asserts that AEA failed to include a basin-wide study of climate change impacts as they affect the operation of the Project and surrounding natural resources.

Specifically, NRDC has requested that AEA develop a climate model for the entire basin, using downscaled climate change projections to simulate future non-stationary environmental conditions (including changes to evapotranspiration, glaciers, permafrost, hydrology, and surface temperature) in accordance with the lifespan of the Project (anticipated to last 100 years), and apply this updated environmental baseline to analyses of Project effects on the aquatic, riparian, and terrestrial habitat and species both upstream and downstream of the proposed dam. NRDC requests that FERC modify the Study Plan or order a new study and reverse its prior decision not to study climate impacts throughout the entire basin. NRDC claims that its request meets FERC's requirements for a new study. Other commenters also suggest study modifications to the existing Glacier and Runoff Changes Study (7.7). The NRDC study request is similar to requests submitted by other licensing participants to modify Study 7.7, and AEA's response to those proposed study modifications are discussed in Section 2.4.3 of this document. NRDC also asserts that its study request meets FERC's requirements for a new study.

AEA disagrees that a future non-stationary baseline is necessary to assess Project effects and determine protection, mitigation and enhancement measures (PM&Es). AEA's approach to address impacts on the aquatic, riparian, and terrestrial habitat and species within the reservoir area and downstream of the proposed dam is based on the conventional hydrologic Study Plan approved by the Commission, the AEA-commissioned climate change study, a sensitivity analysis, and common sense. This will provide information that the Commission and cooperating agencies can use in their Environmental Impact Statement to address climate change effects.

3.2.1. Rationale and Establishment of Good Cause

NRDC argues that a basin-wide climate study is needed for the Commission to adequately discharge its statutory duty under section 4(e) of the FPA to give equal consideration to the protection, mitigation of and damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality when making a decision to grant a hydropower license. NRDC believes that this information is necessary for NMFS and USFWS to develop recommendations to protect, mitigate damage to, and enhance affected fish and wildlife and habitat as authorized in the FPA. In particular, NRDC's comments focus on the need for developing a predictive model framework to assess the cumulative impacts of climate change and the Project on the watershed's ecosystem.

NRDC states that President Obama has issued several executive orders since the Commission's initial Study Plan Determination. These executive orders seek to ensure that federal agencies are advancing climate change preparedness and resilience. NRDC also references the Council on Environmental Quality (CEQ) revised guidelines released in 2014, calling for federal agencies to incorporate climate change projections into assessments of both the baseline environmental conditions and the impacts of proposed federal actions.

NRDC states that the AEA-commissioned study is narrowly focused on reviewing future glacial wastage and surges in the upper basin and how these changes will impact sedimentation and flow into the dam's reservoir. NRDC asserts that the entire basin will be influenced by climate change and therefore impacts to sensitive fish and wildlife habitats downstream need to be assessed.

NRDC maintains that the request has been made previously and that now is the time to grant the request. NRDC continues that significant new information material to the study objectives has become available. In particular, climate modeling has advanced significantly since FERC issued its initial Study Plan Determination in 2013. NRDC then goes on to address the study criteria in 18 CFR Section 5.9(b).

3.2.2. AEA's Rationale for Not Adopting the Proposed Study

AEA requests that FERC not adopt this proposed new study because the request does not meet the criteria established in 18 C.F.R. § 5.15(e) for adoption of a new study proposal. A climate change study as proposed by NRDC is not needed for a Commission licensing decision and would result in significant uncertainty related to timing and future climate effects on water temperature and fish and wildlife habitat and at great cost. On April 26, 2013, the FERC Director found the proposed climate change studies to be unnecessary to conduct the Commission's environmental analysis and therefore were not required to be conducted by AEA. The Commission-approved Study Plan approach will enable development of a valid baseline, assessment of Project impacts to fish and wildlife and their habitat, and development of PM&Es both in the reservoir area and downstream based upon existing conditions. The Commission can then use an adaptive management approach to protect the downstream environmental resources as discussed in its July 18, 2013 Order Rejecting and Denying Rehearing.[40]

AEA concurs with several of the statements of NRDC on the appropriateness of a climate change study for a new project the size of Susitna-Watana and its long-term implications on meeting Railbelt energy and natural resources needs, and in fact conducted the AEA-commissioned study as proposed in the RSP, independent of the FERC-approved Study Plan Determination. However, AEA does not agree with the proposed NRDC new study request that goes beyond the AEA-commissioned Glacier and Runoff Changes Study (Wolken et al. 2015) already conducted. AEA's approach to climate change will permit the Commission and other NEPA cooperating federal

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[40] *Alaska Energy Auth*., 144 FERC ¶ 61,040 (2013).

agencies to effectively address climate change in the EIS, should FERC elect to do so. AEA's proposed approach capitalizes on the Commission's conventional hydrological approach as discussed in the Commission's July 18, 2013 Order Rejecting and Denying Rehearing in this ILP proceeding, the AEA-commissioned study, and an assessment of future trends based on planned sensitivity analyses and common sense.

AEA's Commission-approved modeling framework will enable baseline and Project impacts on biophysical resources to be assessed in the reach between Watana Dam and Talkeetna. The FERC-approved study program includes hydrology, meteorology, and habitat studies designed to evaluate Project effects over a range of reasonable plausible conditions (e.g., varying temperature conditions). The range of reasonable plausible conditions spans flow variations that greatly exceed effects from climate change based on the results of the AEA-commissioned climate change study. The meteorology and hydrology conditions to be modeled will yield Project effects relative to existing conditions and allow PM&E measures to be developed to protect resources. This information can also be used to determine an appropriate level of control that should be available to assist in protecting downstream resources from future climate changes. Thus, the NRDC proposed new study request does not meet criterion 5.9(b)(7), which requires a demonstration that "any proposed alternative studies [i.e., those currently underway in the FERC-approved Study Plan] would not be sufficient to meet the stated information needs." NRDC's proposed study also does not meet criterion 5.15(e)(2), which mandates that a new study request demonstrate "[w]hy the goals and objectives of any approved study could not be met with the approved study methodology."

AEA disagrees with NRDC on the cost and time needed to conduct the climate change study as proposed by NRDC. AEA has expended approximately $1,000,000 to conduct the AEA-commissioned study, excluding logistics support. Although some work has been done on downscaling and model development that could be readily used in expanding AEA's effort to the entire basin, the effort will be substantial merely to expand the model downstream to Cook Inlet. The area upstream of Watana dam includes only about a quarter of the Susitna River basin. To obtain comparable data for the remainder of the basin, AEA would need to collect additional field data including topographic, land use, soils, groundwater, and glacier data. Climatological and meteorological data would need to be expanded. Glacier mass balance modeling would be needed for glaciers in the Chulitna and Talkeetna basins. Further, the water flow and balance simulation model (WaSiM) would need to be expanded. This effort would be more significant than the initial effort for the Susitna basin upstream of Watana since the balance of the basin is about four times the basin area upstream of Watana. Added to this is the calibration and validation of WaSiM. This effort, which AEA roughly estimates would cost about $3,000,000, would only provide flow changes attributed to climate change. To add future water temperature, fish and wildlife baseline effects over the next 100 years would be an enormous effort given the amount of modeling involved. This could easily exceed $500,000 as that was the cost estimate AEA developed just to run the run-of-river scenario required by the Commission. In addition to that, AEA would need to run the with-Project models and that would easily add an additional half million dollars. Therefore, AEA estimates that the cost to fully assess a future baseline and future Project effects could easily exceed $5,000,000, far above the NRDC estimate. AEA submits, therefore, that the NRDC study request does not meet study criterion 5.9(b)(7), which requires "considerations of level of effort and costs," as the estimated $5 million cost of this study is not expected to yield information that is more insightful and reliable than what is already provided for under the FERC-approved Study Plan and existing information.

AEA disagrees with NRDC that the entire basin needs to be assessed to fully evaluate climate change. Section 1.5.3 discusses AEA's initial analysis for not extending fish and wildlife studies beyond those approved in the Commission-approved Study Plan. Although there are influences that extend downstream beyond Talkeetna, the level of effect does not warrant an expensive, time consuming climate change study of the Middle and Lower River. In addition to the Project reservoir, the primary reach affected by the Project is the reach from Watana Dam to Talkeetna.

NRDC proposes that AEA develop a predictive climate model using downscaled climate projections to simulate non-stationary future environmental conditions (including changes to glaciers, permafrost, hydrology, evapotranspiration, and surface water temperature) in accordance with the lifespan of the Project. As acknowledged on page 20 of NRDC's comments, AEA has done this (with the exception of the surface water temperature) for the Susitna basin upstream of Watana Dam. The AEA-commissioned study, Wolken et al. 2015, did acquire and evaluate downscaled climate projections for the Susitna basin including Zhang et al. 2015. As also pointed out by NRDC, AEA's analysis did not address river ecology downstream of the dam. Because of the uncertainty associated with predicting climate change rates and then using that in combination with downstream modeling, relying on such results for development of PM&E measures is not warranted. Therefore, AEA maintains that further glacial and hydrologic impacts modeling attributed to climate change would not be cost effective nor would it result in definitive licensing conditions—and, again, does not meet study criteria 5.9(b)(5), (b)(6), (b)(7), and criterion 5.15(e)(2) that applies at the ISR stage of this ILP.

The NRDC proposes that AEA conduct an analysis of projected surface water temperature because that factor can greatly influence the health of aquatic ecosystems. AEA does not dispute the importance of water temperature on aquatic ecosystems. However, predicting water temperatures and then making decisions on licensing conditions that affect Project operations would be speculative at best. Given the uncertainty of the timing of climate change (e.g., there a numerous climate change scenarios) and the uncertainty associated with the effects that permafrost melting and vegetation changes have on water temperature, the confidence in the water temperature outputs from the model would be limited. Conducting a sensitivity analysis of varying water temperature inputs and other key factors in the EFDC model are likely to be more valuable in understanding the system response to water temperature (and climate change) in the reservoir and downstream. Thus, the NRDC study request does not meet study criteria 5.9(b)(5), (b)(6), (b)(7), and 5.15(e)(2).

NRDC requests that the Commission require an analysis of ecological impacts. NRDC asserts that the Commission must require a study of climate change impacts to the affected resources, not just to the Project. Specifically, NRDC proposes that the Commission consider the effects of climate change on aquatic, riparian, and terrestrial habitat and species. The approach proposed by NRDC would be costly, time consuming and exacerbate the uncertainty associated with climate and water temperature predictions. The Commission-approved approach to modeling the ecological impacts of the Project based on meteorology and hydraulic combinations associated with the historic record (see July 18, 2013 Commission Order Rejecting and Denying Request for Rehearing) and then applying a sensitivity analysis would be far more effective in understanding how changes in these parameters could affect the downstream ecology. Based on the AEA-commissioned Glacier and Runoff Changes Study, common sense can be applied to determine which sensitivity analyses should be undertaken, and therefore the NRDC study request does not meet study criteria 5.9(b)(5), (b)(6), (b)(7), and 5.15(e)(2).

NRDC notes that the AEA-commissioned study does not include the impacts of climate change throughout the basin and overlooks critical climate-induced environmental changes beyond glacial retreat. Accordingly, NRDC requests a basin-wide analysis of impacts that considers the seasonal, annual, and long-term changes in volume, timing, and frequency of precipitation and flows, above and below the dam. Further, NRDC states that both reservoir releases and climate-induced changes to tributary hydrology will influence the flows and are likely to affect fish habitat. AEA does not dispute NRDC's comment that both reservoir releases and changes to tributary hydrology can influence flows and fish habitat. For the same reasons stated above, NRDC's approach would likely result in significant modeling uncertainty associated with various climate change scenarios. AEA's approach would consider the effects of flows and their timing, along with other physical alterations to determine the impact on environmental resources downstream of the Project. This, coupled with a sensitivity analysis on tributary flows and reservoir release scenarios, will provide a superior understanding of the effects in changes to these parameters and in a more cost-effective manner. Again, a common sense approach can be used to test the sensitivity to parameters like tributary inflow and tributary temperatures. Further, as noted above and in Section 1.5.3, based on AEA's studies to date, Project effects will be greatly attenuated downstream of the Three Rivers Confluence and even more so downstream of the Yentna River confluence. For these reasons, the NRDC-proposed study does not meet study criteria 5.9(b)(5), (b)(6), (b)(7), and 5.15(e)(2).

NRDC also suggests that the Commission require an assessment of altered thermal and flow regime and altered sedimentation rates because the combined effects of climate change and Project operations will be complex and varied. Again, the Commission-approved approach including the associated sensitivity assessment will allow an understanding of how altered thermal and flow regime and altered sedimentation rates will affect downstream resources. The modeling analysis will demonstrate the interaction of Project operations with variations in thermal and flow regime and altered sedimentation rates. For example, the EFDC water quality modeling (Study 5.6) and geomorphic studies (Studies 6.5 and 6.6) will show how the Project affects sedimentation rates in the reservoir and downstream. Because of the efficiency of the reservoir in settling suspended and bed loads, there is not likely to be much difference in sediment output from the reservoir with or without climate change. However, downstream sedimentation could be affected with tributary flow and sedimentation rates attributed to factors like climate change. A sensitivity assessment can be used to demonstrate the effects of changes in downstream sedimentation rates and their corresponding effects on fish habitat—again demonstrating that the NRDC-requested study does not meet the criteria for new studies established in 18 C.F.R. §§ 5.9(b) and 5.15(e).

In summary, as the Commission has noted in its July 18, 2013 denial of NMFS's rehearing request relating to the climate change study requested earlier in this ILP, the results from a climate change study would be speculative. This is particularly true when considering the uncertainty associated with climate change itself, permafrost melting effects which are challenging to model, and then the results of the various model simulations for flow, water quality, ice, groundwater, geomorphology, fish habitat and riparian habitat. In particular, there are many factors that can affect water temperature in a climate-changing environment, including vegetation changes and permafrost changes. Rather, a trend analysis should be sufficient to understand potential climate change effects coupled with Project operations. That information, which is being generated through AEA's implementation of the Study Plan already approved by the Commission, can be used in a common sense approach to consider adaptive management strategies.

The AEA-commissioned study can be used with AEA's FERC-approved modeling studies, associated sensitivity analyses and common sense to consider future environmental trends downstream of Watana dam. The sensitivity analyses will provide information on Project impact trends on the aquatic, riparian, and terrestrial habitat and species downstream of the dam. The EFDC reservoir model will provide information on impact trends on the aquatic resources in the reservoir. Since the Project does not affect habitat upstream of the reservoir, there is no need to consider effects upstream of Watana reservoir other than to determine input data for the EFDC model. AEA's modeling effort will be captured in the USR and license application.

For these reasons, AEA requests that FERC not adopt NRDC's proposed new study.

3.3. Terrestrial Invertebrates Study

The Copper Country Alliance (CCA) has requested a new study on terrestrial invertebrates. According to CCA, the exclusion of an investigation on terrestrial invertebrates "is a major data gap" in the FERC-approved Study Plan because "terrestrial invertebrates, being important at the base of many food chains, are of great significance to so many other forms of life, including humans." Similarly, Becky Long states in her comments: "The [CCA] request for a new study on the terrestrial invertebrates in the Project Area is necessary to fill a data gap. The ecosystem value of the terrestrial invertebrates includes pollination, decomposition, prey food, and aesthetics to name a few. I support this study request." In supporting this study request, Cathy Teich states in her comments: "Other studies that one might not think important without considering the entire food chain/ecosystem should be critical. The [CCA] has brought up a significant study that should have been considered from the start: Terrestrial Invertebrates. This population is key in any ecosystem."

3.3.1. Rationale and Establishment of Good Cause

In support of its request for a new study on terrestrial invertebrates, CCA states that invertebrates are "keystone species," responsible for critical ecosystem functions such as pollination, decomposition, food source for other species, aesthetics, and ethics. CCA also cites ADFG's *Alaska's Wildlife Action Plan* as indicating that several orders of terrestrial invertebrates are listed among the species of greatest conservation need in Alaska.

With regard to the required criteria under 18 C.F.R. § 5.15(e) for justifying a new study, CCA states that there have been no material changes in the law or regulations applicable to this new study since the Commission approved the Study Plan in 2013. CCA argues that the goals and objectives of its proposed new study cannot be met with the approved study methodologies for several of the FERC-approved wildlife studies—focusing on Bat Distribution and Habitat Use (Study 10.13), Landbird and Shorebird Migration, Breeding, and Habitat Use (Study 10.16), and Wood Frog Occupancy and Habitat Use (Study 10.18). CCA admits that this study request was overlooked earlier in the process, citing limited resources and the voluminous FERC-approved Study Plan. Finally, CCA also admits that there has been no significant change in the Project proposal and that significant new information material to the study objectives has not become available since the Commission's Study Plan Determination in 2013.

3.3.2. AEA's Rationale for Not Adopting the Proposed Study

AEA requests that FERC not adopt this proposed new study because the request does not meet the criteria established in 18 C.F.R. § 5.15(e) for adoption of a new study proposal. First, CCA has failed to identify any material changes in the law or regulations applicable to this study request since the Commission approved the Study Plan for this Project in 2013, and in fact it acknowledges that no such change has occurred. Second, CCA's rationale for submitting this new study proposal at this juncture of the ILP—basically, that it did not think of this study until reviewing the Initial Study Reports—is not a showing of good cause. CCA and all other licensing participants had ample opportunities during the Study Plan development in 2012–2013 to review and consider the Study Plan as a whole, particularly in light of AEA's iterative and enhanced process for developing the Study Plan during that early phase of the licensing process. Finally, CCA admits that this new study proposal is not supported by any significant changes in the Project proposal or significant new information.

AEA notes that none of the three commenters raised this concern in 2012 when they each participated in the scoping process (see SD2, 16 July 2012), nor did they submit a study request during the ILP study planning process, during which aquatic macroinvertebrates were specifically mentioned in other study plans (e.g., Study 9.8, River Productivity). Similarly, no other stakeholders, including federal and state resource management agencies, requested this study.

With regard to the required study criteria under 18 C.F.R. § 5.9(b), AEA acknowledges that terrestrial invertebrates are important ecosystem components, but this proposed study does not meet the criteria. As the commenters advocating for this proposed new study correctly note, FERC does not routinely evaluate terrestrial invertebrates in the licensing process. Hence, the lack of a specific study cannot be characterized realistically as a major data gap. Assessment of terrestrial invertebrates in NEPA documentation is virtually nonexistent. The inclusion of resources to be evaluated in NEPA documents is dictated by legal and regulatory requirements, as well as by ecological and sociocultural concerns. The depth of coverage of biological resources in FERC licensing and NEPA documentation is commensurate with these characteristics and with the expected level of impact. Thus, the proposed new study fails to meet criterion 5.9(b)(6).

Moreover, it is highly unlikely that construction of the proposed Project would cause significant or detectable effects on the regional occurrence or abundance of terrestrial invertebrates. Terrestrial invertebrates would be lost in areas affected directly by inundation and by gravel excavation and placement, but they would persist in areas immediately adjacent to those areas of direct impact, as well as elsewhere throughout the Project area. In the proposed inundation zone, aquatic invertebrates would be likely to increase in abundance due to the presence of the reservoir. Further, it is important to note that the Susitna-Watana Project would not affect climate change other than to reduce carbon dioxide emissions which contribute to climate change. Hence, the proposed new study would not yield information that would inform the development of licensing requirements and therefore fails to meet criterion 5.9(b)(5).

AEA also notes that no wildlife agencies or other resource agencies have designated terrestrial invertebrates as resources of legal or regulatory concern in Alaska. The only agency planning document of which AEA is aware that contains any reference to terrestrial invertebrates is the State Wildlife Action Plan (SWAP) by the Alaska Department of Fish and Game (ADF&G), a document required for Alaska to qualify for funding through the federal State Wildlife Grants (SWG) program administered by the U.S. Fish and Wildlife Service (USFWS). The plan was first published in 2006 (ADF&G 2006) and a draft of a 10-year revision was produced in late 2015 (ADF&G 2015); the revision has not yet been completed, pending review by the USFWS. Both versions of the plan heavily emphasize vertebrate species.

As with other “nongame” taxa, the lack of basic information on the distribution and abundance of terrestrial invertebrates is an impediment in developing background data for conservation strategies across the entire state. ADF&G (2006: 97) stated “Similar to other taxonomic groups, there is an absence of general and site-specific knowledge about species. The habitat use and distribution of most species remains unknown except for anecdotal information and studies in small areas.” Page 70 of Appendix 4 in ADF&G (2006: 292) listed problems and issues regarding terrestrial invertebrates, including the following:

- Lack of information on geographic distribution, abundance, habitat use, and species diversity.
- Many habitats are under-surveyed.
- Information such as taxonomic keys and species descriptions needed to identify species is lacking.
- The ecological roles of terrestrial invertebrates are poorly understood or not appreciated.
- Endemic species need to be identified and their conservation status assessed.

Nevertheless, terrestrial invertebrates do not appear to be at imminent risk in Alaska. Given the large expanses of undeveloped landscapes in the majority of the state, ADF&G (2006: viii) noted that “For most species that have been well studied, populations and habitats are largely intact except in certain parts of the state. The exceptions generally include areas such as the Kenai Peninsula, Anchorage Bowl, and Matanuska–Susitna valleys, which are experiencing increased urbanization.” The original SWAP also stated that “Although basic biological information on life history, population levels, and other parameters is lacking for many species, the majority of Alaska’s wildlife resources are considered healthy” (ADF&G 2006: 1) and that “Habitat for many terrestrial invertebrates generally is assumed to be abundant and widely distributed across the state” (ADF&G 2006: 292).

The two versions of the SWAP have taken different approaches to the inclusion and treatment of terrestrial invertebrates, demonstrating that consensus on which taxa to include is uncertain and still being developed. The first version identified 6 phyla and 19 species as “nominees” for Species of Greatest Conservation Need (SGCN; see ADF&G 2006: Appendix 7, p. 31). In contrast, the revised SWAP (ADF&G 2015) took a more focused approach in defining SGCN and reduced the list of candidate taxa, excluding most invertebrates while designating five broad taxonomic groups of terrestrial invertebrates (all arthropods) as SGCNs—the insect orders Hymenoptera, Diptera, Odonata (also listed as aquatic invertebrate SGCNs), and Lepidoptera, and the arachnid Order

Araneae (spiders, which were listed erroneously as "Order Arachnida")—on the basis that they are economically and ecologically important. Although these taxa are mentioned briefly in text and listed in Appendices A, B, and D of ADF&G (2015), they are not discussed in any detail, in contrast to marine and aquatic invertebrates. Designating entire orders of animals (rather than species, genera, or even families) reflects an extremely broad approach to identifying "species" of conservation need, further underscoring the general lack of knowledge about how to monitor these taxa. In addition, it should be noted that many species, genera, or families in the orders Diptera and Odonata actually spend significant stages of their life histories in aquatic environments, and that some of those taxa are being assessed as part of Study 9.8 (River Productivity).

For various reasons in addition to the changing treatment of terrestrial invertebrates in the SWAP, AEA contends that the requested new study of terrestrial invertebrates specifically for this Project does not meet study criteria 5.9(b)(2), (b)(4) or (b)(5). CCA identifies no applicable resource management goals of USFWS and ADF&G that would apply to such study; fails to explain why additional information on terrestrial invertebrates is necessary; and establishes no nexus to the Project or how this information would inform license requirements. ADF&G's SWAP does not indicate that terrestrial invertebrates are at risk.

With respect to study criterion (b)(6), monitoring of terrestrial invertebrates as bioindicators has been used primarily to track contaminant effects and ecosystem health at specific sites (e.g., Hilty and Merenlender 2000, Hodkinson and Jackson 2005, Gerlach et al. 2013), rather than across broad regions or expansive study areas. Although attempts are being made to converge on standard approaches, monitoring methods and indices of terrestrial invertebrate diversity are variable and not well-established (Kimberling et al. 2001, Hodkinson and Jackson 2005, Rohr et al. 2007). CCA does not specify how to conduct the field sampling other than to state that the study should use "sample plots and/or transects in representative habitats within the area of the proposed lake [presumably meaning the reservoir] and a 2-mile buffer on each side." It is unclear, however, why a 2-mile buffer around the reservoir would be necessary if the expected effects are direct impacts from filling of the reservoir. AEA does not believe CCA's request is consistent with generally accepted practice in the scientific community.

Finally, this new study request does not meet study criterion 5.9(b)(7), as it would be difficult and expensive to conduct and to evaluate in a meaningful context, given the rudimentary and evolving knowledge concerning terrestrial invertebrates in Alaska. CCA's request states that "field observations would be combined with researchers' prior knowledge and literature searches to determine the ecosystem function of each species." Identification of terrestrial invertebrates to the species level is difficult and is hampered by a lack of appropriate keys (ADF&G 2006) and most inventories do not attempt to identify taxa below the family level (Hilty and Merenlender 2000). The literature on arthropods in Alaska is sparse, with broad data gaps. Hence, identification of collected specimens to the species level would be exceedingly difficult, if not impossible, requiring an enormous investment of time and effort and the likely need to develop new taxonomic keys across five orders of arthropods. Moreover, the likelihood of discovering an endemic species that is restricted to the upper Susitna River basin, as suggested by the commenters, is extremely remote.

Adding to this cost, CCA states that the study should "employ observation and capture techniques (e.g., pitfall traps, Malaise traps, Berlese funnels, sweep netting, and hand collecting) best suited to the invertebrate groups and situations in the study area." In fact, multiple sampling techniques—

using all of these techniques and more—would be required to document all of the life stages of all species, genera, or families in the five orders being targeted in the proposed study. CCA's study request states that field sampling should be performed in one field season (i.e., calendar year), "beginning shortly before green-up and ending by freeze-up, occurring with enough frequency during the field season to detect the presence of these invertebrates in their various life stages." Thus, the field season would require multiple sampling trips by several field teams from the beginning of May until late October, requiring extensive logistical support for access to the remote study area. The need to document five different orders of arthropods across a wide array of habitats would require intensive field sampling in all habitats throughout the entire ice-free season to adequately characterize their presence, distribution, and abundance with even a modest degree of statistical validity.

Thus, CCA has not demonstrated that this expensive study—which AEA conservatively estimates would cost approximately $500,000–$750,000, depending on the final study design and level of taxonomic discrimination required (involving an extensive amount of laboratory time to key out the thousands of specimens that would be collected)—meets study criterion 5.9(a)(7). Such a large expense is not warranted where, as here, the study would produce uncertain results that are only tangentially relevant to understanding Project effects and to developing license requirements.

For all of these reasons, AEA requests that the Commission not adopt CCA's proposed new study. CCA has not met its burden to show "good cause," nor did it demonstrate that each criterion set forth in 18 CFR 5.15(e) is met for this requested study—and, in fact, plainly admits that many of these criteria have not been met. While CCA did include a discussion of the elements under 18 CFR 5.9(b) in making its request, standards (2), (4), (5), (6) and (7) are not met, as discussed above.

3.3.3. References Cited

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3.4. Susitna-Watana Integrated Modeling and Decision-Support System

The USFWS and NMFS have requested that a Susitna-Watana Integrated Modeling and Decision-Support System Study be handled separately from the Fish and Aquatics Instream Flow Study 8.5. In addition to requesting this integrated modeling as a new study, the Services variously characterized this request as a comment, recommendation, or modification to the Fish and Aquatics Instream Flow Study 8.5 (Section 2.5.1), the Water Quality Modeling Study 5.6 (Section 2.2.2), the Fluvial Geomorphology Modeling Study 6.6 (Section 2.3.2), the Groundwater Study 7.5 (Section 2.4.1), the Ice Processes Study 7.6 (Section 2.4.2), and the Riparian Instream Flow Study 8.6 (Section 2.5.2). As appropriate, AEA's responses to such comments, recommendations, and proposed study modifications appear in the applicable sections of this document as outlined above.

The Services' request for model integration refers to the process of linking together individual study data inputs, analyses, and models to form a complete picture of baseline resource conditions. The Services believe that a Decision Support System (DSS) should incorporate the results of the model integration along with other qualitative and quantitative information from other studies and provide a framework to compare the environmental impacts of alternative operational scenarios as compared to Existing Conditions (i.e., without Project). The Services believe that model integration and decision support cannot be achieved satisfactorily unless a new study is undertaken. Rebecca Long supported the NMFS Study Request for Model Integration. TNC did not request a new study, but in its proposed Modification 4.8.4 it recommended a framework to define and communicate uncertainty of the integrated model approach.

3.4.1. Rationale and Establishment of Good Cause

In explaining the basis for this new study request, the Services relied on some of the criteria under 18 C.F.R. § 5.15(e), but failed to address all these criteria as required by the Commission's ILP regulations. Although required under criterion 5.15(e)(1), the Services did not indicate any material changes in the law or regulations applicable to the information request.

To meet criterion 5.15(e)(2), the Services advance their belief that the goals and objectives of the approved studies cannot be met with the approved study methodology because the details of the DSS are not defined in the ISR or supporting documentation, and that these details are critical for determining the applicability of the methods and framework that will be used to integrate the numerous study results/outputs proposed and discussed above to assess the Project effects on natural resources throughout the Susitna River.

With regard to criterion 5.15(e)(3), the Services indicate that the study request was made earlier in the ILP process, in 2013 and 2014. They indicate that they are renewing the request here in a formal manner because the integrated modeling and DSS have not been developed or prioritized to a degree that they believe is necessary to produce results that are meaningful and useful within the timeframe for making licensing decisions and for developing measures to protect, mitigate for, and enhance Project-affected resources.

Under criterion 5.15(e)(4), the Services indicate—incorrectly—that there have been significant changes in the Project proposal and that significant new information material to the study objectives has become available. They advance the idea—again, inaccurately—that the ideas for how the proposed Project will be built, operated, and maintained continue to change, and that the foundational studies, upon which evaluations of the "final" Project Alternatives, Project design, construction, and operation/maintenance are based, continue to change. They also state that the studies continue to yield information that will and should provide "lessons learned" to guide future studies, refine the proposed Project, and define Project Alternatives.

As required under criterion 5.15(e)(5), the Services provided a description of their New Study Request's goals and objectives and the information it will obtain, to support their study request using the study criteria in §5.9(d).

3.4.2. AEA's Rationale for Not Adopting the Proposed Study

AEA requests that FERC not adopt this proposed new study because the request does not meet the criteria established in 18 C.F.R. §5.15(e) for adoption of a new study proposal. Not only did the Services fail to meet all criteria for justifying a new study under 18 C.F.R. § 5.15(e), the goals and objectives of this proposed new study will be sufficiently met through the existing FERC-approved studies. Moreover, the Services have not established "good cause" as required by the ILP regulations. The expense and schedule is not warranted where, as here, much of the study would duplicate information that will be generated through the FERC-approved Study Plan, and unneeded to understand Project effects and develop license requirements.

The Services have not demonstrated that this new Integrated Modeling and DSS Study, which AEA estimates would cost $1,000,000 to $5,000,000 and require multiple years to develop, is necessary. AEA has already committed to developing a DSS tool to evaluate the benefit and potential impacts of alternative Project scenarios (RSP Section 8.5.4.8.1). Because the FERC-approved Study Plan already includes development of the DSS, a new study is unneeded, and the Services have not demonstrated why the goals and objectives of its new study proposal "*could not be met with the approved study methodology*," as criterion 5.15(e)(2) requires, nor do the Services explain "*why any proposed alternative studies*," i.e., those already approved by the Commission, "*would not be sufficient to meet the stated information needs*," as criterion 5.9(b)(7) mandates.

The Services have not identified any material changes in the law or regulations applicable to this study request since the Commission approved the Study Plan for this Project in 2013, and AEA is unaware of any such change. In addition, the dam features and dam operation schemes described in the December 2012 RSP are very similar to that shown in the *Susitna-Watana Hydroelectric Project Engineering Feasibility Report* (MWH December 2014). The Services inaccurately claim that AEA has made changes to the Project proposal, and they certainly cannot meet the requirement under criterion 5.15(e)(4) to demonstrate "significant changes."

AEA has expended significant effort coordinating riverine modeling efforts and has demonstrated significant progress in model integration given the current ISR stage of licensing. AEA held a 3-day Riverine Modeling Technical Team meeting in November 13-15, 2013, and held a 3-day Proof of Concept meeting in April 15-17, 2014. AEA is continuing to gather baseline data, develop and calibrate riverine and other models, and ensuring model integration by continued coordination between resource study leads. For example, coordination meetings among riverine modelers were held in 2016 on May 9, June 1, June 21, July 27, August 31, and September 22 to resolve model interdependencies, ensure modeling results are correctly integrated, consider uncertainty, and fully meet the stated objectives of the various Study Plans.

AEA acknowledges that at the current ISR stage, integration of riverine process models, resolving model interdependencies, and spatial and temporal model integration into a DSS is an ongoing process. As described in the FERC-approved Study Plan, implementation will continue in the next study period. Consistent with the June 23, 2016 FERC ISR comment letter, AEA has committed to providing preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario in the USR.

As described in the FERC-approved Study Plan, AEA has also committed to developing a DSS tool in support of the License Application. AEA reviewed a range of DSS tools during development of the Study Plan (RSP Section 8.5.4.8.1) and initially selected a matrix-based approach because it has been used successfully in other FERC proceedings, provides transparency in the decision-making process, and is inherently easy for both professionals and lay-persons to understand. While experienced modelers may be comfortable with the need to translate contentious issues into numerical values and modeling algorithms, such abstract representations, are a significant impediment to reaching decisions within a relatively short period of time. Complex DSS modeling tools require years to develop and getting disparate interests to reach consensus on a relative resource weighting system may not be achievable within the FERC ILP schedule. A matrix-based approach may not provide all of the functions provided by a complex modeling DSS tool, but a matrix-based approach is sufficient for FERC to evaluate Project effects and identify potential protection, mitigation, and enhancement measures. AEA's commitment is to develop a DSS tool to assist in the evaluation of Existing Conditions and an operational scenario that addresses licensing participant interests in support of the License Application.

The Services maintain that the requested new study would not require additional fieldwork and no new scientific work is expected beyond that necessary to meet scientific and statistical quality standards. However, they also state that "*DSS tools that are currently available would require considerable adaptation and data input to reflect the specific conditions of the Susitna watershed.*" The Services do not offer an estimate of such "considerable adaptation," but TNC commented that a DSS described by the USGS at the April 2014 Proof of Concept meeting required more than 10 years to develop. The Services may desire a more sophisticated modeling effort be developed earlier in the FERC licensing schedule than defined in the FERC-approved Study Plan, but they have failed to demonstrate that ongoing implementation is insufficient to meet study objectives. AEA remains open to modifying and improving the DSS in a collaborative framework as part of the USR (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study), provided the level of effort and time frame are consistent with the FERC-approved Study Plan and licensing schedule.

3.4.2.1. The Services Have Not Established Good Cause

Although required under 18 C.F.R. § 5.15(e), the Services have not established "good cause" justifying this new proposed study.

First, contrary to the Services' belief, the goals and objectives of the approved studies can be met with the approved study methodology. AEA considers the Model Integration and DSS to be a platform to reduce the complexity of information and focus attention on tradeoffs involved with decisions regarding Project operations. As described in the FERC-approved Study Plan (RSP Section 8.5.4.8.1), the Model Integration and DSS and supporting software will be completed *after* the initial results of the various modeling efforts are available. Model inputs, results, and potential evaluation metrics are being developed in response to feedback from the Technical Workgroup (TWG). As described in the RSP, and discussed during the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting (ISR 8.5, Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*), riverine process modeling results must be integrated spatially and temporally to evaluate effects of Project operations on downstream resources. Several options were presented that ranged from the simplest to the more complex. These options included extrapolation by linear distance, macrohabitat linear distance, macrohabitat area, and macrohabitat weighted by fish use. Decisions on spatial and temporal extrapolation, and development of final evaluation metrics for all resources are needed for input to a DSS-type process but are not required at the current stage in the implementation of the FERC-approved Study Plan.

Second, the integrated modeling and DSS have been developed or prioritized to a degree necessary to produce results that are meaningful and useful within the timeframe for making licensing decisions. As described in the FERC-approved Study Plan (RSP Section 8.4.4.8.1), AEA has already committed to developing a DSS-type process to evaluate the benefit and potential impacts of alternative Project scenarios. The selection of evaluation metrics will be developed in collaboration with the TWG. Development of a DSS-type process, and supporting software to efficiently process data analyses, will be initiated in collaboration with the TWG after the initial results of the various habitat modeling efforts are available. The intent is to prepare the DSS tool to assist in the evaluation of Existing Conditions and develop an operational scenario that addresses licensing participant interests in support of the License Application (RSP Section 8.5.4.1). Because the FERC-approved Study Plan already includes development of the DSS, a new study is unneeded, and the Services' requested study does not meet criteria 5.15(e)(2) and 5.9(b)(7).

Third, although required under criterion 5.15(e)(1), the Services have not identified any material changes in the law or regulations applicable to this study request since the Commission approved the Study Plan for this Project in 2013, and AEA is unaware of any such change.

Fourth, contrary to the Services' allegations of purported changes to the Project proposal, and as shown in Table 3.4-1, the dam features and dam operation schemes described in the December 2012 RSP are very similar to that shown in the *Susitna-Watana Hydroelectric Project Engineering Feasibility Report* (MWH December 2014). The main differences include a shorter dam now (mainly due to bedrock found at a higher elevation in the dam footprint determined from geotechnical studies performed in 2012-2014), slightly smaller turbine-generator units now and a change in the operational scheme where Watana power is now assigned to satisfy intermediate load following of the Railbelt demand, which results in smaller fluctuations in turbine water flow throughout the day than would be experienced by the maximum load following scheme envisioned in the RSP.

Table 3.4-1. Comparison of facility features and operations described in Section 1.3 of the Revised Study Plan (December 2012) to features described in the *Susitna Watana Hydroelectric Project Engineering Feasibility Report* (MWH December 2014).

Dam Features	**2012**	**2014**
Dam height	750 ft	705 ft
Dam material	roller compacted concrete	roller compacted concrete
Dam length at crest	3100 ft	2810 ft
Reservoir max operating level	El 2050 ft	El 2050 ft
Reservoir min operating level	El 1850 ft	El 1850 ft
Reservoir area at max	23,546 acres	23,500 acres
Reservoir length at max	42.5 mi	42 mi
Reservoir total capacity	5,200,000 ac-ft	5,170,000 ac-ft
Reservoir active storage	3,400,000 ac-ft	3,380,000 ac-ft
Powerhouse - turbine #s/unit cap.	4 / 150 MW with one empty bay	3 / 206 MW with one empty bay
Total nominal turbine capacity	600 MW at average pool level	618 MW at max pool level
Average annual generation	2,800 GWh	2,800 GWh
Dam Operations		
Average reservoir drawdown	150 ft	120 - 150 ft
Maximum reservoir drawdown	200 ft	200 ft
Operating case	**OS-1**	**ILF-1**
High flow discharge rate	15,000 cfs	14,000 cfs
Average January discharge rate	9,600 cfs	8,360 cfs
Min. August flow release (Gold Cr.)	9,000 cfs	9,000 cfs
Min. January flow release (Gold Cr.)	3,000 cfs	3,000 cfs

The current Project features and dam operation scheme are very similar to the 2012 RSP. The current Project feature of a dam crest at 2,025 feet is within the initial crest elevation of 2,025 feet to 2,125 feet. The initial operational scheme was using Susitna-Watana energy for load following with a maximum powerhouse discharge of about 15,000 cfs, average January discharge rate of 9,600 cfs, minimum January flow (Gold Creek) of 3,000 cfs, and minimum August flow (Gold Creek) of 9,000 cfs. While there have been few changes to the dam features and dam operations schemes at the current ISR stage, they certainly do not meet the requirement under criterion 5.15(e)(4) for "significant changes," and in any event the Services fail to establish why these changes have any relevance to their proposed study. AEA will consider changes to the operations schemes to address multiple resource interests as the results of ongoing studies become available and the Draft License Application and Final License Application are prepared.

3.4.2.2. The New Study's Goals and Objectives Are Achieved by the Existing Study Plan

The Services' new study request fails to meet criteria 5.15(e)(2) and 5.9(b)(4) because goals and objectives advanced by the Services are amply met through studies that FERC has approved and which are currently underway. Specifically, the Services' goals for model integration and DSS include the integration of simulation models, data analyses, and other information generated by individual studies to predict various biological and other metrics under Existing Conditions, alternative operational scenarios, and Project alternatives will be met through continued study implementation.

As part of study implementation, a Riverine Modeling Technical Team meeting was held with licensing participants on November 13-15, 2013 to provide a forum to review and discuss data analysis, model interdependencies, model outputs, and study integration efforts. A follow-up Proof of Concept meeting was held April 15-17, 2014 to advance the understanding of riverine process modeling (i.e., Water Quality (Study 5.6), Fluvial Geomorphology Modeling (Study 6.6), Groundwater (Study 7.5), Ice Processes (Study 7.6), and fish habitat modeling (Study 8.5) by demonstrating the application of the models specific to two key biological metrics (i.e., effective salmon spawning-incubation habitat and juvenile salmonid rearing habitat) at Middle River FA-128 (Slough 8A). Meeting agenda topics included options for spatial and temporal model integration into a DSS. These meetings were held early in the study implementation process to allow potential data gaps or format inconsistencies among the various riverine models to be identified and resolved.

Integration of riverine process models, resolving model interdependencies, and spatial and temporal model integration into a DSS is an ongoing process and will continue in the next study period. AEA is continuing to gather baseline data, develop and calibrate riverine and other models, and ensure model integration by continued coordination between resource study leads. AEA recognizes that model outputs developed by one study (e.g., SRH2-D hydraulic modeling [Study 6.6 SIR, Appendix B: *FA-128 2-Dimensional Sediment-transport Model Development and Calibration*]) represents a model input for another study (e.g., Study 7.5 SIR, Appendix B: *Preliminary MODFLOW Three Dimensional Groundwater Model for FA-128 (Slough 8A)*). AEA has continued study coordination efforts among study representatives to ensure modeling results are correctly integrated, consider uncertainty, and fully meet the stated objectives of the various Study Plans.

The USR will contain preliminary results for all models required by the Study Plan for Existing Conditions and at least one operating scenario (FERC_ppA-1_ph01, June 23, 2016). This will include an evaluation of Project effects over an assumed 50-year licensing period using 1-D and 2-D bed evolution models to calculate changes in physical channel conditions that will provide input to the fish habitat and other riverine process models. Additional information on the linkages-coupling between the Fish and Aquatic Instream Flow Study (8.5) and other dependent studies is presented in the Study 8.5 ISR (Part C, Appendix N: *Middle River Fish Habitat and Riverine Modeling Proof of Concept*). Additional details regarding bed evolution modeling are provided in the Fluvial Geomorphology Modeling SIR (Study 6.6 SIR, Attachment 1: *2014 Fluvial Geomorphology Model Development*, Section 2.2: Comprehensive Modeling Approach).

In advancing their new study request, the Services raise general concern that AEA's current process is incomplete. While AEA believes that such concerns are unfounded—and, in fact, the Services admit that they have not reviewed relevant information released by AEA since the June 2014 filing of the ISR—AEA agrees that the model integration process under the FERC-approved Study Plan has been, and will continue to be, challenging. For example, many simulations will be required to complete the 1-D bed evolution modeling of the range of operational scenarios and 2-

D bed evolution modeling of the selected representative years over time at the Focus Areas. The large number of scenarios is a known issue for Study 6.6, which is why a future Decision Point was identified in the Study 6.6 ISR (Part C, Section 7.1.1.2.2) to identify Focus Areas to run specific 2-D model scenarios. The results of the other studies (including water quality, ice processes, groundwater, and open-water flow routing) will also be evaluated for incorporation in an integrated result within the DSS. While the process is not complete, the FERC-approved Study Plan does not require this process to be complete by the time of the ISR's release. Each of these studies developed a Study Plan based on the requirements for that study and resource area. This often required different spatial and temporal scales, each relevant to the physical processes in the study, yet each of the studies is designed to provide the necessary information required to develop an integrated set of results.

As described in the FERC-approved Study Plan (RSP Section 8.4.4.8.1), AEA has already committed to developing a DSS-type process; however, specific details of the DSS are not required to be available at the current ISR stage. The conceptual framework (Study 8.5 ISR Part A, Figure 4.1.1) demonstrates the linkages among various resource studies and describes a systematic way for analysts and decision-makers to review study results, simulate alternatives, and evaluate the potential effects and benefits of alternative operational scenarios. The study framework is being developed in collaboration with the TWG, but the study schedule is dictated by the FERC licensing schedule and milestones must be consistent with the ILP process. AEA remains open to modifying and improving the DSS in a collaborative framework as part of the USR consistent with the FERC-approved Study Plan (Study 8.5 ISR Part D, Section 8: Steps to Complete the Study).

Finally, contrary to AEA's collaborative approach, the Services' proposed study would require FERC to assign "responsibility" for implementation of the DSS study to a technical work group comprised of "agencies, consultants, and stakeholders." These are agencies and entities upon which FERC has no jurisdiction or oversight. As provided for by FERC ILP regulations, it is the Applicant's responsibility to implement the study plan, not third party agencies and entities. Not only would the Services' approach be inconsistent with FERC ILP regulations, but AEA is also concerned that this proposed approach would lack structure and accountability, and lead to long delays and significant additional costs, while producing a work product that provides minimal benefits in terms of assessing the potential Project effects and informing the FERC licensing of the Project.

3.4.2.3. Considerations of Level of Effort and Costs

Finally, neither of the Services provided information on Level of Effort and Cost as per 18 C.F.R. § 5.9(b)(7). AEA is concerned that any modifications associated with Model Integration and DSS must be of a level of effort consistent with the ILP process. The USFWS commented in its New Study Request for Susitna-Watana Integrated Modeling and Decision Support System that modeling and DSS tools would require "considerable adaptation and data input" to reflect the specific conditions of the proposed Project. The DSS modeling process presented by USGS at the April 15-17, 2014 Riverine Modeling Technical Team Proof of Concept meeting and referenced by TNC far exceeds the scope of the ILP process (TNC_pp020_ph02, June 20, 2016):

> *This DSS was developed over more than ten years, not because of the lag in technology, but in large part due to the complex task of defining values across*

> *stakeholders quantifying those values in space and over time and calculating representative metrics to approximate whether those values will be met under various scenarios, and lastly, testing the sensitivity of those approximations and optimization functions.*

Depending on the details of the DSS software and implementation process, the estimated cost of the requested study would easily exceed $1,000,000 and could exceed $5,000,000. DSS model development, to the level of effort described by the USGS, would require multiple years to develop. AEA does not believe that this significant expense and level of effort justify the new study—particularly since it would replicate what is already required and underway in the FERC-approved Study Plan.

As a final point of clarification, the Services appear confused regarding the relationship between the Biological Performance Tool and fish passage evaluation matrix (Study 9.11 SIR, Section 5.12) and the DSS matrix approach described in the Fish and Aquatics Instream Flow Study (RSP Section 8.5.4.1). They incorrectly suggest that Project alternatives, model integration, and DSS were discussed in the Fish Passage Technical Workgroup meetings. The Biological Performance Tool is one component of the Fish Passage Feasibility Study (9.11) and is designed to evaluate the relative success of *fish passage alternatives* to attract, collect, and transport downstream migrants through the proposed Watana Dam and reservoir (Study 9.11 SIR, Appendix A: *Biological Performance Tool*). During the Fish Passage Technical Team meetings, over 170 fish passage facility concepts were identified and discussed. Concepts ranged from entire fish passage alternatives to stand-alone passage facilities, supplemental features, and locations of facilities. The Fish Passage Evaluation Matrix is a component of the Fish Passage Feasibility Study (9.11) and is designed to evaluate those fish passage alternatives that are considered to have the greatest potential for application at this Project (Study 9.11 SIR, Section 5.12). The results of the Fish Passage Feasibility Study (9.11) would be included as one input into the DSS matrix described in the Fish and Aquatics Instream Flow Study.

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 1

Comment Letter from Ahtna, Incorporated

June 23, 2016

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Our Culture unites us; Our Land Sustains us; Our People are Prosperous

June 23, 2016

Alaska Energy Authority
813 W Northern Lights Blvd.
Anchorage, AK 99503

Re: Comments on the Susitna Watana Hydro-electric Environmental Studies Presentation

Dear Sir or Madam,

Ahtna, Incorporated would like to thank the Alaska Energy Authority for allowing our participation in the presentations of the Sustina-Wantana Hydroelectric studies. The scientific studies reported on were quite an ambitious undertaking. Ahtna, Incorporated is impressed at the thoroughness of these scientific studies. However, Ahtna, Inc. has some concerns in regards to a few of the studies performed.

Study 12.5 Recreation Resources Study

The majority of this study appears to be a compilation of data from public recreational use of the Denali State Park and the BLM trail systems and waysides. It would appear that the majority of recreational users are from out of state. Buried under the 2.5 million user days of these public lands is the sub-category of recreational hunting. Recreational hunting is a classification given to non-rural Alaska resident hunting. Ahtna, Inc. would like to see a study done separating this recreational hunting from other recreational uses in this area.

Study 9.14 Genetic Baseline Study for Selected Fish Species
Study 9.5 Fish Distribution and Abundance in the Upper Susitna River

The project overview page on the Susitna-Watana Hydro website state that the dam will be located on the Susitna River above the Devils Canyon which acts as a "natural impediment to salmon migration." Both of these studies report juvenile salmon located within and above the Devil's Canyon and the proposed reservoir. Quoting the presentation "398 juvenile Chinook salmon were found at 9 sites, within the reservoir area 107 fish were found at 7 sites. 376 sockeye were found at 15 sites, 659 chum were found at 14 sites, 1101 coho were found at 15 sites, and over 400 pink salmon were found also found." Specifically juvenile Chinook salmon were found in Kosina Creek and Black River. With Chinook salmon in decline state wide, and a 705 foot dam impeding access to these spawning streams Ahtna, Inc. believes this project will negatively impact the Chinook salmon Susitna River stock population, but also other salmon populations of the Susitna River Drainage.

Study 10.14 Surveys of Eagles and Other Raptors

The Bald and Golden Eagle Protection Act (1940) protects eagles from a "loss in productivity by substantially interfering with normal breeding, feeding, or sheltering behavior, or nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior, or nest abandonment" (US Fish & Wildlife). This study has identified six (6) occupied bald eagle nests within the proposed reservoir site. Federal law prohibits them from being disturbed.

Study 14.5 Subsistence Resources

In twenty two (22) communities household harvest surveys were completed. Of the twenty two communities five (5) were Ahtna Villages and Ten (10) communities were located on Ahtna Traditional Village sites. Local knowledge workshops were conducted in seven (7) communities. Five (5) communities were Ahtna Villages. Two (2) communities were CIRI Working Group Villages. ABR, Inc. presented a study overview and the household survey results to the CIRI Working Group on July 2014. ABR, Inc. has not presented to Ahtna, Inc. though our Villages were included in the studies.

Study 10.5 Moose Distribution, Abundance, Movements, Productivity, and Survival

The browse study conducted in March of 2013 had no report of findings in the presentation. The late winter survey conducted in the reservoir inundation zone in 2012 and 2013 concluded that there were 1.97 moose per square mile in 2012 and 2.06 moose per square mile in 2013. These are good healthy moose population numbers. The GeoSpatial Population Estimator (GSPE) survey that was conducted in November of 2013 for the entire project area reported 0.95 moose per square mile. These numbers seem to indicate that the reservoir inundation zone is likely the most productive habitat for moose within the entire project area.

The project area and surrounding areas are very popular with the "recreational" hunters. This is evidenced by the influx and overcrowding at Eureka and at the Susitna River on the Denali Highway during moose hunting season (ATV tail heads). Ahtna, Inc. is a staunch defender of our shareholders customary and traditional rights (formerly called subsistence rights). Ahtna shareholders in Cantwell and Gulkana hunt in the project area and would like to see their hunting rights protected. The lands within and surrounding the project area are traditional hunting areas used by subsistence hunters. These hunting areas need to be protected.

Study 10.6 Caribou Distribution, Abundance, Movements, Productivity, and Survival

The Nelchina Caribou Herd is maintained by Alaska Department of Fish and Game (ADF&G) at 40,000 animals. It migrates from North and East of Tok, Alaska down the Tok Cut off, across the Richardson Highway to the traditional calving grounds north of Lake Louise then North and West through the Alphabet Hills to their summer Range. Then in the fall they migrate back. There are a couple sub groups in the herd: the Cantwell herd stay in the Cantwell region over winter, and the Wrangell St. Elias group that winter over on the foothills of Mt. Drum and Mt. Sanford. The Nelchina Caribou herd is the most road accessible herd in the State of Alaska and conversely this herd has the heaviest hunting pressure on it.

Finding of this study show that the inundation zone of the reservoir lies directly in the path of the migration route from the caving grounds to the summer and fall ranges. Studies have shown that on the North Slope caribou have moved to avoid areas of development and activity. Ahtna, Inc. is concerned that the road development within this area will 1) cause the herd to move to avoid these area, and 2) that the access road constructed to the project area will open the area to new hunters. It appears that all proposed access routes into the project area will have an impact on the Nelchina Caribou Herd. Currently the calving grounds North of Lake Louise and the Alphabet Hills are a refugia for the caribou with limited contact with humans.

The slide in the presentation labeled Late Spring Movement is of concern. This slide depicts the spring migration movements of 2013 and 2014. During the spring of 2013

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there was major flooding and high water throughout the Copper River Basin. This resulted in hazardous river crossing during migration and low calf survival rates. The majority of caribou did not migrate back to Northeast of Tok during the winter of 2014, but remained west of the Lake Louise uplands for the winter. There was also an overwintering population in Glennallen. The migration pattern for 2014 is an outlier and should not be included in this study.

During the presentation it was reported that the final report for this study was not complete. The ADF&G spokesperson stated that it would be completed by July 1st, 2016. This date is after the deadline for the submission of comments on the initial study reports. It is unfortunate that we are not able to review this report to provide further comments.

In closing Ahtna, Inc. would like to say that we are not in favor of any development in this area. All proposed road development into this area will disturb the caribou refugia already mentioned. The dam and inundation zone will create a barrier across the annual migration route of the caribou herd. The project area and surrounding lands are a traditional moose hunting area that needs to be protected for customary and traditional uses. The Bald Eagle nests discovered inside the inundation zone are protected by federal law, and cannot be disturbed or destroyed. Contradictory to previously belief, these studies show that the project area is a salmon spawning and rearing habitat. In particular concern are the Chinook spawning streams located beyond the dam and the reservoir. This project has the ability to have a negative effect on the salmon stocks of the Susitna River.

Thank You,

Michelle Anderson

Michelle Anderson
President

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 2

Baseline Water Quality Study

Study Plan Section 5.5

Supplement to the Study Completion Report

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 3

Groundwater Study

Study Plan Section 7.5

Upwelling Broad-Scale Mapping of the Middle Susitna River Technical Memorandum

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 4

Fish and Aquatics Instream Flow Study

Study Plan Section 8.5

Alternative HSC/HSI Development Methods

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 5

Fish and Aquatics Instream Flow Study

Study Plan Section 8.5

Discussion of Habitat Suitability Criteria Model Validation

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 6

Fish and Aquatics Instream Flow Study

Study Plan Section 8.5

Decision Support System Uncertainty

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 7

Fish Distribution and Abundance

Study Plan Sections 9.5 and 9.6

Development of Relative Abundance and Fish Habitat Use Indices – Technical Memorandum

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 8

Fish Distribution and Abundance

Study Plan Sections 9.5 and 9.6

2013-2015 Radio Telemetry Implementation Report

Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Response of the Alaska Energy Authority to Comments on the Initial Study Report

Attachment 9

Characterization and Mapping of Aquatic Habitats

Study Plan Section 9.9

Supplement to Study Completion Report