Revised Study Plan

Susitna-Watana Hydroelectric Project

FERC No. 14241

Appendix 2

FERC-filed Letters Coded with Comment Identifiers

ALASKA ENERGY AUTHORITY

December 2012

Appendix Arrangement: Comment Letters in Appendix 2 are provided in the following order:

1. Federal Energy Regulatory Commission (FERC)
2. State of Alaska
3. United States Department of the Interior – National Park Service (NPS)
4. United States Department of the Interior – Fish and Wildlife Service (USFWS)
5. United States Department of Commerce – National Oceanic and Atmospheric Administration (NMFS)
6. United States Department of the Interior – Bureau of Land Management (BLM)
7. United States Environmental Protection Agency (EPA)
8. Cook Inlet Region, Inc. (CIRI)
9. Alaska Hydro Project (AHP), Alaska Survival (AS), Coalition for Susitna Dam Alternatives (CSDA)
10. Natural Resource Defense Council (NRDC)
11. Trout Unlimited (TU)
12. Chase Community Council (CCC)
13. Copper County Alliance (CCA)
14. The Center for Water Advocacy (CWA)
15. Talkeetna Community Council, Inc. (TCCI)
16. The Nature Conservancy (TNC)
17. Talkeetna Defense Fund (TDF)
18. Jennifer Barnett
19. Donnie Billington
20. Donnie Billington
21. Will Boardman
22. Greg Campbell
23. Shelly Campbell
24. Coalition for Susitna Dam Alternatives (CSDA)
25. Tony Crocetto
26. Davis B. Downey
27. Lara Gentzel
28. Sarah Kohe
29. Jen Latham
30. Becky Long
31. Brian Okonek
32. David and Sandra Porter
33. Denis Ransy
34. Mary L. Rachel
35. Cari Sayre
36. Douglas Smith
37. John Strasenburgh
38. Cathy Teich
39. Cathy Teich
40. Ellen Wolf
41. Ruth Wood
42. Katie Writer
43. Diane Ziegner

Comment Code, RSP Study Title, and RSP Section Number Key:

Comment Code[i]	RSP Study Title (Resource Area)	RSP Section Number
GEN	General Comment	No Particular Section of RSP
GS	Geology and Soils	4.5
WQ	Baseline Water Quality Study	5.5
WQMOD	Water Quality Modeling Study	5.6
MERC	Mercury Assessment and Potential for Bioaccumulation Study	5.7
GEO	Geomorphology Study	6.5
FGM	Fluvial Geomorphology Modeling below Watana Dam Study	6.6
GW	Groundwater Study	7.5
ICE	Ice Processes in the Susitna River	7.6
GLAC	Glacier and Runoff Changes Study	7.7
IFS	Instream Flow Study	8.5
RIFS	Riparian Instream Flow Study	8.6
FISH	Fish and Aquatic Resources	General to Section 9 of RSP
FDAUP	Study of Fish Distribution and Abundance in the Upper Susitna River	9.5
FDAML	Study of Fish Distribution and Abundance in the Middle and Lower Susitna River	9.6
ESCAPE	Salmon Escapement Study	9.7
RIVPRO	River Productivity Study	9.8
AQHAB	Characterization and Mapping of Aquatic Habitats	9.9
RESFSH	The Future Watana Reservoir Fish Community and Risk of Entrainment	9.10
PASS	Study of Fish Passage Feasibility at Watana Dam	9.11
BARR	Study of Fish Passage Barriers in the Middle and Upper Susitna River and Susitna Tributaries	9.12
AQTRANS	Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area	9.13
GENE	Genetic Baseline Study for Selected Fish Species	9.14
FHARV	Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area	9.15
EUL	Eulachon Run Timing, Distribution, and Spawning in the Susitna River	9.16
CIBW	Cook Inlet Beluga Whale Study	9.17
WILD	Wildlife Resources	General to Section 10 of RSP
MOOSE	Moose Distribution, Abundance, Movements, Productivity, and Survival	10.5
CBOU	Caribou Distribution, Abundance, Movements, Productivity, and Survival	10.6
DALL	Dall's Sheep Distribution and Abundance	10.7
LGCAR	Distribution, Abundance, and Habitat Use by Large Carnivores	10.8

Comment Code[i]	RSP Study Title (Resource Area)	RSP Section Number
WOLV	Wolverine Distribution, Abundance, and Habitat Occupancy	10.9
TERFUR	Terrestrial Furbearer Abundance and Habitat Use	10.10
AQFUR	Aquatic Furbearer Abundance and Habitat Use	10.11
SMAM	Small Mammal Species Composition and Habitat Use	10.12
BAT	Bat Distribution and Habitat Use	10.13
RAPT	Surveys of Eagles and Other Raptors	10.14
WTBRD	Waterbird Migration, Breeding, and Habitat Use Study	10.15
BREED	Landbird and Shorebird Migration, Breeding, and Habitat Use Study	10.16
PTAR	Population Ecology of Willow Ptarmigan in Game Management Unit 13	10.17
FROG	Wood Frog Occupancy and Habitat Use	10.18
WLDHAB	Evaluation of Wildlife Habitat Use	10.19
WHARV	Wildlife Harvest Analysis	10.20
VWHAB	Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin	11.5
RIP	Riparian Vegetation Study Downstream of the Proposed Sustina-Watana Dam	11.6
WETLND	Wetland Mapping Study	11.7
RARE	Rare Plant Study	11.8
INVAS	Invasive Plant Study	11.9
REC	Recreation Resources Study	12.5
AES	Aesthetic Resources Study	12.6
RECFLW	River Recreation Flow and Access Study	12.7
CUL	Cultural Resources Study	13.5
PALEO	Paleontological Resources Study	13.6
SUB	Subsistence Resources Study	14.5
ECON	Regional Economic Evaluation Study	15.5
SOC	Social Conditions and Public Goods Study	15.6
TRAN	Transportation Resources Study	15.7
HEALTH	Health Impact Assessment Study	15.8
AIR	Air Quality Study	15.9
FLOOD	Probably Maximum Flood Study	16.5
SEIS	Site-Specific Seismic Hazard Study	16.6

[i] Code corresponds to Appendix 2 coding of comment letters.

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426
November 14, 2012

OFFICE OF ENERGY PROJECTS

Project No. 14241-000—Alaska
Susitna-Watana Hydroelectric Project
Alaska Energy Authority

Wayne Dyok
Susitna-Watana Project Manager
Alaska Energy Authority
813 West Northern Lights Boulevard
Anchorage, AK 99503

Reference: Comments on Proposed Study Plan

Dear Mr. Dyok:

Commission staff's comments on your proposed studies are included in the attached schedule A and are based on our review of the Susitna-Watana Hydroelectric Project proposed study plan filed on July 16, 2012, participation in various work group meetings, and our review of the draft revised study plans posted on AEA's web page.

GEN-41

To avoid future coordination and reporting concerns expressed by the National Marine Fisheries Service in their October 31 filing, as well as other agency representatives during the work group meetings, we recommend that your revised study plan include a master schedule that includes the estimated start and completion dates of all field studies, when progress reports will be filed, who will receive the progress reports and in what format, and the filing date of the initial and updated study reports.

If you have any questions, please contact David Turner at (502) 202-6091 or david.turner@ferc.gov.

Sincerely,

Jennifer Hill, Chief
Northwest Branch
Division of Hydropower Licensing

Enclosures: Schedule A

cc: Mailing list
Public Files

Schedule A
Comments on Proposed Study Plan

Unless stated otherwise, our comments are based on our review of the draft revised studies posted on Alaska Energy Authority's web page (http://www.susitna-watanahydro.org/project/draft-revised-study-plan-status-listing/) as of November 7, 2012. We first address some global concerns in our general comments, then turn to study-specific needs. Please address our requests and comments in your revised study plan (RSP), which must be filed with the Commission by December 14, 2012.

General Comments

Tracking Study Disagreements

GEN-22

Section 5.11(b)(4) of the Commission's regulations states that your proposed study plan (PSP) must include an explanation for why any requested studies are not adopted. In your PSP, you state that agencies and other licensing participants made a total of 52 individual study requests. You also state that the PSP includes a proposal to undertake all but one of the requested studies, with some alterations and adjustments. Therefore, you contend that the overwhelming majority of the study requests are incorporated into the PSP.

While it is true that the PSP includes studies that address most of the resource areas that were identified in the study requests filed by agencies and other licensing participants, there are numerous instances in which components of the study requests were not adopted in the PSP, and you do not provide an explanation for why the study components were not adopted. We provide the following examples of study components that were not adopted in your PSP and no explanation as to why they were not adopted was provided: (1) the Fish and Wildlife Service (FWS) requested that you analyze the contribution of marine derived nutrients from non-salmon anadromous species, (2) FWS requested that you characterize the use of biological flow cues to complete life-history strategies, and (3) the National Marine Fisheries Service (NMFS) and FWS requested that riverine habitat be characterized for the entire project area from the mouth to the dam site.

Section 5.13 (a) of the Commission's regulations requires you to include comments on the PSP and how you attempted to resolve disagreements regarding study needs. This includes any components of the study requests that are not adopted in your RSP. We frequently heard from stakeholders during the study meetings, primarily in the aquatic working group, that it was not always possible to determine how a study request component was addressed. To ensure that all differences in perceived study needs are

identified and addressed, we recommend that your RSP clearly track all differences between your study proposal and the requested studies, as well as any future comments you receive on the draft RSP. Your filing must include an explanation of why any components of the study requests are not adopted.

Adaptive Study Implementation

GEN-23

In multiple study plans, you propose to modify the methods or geographic scope of the study in response to preliminary study results (e.g., *Geomorphology* (Section 5.8), *Fluvial Geomorphology Modeling* (Section 5.9), *Water Quality* (Sections 5.5, 5.6, and 5.12), *Fish and Aquatics Instream Flows* (Section 6.5), and *Fish Distribution and Abundance* (Sections 7.5, 7.6)). For each of these studies, the RSP should clearly describe any decision-making process or schedule by which study methods would be refined or adapted in consultation with agencies and other stakeholders during the study implementation period, including any criteria that will trigger changes in the study plan.

Flow-routing Model

Numerous study plans (e.g., *Geomorphology*, *Fish and Aquatics Instream Flows, Ice Processes, etc.)* refer to development of a flow-routing model that, when completed, will be used to determine the geographic scope (i.e., downstream extent) of several other studies and modeling efforts. The flow-routing model is only vaguely defined and referenced throughout various study plans. There is no specific study plan that describes its implementation, a schedule for reporting on its results, or how or when such results would inform or result in modifications to the other study plans. You suggest that, based on the initial results of the flow-routing model, you may need to add additional transects to improve its performance between river mile (RM) 184 and RM 75, and to possibly extend the downstream extent of the model past RM 75.

It is important to define the flow-routing model and the downstream extent of the flow-routing model because a number of studies are dependent on its results to inform various aspects of their implementation (e.g., geographic scope, additional sampling areas if the flow-routing model indicates that project effects would occur downstream of proposed sampling areas). Therefore, please include in your RSP a description of the flow-routing model and a schedule and the specific criteria that you will use to establish the downstream extent of the flow-routing model. The RSP should clearly document: (1) the other study plans that may be modified based on the outcome of the flow-routing model; (2) how each plan would be modified; and (3) triggers for modifications to each plan.

IFS-035

Precedence for Multiple Models

FGM-4
ICE-06
IFS-101
RIFS-03

Several studies (e.g., *Fluvial Geomorphology Modeling below Watana Dam*, *Geomorphology*, *Ice Processes in the Susitna River*, *Instream Flow*, and *Riparian Instream Flow*) discuss hydraulic, flow-routing, habitat-specific, and sediment-transport models. Some of these studies describe the use of one-dimensional and two-dimensional models. Because the focus of each study is different, it is possible that multiple models would be used to assess conditions for a common reach of the river. Where this is the case, please describe in each of the relevant studies how the different modeling results would be used. Where a parameter is measured (or estimated using a model) in more than one study, define which value will take precedence.

Study Framework and Relationships between Studies

GEN-24

All individual study plans within your RSP should use consistent language and terminology throughout the document for terms such as: study site, intensive site, habitat type, study area, focus area, reach, and river segment.

Your RSP should provide a clear description of the relationship between studies. You provided flow charts depicting the interrelationships of the various studies. However, it is still not always clear where information is coming from or how it will be used in the various studies. Figures depicting study interdependency should refer to applicable study plan sections or subsections where appropriate, and the respective study plan sections should describe interdependencies so that the reader understands what specific information is being used in what studies, where it comes from, how results will be presented, how they will be used, etc.

Reach and Habitat Stratification and Study Site Selection and Location

IFS-014
GW-003
ICE-07
WQ-02
GEO-06
RIFS-04

Your RSP should clearly describe the exact number, location, and spatial extent of your proposed focus areas for each proposed study. In addition, the RSP should provide justification for the number of proposed sites selected for detailed 2-D hydraulic modeling and other intensive study elements. Please include criteria to be used for selecting focus areas and study-specific rationale for co-locating sites.

Integrating 2012 Study Efforts into the Project Study Plan

GEN-25
RIFS-43
RAPT-6
RIP-23
CUL-21

In some cases, you have developed plans for and are carrying out studies in consultation with stakeholders to voluntarily collect information in 2012 that will help you prepare or refine a study plan. Please describe how these 2012 efforts were or are

being incorporated into the RSP.

Water Quality

Baseline Water Quality (Section 5.5)

WQ-03 In section 5.5.4.2, *Meteorological Data Collection*, please explain or address the inconsistencies between the text and Table 5.5-2 regarding river miles associated with meteorological stations.

WQ-04 In section 5.5.4.8, *Technical Report on Results*, you state that water quality conditions will be described in greater detail at the Focus Areas (section 5.5.4.5), but descriptions over shorter time intervals will not be possible for general chemistry and metals because site visits and sample collection will be limited to monthly sampling due to the remoteness of the Focus Areas. However, section 5.5.4.5 states that sampling will occur every 2 weeks for 6 weeks. Please resolve this apparent inconsistency.

WQ-05 In section 5.5.4.9, you propose to conduct a pilot thermal imagery study to evaluate the availability of thermal refugia for fish. The objective of the study is to determine whether thermal imagery can be used to identify thermal refugia throughout the project vicinity. Please clarify the criteria that would be used to make the determination on whether to expand the assessment, and provide a schedule for reporting the results of the pilot study. Your RSP should also include any alternative methods that you would use to identify thermal refugia in the event the pilot study is unsuccessful. If you do not propose any alternative methods, then please state that to be the case and provide an explanation for why no alternative methods are proposed.

WQ-06 In section 5.5.4.9.2, *Calibrating Temperature*, please describe how water temperature monitoring instruments will be calibrated, or refer to the SAP/QAPP, as appropriate.

WQ-07 Section 5.5.6, *Schedule*, presents a schematic entitled Interdependencies for Water Resource Studies and indicates that additional detail will be provided. Please provide the additional detail in your RSP.

Water Quality Modeling (Section 5.6)

WQ-08 In section 5.6.4.8, *Reservoir and River Downstream of Reservoir Modeling Approach*, you use the term "initial reservoir condition" to describe baseline conditions without the project. It would improve clarity if you removed the term reservoir and

referred to a without project scenario as initial condition or existing condition.

WQ-09 It appears as though there are inconsistencies between the river miles noted in the text and those presented in Table 5.5-1; please address these inconsistencies in your RSP.

WQ-10 In section 5.6.4.8, please clarify what is meant by the statement: measuring additivity or synergism of toxics effects from multiple stressors is simplistic and is determined by identifying the single, worst, or dominant stressor (simple comparative effect model). If this statement is consistent with current scientific understanding, then please provide a citation to support the statement.

WQ-11 Section 5.6.6, *Schedule,* contains two different versions of the schematic titled Interdependencies for Water Resource Studies. Please remove the outdated version. The schematic and associated discussion also appears in sections 5.5.6 and 5.7.6. Please present the material in just one section and cross-reference to it in subsequent water quality studies.

Mercury Assessment and Potential for Bioaccumulation (Section 5.7)

WQ-12 Section 5.7.1, *General Description of the Proposed Study*, provides a general summary of the technical information presented in Section 5.7.2, *Existing Information and Need for Additional Information*, as an introduction to the key questions and study objectives. It would be helpful to include a few relevant literature citations from section 5.7.2 in this summary, particularly following the sentences beginning with "Many studies…" and "Based on several studies…"

WQ-13 Please review the list of mechanisms for mercury bioaccumulation presented in section 5.7.2., *Existing Information and Need for Additional Information*, for accuracy. Is the focus of methylmercury production on water-column bacteria rather than sediment bacteria? Are anoxic conditions always created by decay of organic material in the water column? Is inorganic mercury used by bacteria to "continue the decay process" or is its use a byproduct of cellular respiration? Do "larger predators" (please define) actually consume bacteria? What about uptake of water column methylmercury by algae and subsequent transfer to higher trophic levels? Please provide citations for the mechanistic processes you are describing.

WQ-14 In section 5.7.3, *Study Area*, please describe how construction-related impacts from road crossing sites affect mercury concentrations. This section also indicates that additional details regarding mercury sampling sites will be added in the RSP. Please provide this additional detail in the RSP.

WQ-15 Section 5.7.4.2, *Collection and Analyses of Soil, Vegetation, Water, Sediment, Sediment Pore Water, Avian, Terrestrial Furbearer, and Fish Tissue Samples for Mercury*, states that data will be collected from multiple aquatic media including surface water, sediment, avian, terrestrial furbearer, and fish tissue. This statement is not consistent with comment responses in Table 5.4-1, which indicate that the mercury study is limited to predicting impacts related to water, sediment, and fish. Sections 5.7.4.2.5, *Avian*, and 5.7.4.2.6, *Terrestrial Furbearers*, indicate that additional information will be provided in the RSP. Please provide the additional information and ensure that it is consistent with comment responses in Table 5.4-1 and addresses both NMFS' and FWS' study requests related to mercury.

WQ-16 Please clarify the reference to "sex and sexual" data collection for fish tissue in section 5.7.4.2.7, *Fish Tissue.* The reference was possibly meant to be "sex and sexual maturity."

WQ-17 The comment responses in Table 5.4-1 indicate the possible addition of macroinvertebrate sampling in section 5.5.4.7, *Baseline Metals Levels in Fish Tissue*, and section 5.5.4.7 states that macroinvertebrate sampling may occur if mercury is detected. However, this is not discussed in section 5.7, *Mercury Assessment and Potential for Bioaccumulation Study.* Please ensure that the water quality studies are consistent with one another.

GEOMORPHOLOGY

Geomorphology (Section 6.5) and Fluvial Geomorphology Modeling (Section 6.6)

GEO-07 In section 6.5.4.1, *Delineate Geomorphically Similar [Homogeneous] Reaches*, you describe using an initial geomorphic classification system containing three single channel reach types and four multiple channel reach types, based in part on their characteristic sediment storage features. Table 9.9-4 in section 9.9.5.4.2, *Characterization and Mapping of Aquatic Habitats*, describes mainstem macrohabitat types (main-channel, off-channel, and tributary) that are nested within these geomorphic reach types and are defined in part by their characteristic morphology. It would be helpful if sediment storage features characteristic of geomorphic reaches were defined or related more directly to the type of geomorphic features characteristic of the mainstem habitat types.

GEO-09 In section 6.5.4.5.1, you state that results from *Study Component 5: Riverine Habitat versus Flow Relationship Middle River* will provide the basis for macrohabitat mapping to support the Instream Flow Study. Please clarify how the results from study

component 5 will be used to quantify total or usable habitat area under a range of flows as part of the instream flow study.

INSTREAM FLOW

Fish and Aquatics Instream Flow (Section 8.5)

IFS-016 In section 8.5.4.2.1.1, you indicate that the instream flow study area consists of two river segments, the Middle River (MR) and Lower River (LR) segments. You currently propose to model from the dam location downstream to RM 75. Based on the geomorphic mapping presented in the geomorphology study (section 6.5, Figure 6.5-4), RM 75 is located near the middle of Reach LR2; therefore, modeling would include all of Reach LR1, and a portion (9 of the 23 miles) of Reach LR2. Please describe how you intend to assess project effects within the Lower River segment using the proposed framework, particularly in regard to reach LR2, when your proposed modeling will encompass less than half of the LR2 geomorphic reach.

IFS-017 In section 8.5.4.2.1.2, you indicate that no focus areas were selected in reach MR3 upstream of Devils Canyon (in addition to reach MR4 Devils Canyon) due to safety concerns. Please describe the safety considerations associated with reach MR3 that would prohibit you from implementing a focus area in this reach. You should also describe how you intend to assess project effects in reach MR3 without a focus area to "provide for an overall understanding of interrelationships of river flow dynamics on the physical, chemical and biological factors that influence fish habitat" in the reach.

IFS-034 In section 8.5.4.3.1, you state that the hydraulic-routing model will extend downstream until flow fluctuations are within the range of without-project conditions. Please define this range and associated thresholds in your RSP and explain them in terms of the operational scenarios (e.g., worst-case scenario) and criteria that will be used in the decision-making process.

IFS-018 In section 8.5.4.2.1.2, you indicate that transects established for the flow-routing model were primarily located across single-thread (i.e., non-braided) sections of the river. While this is appropriate for developing the mainstem flow-routing model, the same model/transects would not adequately represent the frequency, distribution, abundance, and diversity of habitats and habitat conditions within the Middle River and Lower River segments for other study purposes. In section 8.5.4.6 (*Habitat Specific Model Development*), you indicate that additional transects will be selected to describe distinct habitat features in addition to those used for defining the mainstem flow-routing model. Presumably, the additional transects will be used to expand the model for the purpose of

assessing habitat conditions in relation to flow for such features, and use the results to extrapolate conditions on a broader scale (e.g., geomorphic reach). To achieve this purpose, additional transects will likely be needed to characterize habitat conditions in the reaches being evaluated. In your RSP, please distinguish between the mainstem flow-routing model and any modified/expanded versions that may be used to describe distinct habitat features (e.g., stranding/trapping), or for purposes such as sediment transport. In addition, please describe how these 1-D models relate to focus areas and whether they overlap or will be integrated with the proposed 2-D modeling that will be implemented within some or all of the focus areas.

IFS-002
AQHAB-02
GEO-08

In section 8.5.3, *Study Area*, you describe your proposed hierarchical habitat classification system. Please ensure that the category descriptions, definitions, and terminology are consistent with those presented in the *Geomorphology Study*, *Characterization and Mapping of Aquatic Habitats Study*, and any other related studies. For example, in Table 9.9-4, you describe split-main and braided-main channel types, which are not described in section 8.5.3. Moreover, in the description of *HSC Study Site Selection*, you refer to a percolation channel, a term that is not used elsewhere.

IFS-006

In section 8.5.4.1, *IFS Analytical Framework*, you state that figure 8.5-11 depicts the analytical framework of the instream flow study commencing with the reservoir operations model that will be used to generate alternative operational scenarios under different hydrologic conditions. However, figure 8.5-11 does not provide a reference to the study plan that describes the reservoir operations model. To improve clarity of the RSP, please include in Figure 8.5-11 a cross-reference to the section of the study plan where you describe the reservoir operations model that will be used to generate alternative operational scenarios. Also, it would be helpful if you included in figure 8.5-11 a cross-reference to the section of the RSP where hydrologic elements (e.g., representative water years, seasonal storage & release, hourly dam releases, flood flows) are described.

IFS-073

In section 8.5.4.5.1.2.2, *Stranding and Trapping*, you describe some of the factors influencing stranding and trapping, and indicate that the calibrated flow-routing model will be used. In section 8.5.4.6.1.6, you indicate that a varial zone model will be used to assess stranding and trapping. It is not clear how you will use these models to assess stranding and trapping. Please include a complete description of how stranding and trapping will be evaluated. Specifically, please provide more detail on the models proposed, the extent of modeling, and whether multiple modeling approaches will be used (e.g., 1-D modeling at the reach-scale and 2-D modeling within focus areas).

Understanding the effects of load following on fish egg incubation, egg and alevin

IFS-080 survival, stranding, and entrapment will be critical to our analysis of the project. To address the potential for adverse effects from load following on fisheries resources, you propose to develop aquatic habitat models (e.g., effective habitat and varial zone modeling) to produce metrics such as frequency and duration of exposure/inundation of the varial zone at selected locations. More detail on these models is required to determine whether your approach will be sufficient to evaluate project effects. Please provide a detailed description of the proposed models, spatial extent of modeling, required input parameters, source of input parameters (e.g., literature, another model), model output, and how results will be analyzed. For all models, especially those based on values in the literature, a sensitivity analysis should be included to identify those parameters with the greatest effect on model results so that uncertainty in these critical parameters can be evaluated.

IFS-074 In section 8.5.4.6, *Habitat-Specific Model Development*, you outline a number of models and analyses. As part of these analyses, it will be important to understand how project operations will change the natural hydrograph, how project operations will change habitat availability in relation to life history timing of fish and aquatic species, and how these changes influence the spatial location of available habitat. In your proposed assessment of spawning and incubation, it will be important to understand the extent that suitable habitat shifts are expected as a result of proposed project operations. For example, if flows during the Chinook salmon spawning period are managed lower than they would be under existing conditions, certain locations currently used by Chinook for spawning may no longer be available; however, new areas not currently used but that meet the spawning habitat criteria for Chinook may become available at the lower managed flow. Such habitat shifts may result in, for example, spawning in locations that are more susceptible to scour, or spawning locations that are no longer close to suitable rearing habitats. We have similar concerns with regard to the assessment of rearing habitat under load following operations. Data developed from these studies will need to provide an understanding the spatial extent of movement required by salmon, as well as the continuity of available habitat over the range of flow fluctuations. Therefore, please specify how your data analysis and reporting will consider the spatial shifts in suitable habitat.

IFS-077 It is not clear what is being proposed and under which studies it is being proposed to assess effects of load-following operations on upwelling and groundwater dynamics related to egg incubation and emergence survival. In section 7.5.4.6, *Aquatic Habitat Groundwater/Surface-Water Interactions*, you indicate that work will be accomplished by the instream flow study. However, in the *Fish and Aquatics Instream Flow Study* (8.5), you no longer include a study to evaluate the effects of load-following operations on upwelling and groundwater dynamics related to egg incubation and emergence survival.

In your RSP, please describe what models are proposed; over what area they would be applied; what parameters would be modeled; how and where the parameters are derived; which parameters are based on field measurements; what assumptions will be made to determine how those conditions will change with project operations; and how the modeling will be used or integrated with other models (e.g., effective spawning and incubation) to evaluate the effects of project operation on egg incubation and emergence survival.

IFS-075 In section 8.5.4.6.1.5, you describe the effective spawning/incubation habitat analysis to evaluate the risk of dewatering and scour. The level of detail provided to address this issue is insufficient to determine the adequacy of the approach. In your RSP, please provide a detailed description of the model including the model framework, input parameters, where the input data is derived (i.e., other models or studies), the area over which the model will be applied, critical model assumptions, the output from the model, and how it will be used to inform the evaluation of project effects.

Riparian Instream Flow (Section 8.6)

RIFS-05 In general, the complexity of the *Riparian Instream Flow Study* (section 8.6) makes it challenging to follow the linkages between the study objectives, methods, and results. A table or graphic listing study objectives, the methods proposed for achieving the objectives, and expected types of results to be generated from the various study tasks would help us evaluate whether the methods contained in the RSP will be sufficient to capture the potential effects of the project on riparian resources.

RIFS-06 The study area section describes the classification scheme proposed for delineating project reaches and habitat types. Although not explicitly stated, the classification scheme appears to inform the delineation of riparian-process domains. If the classification scheme and riparian-process-domain delineation methods are linked, please describe their relationship in section 8.6.3.2, *Focus Area Selection-Riparian Process Domain Delineation*. At end of section 8.6.3.2, you state that focus areas have been selected. If that is the case, please describe the focus areas and the process and rationale that were used in site selection. Please describe the number and approximate location of focus areas, and the number of sampling transects, points, or plots that will be located in each sampling area. The study schedule indicates that focus areas will be selected by early 2013, but that field data collection will begin in 2012. Please reconcile this apparent inconsistency in the schedule and description of focus area site selection.

RIFS-07 The same description of focus area modeling is presented in several sections of the draft RSP. However, the majority of the description appears to be better suited for

section 8.6.3.2, *Focus Area Selection-Process Domain Delineation* because it describes the basis for scaling the results of focus area field surveys and modeling up to process domains. Other portions of the description appear to be better suited for the work products sections under various study objectives.

RIFS-08
IFS-108

In attachment 8-1, *List of Terms and Definitions*, you identify the size classes for nine sediment types to be used in the habitat suitability curve/habitat suitability index (HSC/HIS) study, but you do not identify the methods to determine the sediment sizes. Sampling methods used to collect the bed material to be used in the sediment transport models is described in section 6.6.4.1.2.8, *Field Data Collection Efforts*. It is likely that the bed material sizes used sediment transport models would correspond to the American Geophysical Union sediment classification system, which is not equivalent to the sediment classification presented in attachment 8-1. Consequently, it is possible that the sediment types used in the HSC/HIS study would not be equivalent to sediment types used in the transport model. Because these studies are interrelated, please identify the methodology used to determine the sediment sizes presented in attachment 8-1 and describe any differences to the system used to determine the sediment sizes to be used in the transport models.

FISH AND AQUATIC RESOURCES

Fish Distribution and Abundance in the Upper Susitna River (Section 9.5), and Middle and Lower Susitna River (Section 9.6)

FDAUP-01
FDAML-03

In sections 9.5.4.1 (*Upper River*) and 9.6.4.1 (*Middle and Lower River*), you describe methods for selecting study sites for your fish distribution and abundance studies. In both sections, you propose a five-level, nested stratified sampling approach based on the following stratification scheme: (1) major hydraulic segment, (2) geomorphic reach, (3) mainstem habitat type, (4) main channel mesohabitat, and (5) edge habitat. In Figures 9.6-2 through 9.6-5, you present schematics of strata proposed for sampling in the Lower River and Middle River segments; however, you omit level 2 (geomorphic reaches) from the figures. It is unclear how you intend to describe fish distribution and relative abundance without using level 2 of your stratification scheme. Please consider revising your site selection methods to be consistent with the nested (hierarchical) approach; explain how mesohabitat units from main channel habitats will be selected to represent unique geomorphic reaches; and describe how data collected in mesohabitat units will be extrapolated to broader scales (e.g., geomorphic reach).

FDAUP-02
FDAML-04

Similarly, the *Instream Flow Study* (Section 8.5) proposes ten focus areas for intensive sampling in the middle reach. The number and location of focus areas for the Lower River and Upper River segments have not been proposed. In the *Fish Distribution and Abundance Study*, Figure 9.6-5, you propose to sample a total of 40 different habitat types (i.e., 8 each of 5 different habitat types: side slough, upland slough, side channel, beaver complex, and tributary mouth habitat types) within the 10 proposed Middle River focus areas. However, you do not describe how you will select these sites within the focus areas. In your RSP, please describe how these habitat units will be selected within the ten focus areas.

FDUAP-03

In the *Study of Fish Distribution and Abundance in the Middle and Lower Susitna River* (Section 9.6), you describe in detail in section 9.6.4.2 and Table 9.6-2 your proposed sampling frequency. However, the same level of detail on sampling frequency is not provided in your *Study of Fish Distribution and Abundance in the Upper Susitna River* (Section 9.5), and the information provided is insufficient to determine the frequency of each sampling event. Please revise section 9.5.4.2 of your RSP to include a detailed sampling schedule for the *Study of Fish Distribution and Abundance in the Upper Susitna River* (9.5) that includes the sampling frequency for each method.

IFS-035
FDAML-05

In section 9.6.4.1, *Study Site Selection*, and section 9.6.4.3.1, *Objective 1, Fish Distribution, Relative Abundance, and Habitat Associations*, you state that winter sampling sites and sampling methods will be selected based on information gathered from a pilot study in winter 2012-2013 at Whiskers Slough and Slough 8A. Please include in your RSP a detailed description of the pilot study and provide a schedule for when the results will be finalized and incorporated into your study methods for winter fish distribution sampling in 2013 and 2014.

FDAUP-04
FDAML-06

Details on the PIT-tag portion of the study were requested during the September 13, 2012, study plan meeting, including the number and species of fish to be PIT-tagged. However, this level of detail is not included in your draft RSP. The requested PIT-tagging information is needed to evaluate whether the proposed methods will be sufficient to describe life history timing, migration behavior, etc. Therefore, please include in your RSP specific information on the number and species of fish to be PIT-tagged.

FISH-06

In their May 31, 2012, study requests, FWS and NMFS requested a study to characterize the use of biological flow cues for various life-history behaviors. Neither the PSP nor the draft RSP include an approach to address this objective or provide a justification for why the requested study is not included. Please include in your RSP an approach to address the study objective, or provide an explanation for why it is not

adopted in your study plan.

Salmon Escapement (Section 7.7)

In our May 31, 2012, study requests and comments, we requested that you include in your PSP the specific methods, objectives, and timing for implementing your proposed study of a system-wide Susitna River adult salmon escapement and run apportionment.[1]

ESCAPE-33 Your draft RSP provides some additional information on the proposed study. Specifically, you propose to conduct a commonly applied two-event, capture-recapture experiment for both Chinook and coho salmon. You propose to include two capture sites, one each on the Yetna River and the Susitna River, with two fish wheels deployed at each capture site. You also propose to recapture tagged fish in several tributaries and at various sites along the mainstem Susitna River. Finally, you state that fish would be tagged, but it may also be possible to use genetics to identify the spawning destination of fish captured at the fish wheels, and that studies being conducted in the summer of 2012 will determine the feasibility of using genetics to serve as an identifiable mark, thus eliminating the need to address tag loss and tagging effects associated with traditional capture-recapture models.

ESCAPE-30 The study plan identifies, in general terms, how the study would be implemented; however, it is lacking sufficient detail for Commission approval. Therefore, please include in your RSP the following additional information:

(1) a description of what is meant by a commonly applied two-event, capture recapture experiment;

ESCAPE-31 (2) the number of each species of fish that you will tag during each year of study implementation, including the number that would be radio-tagged or tagged with some other tag device, and a description of any other tag devices that would be used (e.g, spaghetti tag); and

ESCAPE-32 (3) a description of when you intend to finalize the results of the 2012 genetics study and a schedule for incorporating the 2012 study results into your study methods for the system-wide adult salmon escapement study.

RIVPRO-01 River Productivity (Section 9.8)

In section 9.8.4.1 of the *River Productivity Study*, you propose to review,

[1] The preliminary study plan only included a placeholder that did not provide any details on the proposed system-wide adult salmon escapement study.

summarize, and synthesize the literature on the impacts of hydropower development and operations, including temperature and turbidity, on benthic macroinvertebrate and algal communities in cold climates. In its May 31, 2012, study requests, the FWS requested that you develop a white paper to present the results of the literature review. In a September 7, 2012, email communication, the FWS requested clarification on whether your proposed literature review differed from its requested white paper. In your October 24, 2012, table summarizing the consultation history on the fish and aquatic resources study plans, you indicate that the literature synthesis and white paper could be considered synonymous. However, the draft RSP does not describe the form of the literature review and summary. Please describe in your RSP how the literature review will be presented (e.g., written report, annotated bibliography, etc.).

RIVPRO-02 In section 9.8.4.4, you propose to conduct a feasibility study in 2013 to evaluate the appropriateness of using reference sites on the Talkeetna River for monitoring long-term project-related change in benthic productivity. The draft RSP states that sampling results from Talkeetna River sites will be compared to results from similar sites in the Middle Susitna River Reach to evaluate whether the Talkeetna River would serve as a suitable reference site. Please clarify in your RSP the criteria that will be used to determine the suitability of the Talkeetna River as a reference site.

RIVPRO-03 In section 9.8.4.5, you propose to conduct a trophic study, using trophic modeling and stable isotope analysis, to describe food-web relationships in the current riverine community within the middle and upper Susitna River. As part of this study, you propose to develop growth-rate potential models for coho salmon, northern pike, and rainbow trout. Your draft RSP states that detailed foraging parameters and bioenergetics model parameters are available for these three species. Although fish capture methods, target numbers, and sampling schedule are not provided in section 9.8.4.5, it is apparent that you intend to capture individuals of each of these species to collect necessary data for model input. However, during the October 25, 2012, fish and aquatics study meeting, someone mentioned that it was not likely possible to collect northern pike from the Middle River and Upper River segments because the species is believed to be present only in the lower river. You therefore proposed to use another fish species, such as sculpin, instead of northern pike. Please provide an explanation in your RSP for why you have selected sculpin or another fish species instead of northern pike for development of a growth-rate potential model (i.e., clarify the species selected and identify if it is intended to be a

RIVPRO-04 replacement or a surrogate for northern pike). Please address whether sufficient information is available on the alternative species' foraging and bioenergetics parameters

RIVPRO-05 or if model parameters would need to be developed. Please also describe the methods you propose for capturing each fish species, the number of individuals required, sampling site locations, and a sampling schedule.

RIVPRO-06 In section 9.8.4.5.2, you propose to conduct a stable isotope analysis of the riverine food web. The draft RSP describes the use of stable isotopes to investigate the contribution of marine-derived nutrients from spawning salmon to freshwater ecosystems, but does not mention the potential contribution of non-salmonid anadromous species. The FWS requested that you analyze the contribution of marine derived nutrients from non-salmonid anadromous species. Please describe the fish species that will be evaluated in the marine derived nutrient, stable isotope study and provide supporting rationale for inclusion of each species. If you do not propose to include non-salmonid anadromous species in the analysis, then please provide an explanation for why FWS' requested study component is not adopted in your RSP.

RIVPRO-07 In a comment dated September 27, 2012, ARRI requested additional detail regarding locations and frequency of sampling for the fish diet analysis in section 7.8.4.7. Although the consultation table handed out at the October 24, 2012, meeting states that the requested information has been added to section 9.8.4.7, that does not appear to be the case. Please include in your RSP the frequency and timing of fish and macroinvertebrate sampling for this analysis.

RIVPRO-08 In section 9.8.4.9, you propose to estimate benthic macroinvertebrate colonization rates in the Middle Susitna River Reach to monitor baseline conditions and evaluate future changes to productivity in the Susitna River. In its May 31, 2012, study request, the FWS requested that you use a stratified random sampling approach to collect data on macroinvertebrate colonization rates in a variety of habitats (e.g., turbid vs. non-turbid, areas with groundwater upwelling vs. areas without upwelling). The draft RSP states that data will be collected in a mainstem habitat representative of the Middle Susitna River Reach to reflect typical colonization conditions, but does not specify whether the requested "variety of habitat types" will be sampled. Please include this information in your RSP, or, if you do not propose to sample a variety of habitat types, provide an explanation for not including FWS's request sampling.

RIVPRO-09 At the October 25, 2012, fish and aquatics study plan meeting, questions arose regarding whether and how macroinvertebrate sampling would be conducted during high flows. You responded that the objective is to sample in areas that have been wetted for a long enough period of time for macroinvertebrates to colonize, and that at least a month is typically required for this to occur. Please add this information, as well as specifics on timing and location of sampling, to the study description in section 9.8.4.9.

Characterization and Mapping of Aquatic Habitats (Section 9.9)

AQHAB-03 Section 9.9.5.4. *Mainstem Habitat Mapping,* indicates that habitat mapping in mainstem habitats will be limited to linear (mid-line) length estimates except for off-channel slough habitat where areas will be mapped. Please clarify whether this area polygon mapping is limited to side slough and upland slough habitats, or whether other off-channel habitats will be included. Please clarify whether measurements collected during on-the-ground truthing will be used to estimate habitat areas or conditions such as large woody debris loading and cover in reaches not ground-truthed.

A number of sections of the plan were incomplete or indicated that they will be refined in the RSP. We expect these sections to be completed in the final RSP.

Aquatic Resources Study within the Access Alignment, Transmission Alignment, and Construction Area (Section 7.13)

AQTRAN-2 In its August 31, 2012, comment letter, ADF&G requested that transmission line crossing locations be surveyed by electrofishing for a distance equal to 40-wetted stream widths, with a minimum survey length of 50 meters. In your October 24, 2012, RSP consultation table, you note that section 7.13 of the PSP provides for electrofishing a stream length of 40 wetted channel widths, up to a maximum of 400 meters; however, the PSP does not specify a minimum length for the surveys. You state in your October 24, 2012, consultation table that section 9.13 of the draft RSP was revised to propose a minimum survey length of 50 meters. Please ensure that your RSP specifies a minimum electrofishing survey length of 50 meters, or provide an explanation for why the request is not adopted.

AQTRAN-3 In its August 31, 2012, comment letter, ADF&G stated that if the Denali route is chosen, existing stream crossings on the Denali Highway would need to be improved or replaced to accommodate traffic associated with the project. ADF&G also stated that it would require a comprehensive survey of stream crossings so that stream crossings currently hindering or obstructing fish passage can be repaired or replaced with culverts or bridges. You state in your October 24, 2012, RSP consultation table that section 9.13.2 has been revised to indicate that upgrades to existing stream crossings on the Denali Highway would be necessary to accommodate project traffic, and that reviewing these crossings would be completed outside of the current assessment, when required. Because such upgrades would be part of the project proposal, we will need to evaluate the need and benefits of such measures. Therefore, please ensure that your RSP includes an evaluation of stream crossing surveys along the Denali Highway if the Denali route is chosen, and includes a detailed plan with the proposed methods and schedule for

conducting the surveys.

Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area (Section 7.15)

FHARV-2
REC-18

In section 7.15, *Analysis of Fish Harvest in and Downstream of the Susitna-Watana Hydroelectric Project Area*, you propose to analyze fish harvest using data from ADF&G records of commercial, sport, personal, and subsistence fisheries. The data will be used to evaluate the potential for the project to alter harvest levels and opportunities on Susitna River-origin resident and anadromous fish. At the August 15, 2012, technical work group (TWG) meeting, it was noted that ADF&G fish harvest surveys are conducted over large areas. ARRI requested that you conduct additional fish harvest surveys to provide harvest data at an appropriate geographic scale for the proposed analysis. In response, you noted in your October 24, 2012, RSP consultation table, that no additional fish harvest surveys would be conducted because such surveys were not necessary to analyze effects of the proposed project. You provide no further explanation for why you do not intend to conduct additional fish harvest surveys. It is not clear from your response how the existing ADF&G records would be sufficient to cover a geographic area specific to the project. Please include in your RSP an explanation to support your position that the ADF&G fish harvest data are of an appropriate geographic scale to permit an analysis that meets the study objectives. If study objectives cannot be met using the ADF&G data, please include in your RSP a description of alternative data collection methods.

FHARV-3

At the August 15, 2012, TWG meeting, ADF&G requested that effects of emergency fishing closures be included in the analysis of fish harvest. Please ensure that your RSP describes the approach that will be used to analyze the effects of emergency closures on fish harvest levels and opportunities in the commercial, sport, personal, and subsistence fisheries. If you do not intend to include emergency closures in your analysis, then please provide an explanation for why it would not be needed.

Cook Inlet Beluga Whale Study (Section 9.17)

CIBW-03

In Section 9.17.4.2, *Study Methods*, you propose to use video cameras and still camera to document beluga use of the Susitna River delta. It is difficult to determine whether certain terms apply to video camera stations, still camera stations, or both (e.g., "live-feed cameras," "remote cameras," "camera systems," "camera"); please use consistent terminology to distinguish between video- and still-camera stations and be specific as to which system or systems are being referred to in the description of study methods. Further, you say "[Li]ve-feed cameras (up to four, depending on feasibility)

will be established at the mouth of the Susitna River and still cameras (up to four, depending on feasibility) will be placed up to RM 10." Later you note that each camera site will have one or more cameras. Please clarify how many camera stations are proposed and how many and what type of cameras would be employed at each. Please be specific in describing the camera stations or the field of view through remote cameras in order to distinguish from language describing other study sites and areas. For example, when you say "[T]he cameras will have more than one path to allow for independent movement and view of the study area," are you referring to the fact that there is more than one camera at each site and that each can be manipulated separately? See the discussion provided under "Group Counts" for an example of the clarity desired.

CIBW-05 You say "[O]bserver monitoring shifts will be scheduled to cover up to 7 days a week with a primary focus on high-water periods." Clarify whether the term "high-water" in this context refers to high tide or high instream flows or both. Additional detail is required regarding frequency, duration, and timing of monitoring (e.g., months during which monitoring will occur, number of days per week, number of hours per day, time of day).

CIBW-06 Please clarify whether video footage of beluga observations will be digitally archived. Where you mention the potential for identifying individual animals, please describe the previously collected photo-identification information available for the beluga population.

CIBW-07 You do not propose conducting winter studies on beluga distribution or prey availability due to safety and logistical reasons, but indicate that "subsequent impact analyses will assume that whales are present year-round in the Susitna River delta and that they may be foraging" there at that time. Shelden et al. (2003) cite Rugh et al. (2000) and Hansen and Hubbard (1999) as sources of information on beluga winter habitat use in Cook Inlet. Existing information may be used to support not conducting a study. Do these reports provide additional support for not conducting surveys during the winter months? If so, please summarize their findings on winter habitat use.

CIBW-09 Goetz et al. (2012) developed predictive habitat models from beluga data collected from 1994 to 2008. Beluga presence was positively associated with fish availability and access to tidal flats and sandy substrate; group size was positively associated with tidal flats and proxies for seasonally available fish. Maps of habitat that could be integral to the sustainability and recovery of the beluga population were generated. Please summarize available models of beluga habitat for the study area and whether they may be used for assessing potential impacts. Describe any and all ongoing survey efforts by other

CIBW-10 researchers and agencies and how your efforts will compare or build upon others, where

you will collaborate with other agencies in sharing data, etc.

CIBW-11 Acoustic monitoring was brought up as a potential monitoring method for beluga (Bob Small, ADF&G, August 19, 2012, meeting), but was dismissed because it was unlikely to result in significant additional information useful to the beluga study. Please include the request and a detailed justification for not including acoustic monitoring in the RSP or your proposed methodology for conducting the study.

Wildlife Resources

Distribution and Abundance of Wolverines (Section 10.9)

WOLV-1 One of the study objectives is to describe late-winter habitat use by wolverines. This information would be used, in part, to rank levels of habitat use and assess direct and indirect loss and alteration of habitat from project construction and operation activities. In their comments on the study, ADFG stated that a single aerial survey would not be sufficient to develop habitat associations for wolverines and the objective should be eliminated. ADFG suggests that if such information is needed to assess impacts, the most effective way to obtain habitat associations is by using GIS telemetry. Your response to this concern, as described in the Table 10.4-1 (Summary of Consultation on Wildlife Resources Study Plans), indicates that you eliminated this objective from the study. However, the draft revised study plan still includes it. Your revised study plan should accurately reflect your study objectives. Furthermore, your revised study plan must explain how your study results will allow you to assess project effects on available habitat and why you are not conducting the GIS telemetry study in order to achieve the study objectives.

Bat Distribution and Habitat Use (Section 10.13)

BAT-1 The bat study has three specific objectives: (a) assess the occurrence of bats and the distribution of habitats used by bats within the impoundment zone and project infrastructure areas; (b) review geologic and topographic data to assess the potential for roosting sites and hibernacula in the study area; and (c) examine suitable geological features and human-made structures (bridges and buildings) for potential roosting sites or hibernacula. The methods discussion states that ADFG recommended documenting seasonal variation in bat occurrence and activity, expanding sampling to provide habitat-specific indices of abundance, and conducting a more thorough survey of naturally occurring roosts, maternity colonies, and hibernacula. You do not propose to conduct these efforts unless seasonal concentration areas such as roosting sites, maternity colonies, or hibernacula are located in 2013 because you agree with ADFG that

anticipated effects on these species are not expected to be great. You go on to say that ground searches for these concentration areas will be done "to the extent possible" and "if suitable substrates exist." Identification of suitable natural substrates (limestone and large diameter trees) would be based on literature and land-owner information. Your statement of little adverse effects would suggest that this study is not needed. Nonetheless, it is unclear how your efforts would identify important seasonal concentration areas for further study in 2014 and why ADFG's recommendations should not be incorporated into the study plan now. Further, your revised study plan should explain what would dictate "to the extent possible."

Recreation and Aesthetic Resources

Recreation Resources Study (Section 12.5)

In section 12.5.1, *General Description*, in the second bullet, the first use of the word "future" is redundant.

REC-19 The study area map and descriptions provided in section 12.5.3, particularly the "Recreation Use Study Area," are not entirely clear. Place names used in the text should be labeled on the map.

REC-20 You propose to identify and map trails based on aerial imagery, existing GIS datasets, field identification, agency interviews, and surveys, but you do not define the scale at which these trails will be mapped and reported. To ensure sufficient accuracy for analysis, existing trails in the immediate project area should be mapped, where practical, to the 1:24,000 national map accuracy standard of +/- 40 feet.

The assessment of future recreation supply and demand does not appear to integrate relevant socioeconomic data that will be gathered or developed from other
REC-21 studies. The Study Interdependencies chart on page 12-51 illustrates this integration; please describe how and when this integration will occur in the study methods. The
REC-22 recreation demand analysis should also consider latent demand for new facilities or opportunities that could result from development of the project. For example, a large new reservoir accessible to the public could create new recreation demand (e.g., boating, fishing, sightseeing) that is not otherwise apparent in existing data.

REC-23 It appears that intercept and mail surveys are intended to provide data on guided versus unguided use (i.e., commercial outfitter/guided user vs. non-commercial independent user). However, it is not clear in the draft survey instrument how this information would be obtained. For example, the table at the top of page 12-90 combines

guide/outfitter spending with transporter spending. Also some users may hire a guide for one type of activity, require transportation only for another activity, and recreate independently for another activity. The table on page 12-86 should be modified to distinguish between guided versus unguided use. If this is not practical in terms of your survey design, please explain why and provide an alternative approach to understanding commercial versus non-commercial recreational use in the project area.

Aesthetics Resources Study (Section 12.6)

AES-3 You propose to conduct a soundscape analysis to characterize ambient conditions and estimate the effects of project construction and operation. Noise from induced activities (e.g., increased non-project traffic, ATVs, snowmachines, motorized boating, float planes, etc.) and potential effects of project noise on dispersed recreation do not appear to be included in the analysis; these potential noise sources and effects should be included in the analysis so that environmental effects can be fully evaluated.

River Recreation Flow and Access Study (Section 12.7)

RECFLW-5 In section 12.7.4, *Study Methods*, in the fifth paragraph under Surveys, the text refers to the Devils Canyon stretch of Reach 1. It appears this should be Reach 2.

Socioeconomic and Transportation Resources

Regional Economic Evaluation Study (15.5)

ECON-3 One of the objectives of this study is to describe the effects of the project on the regional economy that would result from improvements in the reliability of the electrical power grid. In section 15.5.4.1, *Data Collection and Analysis*, you discuss the need to identify actions that will affect the economy of Alaska through interviews with knowledgeable individuals. The section goes on to say that "[t]he categories of persons to be interviewed and types of interview questions that will be used to develop REMI [Regional Economic Model Inc.] model assumptions are presented in the Appendix". While the appendix does include two tables that show the categories of persons that would be interviewed and topics that would be discussed, no example interview questions are provided.

ECON-4 To improve the readability and clarity of your study plan, please combine tables 1 and 2 to show what information is expected to come from each person (a similar approach was used in the HIA [Health Impact Assessment] section 15.8.2) and provide some example questions as indicated in the main body of text. In addition, please include a line

item in the schedule provided in Table 15.5.1 that shows when the interviews will be completed. You should also provide an explanation on how these interviews will be documented and whether this information will be available as part of the Initial Regional Economic Evaluation Study Report, similar to what is being proposed under the HIA.

ECON-5 In addition, the forecast analysis that would be performed using the REMI model will compare with-project and without-project conditions. The without-project conditions would be defined based on a mix of electrical generation sources developed through production cost modeling with Railbelt utilities and an appropriate alternative that does not include a large hydroelectric project. Your methods do not define what utilities would be consulted, what cost data would be obtained from the utilities, how the production costs would be modeled, and, if known, what assumptions would be applied to the model.

Social Conditions and Public Goods and Services Study (15.6)

SOC-11 The last paragraph in section 15.6.2 discusses the fact that little published data are available on "non-economic, socio-cultural values, quality of life, and needs of study area residents". To fill this data gap, you are proposing a series of "informal interviews" with "community council members, residents, Real Estate professionals, MSB [MatSu Borough] officials and other knowledgeable people." It is unclear whether the use of informal interviews, as described, meets agency requests to "survey residents to evaluate potential changes in quality of life" (June 7th workgroup meeting). Please provide more detail on the number of interviews planned, how individuals will be identified and selected for interview, and the types of questions that will be asked. The interview protocol developed for the Recreation Study Plan has a similar process. Please explain why informal interviews will be successful in collecting the agency-requested information.

SOC-13 The schedule provided in Table 15.6.1 should include a line item for the informal interviews and show when they will be completed. In addition, please explain how the results will be documented and integrated into other studies and whether or not they will be provided in the Initial Social Conditions and Public Good and Services Study Report.

SOC-14 Under section 15.6.7, *Level of Effort and Cost*, there is some discussion of "the collection of secondary data for many communities that will be collected through phone calls and executive interviews." Please clarify if these are the same as the informal interviews discussed earlier in this section?

Transportation Resources Study (15.7)

TRANS-03 The schedule summarized in Table 15.7.6 should include a line item for interviews. In addition, please indicate how the results of the interviews will be documented and whether the results will be provided in the Initial Study Report.

Random Utility Model

SOC-15 In response to agency study requests, you have discussed at various times during work group meetings the possibility of using a Random Utility Model (RUM) to assess economic impacts of changing recreational activities associated with the project. Use of the RUM is not discussed in the draft revised study plan. If you plan to use RUM, you should provide an explanation of the methodology, data needs, assumptions and other aspects of the model and how it will be applied to the project. If you have decided not to use the RUM, please explain why you are not using it and how agency study requests will be accommodated by your proposed methods.

Document Content(s)

STATE OF ALASKA

SEAN PARNELL, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
OFFICE OF PROJECT MANAGEMENT AND PERMITTING

550 W. 7TH AVENUE, SUITE 1400
ANCHORAGE, ALASKA 99501
PH: (907) 269-8431 / FAX: (907) 334-8918
tom.crafford@alaska.gov

14 November 2012

Ms. Kimberly Bose, Secretary
Federal Energy Regulatory Commission
888 First Street
Washington D.C. 20426

Subject: **Comments on Proposed Study Plan and Scoping Document 2 for Susitna-Watana Hydroelectric Project, FERC No. 14241**

Dear Ms. Bose:

The State of Alaska comments on the Proposed Study Plan and Scoping Document 2 for the Susitna-Watana Hydroelectric Project (Project No. 14241).

The State appreciates the 30-day time extension to 14 November 2012 for submittal of comments on proposed study plan (PSP) dated 16 July 2012, and the delay of the comment deadline for the forthcoming revised study plan (RSP) to 18 January 2012. Due to complexity of the issues and the large number of proposed studies, the state supports the due diligence shown by Federal Energy Regulatory Commission (FERC) in providing the time extensions for these reviews.

The State would also like to recognize the effort the Alaska Energy Authority (AEA) has expended in holding several public technical work group meetings and providing site access in order to assist the resource agencies and other stakeholders in understanding the PSP proposed methodology and approach. Incorporating the feedback from these meetings, AEA was able to further refine the PSP and post an updated PSP (referred to as an *interim draft RSP*) on the Susitna-Watana Hydroelectric Project website shortly before the comment deadline.

While recognizing AEA had no obligation to produce an interim draft RSP, which is outside the scope of the integrated licensing process (ILP), and acknowledging a review of the interim draft RSP in any substantive manner would be challenging due to the limited time available prior to the PSP comment deadline, the FERC Project Manager indicated that the resource agencies and other stakeholders were welcome to submit comments on the interim draft RSP to FERC, even if beyond the mandated PSP comment deadline. The state resource agencies would like to commend FERC on this unique collaborative approach.

As a practical matter, many of the state resource agency reviewers providing comments herein have attended the technical work group meetings and have worked with AEA to discuss and refine the PSP, leading to the updated interim draft RSP. The attached comments, while referencing the PSP filed with FERC on 16 July 2002, which is the subject of this review period, reflects the current level of knowledge of outstanding issues and acknowledgement of issues that have been satisfactorily resolved.

The State of Alaska remains a strong proponent of timely decision-making and a collaborative working relationship among state and federal agencies for the remainder of the EIS process, as well as any subsequent permitting of the proposed project. We look forward to working with the cooperating federal agencies toward that end.

Sincerely,

Tom Crafford, Director
Office of Project Management and Permitting

cc:
Daniel Sullivan, Commissioner, Department of Natural Resources
Cora Campbell, Commissioner, Department of Fish and Game
Larry Hartig, Commissioner, Department of Environmental Conservation
Joseph Balash, Deputy Commissioner, Department of Natural Resources
Ed Fogels, Deputy Commissioner, Department of Natural Resources
Kelly Hepler, Special Projects Coordinator, Department of Fish and Game

The Alaska Departments of Natural Resources (ADNR), Environmental Conservation (ADEC), and Fish and Game (ADFG) provide the following comments on the Proposed Study Plan (PSP) and Scoping Document 2 (SD2) for the Susitna-Watana Hydroelectric Project (FERC No. 14241).

I. ALASKA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS AND OUTDOOR RECREATION

General Comments

The Division of Parks and Outdoor Recreation (DPOR) has a vested interest in the recreation and socioeconomic research being conducted by the Susitna-Watana Hydroelectric Project and requests to be included in the distribution list for the relevant documents and data being produced by the project. It is further requested the project planners consult directly with DPOR in regards to Aesthetic and Recreational Resource study plans and activities.

At this time many of the studies occurring in or near the Denali State Park are taking place on the eastern boundary of the park, along the Susitna River. DPOR has issued permits for studies associated with hydrology and fisheries. A wide variety of recreational activities occur in the Denali State Park and the DPOR offices will be monitoring the project closely to ensure that studies related to hydro research do not displace recreational use in the park.

Comments regarding the Proposed Study Plan

Identified Project Area

The following comments are submitted regarding the **identified project area:**

1. Denali State Park lands have been identified and included in the project area.
2. The Susitna River flows for approximately 21 miles through the Denali State Park on its east boundary.
3. Gold Creek flows into the Denali State Park.

Proposed Transmission and Road Corridors

The following comments are submitted regarding the concerns DPOR has with the **transmission and road corridor study areas**:

REC-31

1. The impacts the Gold Creek and Chulitna proposed transmission and road corridors will have on Denali State Park; specifically the potential for providing unauthorized access to the park.
2. If constructed, the western end of the Gold Creek and Chulitna proposed corridors will also provide a direct access corridor to the park, increasing park access. The management

implications of this access are of concern to the Division of Parks and Outdoor Recreation.

3. Visual impacts to the aesthetic resources of the park as a result of transmission line construction.
4. Potential conflicts among recreational users during construction and maintenance of transmission line and road corridors.

The Division of Parks and Outdoor Recreation requests the Susitna-Watana Hydroelectric Project mitigate to the maximum extent possible these impacts to the Denali State Park.

DIVISION OF FORESTRY

Comments regarding the Proposed Study Plan

GEN-26 **Impoundment Area**

The Division of Forestry requests an inventory of the trees and biomass in the impoundment area and an evaluation of the potential for salvage. If viable, the project should ensure salvage is undertaken. The Division of Forestry is available to offer assistance with this assessment of the impoundment area.

OFFICE OF HISTORY AND ARCHEOLOGY

Comments regarding the Proposed Study Plan

Section 11 Cultural and Paleontological Resources

One of the deficiencies of the 1980's Susitna Project archaeological research was the lack of attention to stratigraphic markers for guiding archaeological field testing.

CUL-10 **Recommendation:** The 2013 survey will need to test multiple locations across the project area that have deep aeolian sediments, to better understand the types of soil profiles that will be encountered on the project. This testing must take place at the start of the field season, and in locations that are near sources of high aeolian sediment, namely braided locations along the Susitna River, to get good stratigraphic separation.

Benefit: These soil profiles will help inform on what soil horizons may be in the region, and may include paleosols and volcanic ash falls as well as periods of high and low sediment deposition. This testing may be profitably coupled with information on past and current caribou studies and aerial survey to put soil test locations near known or projected locations where caribou regularly cross the Susitna River.

CUL-11 **Recommendation:** All individuals on survey crews need appropriate training to adequately record and interpret the sediments they encounter. Each crew needs at least one individual

with advanced training who can guide crew members on the soils and tephras that they will encounter.

Benefit: Verifiable interpretation and repeatability of data.

A second deficiency of the 1980's research was the lack of coupling of the archaeological data with paleoenvironmental data, leaving the archaeological data largely un-interpreted, and generating little explanation of lifeways or human-environmental interaction.

CUL-03 **Recommendation:** Recent concern with climate change encourages us to compare our archaeological data to past climatic conditions and fluctuations, to better understand how human societies have dealt with past climate change. Because of this need for paleoenvironmental data, lake core and bog core data should be utilized. If not already available, bog cores should be taken in the project area.

Benefit: These cores will generate chemical signatures and ages for tephras, past vegetation types and frequency through pollen data, grain size analysis for wind regimen, etc.

Probability Modeling

CUL-12 Archaeological site probability modeling is very useful for making the best use of resources when surveying large tracts of land. This modeling should explicitly attempt to address how past humans may have used of the region at different times and with different resources. Hypothesis testing should be employed, coupling the archaeological and paleoenvironmental data, to generate testable locations of where people may have lived at different times, and to get at how people lived in the past and why they utilized the locations on the landscape that they did. It is hoped that the survey planners stay abreast of the biological, ethnographic and other studies being conducted concurrently that can provide data to refine these exploratory and explanatory models.

Coupled with the model information on high and low probability areas given to the crews should be explanations of why areas are modeled high probability. Crew chiefs need to know what makes an area high probability in order to better plan survey of that area.

Probability modeling is a commonly used tool for finding the kinds of archaeological sites that we are already aware of. But in Alaskan archaeology we are regularly finding site types that we previously were unaware of: ice patches in alpine areas utilized by prehistoric caribou hunters; raised beach terraces in southeast Alaska with mid or early Holocene archaeological sites, etc.

CUL-13 Consequently, part of the Susitna survey should include use of some type of random sampling, possibly stratified random sampling, to test a variety of location types, in an attempt to insure that unknown site types are not missed.

CUL-14 **Cultural Resources Study Planning**

The Cultural Resources Study section does not mention a Programmatic Agreement (PA). Given the scope and magnitude of this complex undertaking, a PA may be an appropriate approach to

dealing with the Section 106 process. As noted at 36 CFR 800.14[b][1][ii], PAs may be used 'when effects on historic properties cannot be fully determined prior to the approval of an undertaking'; and 'when nonfederal parties are delegated major decision-making responsibilities'.

CUL-02 The Cultural Resources Study section initially seems to imply that the entire APE will be intensively inventoried for cultural resources. However, the methods for identifying areas of high probability for the presence of cultural resources are then discussed later, which shows that select areas will be more intensively inventoried than others. Please clarify this earlier in this section – the Section 106 process does not require intensive (e.g., 100%) pedestrian inventory across the entire APE, but rather a "reasonable and good faith identification effort."

Additional Comments and Edits

Additional comments and edits on Section 11 Cultural and Paleontological Resources are correlated in Table 1 to the specific locations in the PSP.

Table 1 Additional Comment for Section 11 Cultural and Paleontological Resources

Section 11.0 Cultural and Paleontological Resources	
Sub-Section	**Comment**
11.1	Page 11-1 Introduction, first paragraph, second sentence: **Suggest slightly rewording to: "Information from these studies will be used to assist in identifying appropriate protection, *avoidance, minimization,* mitigation, and enhancement measures…"**
11.1	Page 11-1 Introduction, second paragraph, second sentence: **Recommend defining "historic properties" right up front (use definition from 36 CFR 800,16[l]). Also, it may be helpful to distinguish the difference between "cultural resources" and "historic properties" early on as they are often (and inappropriately) used interchangeably.**
11.2	Page 11-2 Header: The use of the words "Nexus" and "Existence" seems a bit odd. Is the intention to express effects throughout the life of the project (from planning through to operations and beyond?). **Suggest using the phrasing "Consideration of Immediate and Long-Term Effects on Historic Properties" or similar.**
Section 11.5 Cultural Resources Study	
Sub-Section	**Comment**
11.5.1.1	Page 11-7 Study Goals and Objectives: **Suggest slight rewording of the first paragraph and accompanying bulleted list. Recommended changes are highlighted below:** **The goals of the 2013-2014 cultural resources study plan are to systematically**

CUL-15

CUL-16

CUL-17

CUL-18

		inventory cultural resources within the APE (36 CFR 800.4[b]), evaluate the National Register eligibility of inventoried cultural resources within the APE that have not been previously evaluated (36 CFR 800.4[c]), and assess Project-related effects on National Register-eligible historic properties within the APE (36 CFR 800.5[a]). These goals ensure evaluation of cultural resources identified within the APE for NRHP eligibility. NRHP evaluation should not just be done for those that may be adversely affected (as this may change and assessment of adverse effects comes at the next step). If they are located within the APE, that presumes the potential for effects and cultural resources identified therein should be evaluated for NRHP eligibility. **Similar adjustments should be made to the corresponding bulleted list of items that immediately follow this paragraph.**
CUL-19	**11.5.2.1**	The bulleted second sentence on p. 11-8 was left unfinished: "document hydrological concepts embedded in place names, directional system, and landscape narratives; and…" **Please complete this sentence.**
CUL-07	**11.5.2.1**	Page 11-9 states that only a sample of sites will be dated. **It is hoped that all sites that can practically be dated, will be dated.**
CUL-20	**11.5.4.3**	This project has the potential to generate multiple products that will stand as a legacy to the all the effort and funding involved. **Hopefully NLUR will go beyond the stated goal of "Updat(ing) cultural chronology" to make sure in their final report that they generate a synthesis of regional prehistory that will be useful for workers in the region for decades to come. While this synthesis should integrate Ahtna land perspectives and Ahtna place name data, other publications should encapsulate the Ahtna data, with one or more of these written for the general public.**
Section 11.6 Paleontological Resources Study		
Sub-Section		**Comment**
PALEO-03	**11.6.3**	Study area for Paleontological Resources: The archaeological survey plan has included the areas along to the Susitna River between the Denali Highway and the impoundment as part of the indirect APE because of the concern for negative impacts from increased recreational traffic. **The paleontological study should include the same indirect APE for the same reason, namely concern for the unauthorized collection of these resources. The PSP mentions the 29,000 year old mammoth remains found at the confluence of the Susitna and Tyone rivers (Thorson et al. 1981), but doesn't suggest including this area in survey. Because of this concern with unauthorized collection, Pleistocene exposures along the Susitna River should be examined for possible paleontological resources.**

DIVISION OF MINING, LAND AND WATER

Comments regarding the Scoping Document 2

Sections 4.2.6 Recreation Resources and Land Use and 4.2.9 Socioeconomic Resources

TRANS-04

Two project-specific resource issues identified in the FERC Scoping Document 2 as having potential for substantial environmental effects were: 1) Effects of altered hydrologic regimes and ice cover on timing and extent of river access and navigation within and downstream of the reservoir, and 2) Effects of altered flows and ice conditions on river-dependent transportation along or across the Susitna River.

To address these issues, the Division of Mining, Land and Water (DMLW) recommends a detailed analyses of the altered hydrologic regimes, ice cover, and ice safety be conducted for the Lower and Middle Susitna River from tide water to the bottom of Devils Canyon. This area is currently, and has historically, been utilized as a highway of commerce. The BLM determined the Susitna River navigable to Indian River based on steamship use.

Currently the Susitna River is navigated from tide water to the base of Devils Canyon for commercial purposes by a number of guides and tour operators. In the lower river, lodge owners and operators as well as fishing and hunting guides utilize the river to make their living. Boats and ice roads are utilized on the lower Susitna River from multiple locations such as Deshka Landing and Susitna Landing to transport fuel, supplies and customers for commercial lodges, homesteads, and recreational cabins.

The potential impacts of flow pulsing and other flow fluctuations on ice formation, layering and overflow to ice roads should be analyzed and solutions proposed prior to construction. DMLW requests an in-depth analysis and discussion of decreased flows to determine the impact to timing and extent of river access and navigation within and downstream of the reservoir, including, but not limited to launch sites at Deshka Landing, Susitna Landing, Susitna Bridge, and Talkeetna River.

Section 5.0 Proposed Studies

TRANS-05

Of great concern to the Alaska Division of Mining, Land and Water is the interconnected nature of the post construction ice processes on the Social and Transportation Resources as well as the Water Resources. The potential impacts to ice road formation may potentially impact the length of the river downstream of the dam, detrimentally impacting the delivery of fuel and supplies to lodges, homesteads and cabins from tidewater upstream. This would translate to increased costs of doing business and costs of living on the west side of the Susitna River downstream of the Parks Highway Bridge. The potential need to construct ice bridges over the Susitna River in response to this impact should be analyzed.

Comments regarding the Proposed Study Plan

Fluvial Geomorphology

FGM-06 Determination of the grid size spacing for the fluvial geomorphology numerical models should be determined based on the spatial resolution of available data and not on the computational run times. A statement regarding the approach used in the determination of grid size spacing should be included with the reported results.

FGM-05 There are several different numerical models being developed to gain a better understanding of processes. Will there be any cross-checking (as applicable) among the simulated results from the various models where overlap occurs? In other words, is there consensus among the simulated results (as applicable)?

FGM-03 The numerical models currently being developed are for the primary purpose of gaining a better understanding of processes. Are there plans to apply a more holistic, integrated approach during later phases of the analyses?

Instream Flow, Hydrology, Groundwater and Glacial Runoff

The following comments are submitted regarding **Surface Water Hydrology**:

1. Most surface water hydrologic aspects are covered by the plan, with a well designed network of streamflow measurements to facilitate understanding the drainage system.

RIFS-09 2. There are no large lakes in the project area but there are many wetlands and there may also be a number of smaller ponds, within the wetland areas. There does not appear to be plans for a study of wetland functioning within the study area. This would be a multi-disciplinary as aspects of both surface water and groundwater hydrology are involved.

RIFS-10 WETLND-01 3. There is no mention of the source of recharge to the wetlands that was referred to. Much of the wetland area is inundated during ice dam events, but the timing of these events are irregular in nature and the ground surface may be frozen during the events, preventing regular infiltration. While upwelling groundwater and percolating precipitation, primarily snowmelt, may account for a significant portion of the wetlands, both recharge and discharge due to river stage, i.e. potential horizontal flow to and from the wetlands, may be significant.

WETLND-02 4. During low flow periods in the river, local wetland storage of water may play a significant role in supporting the small ponds and interconnections that are typical habitat for small fish. The horizontal movement of water within the wetlands needs to be addressed as does the functioning of wetlands within the larger system.

The following comments are submitted regarding **Groundwater Hydrology**:

1. There is a plan in place to drill shallow groundwater monitoring wells and to attempt to relocate the prior set of observation wells that were drilled during the 1980's study; so, the shallow groundwater, which may be locally confined, has been addressed.

GW-004

2. While deeper wells are not common in the area and no deep observation wells are planned for studying this specific aspect of the groundwater system, other deep borings to identify fault zones and other structural features may provide insight into the deeper groundwater zones.

GW-005

3. The current monitoring phase would last for a maximum of two years. The groundwater study should be extended to better understand the interactions between groundwater and wetlands under differing hydrologic conditions, which may evolve over time periods much longer than two years, and certainly will over the life of the proposed dam.

The following comments are submitted regarding **Prior Appropriator Water Rights:**

GW-006

1. The Water Resources Management Unit is concerned with ground water connectivity to the Susitna River. Most water rights downstream of the dam site are groundwater wells which may be affected by changes in the flow regime of the Susitna River caused by this project.
2. There are several ground water wells along the Susitna River. Many of these wells are located within communities that are along the Susitna River. Many of these wells have water rights associated with them. The project's affects on lower river flows during the summer months needs to be evaluated in order to determine how this project may affect the prior appropriators' water rights.
3. Studies to determine the effect of ground water/ surface water connectivity should be preformed.

Additional Comments and Edits

Additional comments from the Division of Mining, Land and Water on Sections 5.0 Water Resources and 13.7 Transpiration Resources are correlated in Table 2 to the page locations in the PSP.

Table 2 Comments for Sections 5.0 Water Resources and 13.7 Transportation Resources

Section 5.0 Water Resources Study	
Sub-Section	**Comment**
5.1	Page 5.1 "The potential effects of the Project on ice formation, surface and groundwater….." **Consideration for winter ice stability and maintenance should also be considered. The statement should state: "The potential effects of the Project on ice formation**

TRANS-06

		and stability, surface and groundwater…" For the Susitna River to continue to be utilized as a frozen highway and bridge to the Western Cook Inlet oil and gas industry, commercial lodges and homesteads the stability of the ice is an important consideration that is not addressed in this section, the recreation section or the transportation section.
TRANS-07 SOC-23	**5.2**	Page 5.1 Changes to ice processes and flows in the Susitna River **The impacts to the flow regime and pulsing in the winter months has a strong potential to impact ice formation below the proposed dam. As the ice is utilized as road and bridge crossings the safety of the ice becomes highly important. The downstream ice processes in the lower river are important for this reason as they have the potential to impact the economic viability of lodges on the west side of the Susitna River.** **Similar impacts are possible in the summer months with boat traffic to lodges and guides utilizing the lower river for the operation of their businesses. Sufficient flows must be maintained to support these businesses which are also tied to the viability of salmon runs.**
	13.7 Transportation Resources Study	
	Sub-Section	**Comment**
TRANS-08	**13.7.2**	Page 13-14 to 13-15 Tables **The existing Mat-Su Borough Recreational Trails Plan adopted in March of 2000 is not listed in any of the tables of reviewed documents.**
TRANS-09 REC-32	**13.7.3**	Pages 13-17 For river transportation the study will evaluate non-recreation or subsistence transportation uses in the Susitna River corridor from the Denali Highway to the river mouth. **This statement should be clearer. From reading the Recreation Section the only Guide/Tour activity discussed are the tours to the base of Devils Canyon. The use of the Susitna River in the Lower Reach by Guides and Lodges during open water and ice road should be analyzed. None of the other Guides or Lodges are discussed in the recreation section.** **The US Supreme Court in PPL Montana LLC v Montana Decision upheld and supported the use of recreational use of a water body as a valid test for navigability. Therefore recreational use of the Susitna River within the entire length of the impacted portion of the Susitna River should be evaluated.**
TRANS-10 REC-33	**13.7.4**	Pages 13-18 to 13-20 Document Existing Conditions: There is no mention of tracking or documenting use of these RS2477 and easements in the study plan. **Three valid RS2477 Rights-of-Way cross or are within the Susitna River. Two of these ROW's utilize the frozen surface of the Susitna River, RST-199 Sustina-Rainy Pass and RST-200 Susitna-Tyonek. The third RST-1509 Curry Landing Strip Lookout crosses the**

	river and climbs the ridge to the lookout location. All of these RS2477 Rights-of-Way are valid interests owned by the State of Alaska. **There are also existing State and Private easements that cross or utilize the Susitna River in the lower portion such as the State owned Amber Lakes - Trapper Lake easement leaving from Susitna Landing. These easements provide access to Homesteads and commercial lodges on the West side of the Susitna River.** **There is also significant use by the Western Cook Inlet oil and gas industry for utilizing the Susitna River as an ice road in the winter. There is no mention of tracking or documenting use of these RS2477 and easements in the study plan. The potential of utilizing the frozen surface of the Susitna River post dam construction may possibly impact the ability of the river to be utilized as an ice road or crossing. The potential need for bridge crossings in the lower sections of the river should be analyzed as a possibility if flows impact the ability of the river to be used as a frozen highway.**

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

Comments regarding the Scoping Document 2

Sections 2.2 Geology, Seismicity, and Dam Failure

SEIS-2

The Pass Creek fault, west of the dam should also be considered in seismic hazards analysis. This fault is associated with a large (~3 m) scarp that offsets latest Wisconsin-age glacial deposits. This fault is an active structure capable of producing large ground motions at the site. It is recommended that the independent consultant also consider the Pass Creek fault in addition to other sources that have already been described.

Comments regarding the Proposed Study Plan

The Division of Geological & Geophysical Surveys (DGGS) has reviewed Sections 4.5, 5.8, 5.11, 11.6, 14.5, and 14.6. DGGS comments and edits are correlated in Table 3.

Table 3 Comments for Sections 4, 5, 11, and 14.

Section 4.5 Geology and Soils Characterization Study	
Sub-Section	**Comment**
4.5	Page 4-4 **Necessary laboratory tests of physical and strength properties of rock and soil should include solubility testing of component minerals.**
Section 5.8 Geomorphology Study	
Comment	
5.8.1	Page 5-58 **It is unclear whether due consideration is being given to the Upper River and the dam's potential impact on geomorphologic conditions there.**

GS-3

GEO-09

GEO-01	**5.8.4.3.3**	Page 5-69 **Will there be an opportunity to comment on the Geomorphology report?**
GEO-10	**5.8.4.6.1**	Page 5-77 **Will the potential impact of wildfires on sediment load be factored into this study?**
GEO-11	**5.8.4.8.2.3**	Page 5-88 **Proper terminology would be 'thawing of permafrost', not 'melting of permafrost.'**
GEO-12	**5.8.4.10.2**	Pages 5-93 to 5-94 **Suggest including an evaluation of potential icings (aufeis) at stream crossing locations.**
	Section 5.11 Glacial and Runoff Changes Study	
	Comment	
GLAC-07	**5.11.1.1**	Page 5-147 P3 **While this is generally true there are situations where positive glacier net balance can be concurrent with higher water flows. For example, consider a winter of heavy snow that is followed by a summer with a lot of melting, but not enough melting to get rid of all the snow. Mass balance would be positive at the same time as there are high water flows.**
GLAC-08	**5.11.2.1**	Page 5-148 P2Definition **of 'recent period' in this context would be helpful. Accepted formal terminology prefers 'Holocene' to 'Recent' if the geologic timescale is being referenced here. If 'recent' refers simply to 'having happened, begun, or been done not long ago or not long before,' the use of 'period' after 'recent' confuses the intent because it implies the more-formal terminology. Suggest either using 'Holocene' or else more specifically defining the amount of time encompassed by 'recent' in this context (e.g., 'during the past xxx years').**
GLAC-09	**5.11.2.1**	Page 5-148 P2 **Reference needed for statement "Alaska glaciers with the most rapid loss are those terminating in sea water or lakes."**
GLAC-10	**5.11.2.3**	Page 5-149 P1 **Is it relevant to include mention of a predicted longer growing season in this section? If so, consider explaining how this is relevant to the research question.**
GLAC-11	**5.11.9**	Page 5-159 13 Fig. 5.11-1 **A directional arrow or statement of direction of view shown in photo would be helpful, especially since the caption includes reference to 'western end' of the lake.**
GLAC-12	**5.11.9**	Page 5-160 14 Fig. 5.11-3 **Suggest labeling Susitna Glacier**
GLAC-13	**5.11.9**	Page 5-161 15 Fig. 5.11-5 **Caption should read "Mean annual temperature and total annual precipitation at Talkeetna…"**

	Section 11.6 Paleontological Resources Study	
	Comment	
PALEO-04	**11.6.2**	Page 11-17 **The first sentence in this sub-section implies that the Hadrosaur fossils are Pleistocene in age, which is not the case. Suggest rewording the beginning of the sentence to "The potential for vertebrate faunal remains should be reviewed…"**
	Section 14.5 Probable Maximum Flood (PMP) Study	
	Comment	
FLOOD-1	**14.5.1.1, 14.5.4.1**	Page 14-2, 14-3 **Who comprises the Board of Consultants and how are members selected?**
FLOOD-2	**14.5.4.3**	Page 14-4 **Will the results of the glacier runoff study be included in determining the 100 year snowpack and snow water equivalent?**
FLOOD-3	**14.5.4.13**	Page 4-7 **Will the freeboard analysis be conducted using initial construction parameters only or will it also be calculated for a suite of reservoir sedimentation/infill scenarios post-construction?**
FLOOD-4	**14.5.4.13**	Page 14-7 **"The study of freeboard will take into account unusual circumstances." It would be useful to provide one or more examples of what would be considered an unusual circumstance.**
FLOOD-5	**14.5.6**	Page 14-8 **The PMP/PMF anticipated completion predates the anticipated completion of other portions of the Study Plan such as geologic mapping. Will there be any effort to update the flood model in 2014 with improved information from the ongoing studies (this may refine estimated infiltration rates, include longer stream gauge records and incorporate fluvial-geomorphic findings).**
	Section 14.6 Site Specific Seismic Hazard Evaluation Study	
	Sub-Section	**Comment**
SEIS-4	**14.6.1.1**	Page 14-9 **The components outlined are adequate and represent state of the practice for assessing seismic safety of dams.**
SEIS-5	**14.6.2**	Page 14-10 **The section clearly outlines the previous studies conducted at the site except for the seismic hazards study conducted by Fugro in Dec. 2011.**
SEIS-6	**14.6.2**	Page 14-10 **Example topics in the proposed studies do not include assessment of the Pass Creek fault. This fault should be considered. Additionally, probabilistic seismic hazards maps (Wesson 2007) should be augmented with a site specific ground motion assessment.**
SEIS-7	**14.6.3**	Page 14-10 **The Pass Creek fault should be added to the list of potential faults to study. Additionally, the relative activity of the Talkeetna Thrust and other parallel faults mapped in bedrock such as the Bull River fault, Broxson Gulch fault, and**

	Broad Pass fault should also be considered.
14.6.4.2	Page 14-11 **Who comprises the Board of Consultants and how are members selected? We recommend that a DNR-DGGS geologist be part of the Board of Consultants review panel for seismic hazard studies**
14.6.4.4	Page 14-11, 14-12 **Most of the proposed work has already been performed by Fugro (Dec. 2011). A notable exception is the conducting of geologic studies using the recently acquired lidar data. These data should be evaluated with a combination of field and office assessments.**

SEIS-9

SEIS-8

II. ALASKA DEPARTMENTOF ENVIRONMENTAL CONSERVATION

DIVISION OF WATER

General Comments

The ADEC Division of Water Quality will review the SAP/QAPP when it is published.

Comments regarding the Proposed Study Plan

The Division of Water has reviewed Section 5.5 of the Proposed Study Plan (PSP) dated 16 July 2012 and submits the following comments in Table 4 which have been correlated to the specific location in the PSP.

Table 4 Section 5.5 Baseline Water Quality Study Comments

Section 5.5 Baseline Water Quality Study	
Sub-Section	**Comment**
5.5.4.3.1	Page 5-14 States "Water quality parameters above that do not exceed Alaska Water Quality Standards will not be collected in succeeding months; the exception are those parameters in Table 5.5-4 associated with monthly sample collection from surface water." **Replace this language with, "Table 5.5-4 lists the water quality parameters to be collected and their frequency of collection."**

WQ-18

DIVISION OF AIR QUALITY

Comments regarding the Proposed Study Plan

The Division of Air Quality has reviewed Section 13.9 and submits the following comments in Table 5 which have been correlated to the specific location in the PSP.

Table 5 Section 13.9 Air Quality Study Comments

	Section 13.9 Air Quality Study	
	Sub-Section	**Comment**
AIR-03	**13.9.1.1**	Page 13-27 States the analysis will evaluate impacts from the Project and how Project emissions compare to the Without-Project alternative. **Recommend also compare to current conditions.**
AIR-04	**13.9.2**	Pages 13-27 to 13-28 The primary air quality concern in the area is particulate matter (PM10 and PM 2.5) from fugitive dust, volcanic ash, and wildfire smoke. **There are also concerns from wood-heating or wood-burning devices.**
AIR-05	**13.9.2**	Page 13-28 There are some limited data available from a site in Denali National Park. **There are two Denali monitoring sites. To which site is this statement referring?**
AIR-06	**13.9.2**	13-28A table comparing the Project emission with Without-Project alternative emissions will be generated. **Also include in table current emissions**.
AIR-07	**13.9.2**	Page 13-28 If site specific monitoring data is required… **How would the need for site specific monitoring data this be determined? What are the criteria for determining the pollutant of concern or will all pollutants be monitored? Is there a clear understanding of the cost and effort needed to collect data?**
AIR-08	**13.9.2**	Page 13-28 It is anticipated that at least one year's worth of data will be collected consistent with methods outlined in 18 AAC 50.035. **The citation should be 18 AAC 50.215(a).**
AIR-09	**13.9.2**	Page 13-28 The area is likely considered unclassifiable under18 AAC 50.015, as there may be insufficient data to determine whether it is in attainment with respect to all criteria pollutants. **The classification should not be in question. Nonattainment areas are clearly defined in 18 AAC 50.015. This area should fit either the criteria for an attainment or nonattainment area.**
AIR-10	**13.9.2**	Page 13-28 EPA maintains a list of non-attainment areas for all six criteria pollutants on their Green Book website: (http://www.epa.gov/oar/oaqps/greenbk/index.html). **The Alaska Administrative Code 18 AAC 50.015 also lists the non-attainment areas.**
AIR-11	**13.9.4**	Page 13-28 The study assumes emission estimates from the Project are expected to be below major source thresholds, therefore a PSD and Title V permit are not anticipated for the Project. **In order to construct a dam consistent with the project description provided in**

	Section 13.9 Air Quality Study	
	Sub-Section	**Comment**
		http://www.susitna-watanahydro.org/project/project-description/ , it may be necessary to build a Portland cement plant on-site. **Per 40 CFR § 51.21(b)(1)(i)(a) Portland cement plants have a 100 tpy threshold of any regulated NSR pollutant for PSD permit applicability. Additionally per 40 CFR § 51.21(b)(1)(i)(c)(iii)(c) and 40 CFR § 71.2, Portland cement plants are stationary sources whose fugitive emissions must be included in determining whether or not the plant is a PSD major stationary source or Title V major stationary source.** **Even if not subject to PSD or Title V permitting the source may be subject to minor permitting requirements under Article 5 of 18 AAC 50.** **The Division of Air Quality will need more specific information about the type(s) of operation planned before the permit requirement can be determined.**
AIR-12	**13.9.4**	Page 13-29 The air quality study will assess the existing conditions of the area against applicable state and national air quality standards and evaluate the Project's air quality impacts against these standards. The analysis will include evaluation of both short-term and long-term impacts from the Project and a comparison of Project emissions to the no-action alternative. **This can be a substantive task. What are the proposed methods to be used for this analysis and what are the criteria for determining the pollutants to be analyzed? Is there adequate meteorological data available? How will it be determined if an air quality study this extensive is needed for a hydroelectric project?**
AIR-13	**13.9.4**	Page 13-29 States the analysis will include evaluation of both short-term and long-term impacts from the Project and a comparison of Project emissions to the no-action alternative.
AIR-14	**13.9.4.1**	Page 13-29 States that once a non-attainment area meets the standards, the EPA will re-designate the area as a "maintenance area". **This brief statement is an oversimplification of the process required to develop a maintenance plan for a previously designated nonattainment region and the process should be outlined to avoid misunderstanding.**
AIR-15	**13.9.4.2**	Page 13-29 Lists fugitive *particle* matter emissions from the handling and storage of raw materials and wind erosion during construction to be quantified according to methodologies specified in EPA's Compilation of Air Pollutant Emission Factors (AP-42) or similar source of emissions factors. ***Particle* should be *particulate*.**
AIR-16	**13.9.4.2**	Page 13-29 States if a state *license* is required, air quality dispersion modeling may also be required and will be performed consistent with 18 AAC 50 dispersion

Section 13.9 Air Quality Study	
Sub-Section	**Comment**
	modeling guidelines. ***License should be permit.***
13.9.4.2	Page 13-29 States emissions from construction equipment and related activities will be estimated for comparison to appropriate state licensing criteria. **Secondary emissions do not count towards "potential to emit" per 40 CFR 51.166(b).**
13.9.4.2	Page 13-30 States if the Project generates average daily traffic volumes that exceed a state mobile source threshold for CO, PM10/PM2.5, or mobile source air toxics (MSATs) analyses, then a mobile source evaluation may be required. **There are no mobile source thresholds in permitting.**
13.9.7	Page 13-31 States existing monitoring data may not be representative of the area and a program of air quality monitoring would need to be implemented to gather baseline data. **There is no regulation that requires a program of air quality monitoring to gather baseline data. What criteria would be used to determine if baseline data is necessary?**
13.9.1.1 **13.9.2** **13.9.4**	Pages 13-27 to 13-28 contains multiple citations of Alaska Administrative Code Title 18, Chapter 50, various Sections, but does not reference Alaska statutes. **Please cite the applicable Alaska Statutes in addition to the Alaska Regulations.**

AIR-17

AIR-18

AIR-19

AIR-20

III. ALASKA DEPARTMENT OF FISH AND GAME

To the best of our abilities, the 29 October 2012 draft interim Revised Study Plans were reviewed but more time will be needed to fully assess. Consequently, most of the comments reference the Proposed Study Plan and include preliminary comments on the recent Revised Study Plans when possible.

General Comments

While portions of the study plans have been developed according to criteria identified in 18 CFR 5.11, other parts of these plans lack sufficient specificity and detail. Following are general comments.

GEN-27

- Study plans need to stand alone. Methods in these plans often refer to other studies which often do not provide specific information to the topic under discussion or repeat additional information already summarized in the lead study. It is preferable that studies describe what

data is needed from other studies and how it will be used without repeating the methods for obtaining the data – that information should remain within the originating study.

GEN-28
- Sampling plans need to include a thorough description of methodology, sampling and QA/QC procedures, etc. In general, more information is needed on sampling protocols, timing, location(s) and site selection criteria.

GEN-29
- Include a list of definitions of key terms for each study plan. We understand different specialties often have their own terminology and a list of definitions would help to better understand differences.

GEN-30
- Protocols for sampling methodologies should not simply reference state or federal protocols. Many of these may not exist. Citations should refer to specific scientific methods, references or manufacturer instructions.

Comments regarding the Proposed Study Plan

Section 5.5 Baseline Water Quality Study

GW-007
WQ-19
- Information is needed on preliminary results from the thermal imaging assessment that was scheduled to be conducted in the fall 2012. An assessment on the feasibility of this investigation is needed and if it is determined feasible, how additional thermal imaging data will be collected and calibrated. These comments are repeated in section 5.7. Groundwater-Related Habitat Study since the thermal imaging assessment was also described there and it is unknown who is the project lead.

WQ-20
- Information is needed on the availability of the "Sampling and Analysis Plan" and the "Quality Assurance Project Plan".

WQ-21
- All field sensors and equipment should be calibrated pre- and post-monitoring according to accepted industry or manufacturer protocols and field measurements collected for post monitoring calibration/processing.

WQ-22
- Monthly measurements will not adequately characterize water quality in the Susitna River because some parameters are highly variable. We suggest more frequent measurements of basic water quality parameters (e.g. dissolved oxygen, turbidity, conductivity, and pH) at select sites.

Section 5.7 Groundwater-Related Aquatic Habitat Study

We support the goals and general approach of the groundwater study. Information collected during this study and incorporated with other related studies will help to evaluate project effects on aquatic and terrestrial resources. Following are additional information needs.

- Information is needed on preliminary results from the thermal imaging assessment that was scheduled to be conducted in the fall 2012. An assessment on the feasibility of this

investigation is needed and if it is determined feasible, how additional thermal imaging data will be collected and calibrated.

GW-008
IFS-058
- Dissolved oxygen should also be measured as a parameter for HSC and HSI development.

GW-009
- More information is needed on the monitoring strategy in focus areas. For example, how will the study assess groundwater influences over different habitat types in a focus area? An example figure/diagram showing proposed groundwater monitoring well locations in a focus area would help to better understand proposed sampling design.

Section 6.5 Fish and Aquatics Instream Flow Study

We support the goal to provide quantitative indices of existing aquatic habitats and resources that will enable an evaluation of the effects of alternative project operational scenarios. We also support close coordination and integration with related studies to provide a comprehensive evaluation.

Following is a list of information needs and comments.

IFS-066
- We support the HSC/HSI data collection objective. Information is needed for identified target species over multiple years to incorporate habitat variability associated with utilization. Further discussion is needed on the selection of these species and data needs. Site-specific HSC/HSI data is critical to obtain meaningful results and may entail consideration of alternative strategies to meet these data needs.

IFS-065
- We support the addition of lateral edge habitat evaluation for assessing aquatic resource effects in this habitat. More information is needed on the sampling approach, sampling area, equipment, etc.

IFS-076
- Information is needed on flow ranges that will be collected to evaluate flow-habitat relationships for each modeling approach.

IFS-061
- Information is needed on criteria that will be used to identify cover types and substrate sizes.

IFS-072
- For PHABSIM and similar transect-based methods, will transects be hydraulically independent, dependent or a combination and accordingly, what water surface elevation models and composite suitability index will be used?

IFS-083
- What criteria will be used to select and weight transects used to provide information for habitat-flow models?

IFS-032
- What criteria will be used to identify "a representative number" of habitat types within the description of study sites for fish passage/off-channel connectivity (§6.5.4.5.5.)?

IFS-031
- We support the hierarchical classification system for characterizing habitat categories. This system was derived from the 1980's information and provides a sound framework for designing sampling protocols and evaluating study results. Still needed is the habitat

inventory data scheduled to be collected this year and summarized according to the above classification system for future decision-making.

IFS-087
- How will the data be aggregated from the different models to evaluate single flow recommendations?

IFS-100
- A description is needed on the manner in which information will be compiled to present results (e.g. Decision Support System) including data sources that will be incorporated, geo-spatial capabilities, and product outputs.

IFS-062
- Information is needed on equipment that will be used and calibration protocols.

IFS-105
EUL-2
RECFLW-6
- For the eulachon (Section 7.16) and boating (Section10.7) studies, similar information is needed on how the flow-habitat/resource information will be collected. For example, what is the study area, what sampling strategy will be used, how many and what range of calibration-discharge sets will be collected if appropriate, and how will HSC/HSI data be developed?

IFS-082
- We support the use of varial zone modeling to assess effective spawning/incubation habitat. Modeling simulations may need smaller time steps during the analysis phase (possibly down to 15-minute increments) depending on the rate of flow change over time with proposed operation scenarios.

IFS-025
- More details are needed on sampling approaches. For example, what criteria will be used to determine how many focus areas, mesohabitats and critical area sites will be selected?

IFS-081
- We support and agree with the approach proposed for using 2-D modeling in the main channel and other areas as appropriate for sampling focus areas.

IFS-068
- Intergravel, over-winter temperature monitoring of redds should be expanded to include measurements of dissolved oxygen.

- <u>Fish Stranding and Trapping</u> – an evaluation of fish stranding and trapping is needed. Stranding typically involves the beaching of fish on low gradient shorelines as a result of declining river stage. Salmonid stranding associated with hydropower operations has been widely documented (Hunter 1992 provides a list citations). Trapping is the isolation of fish in pockets of water with no access to the free-flowing surface water (Hunter 1992). The evaluation should include, at minimum, the following information:

IFS-071
1. An analysis of natural Susitna River stage changes over the available period-of-record is needed similar to the analyses presented in Hunter (1992). At a minimum, the data should be tabulated similar to results provided in Hunter (1992), Tables 1 and 2.

IFS-056
2. An analysis is needed on Middle River areas susceptible to fish stranding and trapping. Hunter (1992) cites 2 studies that indicate stranding can occur on low gradient areas, less than 4 percent (Bauersfeld 1978) and 5 percent (Beck Associates 1989). A topographical survey of potential stranding areas is needed with modeling

at hourly time increments to assess stranding and trapping potential. Simulation should include existing and alternative operation scenarios under normal, dry and wet hydrologic conditions. Factors that may contribute to stranding and/or trapping should be considered including: aquatic species/lifestage, cover, duration of a stranding/trapping event, and time of year.

IFS-086

3. An analysis and discussion of results on how proposed operations will affect fish and other aquatic organisms including but not limited to: juvenile emigration (salmonid drift), spawning interference (conditions that may affect the ability of fish to successful complete spawning without interference/interruption from flow related effects), and effects on aquatic invertebrates.

Bauersfeld, K. 1978. Stranding of juvenile salmon by flow reductions at Mayfield Dam on the Cowlitz River. WDF, Olympia, WA, Tech. Rep. 36:36 pp.

Beck Associates, R.W. 1989. Skagit River salmon and steelhead fry stranding studies. Prepared by R.W. Beck Associates for the Seattle City Light Environmental Affairs Division, March 1989. Seattle, WA 300 pp.

Hunter, M.A. 1992. Hydropower Flow Fluctuations and Salmonids: A Review of the Biological Effects, Mechanical Causes, and Options for Mitigation. State of Washington Tech. Rep. 119. 58 pp.

Section 7.5 Study of Fish Distribution and Abundance in the Upper Susitna River

FDAUP-05

Recommend a section be included to specifically address winter sampling methods. Minnow trapping under ice should be conducted during the winter period to document fish presence and absence; we also recommend evaluating the feasibility of under ice videography.

7.5.1.1. Study Goals and Objectives (Page 7-9 & 7-10)

"The overarching goal of this study is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous species (e.g., Bering cisco, Dolly Varden, humpback whitefish, northern pike, and Pacific lamprey), and freshwater rearing life stages of anadromous fish (fry and juveniles) in the Susitna River above Devils Canyon."

FDAUP-06

- Fish distribution efforts should be directed at streams not already identified as supporting anadromous fishes in ADF&Gs Anadromous Waters Catalog (AWC). AWC information can be accessed through ADF&Gs online Fish Resource Monitor at: http://gis.sf.adfg.state.ak.us/FlexMaps/fishresourcemonitor.html?mode=awc

FDAUP-07
WQ-23

- Baseline metals and mercury assessment are not the same. What is being sampled and to what standards? What metals are being studied?

FDAUP-08
- Recommend to add: **8. Identify spawning locations for both anadromous and resident fish species.** The need is noted below in text but not specifically included in goals and objectives.

FDAUP-09
- Arctic grayling were listed as "believed to be" the most abundant species in the inundation zone (Delaney et al. 1981, Sautner and Stratton 1983), yet are not included in the species of interest listed above. Recommendation - Identify and list target species for this and every study. Documentation of all fish collected during sampling shall include species and length.

FDAUP-10

FDAUP-11
- Species listing in this section does not match species list on Table 7.5.9. Update table with current information.

7.5.2. Existing Information and Need for Additional Information (Page 7-11)

FDAUP-12 "Chinook salmon are the only anadromous species known to occur in the upper Susitna River and tributaries although the information on the extent of their distribution is limited."

- Dolly Varden in Alaska systems are not evenly distributed and may be found in tributaries.
- Longnose suckers are found in high densities in Upper Susitna tributaries.

FDAUP-13 7.5.4.1 Passive and Active Sampling (Page 7-13)

"nighttime sampling"

- Long daylight hours during the summer may reduce the difference between day and "night" sampling effectiveness. The periods of twilight are important sampling periods.

FDAUP-14 "and state and federal regulatory agencies will grant permission to conduct the sampling efforts"

- This statement appears to imply state and federal agencies will automatically grant permission or permits. Recommend rewording, i.e. Fish sampling will only be conducted after all required state and federal permits are obtained.

FDAUP-15 Gill Net Sampling (Page 7-13)

Identify the net information...if we know what was used in the 1980's then it should be identified. What is the depth of each net? Did they mean 7.5 ft. deep panels instead of 7.5 ft. long panels? List mesh sizes, number of panels, panel lengths and overall net length. Will small mesh ends be located nearshore or will sampling be random or reversed as to mesh size close to shore? Will surface and bottom set nets be deployed? What is the targeted time duration for each set.

Electrofishing (Page 7-13)

"Conduct monthly, boat-mounted, barge, or backpack electrofishing surveys using standardized transects."

FDAUP-16
- More detailed descriptions are needed on how catch-per-unit-effort (CPUE) will be calculated during multi-pass electro-fishing. CPUE results should provide a meaningful estimate that is not significantly biased.

FDAUP-17
- Due to the size of the area to be studied, it is not clear if monthly sampling will be adequate. Further description of the rationale for this sampling frequency is needed.

FDAUP-18
- Electrofishing should be discontinued in a sampling reach if large salmonids are encountered. Criteria should be developed to determine when or if electrofishing should be discontinued when other large fish are encountered. Rainbow trout are particularly sensitive to electrofishing. Sampling plans should include a description of electrofishing protocols.

FDAUP-19
- Electrofishing may be effective in the side channels or sloughs but may have limited success in swift or turbid waters. Suspended materials in turbid water can affect conductivity which may result in harmful effects on fish, especially larger fish due to a larger body surface in contact with the electrical field. Sudden changes in turbidity can create zones of higher amperage which can be fatal to young-of-year fish as well as larger fish. Electrofishing in swift current is problematic with fish being swept away before they can be netted. Similarly, turbidity increases losses from samples.

"In all cases the electrofishing unit will be operated and configured with settings consistent with guidelines established by ADF&G." (Page 7-13)

FDAUP-20
- ADF&G has not established SOP's related to electrofishing settings etc. Smith-Root is the manufacturer of most electrofishing equipment and boats and offers certified training in safety and use of their equipment.

FDAUP-21
- Field protocols and site selection/justification is needed. Length of transects, type of substrate, geomorphic characteristics etc. need to be identified. Block nets should be used to ensure meaningful sampling results during backpack shocking for relative abundance surveys.

Trot Lines (Page 7-14)

"Trot line sampling was one of the more frequently used methods during the 1980s and was the primary method for capturing burbot."

FDAUP-22
- Trot line sampling is terminal, recommend use of alternative, non-lethal methods of burbot sampling whenever possible.

FDAUP-23
- More information needed on site selection and rationale.

FDAUP-24
- Burbot are mass spawners and migrate and collect in large "balls" during the winter (January and February). This spawning probably occurs in slow moving side channels. Under ice video may be of some use once locations are identified.

FDAUP-25 • Recommended reference material: Paragamian, Vaughn L and David H. Bennett, 2008. Burbot: Ecology, Management and Culture. American Fisheries Society, Symposium 59, Bethesda, Maryland. AFS Stock Number 54059P, 270 pages.

Minnow Traps (Page 7-14)

FDAUP-26 • Salmon eggs are required to be sterilized or disinfected in iodine solution under conditions of ADF&G sampling permits.

FDAUP-27 • When and where will minnow traps be deployed and how will areas for deployment be selected?

FDAUP-28 • Winter deployment of minnow traps should be considered.

Snorkeling (Page 7-14)

"Two experienced biologists will conduct snorkel surveys along standardized transects in clear water areas during both day and night during each field survey effort."

FDAUP-29 • Will two or one biologist snorkel during each snorkeling survey event?

FDAUP-30 • What is the sampling schedule? When? Seasons? Site selection criteria/rational needed.

FDAUP-31 • Will block nets be used?

Fyke/Hoop Nets (Page 7-15)

FDAUP-32 • What is the mesh size, hoop size, number of hoops, length of nets, etc.?

"The nets will be operated continuously for a two-day period."

FDAUP-33 • Is this continued sampling or a single event? What time of year? How many sampling events? List protocols.

Beach Seine (Page 7-15)

FDAUP-34 • Identification of beach seines should not limit the equipment choices as to length and depth. What is the mesh size?

FDAUP-35 • Small water can be sampled using a shorter and shallower beach seine. As long as the area sampled is noted and the net is deep enough to fill the water column then comparisons can be made.

FDAUP-36 • Will different substrate types be sampled? Identify geomorphic areas to be sampled.

FDAUP-37 • Will sampling include all time periods including daylight, twilight and periods of darkness?

FDAUP-38 • Identify protocols.

Outmigrant Trap (Page 7-15)

FDAUP-39 • Identify if traps will be manned during deployment.

DIDSON and Video Cameras (Page 7-15)

FDAUP-40 • Recommend that these cameras be used to identify burbot spawning in these areas.

FDAUP-41 • Identify camera locations.

FDAUP-42 • Location of all video and DIDSON surveys should be located by GPS and identified on aerial photos and project maps.

Fish Handling (Page 7-16)

FDAUP-43 • See comments under section 7.5.4.2. regarding use of PIT tags. Describe the method to implant PIT tags and where on fish they are to be tagged. Describe anesthetic procedures that will be used. Will FLOY^{TM} tags be used for recapture studies?

"Tissue or whole fish samples will also be collected in the mainstem Susitna River for assessment of metals concentrations (Objective 4) (see *Mercury Assessment and Potential for Bioaccumulation Study*, Section 5.12)."

FDAUP-44 • Goals for assessment of baseline metal studies and mercury studies may be vastly different and require different age classes.

FDAUP-45 • Due to subsistence uses of whole fish, whole fish samples should be processed.

FDAUP-46 • Sampling should focus on older fish initially to identify if bioaccumulation is occurring. Younger fish have lower levels of bioaccumulated metals or pollutants which may cause results to indicate lower concentrations than targeted, older ~~harvested~~ fish. If results are positive, additional sampling will be needed..

7.5.4.2. Remote Fish Telemetry (Pages 7-16 to 7-18)

FDAUP-47 • Further discussion regarding use of PIT tags has raised concern on the ability of this technology to be utilized effectively in the project area. The primary concern is that, as noted in this section, PIT tagged fish must pass in close proximity of an antenna array thereby limiting its use to sufficiently small water bodies. It is unknown how many water bodies fit this criteria and where they are located to provide a complete assessment. Further discussion is needed.

FDAUP-48 • The likelihood of unintentional human consumption of PIT tags needs to be addressed.

Section 7.6 Study of Fish Distribution and Abundance in the Middle and Lower Susitna River

FDAML-07 Recommend a section specifically addressing winter sampling approaches. Minnow trapping under ice should be incorporated during the winter sampling and recommend evaluating the feasibility of under ice videography and Didson technologies.

Section 7.6.1.1. Study Goals and Objectives (Page 7-23)

FDAML-08
- Fish distribution efforts should be directed at streams not already identified as supporting anadromous fishes in ADF&Gs Anadromous Waters Catalog (AWC). AWC information can be accessed through ADF&Gs online Fish Resource Monitor at: http://gis.sf.adfg.state.ak.us/FlexMaps/fishresourcemonitor.html?mode=awc

FDAML-09
- Identify target species

FDAML-10
- **Section** Is goal #1 for juveniles only?

Section 7.6.4.1.2. Outmigrant Traps (Page 7-27)

FDAML-11
- Identify locations of outmigrant traps and if traps will be manned during deployment.

FDAML-12
- Page 7-27 states "Flow conditions permitting, traps will be fished on a cycle of 48 hours on, 72 hours off throughout the ice-free period."

  Is this from ice-out to ice up? This is several months of two days on and three days off. Equivalent to 40% of all hours between spring thaw and fall freeze up. Is this really what is proposed?

Section 7.6.4.2. Remote Fish Telemetry (Page 7-27)

"However, the "re-sighting" of PIT-tagged fish is limited to the sites where antenna arrays are placed."

FDAML-13
- See comments regarding use of PIT tags in section 7.5.4.2. All fish captured by any sampling method after the first PIT tagging event will need to be checked for a PIT tag. If fish are sacrificed, the PIT tag registry must be updated as soon as possible. Checking all fish for PIT tags will prevent double tagging of a fish which could introduce error in later passive tag reading.

Section 7.6.4.2.1. Radiotelemetry (Page 7-27)

"Radio transmitters will be surgically implanted in up to 10 fish of sufficient body size of each species from five habitat types in the middle and lower river."

FDAML-14
- Identify species to be tagged.

FDAML-15
- Define surgical methods and placements of radio tags in fish. Will an exterior mark be also used to quickly identify radio tagged fish during later sampling events?

Section 7.7.4.1.1 Fish Capture, Page 7-36
- Removing fishwheels at Curry in the first week of September likely misses a substantial portion of the coho and chum runs. Should consider operating fishwheels through September into October.

Section 7.8 River Productivity Study

Overall, more information needed on sampling methodology.

Section 7.8.4.2.1.Benthic Macroinvertebrate sampling.

RIVPRO-10
- Should consider drill holes for winter macroinvertebrate sampling; probably safer than sampling winter open water sites.

RIVPRO-11
- Explain site selection and how site will be sampled at all flows. If sample sites will not be permanently wetted, how is the length of time required for colonization determined in order to sample sites that are not permanently wetted.

RIVPRO-12
- More information is needed on woody debris sampling design. Multiple sections taken from each snag would likely result in pseudoreplication issues. Recommend sampling multiple snags.

RIVPRO-13 Section 7.8.4.2.2 Benthic Algae Sampling

Describe the methods that will be used for sampling and analysis.

RIVPRO-14 Section 7.8.4.4. Surrogates for future impacts

Should assess the feasibility of establishing reference sites in adjacent systems (e.g. evaluate the Chulitna, Talkeetna, etc.).

Section 7.8.4.7 Fish Diet

RIVPRO-15
- What are the targeted species and lifestage for diet analysis? What methods will be used and what is the feasibility of non-lethal methods for juvenile salmonids?

RIVPRO-16
- What sample preservation will be used? Need to consider prey condition after flushing. To what level of taxonomic resolution will samples be identified?

RIVPRO-17 Section 7.8.4.9 Macroinvertebrate Colonization

What is the artificial substrate material and likelihood it will influence colonization results?

Section 7.17 Cook Inlet Beluga Whale Study

Three objectives have been identified for this study:

1. Document the presence of all marine mammals in the Susitna River delta, focusing on Cook Inlet Beluga whales (CIBW) distribution within Type 1 critical habitat;
2. Determine marine mammal utilization of the Susitna River, focusing on the upstream extent of CIBWs; and
3. Evaluate the relationships between potential hydropower-related changes in the lower Susitna River, CIBW in-river movements, and CIBW prey availability.

Section 7.17.4 Study Methods

The basic approach to the draft proposed CIBW study plan is to obtain additional information on CIBW distribution and group size during the months of open-water. Other studies will gain information on some open-water period prey species; i.e., eulachon and salmon.

CIBW-12 Apparently, as indicated in Section 7.17.4.3, estimated effects on CIBW will be determined through a modeling approach, incorporating results on the distribution of CIBW from this proposed study, and results from other hydrologic, prey, and habitat studies. The Project may have indirect effects on CIBW caused by changes in the distribution or abundance of some prey species, or by restricted access to prey species. The methodology should describe the general modeling approach especially as applied to objective number 3.

Section 7.17.4.1 Document CIBW and other Marine Mammal Presence within Susitna River Delta (Page 155 – 156)

CIBW-13 Section 7.17.4.1 describes the proposed methods for aerial surveys, apparently to obtain 'fine-scale' information on CIBW seasonal distribution. The specific objective of the surveys relative to distribution and abundance should be more clearly defined. If an estimate of abundance is sought, the proposed survey effort will result in minimal levels of precision and accuracy. Obtaining relative group size information appears to be more realistic, and methods other than Hobbs et al. (2011) that are more consistent with the objectives of this study should be considered.

CIBW-14 Section 7.17.4.1 describes the proposed methods using video and still cameras to determine the upstream extent of CIBWs in the Susitna River. Our preferred approach is to use satellite telemetry backed up with Passive acoustic monitoring (PAM). Satellite tags will allow estimation of the proportion of time individuals are using the Susitna as opposed to other areas. This will complement the other methods efforts to estimate spatial extent and total amount of use of the Susitna. Those efforts should include PAM for the following reasons:

- The proposed methodology (video and still cameras) will limit data collection to the day light hours, and periods of good visibility (i.e., not during heavy rain or fog). PAM should be used to collect additional information on the presence of CIBW, 24 hours per day, 7 days a week, independent of weather conditions.
- Determining if project-induced changes in prey distribution and prey habitat will affect CIBW is problematic when only knowing the distributions of CIBW and their prey. Information on when and where belugas are foraging, which can be obtained through PAM, will increase the ability to determine project-induced changes. CIBW foraging behavior is extremely difficult to identify through visual methods due to the turbidity of the water in Upper CI.

- When visual and PAM methodologies are used concurrently at the same locations, acoustic behavioral information (e.g., foraging) from those locations can be applied to acoustic datasets from areas where no visual observations are collected.
- Substantial detail is provided on video data collection, including behavior logs and group counts, yet the rationale for this level of detail to the primary objective of the study is not clear. Substantial costs will be incurred to complete the processing of large amounts of video and still imagery collected. PAM should be considered an alternative to reduce costs and obtain results more quickly and consistently (e.g. continuous sampling independently of weather and daylight). Specifically, existing software that has been used in similar river environments within Cook Inlet (i.e., Eagle River, Knik Arm) successfully detected beluga whales and provided automatically processed data, and semi-automated analysis methods have been successful at sites near Beluga River and the within the Little Susitna River. Further, based on visual vs. acoustic comparisons in Eagle River, an index to relative abundance based on acoustic data of CIBW was established. A similar index could be established for the Susitna Delta, and be applied to acoustic data in areas where visual data are not collected.

CIBW-15
- The over-winter period should not be excluded from the study. Information exists (Goetz et al. (2012) that indicates belugas may forage in this area more in winter than summer, and such over-winter foraging could potentially be very important to belugas, especially juveniles and pregnant/lactating females. If data on the presence of belugas in this area is deemed important, PAM has been used successfully to detect belugas during the overwinter period in a similar environment; i.e., outside of Beluga River, to the west of the Susitna Delta.

Section 8.5 Study of Distribution, Abundance, Productivity, and Survival of Moose

MOOSE-5
- ADF&G proposed this study and intends to conduct GeoSpatial Population Estimation (GSPE) in the fall of 2012. If this is not feasible due to weather or other constraint, then 2013 project will need to be amended to include a GSPE component.
- The interim draft RSP appears to adequately address concerns with the moose study plan.

Section 8.6 Study of Distribution, Abundance, Movements, and Productivity of Caribou

- ADF&G Division of Wildlife Conservation (DWC) proposed this study and intends to take responsibility for implementation. Except as noted below, the interim draft RSP appears to adequately address concerns with the caribou study plan.

CBOU-2
- This study was originally proposed to extend through 2016 in order to better characterize year to year variation in caribou movement patterns, but it was changed to end with the license application date of 2014. Two years of data are not expected to sufficiently characterize caribou movement patterns. This project will likely need to be extended.

Section 8.7 Study of Distribution, Abundance, and Habitat Use of Dall's Sheep

DALL-1
- DWC agreed to conduct Dall's sheep surveys of suitable sheep habitat within GMU 13E south of the Denali highway and east of the Park's highway. ADF&G submitted a revised draft study plan that describes this work.

DALL-2
- The interim draft Dall's sheep study plan appears to adequately describe the study area and methods to be employed by ADF&G during the summer count. The map still needs to be revised to reflect the redefined study area.

DALL-3
- As discussed at the October 16 Terrestrial Resources working group meeting, ADF&G believes the proposed survey work along with analysis of previous studies and site inspection of the Jay Creek and Watana mineral licks is adequate to assess sheep status. It is not necessary to intensively monitor the licks in 2013 or to place radiocollars on sheep in the study area.

Section 8.8 Study of Distribution, Abundance, and Habitat Use by Large Carnivores

LGCAR-1
- DWC agreed to conduct spatial modeling of bear density in cooperation with David Miller of the University of Rhode Island and has submitted a proposal describing the project.

LGCAR-2
- As noted in the interim draft RSP, DWC would like to be consulted during sampling design and analysis of hair samples downstream of the proposed dam for DNA and stable isotope analysis.

Section 8.9 Study of Distribution and Abundance of Wolverines

WOLV-2
- DWC agreed to conduct a Sample-Unit Probability Estimator (SUPE) survey for wolverine.
- A study plan has been submitted that deals with the issues identified in the interim draft RSP consultation table version 10/15/2012.

WOLV-3
- This proposal includes conducting occupancy modeling in 2013 and 2014 and as such is expected to provide information on habitat associations. Occupancy modeling will also provide population trend information in the future.
- The recently released interim draft RSP for Wolverines appears to adequately incorporate these changes.

Section 8.10 Study of Terrestrial Furbearer Abundance and Habitat Use

TERFUR-1
- DWC supports this project intended to assess abundance of coyote, red fox, lynx and marten with modifications to address concerns expressed here.

TERFUR-2
- DWC recognizes that objectives were edited in the interim draft RSP to reflect that DNA analysis of scats and hair will be used for markers rather than the raw sources (scat/hair)

mentioned in the PSP objectives. Similarly, the kind of snowshoe hare sign to be quantified in objective 4 was specified as pellet counts.

TERFUR-3

- To improve reliability of results the final study plan will need to address sample sizes, capture heterogeneity, and population closure for DNA mark-recapture estimates. The final study plan should also address the length of the study and sample sizes relative to estimation of vital rates and population size.

TERFUR-4

- FERC's Integrated Licensing Process legitimately seeks to document abundance of a wide variety of wildlife species prior to project approval. The limitations of abundance data for species that depend on the hare cycle and are naturally cyclic themselves must also be acknowledged. This work will likely be conducted during a low in the hare cycle, and so predator populations will likely be higher after dam construction begins despite any direct effect of the development. While the comparison to Denali National Park will help, caution is necessary.
- The interim draft RSP includes more details describing the proposed sampling design and the statistical analysis to address concerns about population closure and heterogeneity. DWC is encouraged to see these changes.

Section 8.11. Study of Aquatic Furbearer Abundance and Habitat Use

AQFUR-1

The interim draft RSP indicates that river otter track surveys will be conducted repeatedly 2-3 days after fresh snow fall. This approach lends itself to transect sampling. Occupancy modeling from these data may also be feasible depending on study design. DWC supports this general approach and should be consulted during study design.

Section 8.12. Study of Species Composition and Habitat Use of Small Mammals

SMAM-1

The idea of removing the trapping effort from the study design was discussed. The rationale for not trapping was to avoid killing a large number of small mammals known to be in the study area from previous studies.

- Small mammal populations are very dynamic and tend to be eruptive. Small mammals are very important to the prey base for mammals as well as birds, especially raptors. Long term studies are necessary to gather meaningful information.
- Given the limited opportunity to acquire the necessary long-term information, there is some justification for not engaging in a large one-time trapping effort.

Section 8.13. Study of Distribution and Habitat Use of Little Brown Bat

The specific objectives of the bat baseline study are to:

1. Assess the occurrence of little brown bats and the distribution of habitats used by bats within the impoundment zone and infrastructure areas for the Project;

2. Review geologic and topographic data for potential roosting and hibernacula sites; and
3. Examine human-made structures (bridges and buildings) for potential roosting or hibernacula.

- Flooding is biggest threat to hibernacula and maternity colonies. Timing of inundation could affect level of loss and therefore any necessary mitigation.

BAT-2
- Need to identify and locate geological features including any karst topography, caves or abandoned hard rock mines that could serve as maternity colonies or hibernacula.

BAT-3
- Locate any potential human-made structures within the inundation zone that could serve as maternity colonies or hibernacula.

BAT-4
- Document level of use for any maternity colonies or hibernacula identified.

Section 8.14 Waterbird Migration, Breeding, and Habitat Study

WTRBRD-03
- Harlequin duck surveys to be conducted from a R44 type helicopter along all suitable moving water bodies (i.e. rivers, streams) within study area. The interim draft RSP states that moving water bodies will be surveyed as far upstream as practical; even outside of study area. The number of moving water bodies surveyed and the extent to which they will be surveyed will become more apparent after the initial survey period. Question whether practical to follow streams all the way up into the watershed (Watana Creek has a very large watershed outside of study area).

WTRBRD-04
- DWC consulted with AEA and the USFWS and the interim draft RSP appears to adequately address concerns discussed during consultation.

WTRBRD-05
- The interim draft does not specify a minimum size for waterbodies to be surveyed. Surveyed lakes should include those surveyed previously by Kessel et al. (1982). Experienced observers should also be able to select waterbodies based on nesting habitat suitability in the immediate vicinity of the waterbody.

Section 8.16. Breeding Survey Study of Landbirds and Shorebirds

DWC has previously commented that "distance estimation techniques suggested have been recently shown to produce very problematic density estimates (Alldredge et al. 2007a, Alldredge et al. 2008, Efford et al. 2009). Detectability is notoriously difficult with auditory surveys. At a minimum a double count observer method should be employed. Differences in auditory distance estimation can still lead to profoundly unstable results (Alldredge et al. 2007b). Despite these concerns, the protocols should be compatible with Alaska Landbird Monitoring System (ALMS), and the data should be made available to USGS for inclusion in ALMS for inventory and habitat associations after completion."

To deal most effectively with these concerns, we suggest:

BREED-04 1. Establishing 3 – 4 or more distance bands instead of requiring observers to estimate actual distances.

BREED-05 2. Observers must be trained, tested and prequalified for species identification and distance before going afield.

BREED-06 3. Using double observers if densities are to be calculated. Using double observers has been the subject of debate, most recently at the Terrestrial Wildlife Working group meeting on October 15, 2012. DWC continues to recommend use of double observers as it is the best way to overcome deficiencies described above,

Alldredge, M. W., T. R. Simons, K. H. Pollock. 2007. A Field Evaluation of Distance Measurement Error in Auditory Avian Point Count Surveys. The Journal of Wildlife Management. 71(8).

Alldredge, M. W., T. R. Simons, K. H. Pollock, and K. Pacifici. 2007. A field evaluation of the time-of detection method to estimate population size and density for aural avian point counts. Avian Conservation and Ecology - Écologie et conservation des oiseaux 2(2): 13. [online] URL: http://www.ace-eco.org/vol2/iss2/art13/

Alldredge, M.W., K. Pacifici, T.R. Simons and K. H. Pollock. 2008. Blackwell Publishing Ltd. A novel field evaluation of the effectiveness of distance and independent observer sampling to estimate aural avian detection probabilities. Journal of Applied Ecology 45: 1349–1356.

Efford, M.G. and D.K. Dawson. 2009. Effect of Distance-related Heterogeneity on Population Size Estimates from Point Counts. The Auk 126(1):100–111.

Kessel, B., S. O. MacDonald, D. D. Gibson, B. A. Cooper, and B. A. Anderson. 1982. Susitna Hydroelectric Project environmental studies, Phase I final report—Subtask 7.11: Birds and non-game mammals. Report prepared by University of Alaska Museum, Fairbanks, and Terrestrial Environmental Specialists, Inc., Phoenix, NY for Alaska Power Authority, Anchorage. 149 pp.

Section 8.16.4 Study Methods (Page 8-95)

BREED-07 • DWC supports 2 sampling periods and 2 years of sampling as called for in plan.

BREED-08 • Need specific surveys to inventory shorebirds and cavity nesters in addition to raptors and water birds as proposed.

Section 8.18 Study of Distribution and Habitat Use of Wood Frogs

FROG-1 • DWC has been in consultation with AEA about wood frogs and is pleased to see the interim draft RSP for Wood Frogs. Unfortunately, we have not yet had an adequate opportunity to review the revisions and will continue to consult on study design.

Section 10. Recreation and Aesthetic Resources

REC-34 More detailed information is needed to better understand what data will be collected, and how it will be summarized, analyzed, and results generated. In particular, more information is needed on the following components:

a) Incidental Observation Survey

b) Telephone Survey of Railbelt Residents

c) Intercept Surveys and Structured Observation Visitor Counts

ADF&G recommends that AEA conduct a technical review with interested agencies on the preliminary results generated by the proposed recreation use and demand surveys noted above (after data collection and preliminary analyses) to identify possible concerns related to the detailed analyses prior to development of the final reports. It is often the case that errors in data analysis can be spotted at this phase prior to interpretation and reporting.

REC-35 Section 10.5.4 Recreation Use and Demand (pg.10-6)

Paragraph #1, Sentence #2: The sentence "visitors to the area participate in a wide variety of activities, including…" should also mention all-terrain vehicle (ATV) and/or off-road vehicle (ORV) use, hiking, and wildlife viewing. The activities noted are certainly not inclusive and more detailed lists and inclusive language are used elsewhere in this document.

REC-36 Paragraph #3, Sentence #2: "Effects of the project features (e.g. reservoir and access roads) on….." is rather non-inclusive of the various recreational activities in the project areas and the language probably should be modified. Fishing and berry picking are other "consumptive" recreation activities that should be mentioned. Bird-watching, as an example of non-consumptive use, should be broadened to wildlife-viewing.

REC-37 Paragraph #3, Sentence #4: The sentence that reads "There are also potential effects of induced recreation along the Denali Highway…." doesn't make sense. Are they trying to say "there is also the potential for induced effects on recreation from the project along the Denali Highway"? This statement should be clarified if left in the document.

REC-38
SOC-24 Paragraph #4: Regarding the reference to the Socioeconomic Resource Study and the economic contribution of recreation in the study area. AEA should be aware of the following study related to economic contributions of sport fishing to the Alaska economy.

> Southwick Associates Inc. and W. J. Romberg, A. E. Bingham, G. B. Jennings, and R. A. Clark. 2008. Economic impacts and contributions of sportfishing in Alaska, 2007. Alaska Department of Fish and Game, Professional Publication No. 08-01, Anchorage.

Although the regional analysis may not provide direct estimates related to the proposed project, it is a template for estimating expenditures associated with recreation use in Alaska. This study will likely be repeated in 2014 or 2015.

REC-39 Section 10.5.4 Identification and Analysis of Salient Date from Existing Survey Research

The Alaska Visitor Statistic Program (AVSP) is a reasonable survey instrument and data source for non-resident recreation use in and around the project area. Other relevant sources of salient data for both non-resident and resident recreation use which are not noted in this proposed study plan, include:

ADF&G Statewide Harvest Survey. Annual survey of resident and non-resident sport fishing households. Survey provides annual statewide, regional and watershed estimates of sportfishing days fished by species by residency, guided/unguided. Estimates available for the past 30 yrs. Published report through 2010, available data through 2011. See:

Jennings, G. B., K. Sundet and A. E. Bingham. 2011. Estimates of participation, catch, and harvest in Alaska sport fisheries during 2010. Alaska Department of Fish and Game, Fishery Data Series No. 11-60, Anchorage.

Alaska Resident Statistics Program (ARSP). Survey commissioned in 2000 to estimate Alaska resident recreation behavior patterns and preferences. See:

Fix, P. J. (2009). Alaska Residents Statistics Program Final Report. Fairbanks, Alaska: School of Natural Resources and Agricultural Sciences, Department of Resources Management, University of Alaska Fairbanks.

REC-40 Section 10.5.4 Incidental Observation Study (p.10-8)

The description of this study (IOS) states that this survey will not have statistical value, but will be used throughout the study. How will the IOS feed into other studies and decision making? Will the results of the incidental observation just be a map with points indicating observed recreation for reference, or are there some other methods that could be employed to otherwise use the results of the IOS. There should be more explanation and details on how else this information could be useful in the process.

REC-41 Section 10.5.4 Telephone Surveys of Railbelt Residents (p.10-8)

Paragraph #1, Sentence #2: The plan says that a statistical sample of 600-900 randomly-selected Railbelt residents will be drawn and later that estimates for possible sub-groups will be developed (and sample adjusted). It is our experience with public surveys that likely response rates to the survey will be relatively low (less than 40% of drawn sample), so we believe that the 600-900 sample size is probably too low to provide sufficient responses for sub-group estimates to be developed with any degree of precision. Suggest identification of sub-groups during study development and adjustment of sample size and sampling protocol as needed. Question: what are the sub-groups likely to be based on – location of residence, recreation type or mode of travel? Please explain in subsequent detailed study plan. The ARSP study plan (noted above) may provide useful background for sub-group identification.

Given that statistical estimates of resident recreational use and other recreation variables are to be developed from this study, it is recommended that a detailed study plan for the telephone survey be developed and review by relevant agencies and organizations for adherence to current social science research practices prior to implementation.

REC-42

Section 10.5.4 Intercept Surveys and Structured Observation Visitor Counts (p.10-9)

Paragraph #1. Although the list of specific recreation access modes mentioned in this paragraph does not appear to be exclusive, it seems that ATV/ORV access should be mentioned among those listed given the large number of ATV/ORV access points along the Denali Hwy south as well from the Talkeetna area. If in paragraph #2 the plan is going to mention specific mode examples, it should list an ATV/ORV major access trail as well.

It appears that this will be a non-probability sample of recreation users (paragraph #4 last sentence) - since there appears that a statistical sampling process will not be employed. Please explain how the resulting data from this particular sub-study would be summarized and integrated with other recreation data.

This concludes the current SD2 and PSP comments from the State of Alaska.

Document Content(s)

United States Department of the Interior

NATIONAL PARK SERVICE
Alaska Region
240 West 5th Avenue, Room 114
Anchorage, Alaska 99501

IN REPLY REFER TO
L7425 (AKRO-EPC)

VIA ELECTRONIC MAIL: NO HARD COPY TO FOLLOW (FERC eFile P-14241-000)

NOV 09 2012

Kimberly D. Bose
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Subject: General and Study-specific Comments on the Draft Revised 2013-14 Study Plans (DRSP) 10.5 (Recreation Resources), 10.6 (Aesthetics Resources), and 10.7 (River Recreation Flow and Access) for the Susitna-Watana Hydroelectric Project (P-14241), Susitna River, Matanuska-Susitna Borough, Alaska

Dear Secretary Bose:

The National Park Service (NPS), Alaska Region offers the following comments in response to the Federal Energy Regulatory Commission's (FERC) Notice of Soliciting Comments on the 2013-14 Proposed Study Plans (PSP). The NPS Hydropower Recreation Assistance program consults with license applicants and stakeholders providing technical assistance in assessing impacts on public recreational resources during the FERC licensing process. The program draws its authority from the Federal Power Act and technical assistance provisions of the Outdoor Recreation Act of 1962, the Wild and Scenic Rivers Act of 1968, and the National Trails System Act of 1968.

General Comments

To date, NPS has been fully engaged with the Alaska Energy Authority (AEA) and their consultants. Our comments build on the prior comments and engagement by NPS in this process. We have commented on the Preliminary Permit Application and Pre-Application Document (PAD), submitted detailed study requests; and examined numerous preliminary study plans, including the PSPs and three DRSPs. We are encouraged that many of our comments and recommendations have been considered and adopted, and are confident that the consultant team chosen by AEA (URS, Oasis-ERM, and the McDowell Group) possesses the competence, cooperative spirit, and energy needed to ensure successful planning and implementation of the recreation and aesthetic resource studies.

In the area of Aesthetic Resources, we are supportive of the current, progressive approach being taken by AEA's consultant, URS, in using an expanded/modified version of BLM's basic Visual Resources Management method. URS's presentation during the October 3, 2012 work group meeting was highly informative and we look forward to future collaboration on this study.

To aid stakeholders and FERC in assessing progress towards agreement on the scope, design and execution of the project's recreation and aesthetics studies, AEA and its consultant team have developed a table outlining issues we and other stakeholders have raised and AEA's response. This table – Table 12.4-1 of the Recreation and Aesthetics DRSP – is a very helpful tool in support of our mutual interest in resolving outstanding study plan issues. We appreciate the work involved in producing this table, and agree with many of the applicant's responses to our questions and concerns. There remain some areas, however, where NPS continues to have concerns. Our comments, below, focus on these areas, and are based on a somewhat rushed review of the applicant's most recent versions of the various study plans and survey instruments, rather than the original PSP filed in July 2012.

AEA and its consultants have indicated that NPS and other stakeholders will be consulted as critical milestones approach, such as 2012 study results dissemination, further development of recreation survey instruments and methodology, and revisions to study scope or methods that may be necessary following the first field season of Integrated Licensing Process (ILP) studies in 2013. We look forward to maintaining a collaborative relationship with AEA, its consultants, and other stakeholders. We do believe, however, that AEA could be doing more to meet the requirements of 18 CFR 5.11(b)(3), which requires applicants to include, for each study in its PSP, "Provisions for periodic progress reports, including the manner and extent to which information will be shared; and sufficient time for technical review of the analysis and results." We understand the massive workload associated with preparing a PSP that includes 58 separate studies of a remote area where previous studies are either dated, or non-existent. The State of Alaska nonetheless chose to use the ILP in its ambitious licensing and construction schedule. Given our own capacity, it is already proving difficult for NPS to fully engage, covering technical working group (TWG) meetings that have been scheduled at short notice without first polling stakeholder availability, and with last minute agendas; and checking the project website multiple times a day to see if new documents have been posted. We have endeavored to review and respond in a meaningful manner to interim work products that have been released at, rather than prior to, workgroup meetings, but have not always been able to give these documents the level of scrutiny they deserve. We believe that better use could be made of AEA, consultant, resource agency, and other stakeholder time if individual workgroups had more autonomy to decide where and when to meet, and if meetings were timed to allow advance review of important interim work products. In addition, as we note in more detail below, we believe this project would benefit from following the Communication Protocol mentioned in the PAD and resource study specific schedules and communications plans to reduce conflicts, confusion and delays about "the manner and extent to which information will be shared."

GEN-01

Baseline Data and Information - In our comments on the 2012 (pre-ILP) studies, we underscored the need for baseline information on both recreation and aesthetic resources in the area potentially affected by the project. Very limited field work for these resources was compiled for the previous Watana project in the 1980s. The 2012 field reconnaissance work represents the first effort to collect data using methods consistent with current hydropower licensing requirements. However, because the results of the 2012 studies have not yet been released, NPS and other stakeholders have had to develop our recreation and aesthetic resource study requests without benefit of solid baseline resource information, e.g. without knowing for certain which recreational activities take place in the project area, or which routes and sites are particularly important to recreational users.

Our study requests reiterated the need for more detailed information concerning the Watana project area's existing recreation and aesthetics resources, as well as the likely effects of the project on these resources over a 50-year license period. Much of our subsequent agreement and confidence in the direction of the 2013-14 studies is predicated on the effectiveness of the data collection and compilation of historic information, plus the rigor of the reconnaissance effort currently underway (2012 studies).

Our concern about this issue was noted in Table 12.4-1 (see fifth comment). AEA summarized this concern as follows: REC-1

"According to current published schedule, agencies and stakeholders will not have results of critical 2012 reconnaissance, baselining studies that are key to determining scope, adequacy of the 2013-14 ILP studies before NPS's final opportunity to comment on ILP studies."

AEA's response is:

"AEA study teams **are using** information gathered in 2012 to inform the study plan process in those instances that such information is applicable to customize or alter specific methodologies. Much of the work being done in 2012 has to do with collection of baseline information which by itself does not necessarily alter the study methods proposed" (emphasis added).

NPS notes that no 2012 study reports have yet been released. Perhaps AEA and its consultants "are using" internal drafts of the reports to inform the DRSPs, but if so, this information is not available to resource agencies, the public, and presumably FERC. If our own analysis of the 2012 results leads us to believe that certain activities, locations, or issues may have been overlooked in the Revised Study Plans (RSP), NPS reserves the right to request amendments to the relevant study plans, even if the ILP deadline has passed. Without such amendments, data gaps may make it difficult for us develop appropriate license condition recommendations to protect, mitigate and enhance outdoor recreation resources.

While we agree that some aspects of study methodology are independent of baseline information about the spatial and temporal distribution of recreational activities in the

project area, other aspects are not. For example, AEA is not currently proposing to perform intercept surveys during the coldest, darkest quarter of the year (during the three month period from mid-November to mid-February), citing contactor safety concerns and likely low numbers of recreational users at this time of year. Yet without the 2012 reconnaissance study results, we do not yet know what those numbers are. In addition, the value of a recreational resource is more than a function of the number of its users. Resources that provide rare or distinctive opportunities, e.g. viewing the Northern Lights in near complete silence on New Year's Eve from an ice-covered river accessed by dog-sled, snow machine, or ski, cannot be said to be less important than summer activities that also see low participation rates, such as paddling one of North America's few relatively accessible Class V+ rivers at 29,000 cfs.

It is possible that the 2012 reconnaissance work will tell us that some areas potentially affected by the project do see important use during this period, or are significant for aesthetic opportunities unavailable during the other nine months. We encourage the study team to consider ways to survey recreationists visiting the study area during these months that don't involve intercepts at remote locations. We remain concerned about whether this kind of 2012 survey result will be applied correctly to the ILP study plans in the absence of any involvement by stakeholders, the public, or, potentially, even FERC's own recreation specialists. Our concerns also apply to Aesthetic Resources and River Recreation Flow and Access PSPs. NPS and other resource agencies, along with the public, are effectively being asked to take AEA's word that if results of 2012 studies indicate a need to modify ILP studies, such modifications will be made voluntarily, after the ILP study plan resolution period has concluded. This points to the larger problem, unique to original projects that are being licensed using a process designed for existing projects with abundant baseline resource information (i.e., the ILP), of trying to finalize study plans for a project before reconnaissance level work is complete.

The DRSPs are replete with references to the integration of 2012 study results having been taken into consideration, using the past tense. To date, we have not seen any results from the 2012 recreation and aesthetics studies, although it appears that AEA is making progress in consolidating baseline information. At one of the workgroup meetings this fall, AEA's Project Manager suggested that 2012 preliminary results might be released for our review prior to the November 14, 2012 PSP comment deadline, provided we understood that the data were subject to change and corrections and were not ready for release to the general public. While we can appreciate that emerging data and information is being integrated into the revised study plans piecemeal, we anxiously await a report from the 2012 studies that satisfies our original request for comprehensive reconnaissance and assessment of baseline information for this project. Because we do not yet have this report, we are filing these comments without the benefit of information about recreational and aesthetics issues that the 2012 study report might contain.

We have one more opportunity under the ILP to submit formal comments about this project's study plans: comments on the applicant's RSP, which are due in mid-January. And since no workgroup meetings are planned between the release of the RSP on December 14, 2012, and the deadline for our comments on January 18, 2013, there will be

no opportunity to consult with AEA and its team of specialists regarding the implications of the 2012 study reports. It is not known when these reports will be made available – possibly not until after we've written our RSP comments, which are due for internal agency processing by mid-January 2013.

Inclusion of Lower River in Recreation and Aesthetics Study Area - From the beginning of NPS's involvement in this project we have maintained that the proposed project may significantly alter the character and supply of recreational opportunities currently provided within the proposed project area. We also believe that aesthetic values (e.g., visual resources and natural sounds) will be altered. Changes in flows, channel and floodplain morphology, riparian vegetation and winter snow and ice cover downstream of the proposed project may affect recreational access to those areas, e.g., recreational boating and winter travel along and across the Susitna River. While we understand that two large tributaries to the Susitna – the Chulitna and Talkeetna rivers – contribute substantial volumes of flow and sediment to the system from Talkeetna downstream to the mouth of the Susitna River, we note that the preliminary revised study plans for ice processes, instream flows, riparian vegetation, etc. nonetheless continue to include the "lower river" (i.e. reach from Talkeetna to Cook Inlet) in their geographical scope.

For example, on pages 18-19 of the October 28, 2012 DRSP for Instream Flow, AEA states:

"The lower extent of the Project Area will be assessed by the flow routing modeling to the extent of Project operational influence. The final Lower River study area extent will be determined by examining the flow routing model results in consultation with the TWG."

REC-2
AES-1

NPS continues to question why the study area extent for recreation and aesthetics is being prematurely constrained by AEA to the upper and middle rivers when this decision is being deferred, and delegated to the appropriate TWG, for other resources. Recreation and aesthetics resources are highly dependent on biophysical conditions, such as the continued availability of sport fish, the navigability of the river in summer, the existence of sloughs and gravel bars for fishing and camping, and of course the existence of stable ice for winter travel.

NPS contends unless and until the results of these biophysical studies prove conclusively that project operations will have no significant effect on flows, sediment transport, fluvial geomorphology, water quality, sport fish migration and habitat, game and furbearer species habitat, riparian vegetation, and ice formation, the lower river should not be excluded from the scope of the recreation and aesthetics studies. While AEA has stated that, if necessary (i.e., if the flow studies etc. show that project operations will have a measureable effect on lower river conditions), recreation and aesthetics studies along this reach can be added at a future date, this means that the intercept portions of such studies would not be conducted under the same variable baseline flow, weather, fishing, etc. conditions as the proposed 2013-2014 studies. Nor would it be possible for the mail-in or executive surveys to sample the exact same population as will be surveyed in 2013-2014. From an experimental design

standpoint, not including the lower river in the 2013-14 studies will unnecessarily add systematic error to the study results when, as seems likely, this area is later added and sampled in 2015 or later. This approach also risks delaying project readiness for environmental analysis.

NPS strongly recommends that baseline boating, fishing, hunting, recreational trapping, and winter use of the Susitna River corridor from Talkeetna to its mouth be assessed in order to determine the project's impacts on recreation and aesthetics. Only if studies of the river's post-project flows, morphology, ice processes, fish habitat, etc. determine that there will be no effect on relevant biophysical conditions in the river corridor downstream of Talkeetna should the recreational and aesthetics study areas be restricted to the river corridor upstream of the confluence with the Talkeetna and Chulitna rivers.

REC-3

Recreation Management Plan - We reiterate that a Recreation Management Plan (RMP) for both land and water-based use of the project area will need to be developed, as required by FERC (18 CFR 4.51(f)(5)). This plan should be developed in cooperation with NPS, BLM, other appropriate Federal and State agencies, landowners, and the public, and should include recommendations for access policies, new facilities, and safety measures. We underscore the importance of the following recreation activities and programs known to exist within the proposed project area: sport fishing and sport hunting, recreational boating, and land-based recreation.

ILP Process Plan - In our previous comments, NPS questioned elements of AEA's ILP process plan. AEA has combined a number of diverse resources under the general title of "Social Resources" and has generally scheduled all associated TWG meetings for all these resources on a single day. "Social Resources" include recreation, aesthetics, socio-economics, cultural, transportation, subsistence, and land use. NPS has previously noted, and continues to believe, that this approach is inherently unmanageable and inefficient due to the magnitude and diversity of study topics and details that must be squeezed into a seven or eight hour day. While we are pleased that AEA and its consultants have sometimes scheduled meetings focused solely on recreation and aesthetics in addition to the general work group meetings, we recommended that the Social Sciences TWG be divided into logical sub-groups so that this becomes the norm rather than the exception.

Communications Protocol - In our previous comments and on numerous occasions, NPS has requested that a formal communications protocol be developed by AEA in cooperation with stakeholders to address the communication needs. AEA continues to use a website to share documents (e.g. its own draft study requests, meeting notices, meeting agendae, meeting minutes, etc.). Currently there is no provision for automatic notifications for important new documents to allow for downloading by stakeholders, including resource agency staff, making it necessary to check the website frequently (multiple times per day in some instances) to try to ascertain if new documents are there. Due to the complexity of the project and the file naming conventions sometimes used by AEA, it can also be quite difficult to differentiate between older and newer documents.

In addition, there is no consistency in the posting of meeting minutes. Some minutes are posted almost immediately after TWG meetings, other meetings that took place months ago still have no minutes available. As a stakeholder involved in resources that are dependent on numerous other biophysical resources, NPS is interested in the TWG discussions for these other resources. We do not have the capacity to attend all Watana TWG meetings on every topic, so we rely on meeting minutes to provide an overview of important discussions. It would be extremely helpful to us, and presumably, to other stakeholders and the public, if AEA could commit to recording and posting meeting minutes within a few days of each TWG meeting.

Again, we urge AEA to explore ways to ensure that stakeholders, particularly resource agencies, receive email notices whenever materials relevant to their interests are updated. We also suggest that a full description of what each file contains be included in the file name used by AEA, e.g., version number, date, and document type. A communications protocol would help all involved in this project know what to expect, and would give stakeholders recourse for tracking down the occasional document that slips through the cracks, e.g. the 2011 Recreation Data Gap Analysis.

Tracking Interdependent Studies - NPS recognized early on in this proceeding that many of the proposed studies are related and interdependent. Various studies are scheduled within different timeframes, yet our ability to make decisions and proceed with specific inquiries is contingent on the results generated from these other studies. With limited field seasons and finite study schedules, it is imperative that such a system is developed and maintained by AEA. On October 17, 2012 AEA posted graphic illustrations of the study interdependencies with study completion dates by calendar quarter. These are also included as attachments to the DRSPs. While we believe that this process needs to be further refined, the October 2012 graphic does allow for tracking these disciplinary interdependencies.

Comments on AEA's Draft Revised 2013-14 Study Plans for Recreation and Aesthetic Resources and River Recreation Flow and Access

NPS has been encouraged by the level of effort AEA and its consultants have devoted to drafting and refining the recreation and aesthetics resource study plans. The consultants have been very responsive to our comments and interactions. On October 17, 2012 AEA posted a comprehensive table which addressed virtually all of our previous comments and concerns. We are pleased that a majority of our differences have been reconciled and are reflected in the DRSPs.

The following comments reflect a comparison of the goals and objectives from our May 2012 study requests with the most recent 2013-14 DRSPs for Recreation and Aesthetics, which were distributed on October 25, 2012. We also address instances where we still have unresolved concerns based on our read of Table 12.4-1.

DRSP 12.5, Recreation Resources - NPS's Recreation Resources Study Request stated the following goals and objectives:

"The purpose of this study is to evaluate the impacts of the proposed hydropower project on existing and potential recreation use and the quality of recreational experience provided, and to determine potential recreation mitigation, use, demand, and needs over the term of the license. The Recreation Resources Assessment should include all of the necessary components to develop a comprehensive RMP: (1) recreation impact and opportunities analysis on existing water-borne, flow dependent and snow and ice-cover dependent river experiences (including all forms of boating and fishing and winter use), and terrestrial recreation activities known to occur in the project area (including hunting, trapping, hiking, backpacking, and all forms of Off Highway Vehicle (OHV)) use; (2) current and projected recreation visitor use; (3) existing developed and dispersed recreation inventory (including access roads, trails, and developed recreation facilities) and condition assessment; (4) future and potential recreation needs assessment and analysis; (5) recreation carrying capacity; (6) economic impacts due to loss of existing and addition of new recreational opportunities."

Generally, we believe that the DRSPs address these goals and objectives.

Unresolved issues (listed by the section number from NPS's August 2012 preliminary comments on AEA's PSP):

- 10.5.2. Existing Information and Need for Additional Information – Agencies, stakeholders and the public will not have results from the "2012 data gathering efforts" until after the November 14, 2012 due date for these PSP comments.
- 10.5.4. Study Methods, Regional Recreation Analysis – 2012 information will be used to develop the RSP. Will NPS see this prior to the November 14, 2012 due date for agency and public PSP comments? If not, how will agencies and public ensure that 2012 data is applied correctly? This timing issue points to larger problem of trying to finalize study plans for a project before reconnaissance level work is compete. This also applies to Aesthetics and River Recreation Flow and Access PSPs.
- 10.5.4. Study Methods, ID & Analysis of Salient Data from Existing Survey Research – Existing survey research appears biased towards large-scale, packaged tourism. Analysis needs to capture use by independent tourists and local (unguided AK resident) users, many of whom are able to access the area without relying on air taxis or jet boat charters. NPS continues to be concerned that because of the dispersed nature of access and recreation within the project area, and the necessary reliance by intercept surveyors on commercial service providers and outfitters, the intercept survey may under sample independent travelers by favoring packaged tours, whose guests tend to congregate in easy-to-find locations.

REC-4

- AEA contends that Sections 12.5.3, 12.6.3, 12.7.3 have been revised to indicate that the study area may be changed during study implementation if specific findings from other study disciplines indicate resource effects will extend beyond currently anticipated study boundaries. We refer you back to our comment above regarding "Study Area" and ask that the recreation and aesthetics resources study area include the lower river, just as numerous other resource studies do.

- NPS disagrees with Northern Economics' assumption that Susitna-Watana Hydroelectric Project will lead to "increases in visitation." Some types of uses in the baseline project area will likely decrease or disappear post-project, e.g. hunting in the area inundated by the project reservoir, floating the upper Susitna River downstream from Denali Highway, and, potentially, activities dependent on the existing amount of fish habitat and existing extent and duration of stable winter ice cover. In Table 12.4-1 AEA states that it "believes that total project area visitation will increase with the development of the Project, even if some types of users may get displaced." NPS remains interested in the experiential and activity-specific changes in recreational opportunities that will occur, not just net increases or decreases in numbers of users.

REC-5
SOC-21

- Recreation User Intercept Survey

  - We continue to question the value of noting "Don't Know" and "Refused" responses to every question in the survey. These responses do not appear to add value to the survey once initial testing is complete. We definitely want to see these fields eliminated from the mail/online (self-administered) survey instrument.

REC-6

  - Question 20(f) & (g) – The table should ask about need for Information and Education resources: kiosks, signage, trail information, points of interest, geologic, historic and / or cultural information. The revised question continues to limit itself to signage. We believe that users may seek a broader array of information such as boundary information, applicable rules and regulations, etc.

REC-7

  - Question 20(f) & (g) – We believe that user preference for greater management attention (level of maintenance, staff presence, security, etc.) should be added to this question.

REC-8

  - Question 21(a) – Wording is awkward. Perhaps the words "would not" could be deleted from the question, resulting in "If you were somewhat likely or not likely to return to this area . . . "

REC-9

  - Question 24. – We believe that the determination of party size should appear earlier in survey. This important recreational attribute should be captured before subjects potentially abandon the interview. This is still not adequately addressed in DRSP.

REC-10

- Mail/Online User Survey – We have not seen a draft of this survey. The original PSP stated that it would be similar to the Intercept Survey and workgroup discussions suggested the only difference would be that this self-administered survey would omit the "don't know" and "refused" options from each question. NPS would like to see the actual survey instrument.

REC-11

DRSP 12.6, Aesthetic Resources - NPS's Aesthetic Resources Study Request stated the following goals and objectives:

"The overall goal of this study is to identify baseline aesthetic resources, examine the impacts of the proposed project construction and operation on these visual and auditory resources, and evaluate potential mitigation opportunities. This exceeds AEA's proposed tasks of 'identifying BLM visual resource management designations or other visual resource management plans for the Project vicinity and identifying potential key view points and key viewing areas for proposed Project facilities' which are the subject of the 2012 Aesthetic Resources Study."

Unresolved issues:

AES-2

- 10.6.4. Study Methods, Seasonal Surveys of Ambient Sound Levels – What if the results of visitor experiential surveys indicate there need to be more surveys or surveys in different locations in order to quantify baseline resources? This is another example of a situation where the lack of reconnaissance level data makes survey design a guessing game.

AES-4

- 10.6.4. Study Methods, Seasonal Surveys of Ambient Sound Levels – NPS would like to have enough advance detail to involve our specialized soundscapes staff in reviewing this methodology. The consultants indicated in the "Consistency with Generally Accepted Scientific Practice" section of the DRSP that "The sound analysis is consistent with NPS Guidelines." We would like to verify that with our soundscape specialists.

DRSP 12.7, River Recreation Flow and Access

One specific objective of NPS's original study request for recreation included an assessment of the impact of the project on flow-dependent recreation:

". . . recreation impact and opportunities analysis on existing water-borne, flow dependent and snow and ice-cover dependent river experiences (including all forms of boating and fishing and winter use)".

We consider this to be a major concern for this project. We are encouraged by the choice of Oasis/ERM to conduct this assessment and have been pleased to work with John Gangemi directly on this specific DRSP. We were first introduced to this study plan during John's presentation at the October 3, 2012 work group meeting but did not receive a draft of DRSP until October 25, only a week before these comments were prepared for agency review. Thus NPS's collaboration with AEA and its consultants on this study has not progressed as far as on the other two studies we are involved with. Nonetheless, we are pleased, at first glance, to note that several of our recommendations and interests have been adopted in this draft. While there are no more TWG meetings scheduled before FERC renders its study plan decision next February, we request the ability to work directly with John to refine this draft as soon as possible.

Unresolved issues:

RECFLW-8

- We noted that this study's title and some initial statements about its scope appear contradictory. We believe that the study goal should not merely be to contribute data concerning recreational boating and access – it is to look at all forms of recreation that could be affected by flow changes caused by project operations. This includes activities like fishing regardless of whether recreationalists are angling in a boat or from shore. We recognize that the DRSP has been modified to assess impact on most forms of flow-dependent recreation in all seasons.

RECFLW-1

- At the October 3, 2012 meeting (see p. 4 in meeting notes), NPS suggested that focus groups be used to assess optimum and acceptable flow alternatives for the project. AEA's consultant agreed that this would be beneficial but proposed to wait to convene the groups until 2014, when more information about operations alternatives would be available. The DRSP does not include focus groups. NPS hopes this omission can be rectified in the RSP.

RECFLW-2

- 10.7.3. Study Area – The following statement lacks clarity: "areas where the proposed reservoir would create the most flow changes." What is threshold for "most"? Who decides? When? Even assuming consensus on the standard to be used, how can this decision be made before the results of the instream flow, flow routing, ice processes, etc. studies are in hand? What if NPS or others disagree with AEA's geographic scope decision? This should have been determined before the DRSPs were released. We caution the applicant that it risks having to spend additional field seasons collecting baseline data if the results of these other studies, which won't be completed until 2014 or later, alter the area predicted to be affected by project operations.
- We note that the study area for this DRSP extends downstream to the Parks Highway Bridge at Sunshine. While this would include the upstream portion of the lower Susitna River, it still fails to address the rest of the river to Cook Inlet. Regardless of whether there would be detectable changes in flows, fluvial geomorphology, ice processes, and riparian vegetation in the lower river due to project operations, resources such as migratory sport fish are likely to be affected by changes in flows, habitat, and the physical barrier created by the dam in the upper and middle river. Sport fishing is a flow-dependent form of recreation known to occur throughout the lower river, as are numerous forms of winter recreation (e.g. skiing, biking, snowmachining, and mushing races crossing the river on the Iditarod Trail route) that depend on the formation of stable ice across the lower river. By excluding most of this reach from the proposed River Recreation Flow and Access study, AEA again runs the risk of having to re-do this study if the results of other studies indicate that project operations will affect resources in the lower reach.

NPS believes that the ILP requires study plans to address all areas reasonably anticipated to be affected by a project. If the Watana project involved a smaller dam that did not present a major impediment to salmon migration, and was intended to be operated in run-of-the-river mode, the decision to exclude the Lower River from the three recreation and aesthetics study areas would be more

reasonable, but this is not the case. Without information about baseline recreational and aesthetics resources along the lower river, NPS will be unable to formulate recommendations for license terms and conditions to minimize or compensate for project impacts on these resources.

RECFLW-9

- Section 12.7.4, Study Methods, Winter River Recreation Preferences "The Susitna River during the winter ice period provides motorized and non-motorized winter recreation opportunities and serves as a transportation corridor for residents along the Susitna. Construction and operation of the Project may alter the timing and longitudinal extent of ice formation, and impact such uses." Under any of the currently proposed project operations scenarios, the Project will have that effect.

RECFLW-3

- 10.7.6. Schedule – We continue to maintain that one year of study is not an adequate sample size to support conclusions about important flow-dependent activities like sport fishing, and float hunting. The Susitna's flow magnitudes, timing, durations, and rates of change vary significantly from year-to-year, as do other conditions affecting recreational use and access. We note, for example, that there was an emergency Chinook closure this year. How can AEA study the most highly valued fish species in Southcentral AK if harvest is prohibited during the only year of study? Likewise, since most recreational users use the road network to get to and from the river, road closures such as the four-day Parks Highway closure at the Troublesome Creek and Chulitna bridges in 2006, and closures of the Parks and Denali Highways in September 2012, inevitably affect recreational use in the project area. Weather patterns (e.g. late break-up, early snow, persistent rain) and wildfires also affect use. One season is not enough to document baseline opportunities and experiences when they are dependent on highly variable interannual conditions.

  AEA's response to this concern is "There is a provision to capture data in 2014 in the event that unusual circumstances or events do not allow the capture of data in 2013." NPS believes that factors such as the interannual variability in the timing of Chinook salmon runs and return rates, which in turn affect sport fishing timing and level of effort, are not "unusual circumstances." They are known attributes associated with a resource having a multi-year life span and that is dependent on variable oceanographic conditions that are also poorly understood. We contend that the decision to rely on a single year of study for this complex and variable resource is not scientifically valid, and we request FERC to caution AEA that failure to document baseline resources adequately will delay initiation of the required environmental analysis of the project.

Comments on AEA's Proposed 2013-14 Study Plans for Other Resources

Socioeconomic Study - NPS was encouraged to learn about the Random Utility Model (RUM) approach to monetizing the value of recreation in the project area. We commented on our disagreement with the assumption that the project will lead to "increases in visitation." It is almost certain that there will be trade-offs in levels of participation among different types of recreation, as well as gains or losses in the value of each kind of recreational opportunity or experience even if numbers of participants remain the same.

Some kinds of baseline project area uses will likely decrease or disappear post-project, e.g. moose and caribou hunting in the area inundated by the reservoir, and float trips on the flooded portions of the Susitna downstream from the Denali Highway. Potentially, opportunities dependent on the existing amount of fish habitat and existing extent and duration of stable winter ice cover may also decrease. At our last work group meeting, we were assured that AEA will consider all changes in visitation due to the project. However, the recently released DRSP appears to return to the assumption that visitation will increase. NPS restates its concern that by treating recreation as a one-dimensional commodity, the socio-economic study risks a failure to capture the economic effects of project-related changes.

REC-2

Ice Processes – NPS is pleased to see acknowledgement of the need "to understand the potential effects of the project on winter transportation access and recreation, which depend on ice cover **on the lower Susitna River**" (Section 7.6.3.4 of Interim Draft Revised Study Plan, emphasis added). We are, however, puzzled about the inclusion of this objective for the lower river in the ice processes study but not in the River Recreation Flow and Access study (with the exception of a ten mile stretch of the lower river from Talkeetna to Sunshine). Why are the study areas for these two studies different? How will AEA understand the project's ice-cover related effects on winter transportation access and recreation if it does not collect data on winter recreation use from Sunshine downstream to Cook Inlet?

Water Quality – Again, NPS is pleased to see acknowledgement of the nexus between water quality and recreational opportunities, as stated twice on the first page of the DRSP for Water Quality. Aesthetics are, of course, also affected by changes in water quality parameters.

The NPS appreciates the opportunity to comment on the 2013-14 Draft Revised Study Plans. We look forward to working with FERC, AEA, its consultants, and stakeholders in the licensing process. If you have any questions, please contact Cassie Thomas at 907-350-4139 or Harry Williamson at 423-322-4151 with questions regarding these comments.

Sincerely,

Nancy Swanton
Interim Team Manager
Environmental Planning and Compliance

cc:
Wayne Dyok (wdyok@aidea.org)
Susitna-Watana Project Manager
Alaska Energy Authority
813 West Northern Lights Boulevard
Anchorage, Alaska 99503

Document Content(s)

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Anchorage Fish and Wildlife Field Office
605 West 4th Avenue, Room G-61
Anchorage, Alaska 99501-2249

November 14, 2012

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Subject: Alaska Energy Authority's Proposed Study Plans for the Susitna-Watana Hydroelectric Project No. 14241-000

Dear Ms. Bose:

The U.S. Fish and Wildlife Service (Service) has reviewed the Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) for the Susitna-Watana Hydroelectric Project provided to stakeholders on July 16, 2012. This letter transmits comments provided by the Service in accordance with regulations of FERC's Integrated Licensing Process [18 CFR Section 5.12] and provisions of the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.), Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d), Migratory Bird Treaty Act (MBTA) (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and Federal Power Act (16 U.S.C. § 791 et seq.). The Service appreciates the opportunity to work with AEA to ensure that appropriate resource information is acquired to allow us to fulfill our statutory responsibilities.

This submission consists of two parts: (1) a cover letter with general comments and issues pertinent to AEA's Proposed Study Plan of July 16, 2012, and planning and licensing processes of the proposed Susitna-Watana (Su-Watana) Hydroelectric Project No. 14241-000 (Project); and (2) an enclosure containing comments on each of the PSPs that address the Service's 21 study requests of May 31, 2012. The PSP includes 58 individual study plans, organized into 11 natural resource sections, and by topic within each section. We found that 27 of the individual study plans from five sections address elements of the study requests that we provided and are

most pertinent to the Service's resource responsibilities. The enclosure includes specific comments on the topics by PSP section number and title.

General Comments

The Service appreciates AEA's request and FERC's concurrence in granting the resource agencies a comment period extension for reviewing the PSP. The Service also greatly appreciates AEA's provision of Supporting Services to the Service and the National Marine Fisheries Service (NMFS) under the terms of our June 2012 Memorandum of Agreement among AEA, the Service, NMFS, and the Alaska Department of Natural Resources. Because of the geographic scope of the project, the inter-related complexities of the physical and temporal scale of scientific information to be collected, and the valuable fish, wildlife, and habitat resources of the Susitna River watershed, the Service has a substantial interest and responsibility in ensuring conservation of these valuable fish and wildlife resources.

The Service's comments focus on the PSP submitted by AEA on July 16, 2012. Since that time, the Service, NMFS, and our Supporting Services, have participated with AEA and their consultants in a number of technical working group (TWG) meetings to work toward understanding and consensus on sound study plans. However, not all areas of agreement have been subsequently documented. AEA began issuing draft revised study plans (RSP) October 31, 2012, which do incorporate several areas of agreement. However, there was insufficient time for the Service to adequately review all of the draft RSPs, and update our nearly complete comments on the PSP, prior to the November 14, 2012, due date for comments on the PSP. We acknowledge and appreciate AEA's efforts to maintain an iterative process while continuing to refine the PSP to meet agencies' study requests. Where possible, our comments reference agreements reached since AEA's July 16th PSP or the further details provided in the RSP.

The Service recommends future TWG meetings be more interactive and less focused on Powerpoint presentations. This would allow for effective discussions on all topics, leading to mutual understanding. We also recommend that documentation be provided for agreements reached at these meetings, so that there is a common frame of reference for all involved parties. At this time it is difficult to provide written comments on these meeting discussions without the details that a written document provides.

GEN-35 Study Plan/Study Request Crosswalk: As stated above, the Service submitted 21 study requests. AEA's PSP contained 58 individual study plans, organized into 11 natural resource sections, and by topic within each section. Following a comprehensive review of the plan, the Service found 27 of the individual study plans from 5 natural resource sections addressed elements of the study requests that we provided. It has been previously recommended that AEA provide a comparison of agency study requests and AEA proposed study plans and identify any unaddressed study request or study request components to assist our review of the PSP. FERC has affirmed AEA's need to provide this cross-walk comparison of study requests and the PSP. This study request-PSP comparison is necessary in part due to the altered organization of AEA's PSP which differs significantly in organization from the Service's study requests. The issue will gain significance as we continue our review of the draft RSP, as again, the individual study plans are reshuffled and renumbered adding more confusion about which study plans now address our study requests.

At the same time, there is a need to ensure that all study requests are integrated, with the overall findings appropriately influencing design of project alternatives.

GEN-36 Project Design and Study Inter-relatedness/Interdependency: The proposed Project is a large and complicated undertaking that will involve numerous individual studies, agencies, consultants, and individuals throughout the licensing process. Study requests were developed individually, and have not fully benefitted from consideration of how they should be integrated with other studies, including for efficiencies in time and cost of implementation. While the importance for integration may be implied within the various individual PSPs, the Project would benefit if there was a clear plan describing the strategies for information exchange and integration between the various studies and their respective Principal Investigator(s). This integration plan should discuss how model results will be documented and how the information will be provided in a format that is clear and accessible to the other studies. The plan should acknowledge the potential challenges that may be encountered and strategies for dealing with these challenges.

The PSP individual studies are numerous and complex. We recommend that AEA develop a cross-walk for all the studies to help clarify their inter-relationships, and then clearly describe how each study may depend on other studies. During the October 2012 technical work group meetings, AEA started to include helpful graphics and charts depicting study interdependencies, including interactions between different studies and how products from one study feed into another, and timelines indicating when relevant models and other products will be available. AEA will need to continue to refine this product and the Service will need to provide further review. At this stage, studies of biological resources and physical habitat parameters have not yet been interrelated with engineering studies and design considerations. Such integration and collaboration will be essential to ensure the licensing process is efficient, economical, and results in a project that best addresses environmental, economic, and power generation factors.

Many of the individual PSPs rely upon or provide data from/for other studies. Recognizing these relationships is an important part of the Integrated Licensing Process (ILP); however, the study providing the data should describe the methodology and oversee the data collection and analyses, while the study requiring the results should restrict its discussion to the types of data/results required from other PSPs. Repeating the methods in a study not responsible for the data collection and analyses is unnecessary and risks confusion if the methods differ or are inadequate in one of the studies. For example, since the Groundwater PSP 5.7 will be providing data to other studies, the Groundwater PSP should describe the methods as well as list the data/results that will be provided to other studies (e.g., 6.5 Fish and Aquatics Instream Flow, and 6.6 Riparian Instream Flow studies).

Besides interdependency figures, AEA must provide timelines showing how and when the various study components (both among major studies and within studies) will feed into other studies and study components. The Service is concerned the sequencing of some study components may be out of sync with the required products from other studies and study components.

GEN-37 Study methodologies: The study methods should be described in sufficient detail so others can duplicate the study. Citing methods from other studies or accepted industry standards is encouraged, but not in lieu of providing sufficient detail so the methods can be evaluated without

having to refer to the citation. The July 2012 PSP provided few referenced methods; some methods with references lacked citations in the Literature Cited so their appropriateness could not be evaluated, and some methods lacked focus or duplicated methods from other objectives. Since the PSP, AEA hosted TWG meetings and site visits, including the most recent 24 October 2012 TWG meeting, which provided additional opportunities for discussion and clarification. We look forward to seeing these improvements in the RSP and subsequent iterations.

GEN-38 Botanical studies: There is much overlap in the methods and study areas for the Botanical Studies. This is somewhat confusing when considering these studies together, but a little less so when the studies stand alone. AEA should be concerned that they could potentially be headed toward duplicative and contradictory work, and need to consider how to coordinate the Service's study request to quantify the frequency, timing, and duration of surface and groundwater required to maintain riparian communities. The responsibility for this product seems to be scattered among at least three studies and their principal investigators (Groundwater, Riparian ISF, and Riparian Botanical). The result is a confusing strategy within the PSP; these resource questions have not been appropriately addressed in an integrated manner. The Service is unclear about how our request will be addressed, and it seems that AEA is confused about how to tackle it. To date, the TWG meetings have failed to entertain meaningful discussion on this topic. We reiterate the need for the TWG meetings to be less focused on Powerpoint presentations and more interactive which may allow for more meaningful discussions of these interrelated botanical studies and their relationship to the groundwater study.

GEN-39 Historic Data and Study Results: The Service remains concerned that AEA has not yet adequately evaluated and characterized all available historic (1980s) information relevant to the existing Project environment. As we move forward with the current study plan, lack of an evaluation of the previous studies is problematic for several reasons. First, the historic and contemporary studies have not been comprehensively synthesized, so it is difficult to fully understand where we are and where we need to proceed in evaluating this Project proposal. Second, the statistical validity of study results from the 1980s investigations remains unknown. (See our comment letter (December 20, 2011) requesting a biometric review of the data.) Third, we are concerned that the scope of studies conducted in the 1980s, when the Project design was quite different, is not adequate to assess potential environmental effects of the currently proposed Project. Past studies only concentrated on a few fish species and potential effects to their macro-habitats; additional data are needed to evaluate potential Project effects on downstream habitats. Moreover, technological advancements since the 1980s in the areas of tracking fish, genetics, and study methodologies can now be used to better understand relationships between fish and their habitats, in order to better inform the design of a Project with fewer, environmental impacts, and to better assess those potential impacts. Finally, the 1980s project studies were discontinued, therefore those study results were never evaluated or completed to develop final recommendations.

GEN-40 Integrated Licensing Process: AEA has laid out a process plan, schedule and communications protocol prescribing the specific timeframes, deadlines, and responsibilities of FERC, AEA, and other stakeholders in the ILP that extends from filing of the Notice of Intent (December 29, 2011) through filing of the application for license (anticipated September 11, 2015) (Chapter 2 of the Pre-Application Document). Adherence to this plan is essential for guiding the application

development process in a collaborative, structured, complete and timely manner. Sharing that goal, the Service requests that FERC and AEA comply more fully with this plan, including maintaining and improving the Su-Watana project website and following the guidance laid out for technical work group meetings (Section 2, Pre-Application Document, December 2011).

AEA's Licensing Website (http://www.susitna-watanahydro.org/) lacks copies of written communications and other pertinent materials to date. These documents should be added and the site regularly updated. Examples of missing documents include agency and other stakeholder study requests filed by the initial May 31, 2012, due date, and any updates, as well as FERC documents (e.g., FERC Scoping Documents). A complete set of Preliminary Application Document (PAD) Reference Documents is not available; according to AEA these documents are to be distributed via the website or on the Alaska Resources Library and Information Services (ARLIS) website. There are currently few to no such documents on the website. Updates on additions of historic documents and studies as they are added to ARLIS should also be noted and linked. The Service recommends that all reference documents used by the project be distributed via the website, not just those used in the PAD. The website also lacks meeting summaries for several Technical Workgroup Meetings including those held in August.

With regard to ILP Meetings, AEA has not fully complied with the regulatory requirements for study planning meetings as described. The PAD communications protocol states AEA will: solicit input from participants on meeting dates, agenda items and objectives; notify participants of meetings at least 30 days in advance unless circumstances are unavoidable (this should be the exception not the standard); establish draft meeting agendas and post them two weeks in advance so that participants may submit comments on the agenda up to one week before the meeting; and, make available literature citations, documents and other information needed for consultation two weeks prior to the scheduled meetings. It is critical for AEA to follow the communications protocol and the ILP meeting guidance, in order for stakeholders to be able to fully and adequately participate in the study planning process.

Thank you for considering our comments and recommendations. If you have questions on these comments, please contact our Susitna-Watana Project Lead, Catherine Berg at (907)271-2787, or via email at catherine_berg@fws.gov. We look forward to working with FERC and AEA to refine, integrate, and collaborate on recommended studies and project design as more information about the project becomes available.

Sincerely,

Ann G. Rappoport
Field Supervisor

Enclosure

5. Water Resources

5.5. Baseline Water Quality Study

The May 31, 2012 Water Quality Study request submitted by the U.S. Fish and Wildlife Service (Service) combined baseline water quality and water quality modeling into one study. In our review of Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) we will address the baseline water quality and water quality modeling study plans separately.

The baseline water quality PSP proposes: (a) to characterize baseline water quality conditions, (b) to develop a monitoring program to characterize surface water physical, chemical, and bacteriological conditions in Susitna River downstream of the project area, and (c) measure baseline metals concentrations in sediment and fish tissues.

WQ-25 In general, the PSP adequately addresses the water quality issues. The Service recommends specific improvements, as follows:

General Comments by Subtopic:

WQ-26 *Standard Operating Procedures:*
The baseline monitoring program should include a more detailed and uniform level of information concerning the approaches and techniques to be employed during water quality sampling such as a Quality Assurance Project Plan (QAPP). For example, based on the importance of mercury in the future reservoir conditions, an explicit discussion and development of standard operating protocols (SOP) for sampling low-level mercury concentrations ("Clean Hands/Dirty Hands") to limit sample contamination during collection, shipping, and handling should be included. Example SOPs for this technique can be found in EPA 1996 and Lewis and Brigham 2009.

WQ-27 *Sampling Timing and Location*
The baseline monitoring program should include sample collection efforts and dates to correspond with important climatological events which may or may not be captured in the once monthly program presented in the PSP. Events such as early summer snow melt and late season glacial melt can be associated with significant inputs of constituents (e.g., solids) which need to be incorporated in the modeling exercise.

WQ-28 For constituents that get sampled monthly, such as TSS, turbidity and some other chemical constituents, the sampling should occur in a synchronized manner across a range of habitat types (main-stem, side channel, slough, clear-water tributary, glacial tributary) at multiple sites on Susitna River between RM 0 and RM 250.

WQ-29 *Dissolved Organic Carbon*
The baseline monitoring program should consider developing an additional and detailed study of dissolved organic carbon (DOC) in addition to what is already included in the PSP. This component of water quality has a determining role in the levels of mercury methylation and in the bioavailability and toxicity of metals. Understanding and being able to predict DOC in the future river and reservoir will be a critical element of the utility and accuracy of predicting future water quality and toxicity for aquatic life, wildlife, and humans.

MERC-05 *Mercury*
Atmospheric deposition of mercury should be quantified as an additional source to the future reservoir, and as such should be included in the sampling effort associated with the meteorological stations.

WQ-30 *Water Quality Standards*
The PSP should develop and present evaluation criteria specifically protective of aquatic life, wildlife, and human fishers (recreational, commercial and subsistence), rather than just using state water quality standards that are designed to be protective of aquatic life. For example, waters complying with the Alaska Department of Environmental Conservation (ADEC) standard for the protection of human health (0.050 µg/L) could easily exceed the EPA (1997) criteria for the protection of various fish eating wildlife (kingfishers, loons, ospreys, and bald eagles) by a factor of 50-150 times (presuming that 10% of the mercury in the water column is methylated). Standards for each receptor class should be used in the evaluating the results of the baseline water quality sampling effort.

Specific Comments: Methods/Analysis Evaluation

WQ-31 *1)* Page 5-9, paragraph 3, the PSP reads: *"An initial screening survey has been proposed for several other toxics that might be detected in sediment and tissue samples (Table 5.5-4). The single surveys for toxics in sediment, tissue, or water will trigger additional study for extent of contamination and potential timing of exposure if results exceed criteria or thresholds…"*

- More detail is needed here. How many samples, at how many sites? The study plan must identify the specific comparative standards for each analyte and matrix, and get agreement on them up front.

WQ-32 2) Our study request indicated that *"Additional temperature monitoring locations will be identified in cooperation with Fish Studies, the Groundwater Study, and the Instream Flow study to identify areas of thermal refugia for fish".* This does not appear in the study plan.

WQ-33 3) We have requested water temperature data collection throughout the year. The study plan only includes temperature data collection between late June and late December of 2012, 2013 and 2014. Temperature data is critical during winter and spring seasons, as Project operations are expected to significantly alter conditions during these seasons.

WQ-34 4) There are a number of differences, both in total number and in locations, between the proposed meteorological stations specified in the study request (Table 2) and the study plan (Table 5.5-2). The Service recommends further discussion on this topic.

WQ-35 5) The Service Study Request, page 10 (compared to study plan page 5-11, paragraph 4): many of the specifics added by federal hydrologists regarding MET station placement were not included in the Study Plan.

WQ-36 6) The Service's study request included three MET station parameters which were not included in the Study Plan. These are solar radiation (long and short consistent with ice process study needs), snow depth, and evapotranspiration.

WQ-37

7) Page 5-13, paragraph 1: Our study request included a requirement for a Quality Assurance Project Plan (QAPP) for water sampling and analysis, and a requirement that all studies be conducted in accordance with applicable USGS and EPA methodology. None of this language appears in AEA's study plan, which only specifies that the analytical laboratory will be NELAP-certified.
   - Useful, quality data cannot be assured by a quality analytical laboratory alone. Other aspects of the study, including sample locations and timing, sample collection methods, sample preservation and shipping methods, etc., are critical to study plan. We reiterate our request for a project QAPP and compliance with applicable USGS and EPA methodology, as cited in our study request.

WQ-38

8) Page 5-13, paragraph 2, the PSP reads: "*The initial sampling will be expanded if general water quality, metals in surface water, or metals in fish tissue exceed criteria or thresholds.*"
   - The applicable criteria and thresholds for each analyte and matrix must be specified and agreed to up front, before sampling occurs. This information should be contained in the study plan QAPP.

WQ-39

9) Table 5.5-3: AEA's study plan differs from our study request in the number of elements to be analyzed in sediment samples. AEA proposes far fewer elements; specifically barium, beryllium, cobalt, magnesium, manganese, molybdenum, nickel, thallium and vanadium are all absent from AEA's analyte list for sediment.

WQ-40

10) Page 5-13, paragraph 3, the PSP states: *"Metals monitoring for total and dissolved fractions in surface water include the full set of parameters used by ADEC in fish health consumption screening".*
   - This needs clarification: Does it refer to the elements ADEC measures in fish fillets in its Fish Monitoring Program? In that program, ADEC shares the fish tissue data with the state health department, which uses the data to develop fish consumption advice. This doesn't make sense in this context, because water levels do not relate directly to fish levels.

WQ-41

11) Page 5-13, paragraph 3, the PSP states: *"The criteria that will be used for comparison with sampling results are the drinking water primary maximum contaminant levels".*
   - That may be acceptable for the purpose of protecting human health from drinking water contaminants. But it does not address drinking water aesthetic issues (ADEC secondary standards), nor does it protect ecological receptors. Results must also be compared to NOAA SQuiRT tables for surface freshwater, to assess whether metal levels exceed acute and/or chronic toxicity benchmarks for aquatic organisms.

WQ-42

12) Page 5-14, Section 5.5.4.3.2 Sampling Protocol, paragraph 3 in total:
   - Our study request called for monthly sampling year-round. We are especially interested in winter data, and coordination with the Ice Processes study. AEA's study plan is a major departure from this recommendation, as it calls for 4 monthly samples during the summer months, and only 2 other samples collected during the winter months.

WQ-43

13) Page 5-14, Section 5.5.4.3.2 Sampling Protocol, paragraph 4 in total:
   - This paragraph calls for using specific conductance as a surrogate measure for transfer of metals from groundwater to surface water. This might have some utility for major ions

such as iron, but would be completely ineffective for toxic inorganic elements present in relatively "trace" concentrations.

WQ-44 14) Page 5-15, paragraph 2, the PSP states: *"It is possible that a flow-integrated sampling technique…..will be used".*

- This a study plan; the plan should definitively state whether this will happen or not.

WQ-45 15) As a general note, reference to USGS guidance for conducting water quality sampling has been deleted throughout the AEA PSP.

WQ-46 16) Page 5-16, paragraph 6, the PSP states: *"Toxics modeling will be conducted to address potential for bioavailability in resident aquatic life."*

- More detail is needed here. Which model; how?
- Toxics modeling must also evaluate the potential for direct toxicity to aquatic life, and for mixture toxicity (the elements are not present in isolation). Metals do not have to bioaccumulate to have a toxic effect.

WQ-47 17) Page 5-16, paragraph 6, the PSP states: *"Comparison of bioaccumulation of metals in tissue analysis with results from sediment samples will inform on potential for transfer mechanisms between source and fate".*

- AEA will not likely acquire this information from fish sampling, unless it is a very resident/non-mobile fish. Sessile organisms such as mussels or plants would be far more useful to assess transport from sediments to biota.

WQ-48 18) The Service's study request Page 19, paragraph 1, calls for sediment metal data to be compared to appropriate NOAA SQuiRT values to assess whether metal levels exceed acute and/or chronic toxicity benchmarks for aquatic organisms. This does not appear in the AEA study plan.

WQ-49 19) Page 5-17, paragraph 2 in total, the PSP states: *"Body size targeted for collection will represent the non-anadromous phase of each species life cycle (e.g., Dolly Varden; 90 mm – 125 mm total length to represent the resident portion of the life cycle.)"*

- The Service agrees if this is limited to understanding the amount of mercury in the fish that is clearly attributed to the local environment. However, for risk assessment purposes it is also important to sample fish that are representative of those taken for consumption by humans and wildlife receptors. Specifically, large adult fish that are targeted by anglers (and bears) should also be sampled, to determine how much additional mercury can "safely" be added from the project before consumption advisories are warranted. Similarly, for ecological risk assessment purposes it is important to sample fish representative of those in the diet of avian and mammalian piscivores in the project area. Our study request (Page 19 paragraph 3) contains a more robust description of the types and sizes of fish that should be sampled.

WQ-50 *20)* Page 5-17, paragraph 4, the PSP states: *"Results will be reported with respect to applicable Alaska State and federal standards".*

- The comparison values must be specified and agreed to up front. For human risk assessment purposes, US EPA guidance for fish consumption advisories is most appropriate. For ecological risk assessment purposes, risks should be interpreted using published scientific literature, based on both field observational studies and controlled

laboratory experiments, using the same or comparable piscivorous avian and mammalian species.

WQ-51

21) Page 5-17, paragraph 5, the PSP states: *"Results from fish tissue analysis will also be used as a baseline for determining how the proposed Project may increase the potential of current metals concentrations to become bioavailable".*

- Results from fish tissue analysis will be used as a baseline for fish metal concentrations prior to development. In order to understand how the Project may increase the potential for current metal concentrations to become bioavailable, AEA will need to predict how mercury methylation rates may change in response to the Project. This would entail prediction of organic carbon stores, amount of wetland or peat surface area inundated, and the pH, calcium concentration and water hardness of the reservoir…among other factors.

MERC-06

22) Page 5-17, paragraph 5, the PSP states: "*Detection of mercury in fish tissue and sediment will prompt further study of naturally occurring concentrations in soils and plants and how parent geology contributes to concentrations of this toxic (sic) in both compartments of the landscape".*

- The study of *"naturally occurring concentrations of mercury in soil and plants and how parent geology contributes to concentrations of this toxicant"* must be undertaken by AEA, regardless of whether it is currently present in fish and sediment. Vast surface areas and vegetation will be inundated, that are not currently part of the system. There is no need to prove current presence before proceeding to predict the addition from the Project. In any case, if adequate detection limits are used it is a given that fish and sediments will contain mercury, as they do everywhere. There is no reason to delay this "further study", particularly as the ILP process is so compressed. This study needs to be planned and implemented now. Likewise, macroinvertebrates need to be added to the current study plan.

MERC-07

WQ-52

23) Page 5-19, section 5.5.6 Schedule: Several needed elements are missing, including the collection of geomorphology, geology, vegetative type and quantity, etc. These parameters are necessary in estimating mercury inputs to the reservoir. Then modeling is needed to incorporate baseline conditions, estimate new mercury inputs and rates of methylation, and predict mercury levels in biota post-impoundment. Several study plans point to each other regarding this topic, but none actually undertake these tasks.

Literature Cited

Lewis, M.E. and M.E. Brigham. 2009. National Field Manual for the Collection of Water-Quality Data (TWRI Book 9). Chapter A5. Processing of Water Samples, Section 5.6.4.B -- Low-level Mercury (dated 10/04).

United States Environmental Protection Agency (EPA). 1996. Method 1669. Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels. July 1996. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303) 401 M Street S.W. Washington, D.C. 20460.

United States Environmental Protection Agency (EPA). 1997. Mercury Study Report to Congress. EPA-452/R-97-003, December 1997

5. Water Resources

5.6. Water Quality Modeling Study

General Comments:

The May 31, 2012 Water Quality Study request submitted by the U.S. Fish and Wildlife Service (Service) combined baseline water quality and water quality modeling into one study. In our review of Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) we will address the baseline water quality and water quality modeling study plans separately.

The PSP Water Quality Modeling Study proposes to utilize the information collected from the Baseline Water Quality Study to develop a model in which to evaluate potential impacts of the proposed Project and operations on various parameters within the Susitna River watershed. In general, the PSP adequately addresses the water quality issues. The Service recommends the following improvements.

Specific Comments by Subtopic:

WQMOD-02

Water quality model selection
AEA's model selection should consider the geometric and topographic complexity of the river system for potential extension of model boundary down to the Susitna-Talkeetna -Chulitna confluence. The long downstream river has many meandering braided channels with numerous tributaries. This river system will be inundated during summer snow melting seasons. These factors will require the flexibility in model grid generation (e.g., unstructured grid model), robust wetting and drying algorithm, and computational efficiency (e.g., high resolution grid only in zone of interest, parallel computing capability, etc.) for long-term simulation of water quality. The selection of a structured grid model such as EFDC or CEQUAL-W2 may not accurately represent the complex river system. This can deteriorate the prediction capability of the model. AEA should provide an explicit plan in the worst case scenario and consider other unstructured types of models such as MIKE (hydrodynamic + water quality). Another approach to consider may be an external coupling of an unstructured grid hydrodynamic model with a similar grid frame of water quality model such as CEQUAL-ICM.

WQMOD-03

Modeling parameters
In characterizing future conditions following the construction and operation of the Susitna Watana dam, AEA's water quality modeling determination should include a separate and detailed description of the approach to be followed in parameterizing and initializing the final selected model. This should include a description of how terrestrial conditions will be used to develop boundary conditions outside of the current riverine conditions. Model initialization and calibration are important components of establishing model credibility and accuracy and as such should be described in sufficient detail to allow reviewers to evaluate the approach and water quality data needs for each model.

WQMOD-04

Model calibration
The PSP should include an explicit hydrodynamic model calibration plan to be fed for water quality modeling. The calibration against water surface elevation and velocity is a crucial and basic process for the development of baseline hydrodynamic modeling and application to the proposed condition.

WQMOD-06

Toxicity modeling

The study plan should include an explicit description of the modeling approach to be used for determining toxicity of future water quality to aquatic life, wildlife, and human fishers. This model or models should have the capability to address the toxicity of mixtures of metals, and the model determination should also include a discussion of how the potential interactions of toxins (additivity, synergism, antagonism) will be evaluated in the selected model.

The PSP should also discuss approaches to determining and evaluating the bioavailability of metals in the future reservoir and river such as use of the Biotic Ligand Model (BLM). The water quality modeling plan should consider expanding the analytes (i.e., anions and cations) to be sampled in the baseline monitoring program based on the review and utility of the BLM model in evaluating the future toxicity in reservoir and downstream rivers.

Example studies that can be evaluated in the design of modeling the toxicity of metal mixtures can be found in Altenburger et al. 2003; Borgmann et al. 2008; Jho et al. 2011; Kamo et al. 2008; Khan et al. 2011; Kortenkamp et al. 2009; Mumtaz et al. 1998; Sasso et al. 2006; Schmidt et al. 2010; Stockdale et al. 2010; Van Genderen et al. 2012; Vijver et al. 2011.

Literature Cited

Altenburger, R., M. Nendza, and G. Schüürmann. 2003. Mixture toxicity and its modeling by quantitative structure-activity relationships. Environmental Toxicology and Chemistry, 22(8): 1900-1915.

Borgmann, U., W.P. Norwood, and D.G. Dixon. Modelling bioaccumulation and toxicity of metal mixtures. Human and Ecological Risk Assessment: 14(2): 266-289.

Jho, E.H., J. An, and K. Nam. 2011. Extended biotic ligand model for prediction of mixture toxicity of Cd and Pb using single metal toxicity data. Environmental Toxicology and Chemistry, 30(7): 1697-1703.

Kamo, M. and T. Nagai. 2008. An application of the biotic ligand model to predict the toxic effects of metal mixtures. Environmental Toxicology and Chemistry, 1479-1487.

Khan, F.R., W. Keller, N.D. Yan, P.G. Welsh, C.M. Wood, and J.C. McGeer. 2011. Application of the Biotic Ligand and Toxic Unit Modeling Approaches to Predict Improvements in Zooplankton Species Richness in Smelter-Damaged Lakes near Sudbury, Ontario. Environmental Science and Technology, 46z: 1641-1649.

Kortenkamp, A., T. Backhaus, and M. Faust. 2009. State of the Art Report on Mixture Toxicity. Final Report, Executive Summary. Prepared for the European Commission, Directorate General for the Environment. December 22, 2009.

Mumtaz, M.M., C.T. De Rosa, J. Groten, V.J. Feron, H. Hansen, and P.R. Durkin. 1998. Estimation of toxicity of chemical mixtures through modeling of chemical interactions. Environmental Health Perspectives, 106: 1353-1360.

Sasso, A., S. Isukapalli, S.W. Wan, and P.G. Georgopoulos. 2006. Physiologically-based toxicokinetic models for toxic metal mixtures: Development and demonstration of a

mechanistically-consistent framework. Poster presented at Society for Risk Analysis meeting, Baltimore Maryland, December 5, 2006.

Schmidt, T.S., W.H. Clements, K.A. Mitchell, S.E. Church, R.B. Wanty, D.L. Fey, P.L. Verplanck, and C.A. San Juan. 2010. Development of a new toxic-unit model for the bioassessment of metals in streams. Environmental Toxicology and Chemistry, 29(11): 2432-2442.

Stockdale, A., E. Tipping, S. Lofts, and S.J. Ormerod. 2010. Modelling multiple toxic effects in the field – evaluation of the Toxicity Binding Model (TBM). Final report to the International Copper Association (ICA). Centre for Ecology and Hydrology, Natural Environmental Research Council. February 2010.

Van Genderen, E., E. Rogevich-Garman, R. Dwyer, J. Gorsuch. 2012. Incorporating bioavailability into risk assessment for metal mixtures; results of a comparative evaluation. SETA Globe, 13(6).

Vijver, M.G., E.G. Elliott, W.J.M. Peijnenburg, and G.R. de Snoo. 2011. Response prediction for organisms water-exposed to metal mixtures: A meta analysis. Environmental Toxicology and Chemistry, 30: 1482-1487.

5. Water Resources

5.7. Groundwater-related Aquatic Habitat Study

General Comments:

GW-013 The U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled *Groundwater-Related Aquatic and Floodplain Habitat Study* more accurately encompasses the scope of our study request by including both aquatic and floodplain in the title. Although Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) includes objectives for describing floodplain and riparian groundwater and surface-water (GW/SW) relationships, the PSP title implies only aquatic relationships will be investigated. We recommend revising the title to more accurately describe the scope of the study, and including "floodplain" as appropriate wherever the study subject is mentioned in the PSP.

GW-014 Many of the individual PSPs rely upon or provide data from/for other studies. Recognizing these relationships is an important part of the Integrated Licensing Process (ILP); however, the study providing the data should describe the methodology and oversee the data collection and analyses, while the study requiring the results should restrict its discussion to the types of data/results required from other PSPs. Repeating the methods in a study not responsible for the data collection and analyses is unnecessary and risks confusion if the methods differ or are inadequate in one of the studies. Since the Groundwater PSP will be providing data for other studies, the Groundwater PSP should describe the methods as well as the results provided to other studies (e.g., 6.5 Fish and Aquatics Instream Flow, and 6.6 Riparian Instream Flow studies).

GW-015 At the 24 October 2012 Groundwater Technical Workgroup (TWG) meeting, AEA provided a draft study interdependency figure showing which additional studies would provide data for the study, the expected information produced by the study, and which studies will rely upon output from the study. Given the complex integration of the various studies, we appreciate this figure and recommend including figures like these along with a narrative in the introduction for each study. Additionally, the main introduction covering all the PSPs should include a more general interdependency figure showing how all the various studies interrelate. We have not had time to evaluate this draft interdependency figure, but look forward to reviewing additional drafts as the study plans mature.

GW-016 Besides interdependency figures, please provide timelines showing how the various study components (both among major studies and within studies) feed into other studies and study components. The Service is concerned the sequencing of some study components may be out of sync with the required products from other studies and study components.

GW-017 The last sentence in the first paragraph of Section 5.7.1.1 suggests the Groundwater PSP is not much more than a passive summary of other studies, when in fact the Groundwater PSP is a critical input for other studies not unlike the USGS data used by other studies. The Service is concerned that relying upon a variety of investigators with their own study objective priorities risks degrading the quality and consistency of the groundwater hydrology data. The groundwater hydrology investigators should be responsible for all phases of the groundwater study, including well installation, monitoring, data reduction, and analyses.

GW-018 The methods should be described in sufficient detail so others can duplicate the study. Citing methods from other studies or accepted industry standards is encouraged, but not in lieu of

providing sufficient detail so the methods can be evaluated without having to refer to the citation.

GW-019 Unlike the fisheries component of the Aquatic Instream Flow Study where potential future Susitna-Watana Hydroelectric Project (Project) impacts may be compared with other locations in the state because fish populations are routinely surveyed, evaluating potential Project impacts on riparian/floodplain resources without an "untreated" spatial reference (i.e., similar rivers without a dam) risks a significant change may be attributed to an unrelated impact. Green (1979) outlines four prerequisites for an optimal impact study design: 1) the impact must not have occurred; 2) the type, time and place of impact must be known; 3) all relevant biological and environmental variables must be measured; and 4) an area unaffected by the impact must be sampled to serve as a control. The first three prerequisites are included in the PSPs if they are designed and implemented so potential Project impacts can be evaluated by post-dam resampling. We recommend the Groundwater-related Habitat Study also include the fourth component (un-impacted rivers), otherwise AEA risks what Green (1979, p 71) refers to as "… *executing statistical dances of amazing complexity around their untestable results"* to show the Project did or did not have a potential impact on riparian/floodplain resources.

Specific Comments by Subsection:

The following review of AEA's proposed Groundwater-related Aquatic Habitat Study Plan uses the structure of the plan and compares the plan to the Service's study-request objectives to determine if our intent is met, where improvements can be made, and which requested objectives are not addressed.

AEA Study Goals and Objectives: The overall goal of the study is to understand the effects of the Project on groundwater and surface-water (GW/SW) interactions as they relate to habitat for aquatic species (e.g., fish, riparian vegetation) in the Susitna River.

GW-020 AEA's overall study goal is similar to the Service study-request goal; however, the following key phrases (underlined) are not included: *"The overall goal of the study is to understand Project effects on surface-water / groundwater interactions at multiple spatial and temporal scales as they relate to habitat for aquatic and floodplain species (e.g., fish, riparian vegetation) along the Middle and Lower Reaches of the Susitna River."* The omitted phrases help to define the scope of the study to include both landscape and local studies throughout the year, acknowledge the study will include floodplains, and limits the study to the Middle and Lower Reaches of the Susitna River.

AEA's PSP objectives are similar to the Service study-request objectives, except for some minor wording to qualify the scope of the objective. The objectives and wording will be discussed along with their methods below. For now, it's important to recognize that some objectives are really tasks (e.g., 1, 4), rather than true objectives (e.g., 5, 6).

AEA Study Area: The Susitna River from the Parks Highway bridge (RM 84, located near USGS Gage on Susitna River at Sunshine) to an area just upstream of the dam (RM 184) for detailed studies.

GW-021 The Service recognizes the downstream limit of the study area is still under discussion, and we

look forward to participating in this discussion. In addition to the longitudinal dimensions of the study area, we recommend including the width of the study area. For the groundwater study, the width should be at least as wide as the expected area of groundwater influenced by Project operations, and include an additional buffer to demonstrate the adjacent groundwater behavior beyond Project influences.

AEA Objective 1 and Methods: Synthesize historical data available for Susitna River groundwater and groundwater related aquatic habitat, including the 1980s and other studies.

GW-022 Service Objective1 (meaningful differences underlined): *"Synthesize historical data for Susitna River groundwater and groundwater-dependent aquatic <u>and floodplain</u> habitat, including the 1980s studies".* "Floodplain" should be included in the objective to broaden the objective scope.

The first objective is very similar to our study request objective. The goal of our objective is to review existing information on Susitna River groundwater and groundwater-dependent aquatic and floodplain habitat, and to gain insights from other hydro projects with a focus on cold-region projects.

GW-023 Not included in AEA's methods is a review and summary of other hydro projects in cold regions and their effects on ice processes affecting surface-water / groundwater. In addition to including this review and summary, we also recommend a review and summary of the current knowledge of cold regions hydropower projects effects on ice processes and how that has altered instream flow, fluvial geomorphology, vegetation, water quality, and fish habitat. These summaries should be used to identify potential effects of the proposed Project and guide the development of methods and analyses to evaluate these effects.

AEA Objective 2 and Methods: Use available information to characterize the large-scale geohydrologic process-domains/terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow ground water aquifers, GW/SW interactions).

Service Objective 2 (meaningful differences - none): *"Use available information to characterize the large-scale geohydrologic process-domains/ terrain of the Susitna River (e.g., geology, topography, geomorphology, regional aquifers, shallow ground water aquifers, surface-water / groundwater interactions)."*

The second objective is identical to our study request objective. The goal of our objective is to characterize large-scale geohydrologic process-domains (Montgomery 1999) within the Susitna River Basin that influence surface-water / groundwater interactions in the Susitna River and floodplain.

GW-024 We recommend the process domain definitions (Montgomery 1999) be vetted with the resource agencies, and that all relevant information and knowledge gained from the other studies be used to assess and refine the process-domain mapping of the Susitna River basin. Since AEA is proposing to use process-domains as means to extrapolate and predict Project effects on surface-water / groundwater beyond the intensive study focus areas, we recommend an assessment of the precision and accuracy of the predicted effects.

Citing recognized methods is encouraged, such as ASTM standards D5979 and D6106, but the study plan must include enough information about the cited methods so reviewers can evaluate the appropriateness of the proposed methods without referring to the citation.

AEA Objective 3 and Methods: Assess the effect of Watana Dam/Reservoir on groundwater and groundwater related aquatic habitat in the vicinity of the dam.

Service Objective 3 (meaningful differences underlined): *"Assess the effect of Watana Dam/Reservoir on groundwater and groundwater-related aquatic and floodplain habitat in the vicinity of the dam, and the downstream extent of the reservoir's influence on groundwater."*

Although the wording of AEA's third objective differs from our request, the methods are identical to our study request. The goal of our objective is to assess the effect of the Watana Dam and reservoir on downstream groundwater-related aquatic and floodplain habitat, and to assess the downstream extent of the reservoir's influence on groundwater potentially bypassing the dam.

GW-025 In addition AEA's and Service's requested methods, we believe all stakeholders would benefit by defining the downstream extent of the reservoir's influence on groundwater potentially bypassing the dam. Adding this component would require including a description of the methods used to determine the downstream effects on groundwater.

AEA Objective 4 and Methods: Map groundwater influenced aquatic habitat (e.g., upwelling areas, springs).

GW-026 Service Objective 4 (meaningful differences underlined): *"Map groundwater influenced aquatic and floodplain habitat (e.g., upwelling areas, springs, groundwater-dependent wetlands)."*

The fourth objective is very similar to our study request objective, except we recommend including floodplain habitat as well. The goal of our study component is to map locations of surface-water /groundwater interactions at a scale relevant to riverine habitat types (as described in the Aquatic and Riparian Instream Flow, and Fluvial Geomorphology Studies). Groundwater influences floodplain habitat in addition to the aquatic habitat proposed by AEA. Groundwater-dependent wetlands and subirrigated floodplain plant communities are strongly influenced by the frequency, timing, and duration of groundwater levels.

GW-027 Terrestrial groundwater-influenced habitats are much easier to identify than groundwater-influenced aquatic habitats because they can be easily observed (e.g., springs, hydrophytic vegetation). For this objective, we recommend including a component identifying groundwater-dependent wetlands and characterizing their potential groundwater sources. Subirrigated floodplain plant communities and their potential groundwater sources should also be identified at the "reconnaissance level" as part of this objective; although we recognize the Riparian Instream Flow Study (Section 6.6) will likely provide more detailed information regarding subirrigated communities.

GW-028 Aquatic groundwater-influenced habitat on the other hand is more difficult to identify because surface water, especially if turbid or frozen, often obscures direct observation. For this reason, AEA proposed a variety of methods to identify groundwater-influenced aquatic habitat. It is unclear if the various proposed methods in Section 5.7.4.4 are adequate to capture the groundwater influence on aquatic habitats throughout the study area. These methods are a series of study components from ice processes, geomorphology, instream flow, water quality, and fish studies. We have three basic concerns: 1) the mainstem upwelling areas will not be accurately accounted for and no actual groundwater investigation focuses on the mainstem; 2) these methods are not focused on determining upwelling areas and may not capture the actual distribution of upwelling areas; and 3) the Groundwater-related Aquatic Habitat study plan is not responsible for collection of any of this data.

GW-029 There is a high likelihood that these upwelling characterization study components won't accurately capture the upwelling areas, the overall distribution of upwelling will not be accounted for, and the importance of upwelling for over-wintering fish and fish eggs will not be captured. If the pilot thermal imaging assessment successfully captures upwelling areas (with ground-truthing to assess success), then this method should be applied to the middle river from the confluence with the Talkeetna and Chulitna Rivers upstream to Devil's Canyon. The success or failure of the thermal imaging assessment must also be defined. If the trial thermal imaging study is successful how will it be expanded and used to map upwelling? If it is unsuccessful how does AEA plan on identifying the spatial distribution of upwelling? Use of open-leads during winter ice mapping alone will not demonstrate the full extent of upwelling areas.

AEA Objective 5 and Methods: Determine the GW/SW relationships of floodplain shallow alluvial aquifers at Riparian Instream Flow study sites.

Service Objective 5 (meaningful differences underlined): *"Determine the surface-water / groundwater relationships of floodplain shallow alluvial aquifers at Riparian Instream Flow Study sites, <u>including relationships with both the river and the adjacent uplands (e.g., gaining or loosing stream)</u>."*

The goal of our objective is to understand how floodplain shallow-alluvial groundwater interacts with the surface water from the Susitna River and with the adjacent upland groundwater. This study component will provide the necessary groundwater information for the Riparian Instream Flow Study to develop plant community response curves (similar to HSC), which can be used to predict the effects of Project operation on floodplain plant communities.

AEA's methods for this groundwater objective (Section 5.7.4.5) and the Riparian Instream Flow Objective (Section 6.6) confuse responsibilities and methods between the two studies. For example, the last two bulleted paragraphs in the groundwater study (Section 5.7.4.5) describe riparian methods, while Section 6.6.4.5 in the riparian study describes groundwater methods.

GW-030 We recommend describing groundwater methods in the groundwater study, and describing riparian methods in the riparian study. Our comments below focus on the groundwater methods from both studies that should be included in the groundwater study.

GW-031 The suggested four to six intensive study reaches (now called focus areas) instrumented with groundwater and surface-water recording instruments may be insufficient to address this objective if plant response will be described by process-domains (see Service pseudoreplication discussion in our comments for Riparian Instream Flow Objective 2). For the focus areas where multiple study disciplines will focus and complement their work, we recommend the Groundwater-related Aquatic Habitat Study **first** develop criteria required for selecting their study sites independent of the other studies. Next, develop a list of study products from the Groundwater-related Aquatic Habitat Study that other studies require, and then work with the other studies and stakeholders to select focus areas. A master matrix of studies, data needs and data products would greatly facilitate this process and stakeholder acceptance.

GW-032 One-and-a-half growing seasons (July 2013 to September 2014) will likely provide insufficient groundwater hydrology data to fit individual species response curves (especially for annual species), and may not be enough data to reasonably predict groundwater relationships with river stage **and** to verify the model predictions with independent data. The Service recognizes that aquifer properties can be estimated by taking advantage of relatively rapid changes in river stage, but these events can be confounded by other factors such as local precipitation. Precipitation can dramatically affect transient, but critical, shallow groundwater levels (a few

days to a week or more of elevated water levels), which would be difficult to evaluate with limited data. Hydrologists often recommend using at least ten years of data to reasonably extend the period of record for river stage. The study plan must define the uncertainties in groundwater hydrology different than surface-water hydrology, and must consider a reasonable period of record to verify groundwater predictions.

GW-033 The "project accuracy standards used for water-level measurements" for horizontal, vertical and temporal measurements must be defined. If MODFLOW (USGS 2005) will be used, what is the expected accuracy of the predicted water table surface? What are the model and aquifer property assumptions for using MODFLOW, and how are discrepancies addressed and the predictions affected? The difference between the water table being too deep or too shallow for some herbaceous species is as little as 20 cm or less, and for some sedge communities about 50 cm or less. If the depth-to-water will be estimated by subtracting the predicted water table (e.g., MODFLOW) from the ground surface (e.g., LIDAR), then the combined error of both the water table and the ground surface must be considered. In addition, the predicted surface-water stage and its accuracy must also be provided for emergent communities. For complex hydrologic and biotic sites such as Whiskers Slough, the density of recording wells and surface-water gages presented in the 1 October 2012 Riparian Instream Flow TWG meeting may need to be increased in both density along the transects and the total number of transects to achieve the accuracy required for the Riparian ISF study.

The products of this study objective should be sufficient to provide water-level summary statistics for each location (e.g., point, plot, transect, water-table surface) that will be used to test and fit plant response curves, such as growing season cumulative frequency, 7-day moving average, 10-day moving average, 14-day moving average, and arithmetic mean (see Henszey et al. 2004, Table 1). The Service understands that calculating these summary statistics will be the responsibility of the studies responsible for using the groundwater data (24 October 2012 TWG meeting). This is possible for individual wells, but we suspect the other studies will have some difficulty calculating these summary statistics for the water-table surface and recommend the groundwater study conduct this analysis.

AEA Objective 6 and Methods: Determine GW/SW relationships of upwelling/downwelling at Instream Flow Study sites in relation to spawning, incubation, and rearing habitat (particularly in the winter).

Service Objective 6 (meaningful differences underlined): *"Determine the surface-water / groundwater relationships of upwelling/downwelling at <u>Aquatic</u> Instream Flow Study sites in relation to spawning, incubation, and rearing habitat (particularly in the winter)."*

The goal of our objective is to understand how surface-water / groundwater interactions influence salmonid habitat use and biological functions, including selection of spawning and rearing habitats, egg/alevin survival, and overwintering. This goal fits in naturally with the next study objective (Objective 7) to characterize water quality and probable flow paths of groundwater for habitats where groundwater is important for fish habitat. The source and flow path of water are important factors influencing its temperature and chemistry (Johnson 2003). The flow paths of water through the subsurface as groundwater and hyporheic flow may moderate stream temperatures and provide thermal heterogeneity (Johnson and Jones 2000, Mellina et al. 2002, Moore et al. 2005, Rothwell 2005). The results of this objective should facilitate predicting Project operation effects on surface-water / groundwater interactions both temporally and spatially.

GW-034 AEA's methods for the Groundwater-related Aquatic Habitat Study plan are vague and it is unclear which study is responsible for collecting the site-specific groundwater data. We recommend the revised study plan detail the methods for collecting the groundwater potentiometric surface at each of the aquatic study sites.

GW-035 Study sites used to understand surface-water / groundwater interaction and how the process influences habitat use by anadromous fish should span all the geomorphic classification types used by anadromous species, including off channel (side channels, side sloughs, upland sloughs) and mainstem features in the middle and lower river. The methods for extrapolating surface-water/ groundwater study results from the focus areas to the river segments are unclear.

GW-036 AEA Study Objective 5 (with requests submitted above) has a more detailed study description for the floodplain alluvial aquifer than for AEA's aquatic groundwater Study Objective 6, even when considering the schematic detailing the surface-water / groundwater sampling network presented at the 16 August 2012 TWG meeting. We recommend the monitoring and modeling approach described for the floodplain be adapted and applied to the aquatic instream flow study sites and other sites of particular fish habitat importance (spawning, rearing, overwintering habitats).

The data collected for understanding the surface-water / groundwater relationship at each aquatic instream flow study site must consider all the key biologic functions and time periods (particularly in winter), as stated. The aquatic study site data will include empirical data related to surface-water / groundwater interactions (e.g., piezometers, water levels, water temperature and conductivity, tracer studies). Surface-water / groundwater interaction data will be collected at the intensive study reaches utilizing multiple transects of arrays of groundwater wells, piezometers and stage gages. The surface-water / groundwater data will be used to quantify, and model, the relationship between the shallow surface aquifers and aquatic habitat types. At each of the aquatic study sites, surface-water / groundwater interaction models will be developed to allow for temporal analysis of project operations effects on surface-water / groundwater exchange that may influence habitat utilization by aquatic species. This modeling may include the use of MODFLOW (USGS 2005 and Feinstein et al. 2012) surface-water / groundwater interaction models of floodplain shallow alluvial aquifer and surface-water relationships. MODFLOW surface-water / groundwater interaction models will be used to model surface-water / groundwater relationships using empirical monitoring data collected at intensive study reach surface-water / groundwater monitoring stations.

AEA Objective 7 and Methods: Characterize water quality (e.g., temperature, DO, conductivity, nutrients) of selected upwelling areas where groundwater is a primary determinant of fish habitat (e.g., incubation and rearing in side channels and sloughs, upland sloughs).

Service Objective 7 (meaningful differences underlined): *"Characterize water quality (e.g., temperature, DO, conductivity, nutrients) <u>and age (i.e., indication of potential source)</u> of representative upwelling areas where groundwater is a primary determinant of fish habitat (e.g., incubation and rearing in side channels and sloughs, upland sloughs)."*

The Service listed this objective separately, but chose to include the methods along with Objective 6 because the requested investigated water-quality attributes will be used to supplement Objective 6 by further refining fish habitat quality and surface-water / groundwater relationships. AEA's methods (Section 5.7.4.7) state the work for this objective will be accomplished by the Baseline Water Quality Study (Section 5.5). If this is the case, then these

methods belong in that section and not in both sections. Our comments here pertain solely to the methods presented in this PSP.

Characterization of water quality must have a temporal component to assess surface water influences on groundwater quality parameters (temperature, dissolved oxygen (DO), conductivity, pH, dissolved carbon, nitrogen, phosphorous, alkalinity and hardness). This temporal component is especially important where anadromous fish species spawn and overwinter due to the effects associated with load following operations. Spatial and temporal water quality data should be collected to understand processes that contribute to river productivity, habitat quality, thermal refugia, and how surface-water / groundwater processes are influential to those processes. Additionally, we recommend the relative age of water be determined, this may be achieve through several methods that must be described in the study plan. How long the water has been underground will help identify the groundwater source, such as from the active hyporheic zone (recent groundwater) or from a potential upland source (older groundwater).

AEA Objective 8 and Methods: Characterize the winter flow in the Susitna River and how it relates to GW/SW interactions.

Service Objective 8 (meaningful differences underlined): *"Characterize how winter surface-water / groundwater interactions <u>may differ from ice-free interactions for both the existing and the projected Project Susitna River flow regimes</u>."*

The Service listed this objective separately, but chose to include the methods along with Objective 6 because the requested investigated season (winter) supplements Objective 6 by continuing the period of record throughout the year for determining fish habitat surface-water / groundwater relationships, not just during the ice-free season.

The Service agrees with the applicant that surface-water / groundwater interactions are critical to aquatic habitat functions, and the Project operations will have an impact on winter flow conditions, including surface-water / groundwater exchange effects on the habitat quality used by anadromous species. The methods associated with Objective 8 include data collection at stream gages and at specific study areas. It may be implied by this study objective, but we request that both baseline and Project-operation winter flow characterizations are necessary. This should include developing surface-water / groundwater exchange models that include winter operation scenario analyses, accounting for changes in ice thickness and cover, and changes in water quality (temperature, DO, nutrients, specific conductivity); all associated the mixing of surface-water and groundwater, and potentially affected by the proposed winter operations (either load following or baseload).

This objective should also characterize how ice formation affects surface-water and groundwater stage for both the main and off channels of the river. Our understanding of how surface ice affects the routing of surface water or how the location and thickness of ice may influence surface-water and groundwater stage in off channel locations is inadequate. This understanding must be improved, since this process can drastically alter winter fish habitat. Occasional ice-thickness measurements and 2D modeling will likely be insufficient to calibrate the model.

AEA Objective 9 and Methods: Characterize the relationship between the Susitna River flow regime and shallow groundwater users (e.g., domestic wells).

Service Objective 9: Not requested.

Although this objective does not directly relate to Service trust resources, we believe the information gained from this objective will aid in the overall understanding of the Susitna River groundwater system.

Literature Cited

Feinstein, D.T., M.N. Fienen, J.L. Kennedy, C.A. Buchwald, and M.M. Greenwood. 2012. Development and application of a groundwater/surface-water flow model using MODFLOW-NWT for the Upper Fox River Basin, southeastern Wisconsin: U.S. Geological Survey Scientific Investigations Report 2012–5108. 124 pp.

Henszey, R.J., K. Pfeiffer, and J.R. Keough. 2004. Linking surface- and ground-water levels to riparian grassland species along the Platte River in Central Nebraska, USA. Wetlands 24(3):665-687. (*ne.water.usgs.gov/platte/reports/wetlands_24-3.pdf*)

Johnson, S.L. 2003. Stream temperature: scaling of observations and issues for modeling. Hydrological Processes 17:497-499.

Johnson, S.L. and J.A. Jones. 2000. Stream temperature responses to forest harvest and debris flows in western Cascades, Oregon. Canadian Journal of Fisheries and Aquatic Sciences 57:30-39.

Mellina, E., R.D. Moore, S.G. Hinch, J.S. Macdonald, and G. Pearson. 2002. Stream temperature responses to clearcut logging in British Columbia: the moderating influences of groundwater and headwater lakes. Canadian Journal of Fisheries and Aquatic Sciences 59:1886-1900.

Montgomery, D. 1999. Process domains and the river continuum. Journal of the American Water Resources Association 35(2):397-410.

Moore, R.D., P. Sutherland, T.Gomi, and A. Dhakal. 2005. Thermal regime of a headwater stream within a clearcut, coastal British Columbia, Canada. Hydrological Processes 19:2591-2608.

Rothwell, E.L. 2005. The influence of hyporheic flow on the temperature of a riffle-step-pool stream. Thesis (M.S.), Boise State University.

U.S. Geological Survey. 2005. MODFLOW-2005, The U.S. Geological Survey modular groundwater model - the Ground-Water Flow Process: U.S. Geological Survey Techniques and Methods 6-A16.

5. Water Resources

5.8. Geomorphology Study

General Comments:

The May 31, 2012 Geomorphology Study request submitted by the U.S. Fish and Wildlife Service (Service) combined geomorphology and fluvial geomorphology into one study, as the data collected and models developed for both of these topics were directly linked to aquatic habitats in the Susitna River system. In our review of Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) we will address the geomorphology and the fluvial geomorphology modeling study plans separately.

During the August 15-17, 2012 technical working group (TWG) meetings AEA described fish, instream flow, and water resource study plans. These study plans included broad statements regarding collaboration and integration of specific studies. The Service recommends that this integration be described in detail. For the geomorphology and fluvial geomorphology modeling study plans, this should include: the objectives; methodologies that address the objectives; and how the results will influence other studies. This must include data collection and model results that the geomorphology studies rely on and how these results will be applied to other studies. For example, the study plan must describe how the geomorphology study will use the fish habitat utilization data that the Service requested to improve the spatial habitat mapping, and how the results of the geomorphology study will be integrated into the instream flow study to achieve the Service's recommended objectives.

GEO-17
FGM-02

The revisions for the geomorphology and fluvial geomorphology modeling study plans should provide a description of the expected end-product, and whether these results will be sufficient to address Project effects to anadromous fish habitat. The study plan should also include a description of uncertainties associated with the studies, models, and analysis of project effects and how these uncertainties are determined.

GEO-20
FGM-28

Specific Comments by Subsection:

The following review of AEA's Geomorphology Study Plan (2012) uses the structure of the plan's stated objectives and compares them to the Service's study request objectives to determine if the intent is met, where improvements can be made, and which request objectives are not addressed.

AEA Study Objective 1. Determine how the river system functions under existing conditions.

This is a good overarching objective that includes several of the Service's more specific objectives. Geomorphic characterization of the Project-affected river channels should include a good understanding of the current rivers system. This will be achieved by addressing Service-specific objectives and methods, including:

GEO-22

- Characterize and map relic geomorphic forms from past glaciation, paleofloods and debris flow events.
- Characterize and map the geology of the Susitna River, identifying controlling features to channel and floodplain geomorphology.

- Characterize and map the fluvial geomorphology of the Susitna River.
- Describe and identify the primary geomorphic processes that create and influence fluvial geomorphic features.

If the specific objectives we recommend are recognized, including past glacial form, geology, and characterizing the fluvial forms and processes, then the study plan should provide an adequate overall understanding of the river system function. We recommend the study plan provide sufficient detail to support that each of the Service study request objectives are being achieved.

GEO-18 The Service's study request recommends specific methodologies. It is unclear in the PSP if the Service's proposed methods will be incorporated into the study plan or why other methods are adequate or better suited to achieve Service stated study objectives. Methods for channel substrate size characterization, longitudinal and cross-sectional bed profiles are not described in this proposed study plan. In the Geomorphic Characterization of the River section of the Service's study request, we recommend bed material characterization to include spatial sediment facie mapping (Buffington and Montgomery 1999), pebble counts (Wolman 1954), and bulk samples.

AEA Study Objective 2. Determine how the current system forms and maintains a range of aquatic and channel margin habitats

The applicant's second study objective relates to the Service's requests for understanding the primary geomorphic processes that create and influence fluvial geomorphic features. This information along with the delineation and characterization of riverine habitat types for the project area will provide a good understanding of which geomorphic processes create and maintain aquatic habitats. A description of how habitat utilization will inform the habitat characterization should also be included. For example the main channel is currently one of the macro-habitat classifications, but if, through utilization and fish distribution study, it is found that there are unique main channel features that are important, then the classification should identify the processes that maintain those features and substrate composition. This provides a foundation for development of operation effects to habitat, specifically the flows necessary to create and maintain habitats. The Service requested that correlation of geomorphic forms and
GEO-26 processes to riverine habitat types be done for the project area, and that the project construction and operation be assessed to evaluate change to the habitat types. Additional information, such as the characterization of surface area versus flow relationships of riverine habitat types will help characterize the timing and distribution of habitat under the natural flow regime.

GEO-28 The PSP includes several locations where additional data will be collected to supplement historical data (to be performed by the USGS). These locations are on the Susitna River mainstem (near Tonsina Creek, at the Susitna River Gold Creek gage, and the Susitna River at Sunshine, the Chulitna River near the mouth). The PSP proposes to use this information with historic information to calculate the sediment input from major tributaries. The Service maintains that existing sediment transport data from the Talkeetna Rivers is insufficient to conduct a sediment budget or to empirically characterize the Susitna River sediment supply and transport conditions. Instead, we recommend that sediment transport data collection be conducted near the mouths of both the Chulitna and Talkeetna Rivers. The sediment transport data collected at the Chulitna and Talkeetna Rivers is necessary to reduce error and increase

understanding of sediment transport associated with the large and small tributaries and dispersed sediment input associated with hillslope and mass wasting processes.

GEO-37 Characterization of bed material mobilization is described in the PSP. The methods include use of USGS empirical sediment rating curves, incipient motion calculations, and field observations. To achieve the objective of characterizing bed material mobilization, the bed material must be characterized as per the Service's recommendation (see our comments under the first objective).

GEO-30 An assessment of the source, transport, and storage of large woody debris in the Susitna River and the role of large woody debris in channel form and aquatic habitat is needed in conjunction with data from the studies of hydrology, geomorphology, riparian and aquatic habitat, and ice processes, in order to determine the potential effects of project operation on large wood resources. The geomorphology PSP does not specifically state that it will collect large wood information but it does state that large wood information will be used in the assessment of Project effects on geomorphology. The Service recommends that the geomorphology PSP include detail regarding which study will collect large wood information, the sufficiency of this data collection to meet the needs of other studies, and how/when will it be provided to appropriate studies.

AEA Study Objective 3. 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.

- Empirically characterize Susitna River sediment supply and transport conditions;
- Assess channel and study site stability/change (1980s versus current conditions).

This study objective is critically important to the assessment of Project operational effects on riverine habitats by assessing the potential for geomorphic change. This goal should be achieved through conceptual and numerical modeling which is further described in AEA's Fluvial Geomorphology modeling PSP and in our study request under G-7 Modeling Magnitude and Trend of Geomorphic Response.

The examination of magnitudes of change of geomorphic features should also be examined from the perspective of large wood recruitment. The study plan should explain how the geomorphology study will incorporate an understanding of geomorphic change and processes to understand large wood recruitment.

AEA Study Objective 4. Determine the likely changes to existing habitats through time and space.

This objective is similar to our request to evaluate geomorphic stability and change (objective 6 in the Geomorphology study request). All of the data collection proposed in AEA's PSP, in addition to the data we request, will be used to understand the likely changes to existing habitat. AEA proposes to calculate effective discharge for the Susitna River, similar to the methods requested by the Service. This is important as quantification of the range of flows that transport the most sediment provides useful information to assess the current state of adjustment of the channel, and to evaluate the potential effects of altered discharge and sediment delivery to channel behavior. This is a good example of study information that must be integrated with other studies, specifically instream flow, for overall project analysis.

GEO-32

For the lower river, the PSP describes a reconnaissance level assessment (by assessing geomorphology and habitat via aerial photography). AEA proposes that a conceptual frame work be used to assess project effects to the lower river, below the Chulitna and Talkeetna confluences. The conceptual frame work described by AEA and requested by the Service is defined in Grant et al. (2003). We recommend that the conceptual frame work be used downstream of the proposed dam location longitudinally to the downstream extent of the modeled area, and that the study area be extended if the framework calculations find influence in the lower river. This will rely on the development of the hydraulic flow routing models (see our comments on instream flow) and may require the extension of this modeling effort. The decision process and threshold to extend the mapping, models, and more qualitative assessments in the lower river must be described and should include the determining factor for extension of these study components. Also, because the habitat mapping is being done under the Geomorphology study plan, the lower extent of that component must be compared to winter operations and the potential hydraulic or water quality effects downstream. This is necessary to assess which habitats and species may be affected in the lower river.

The characterization of bed material mobilization will be necessary to populate sediment transport models and to assess the likely geomorphic changes associated with reducing the sediment supply, by trapping sediment behind the dam, and by altering the natural flow regime. This information will be used by the Service to make instream flow recommendations under our 10(j) authority. A critically important product listed in AEA's PSP is the calculation of effective discharge for the pre- and post-project conditions, and the likely effects on channel morphology. This is further described in section 5.8.4.4 of the PSP to assess geomorphic change in the middle and lower rivers.

Literature Cited

Alaska Energy Authority (AEA). 2012. Proposed Study Plan Susitna-Watana Hydroelectric Project FERC No. 14241. July 15, 2012.

Buffington, J. M., and D. R. Montgomery. 1999. A procedure for classifying textural facies in gravel-bed rivers. Water Resources Research 35: 1903-1914.

Grant, G.E., J.C. Schmidt, and S.L. Lewis. 2003. A geological framework for interpreting downstream effects of dams on rivers. AGU, Geology and Geomorphology of the Deschutes River, Oregon, Water Science and Application 7.

Wolman, M.G., 1954. A method of sampling coarse river-bed material. Trans. Am. Geophys. Union 35, 95 – 956.

U.S. Fish and Wildlife Service. 2012. Letter and study requests to Secretary Bose, Federal Energy Regulatory Commission. May 31, 2012.

5. Water Resources

5.9. Fluvial Geomorphology Modeling below Watana Dam Study

General Comments:

The AEA PSP stated goal for the Fluvial Geomorphology Modeling below Watana Dam Study is *"to model the effects of the proposed Susitna-Watana Hydroelectric Project on the fluvial geomorphology of the Susitna River; with the Geomorphology study to assess the impacts of the project on the dynamic behavior of the river downstream of the proposed dam, with particular focus on potential changes in instream and riparian habitat."*

AEA proposes four questions to be answered by the fluvial geomorphology and 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?
- Will the Project affect the morphologic evolution of the Susitna River compared to pre-Project conditions?
- If the Project will alter the morphology of the river what are the expected changes over the term of the license?

FGM-29 If the system is found to be in dynamic equilibrium, the Service recommends that the geomorphology and fluvial geomorphology studies provide the magnitude and trend of geomorphic change in response to the Project, and that these changes be translated to spatial and temporal riverine and floodplain habitat changes. If the system is in disequilibrium the geomorphology studies should provide an understanding of the disequilibrium without the Project and then present the Project effects to the system and summarize the effects in a spatial and temporal riverine and floodplain habitat change analysis.

Specific Comments by Subsection:

AEA Study Objective 1. Model channel formation processes in the Susitna River downstream of the proposed Watana Dam site.

AEA describes three study components: 1) bed evolution model development and calibration; 2) model existing conditions and with-Project conditions; and 3) coordination of model outputs.

This objective will provide operating flow analysis over a range of flows to assist the Service in making recommendations regarding instream flow conditions for channel maintenance. In this study request the applicant lists three factors in choosing appropriate geomorphology models: 1) the level of detail required to meet the overall study objectives; 2) the class, type, and regime of flows that are expected to be modeled; and 3) the availability of necessary data for model development and calibration. The Service recommends that the model selection should be made soon to ensure adequate collection of data to populate the models as data collection can be difficult, and may require several seasons. The bed evolution modeling approach will consist of a 1D movable boundary sediment transport model to address reach-scale issues and 2D models to address local scale issues. Both of these should be tied back to effects on habitat by

FGM-31

associated changes to geomorphic form and process. The 1D model will extend from the proposed dam downstream extent of the hydraulic flow routing (RM75, downstream of the USGS Susitna River gage near Sunshine) unless project effects are found to occur at the downstream boundary of the model.

FGM-35 One of the models proposed for 1D model selection is HEC-6T, which allows for user defined transport equations, we reiterate that this will require good sediment transport data and will require data collected on the Chulitna and Talkeetna Rivers, and may additionally need other tributary inputs in the middle reach.

FGM-37 The 2D model, used to evaluate the detailed hydraulic and sediment transport characteristics on smaller, more local scales, will likely overlap with some of the instream flow study sites. Site selection for the 2D models must consider habitat utilization by anadromous fish, importance of the habitat, and dynamic flow patterns and geomorphic processes. Sites should be selected that serve biologic functions (spawning, rearing, migration, overwintering) and with potential for change related to Project operations.

AEA Study Objective 2. Estimate the potential for channel change for with-Project operations.

The channel change associated with Project operations, assessed with the operating flow analysis, will provide the Service with data to make operational recommendations to maintain riverine habitats. AEA describes using the calibrated models to model existing and with-Project conditions (5.9.4.2). The with-Project scenarios will be evaluated over a 50 year continuous operating scenario. The scenarios should represent a variety of operational scenarios to provide the Service with the full operating range from a "no Project" scenario to the current proposal. This information must be coordinated with the other studies (see below).

Additional information should be provided with the estimate of potential channel change, including a translation to habitat change, change in large wood recruitment, change in floodplain sedimentation, and change in substrate size composition.

AEA Study Objective 3. Coordinate with other studies to provide channel output data.

FGM-14 AEA will provide an assessment of where the channel geometry and substrate will likely be affected by project construction and operations to the instream flow study to assess where the instream flow analysis assumptions may not be valid. We recommend that the geomorphology modeling results for Project operational scenarios also be presented in the instream flow study to allow for an integrated analysis of the changes to riverine and floodplain habitats influenced by Project operations. Other information that should be provided to the instream flow analysis is a change in large wood recruitment, change in substrate size composition, discharges necessary to mobilize substrate, the frequency of bed mobilization, bedload and total sediment rating curves, geomorphic response reaches and correlated habitat effects. Additional longitudinal information, such as bed elevation adjustment should be described and provided to the groundwater and instream flow studies to assess effects of geomorphic response on habitat availability and quality.

In the Service's study request the goal of the model coordination is to*: "… provide necessary output to the various other studies that will need to consider channel change. Early coordination with the Instream Flow, Instream Flow Riparian, Ice Processes, Productivity, and Fish studies will be conducted to inventory the information needed within those studies will become available*

with results of the bed evolution modeling and predicted changes in channel conditions for the various Project scenarios."

As previously recommended in our study requests and during TWG meetings we would like to see how the results from the geomorphology study will be integrated into the instream flow study to achieve the objectives that the Service requested in both the instream flow and geomorphology study requests.

Literature Cited

Alaska Energy Authority (AEA). 2012. Proposed Study Plan Susitna-Watana Hydroelectric Project FERC No. 14241. July 15, 2012.

Buffington, J. M., and D. R. Montgomery. 1999. A procedure for classifying textural facies in gravel-bed rivers. Water Resources Research 35: 1903-1914.

Grant, G.E., J.C. Schmidt, and S.L. Lewis. 2003. A geological framework for interpreting downstream effects of dams on rivers. AGU, Geology and Geomorphology of the Deschutes River, Oregon, Water Science and Application 7.

Wolman, M.G., 1954. A method of sampling coarse river-bed material. Trans. Am. Geophys. Union 35, 95 – 956.

U.S. Fish and Wildlife Service (Service). 2012. Letter and study requests to Secretary Bose, Federal Energy Regulatory Commission. May 31, 2012.

5. Water Resources

5.10 Ice Processes in the Susitna River Study

General Comments

May 31, 2012 the U.S. Fish and Wildlife Service (Service) filed a study request with FERC titled Ice Processes in the Susitna River, with the stated goal to characterize and document ice processes of the Susitna River and to use that information to analyze project effects on ice formation, location, persistence, and spring breakup. Changes in the ice processes may directly influence instream flows, habitat availability and quality, river and floodplain morphology, vegetation, and water quality, all of which are important to fish. This study will be used to predict the project's effects on ice processes in the project area and will be integrated with other studies to assess the how these effects will alter instream flow, winter time surface water/groundwater exchange, fluvial and floodplain geomorphology and vegetation, riverine habitat and quality of that habitat, and water quality in the Susitna River ecosystem. This document is a review of the ice processes proposed study plan (PSP) provided by Alaska Energy Authority (AEA) on July 15th within their broader Water Resources study plan (AEA 2012).

ICE-31 The Service requests an analysis of the hydraulic flow routing and ice process model's abilities to assess project effects under the proposed project operations. Specifically, will the model have the ability to assess hydraulic flow routing and ice process effects at a scale relevant to fish and their habitat? What can be determined from the proposed study? How will uncertainty be determined from the study and modeling results? Additional information must be provided to the currently proposed ice process models and the winter hydraulic flow routing models in order to enable a sufficient understanding of the project effects on anadromous fish and their habitat.

During the August 17, 2012 technical working group meetings agencies and other attendees requested a more detailed study frame work; one that not only lists a range of methods but defines the specific objectives and addresses the agencies objectives and information needs, and logic for how the proposed methods would be implemented to achieve those objectives. At this meeting the applicant described two potential ice processes models, but did not describe the data necessary to populate, calibrate and validate the models. It is not known if the proposed models will have the ability to extrapolate to proposed winter operational flow conditions well outside the natural flow regime to understand the effects of the project. Regardless of the modeling method implanted, hydraulic routing and accurate determination of

ICE-10 discharge under ice cover requires direct measurement. Winter discharge measurements are needed at each of the routing cross-sections because ice thickness and roughness will greatly influence the stage-discharge relationships. We request a detailed description of the minimum number and locations of discharge measurements to be taken during winter to populate and calibrate the winter hydraulic flow routing and to be used by the winter ice process model(s).

ICE-11 The Service requested a review and summary of information from existing studies of cold-region hydropower projects around the world that describe the effects of hydro operations on ice-covered rivers. This request was meant to inform potential implications for the proposed project. The PSP provides a general overview of river ice processes that would be applicable to a typical northern river, citing textbook publications. In addition, ice observations and some key findings from the 1980s studies are listed. Further on in the PSP, five ice modeling studies are

referenced and the reader may interpret that the study would only produce a white paper summarizing these five references.
We offer the following comments on the literature review:

- A general overview of river ice processes should be presented with reference to the study reach. River ice processes should be presented in a context relevant to the study reach.
- The literature review should provide more than a "white paper" summary of the five listed modeling studies (refer to PSP Section 5.10.4.6). Consider expanding the review to include international project sites (e.g. Northern European) and other large non-hydropower instream infrastructure projects.
- The review should provide greater insight into understanding river ice processes in the context of the study reach with consideration of the following:
  - Impacts of the project on river ice processes.
  - Methods of analysis and tools used to understand and assess impacts of the project on river ice processes, fish, and fish habitat.
- The study of river ice processes invokes the use of terminology that may be unfamiliar to some readers. Further, there is often a lack of consistency on the use and meaning of river ice process terminology among authors with differing areas of expertise. To illustrate, consider the following terminology: aufies and anchor ice; ice dams and ice jams; frazil, slush ice, and snow ice; shore ice, shelf ice, and border ice; and, breakup described as mild, severe, dynamic, thermal, eventful, or uneventful. The project would benefit from a consistent use in terminology and a glossary of adopted river ice process terms.

There is a strong potential that the winter physical processes models (winter hydraulic flow routing, ice processes, groundwater, and water quality models) will have large uncertainty, also it is likely that a true understanding of fish habitat utilization will not be available with only two winters of fish surveys and studies. The combined limitations of the physical processes and fish studies may present difficulties for the agencies in making recommendations regarding protection, minimization, and enhancement. Without adequate knowledge of project affects the Service will require the project to operate along the natural flow regime; this would result in recommendations that require operations to maintain stable winter flows.

ICE-12

The study plan must include a schedule to collect necessary data, prepare the model, and complete the analysis. Additionally, the plan should include enough flexibility to extend the studies if the data and modeling products are not sufficient for the Service to adequately analyze winter operation effects on anadromous fish.

Specific Comments by Subsection

The following review of AEA's Ice Processes Study Plan uses the structure of the plan's stated objectives and compares them to study request objectives to determine if the intent is met, where improvements can be made, and which request objectives are not addressed.

AEA Study Objective 1. Document the timing, progression, and physical processes of freeze-up and breakup during 2012-2014 between the Oshetna River confluence (River Mile [RM] 233.4) and tidewater (RM 0).

ICE-13 While all northern rivers share similar traits in terms of general river ice processes, they are all very unique. The PSP should outline how the existing regime will be characterized. By characterizing the existing regime the study team will gain valuable insights into the specific behaviors of the study reach over the ice-affected period. A proper characterization would define the key drivers behind the dominant river ice processes and describe the nexus of these dominant processes with fish and fish habitat, and other studies. The characterization should also identify the controlling factors with respect to each nexus. Characterization should consider: spatial and temporal variability; river ice evolution; annual variations; and key physical and meteorological drivers. Adequate characterization will help guide the development of a suitable framework for assessing project impacts. An important characterization task is observation. The PSP should describe the data requirements needed to support characterization of the existing ice regime.

AEA Study Objective 2. Develop a modeling approach for assessing ice processes in the Susitna River.

The proposed winter operations will be an extreme alteration of the currently existing flow regime, with associated effects to anadromous fish and their habitat. A detailed understanding of the project effects caused by winter operations is necessary. If study results are not adequate for the Service to determine project effects, then the study period will need to be extended until an adequate understanding can be gained. If this is not accommodated, then the winter project operations will need to be altered to mimic the natural flow regime (i.e. no load following and baseloads within the range of the natural flows).

ICE-14 The modeling approach must include a discussion of the selected model limitations and the limitations of the winter hydraulic flow routing models. Although the winter hydraulic flow routing model is discussed under the instream flow study plan and the model results are needed by this, among other studies, no detailed data collection for the winter hydraulic flow routing is described.

The PSP emphasizes the application of a computational river ice process model. It is expected that the adopted river ice process model will be a valuable assessment tool. However, it is important to provide context to the adopted tool and clearly set out the expectations and potential limitations of the adopted tool. It is recommended that the PSP outline the overall methodology for analyzing project impacts. There may be merit it developing a conceptual assessment framework where the model resides as a powerful tool within the framework. One role of the framework would be to enable strategies for dealing with potential limitations of the model, data, or general understanding of the nexus between river ice processes and related processes. Specifically:

ICE-15
- Previous modeling efforts using ICECAL, SNTEMP, and DYRESM are mentioned. It would be appropriate to comment more on: the key findings resulting from the application of these models (will these findings help guide the current study?); their data needs (are they similar or very different than current needs?); and, their limitations (what limitations are we overcoming with the proposed model(s)?).

ICE-16
- In section 5.10.2.2, the PSP states that additional data needs are driven by: "*1) the new proposed configuration of the Project and project operational scenarios; 2) advances in predictive models of winter flow regimes beyond what was available in the 1980s; and 3)*

the need to supplement previously documented observations of natural ice processes." The first and second factors imply that post project configurations, operation scenarios, and model data requirements will drive data needs. The PSP would benefit from outlining how data needs for these factors may be different or similar to those for the 1980s studies. Also, how portions of the 1980s data may be useful for the current study. The last factor may require clarification as it seems to read as "additional data needs are driven by the need for additional data".

ICE-17
- Towards the end of section 5.10.2.2, a fourth factor driving data needs is suggested. That is, changes in channel geometry may make certain observations from the 1980s not applicable to current conditions (e.g. locations of ice bridging, open water leads, and ice jams). Also, that the location of the frazil production varied significantly between study years. We suggest that the study team provide more discussion on how the data may be used for the current study, in spite of changes in channel geometry, and temperature variability between study years. And caution against dismissing 1980s data due to changes in channel geometry and annual climate variations.

ICE-18
- The last paragraph of section 5.10.2.2*, "Finally, updated ice processes information is needed by the fisheries, instream flow, instream flow riparian, fluvial geomorphology and groundwater studies"* requires further clarification on how it pertains to additional information needs.

The PSP proposes to use an ice process model, CRISSP1D (or equivalent), to carry out winter flow routing. Comments on the ability of this model to meet the study objectives listed above are:

ICE-19
1. The use of one model to carry out both flow routing and ice processes is recommended due to the interaction between the flow routing and ice processes. CRISSP1D can be used to carry out this modeling but should be calibrated for its flow routing functions under open water conditions before ice effects are introduced. Consideration should be given to using the winter flow model to model flows, water levels and water temperature for the entire year.

ICE-20
2. Hourly time steps are feasible with CRISSP1D and even desirable from the ice process modeling perspective due to the diurnal fluctuations in air temperature.

ICE-21
3. A one-dimensional flow model will not be able to simulate the effects of open leads if they only occupy part of a channel width. If these locations are important due to groundwater inflows, a secondary two-dimensional model should be considered to provide more detailed simulations at selected sites.

ICE-22
4. In some instances, it may be appropriate to extend the 1D model results with very judicious application to address 2D problems.

ICE-24
5. No mention is made of modeling the reservoir and upstream tributaries. Large changes in flow rates can cause changes in reservoir levels that could affect water levels in upstream tributaries. Ice process in these tributaries may also be affected by the ice conditions in the reservoir. Has modeling of flow routing and ice processes within the reservoir and upstream tributaries been considered and will it be included in the final study plan?
6. It is important to be able to model the thermal regime of the reservoir including characterization of: temperature variations; ice thickness; and ice-in / ice-out dates.

ICE-25
The PSP proposes to collect a variety of winter measurements to assist in the calibration of the winter flow routing model. Comments on the ability of this data to meet the study objective to develop a calibrated flow routing model are:

1. Generally the data collection approach is appropriate to meet the objectives.
2. Winter flow measurements should record total and submerged ice thickness and frazil slush thickness, both to assist in the roughness calibration and to provide calibration data for the ice processes.
3. Consideration should be given to collecting vertical velocity profiles using an ADCP as part of the discharge measurements. This can improve accuracy of winter flow measurement and provides additional information to determine under-ice roughness. This may also facilitate 2D model calibrations.

Review on the methodology for developing an appropriate tool or model is partially addressed in the previous section. The following review comments are offered for additional consideration. It is important to emphasize that physically-based, process models are recommended for assessing project impacts. This basic principle behind the modeling effort warrants recognition and explanation in the PSP. A valuable feature of using this approach is that, with suitable analogues of the various river ice processes, we can reasonably extend their application to assessing project impacts.

ICE-26

An effective data collection program is essential for providing the data necessary to support development, calibration, and application of the adopted model. A well-defined data collection program is warranted since a significant amount of resources are required to meet data needs and a lack of sufficient data may impact project schedule. The following discussion points are offered for consideration when drafting the revised PSP.

- The PSP puts emphasis on “what” data needs to be collected. While this is a critically important and potentially challenging task, it may prove to be more challenging to: determine how to collect data, where to collect it, and how often. The planning effort required to execute a successful field data collection program should not be undervalued.
- The field program should recognize that there may be some site-specific logistical challenges that may only be learned through experience.
- An improved understanding of the ice regime is expected as the team observes and collects data. This improved understanding may bring new insights into the data collection needs and the field program may require modification.
- It may be challenging to determine appropriate focus sites prior to gaining an understanding of the ice regime. Additional input from other study teams may impact the number and location of focus sites. Further, data needs for a particular focus site may extend some distance upstream and/or downstream from the local area.

ICE-27

The PSP would benefit from a plan outline of the proposed data collection program. The above considerations do not represent a comprehensive list to be addressed by the plan. While they should be considered, the primary intent is to illustrate the need for such a plan.
The extent of the modeled study area should be confirmed with the other discipline leads. It should be sufficient to adequately capture ice processes within the reaches of interest. For example, the effects of uncertainty on boundary conditions should be minimized through the reach of interest. The PSP acknowledges that “there are currently no accepted models for predicting dynamic ice processes on complex braided channels, such as those found in the Lower Susitna River”… “and therefore modeling will not be planned for a significant portion of the study reach”. The PSP should address how impacts of the project will be assessed through portions of the study reach that cannot be simulated by the adopted model(s). This may be included as part of the overall assessment framework, as suggested previously.

AEA Study Objective 3. Calibrate the model based on existing conditions.

We agree that each of the models must be calibrated based on existing conditions. The data necessary to adequately calibrate and test the models must be described, as discussed previously. The calibrated ice processes model review should include an assessment of the model's ability to predict changes in ice processes under the project operations at a scale relevant to fish and their habitat. Although AEA Study objective 3 is directed towards the ice processes model, the calibration of the ice processes it is also true for the winter hydraulic flow routing model. The calibration and then extrapolation of results from the ice processes model will be used to predict winter load following operations effects downstream of the dam.

ICE-28 The PSP suggests that the ice process models "*will be calibrated to the range of observed conditions".* It is recommended that the PSP discuss how the model will be applied outside the range of observed conditions. Also, will there be some form of model verification, or assessment? This discussion may relate to the benefit of applying a physically-based ice process model. Experience and specialized expertise may be required to justify application of the model outside the range of observed conditions.

ICE-29 The PSP should describe how quantitative predictions of the following (for mild, moderate, and cold climate scenarios), will meet the information requirements of the other studies:

- *"extent and elevation of ice cover downstream of the dam"*
- *"ice-cover progression"*, and
- *"timing of breakup"*.

AEA Study Objective 4. Determine the potential effect of various Project operational scenarios on ice processes downstream of Watana Dam.

ICE-30 AEA's fourth ice processes objective proposes various Project operational scenarios on ice processes downstream of the Watana Dam. This should also include the determination of the ice processes models to provide adequate data to the winter hydraulic flow routing to determine the effects of project operational scenarios on instream flows (timing, quantity, and quality) downstream of Watana Dam. An error analysis on the ice process models is necessary, because the model will be used to extrapolate the project operational flow and temperature conditions well outside of the natural regime. Also, the ice process model results will be used to populate operation scenarios (including load following fluctuations and higher than natural winter flows) for the winter hydraulic flow routing model which will also be calibrated under the natural flow regime which consists of stable winter flows.

ICE-31 As requested above, an understanding of the limitations of the models and results is necessary to determine if they are applicable to assessing project effects on fish and their habitat. An error analysis of the models and results is necessary to examine the extrapolated results from the ice processes model and in the winter hydraulic flow routing model to inform whether a true understanding of winter operations effects is achieved.

AEA Study Objective 5. Determine the extent of the open water reach; and
AEA Study Objective 6. Determine the changes in timing and ice-cover progression and ice thickness and extent.

ICE-32 The ice processes model will be calibrated by one to two winters of data collection under the natural flow regime. The model then will be used to determine the open water reaches, ice thickness, and timing and distribution of ice development under project conditions. As currently proposed the flow regime during the ice period (ice up to break-up) will be highly variable and much higher than the natural flow regime requiring extrapolation of the calibrated model. It is unknown whether the calibrated model be able to assess how load following operations will influence ice processes (destabilization of developing ice, ice jam formations, flooding, etc.) in comparison to the typically stable ice cover during winter (as discussed in She et al. 2011). An understanding of the selected ice processes model's ability to predict ice development and characteristics with the project operations and the uncertainty associated with these predictions is necessary to determine if the winter operations can be analyzed with respect to impact on fish and their habitat.

AEA Study Objective 7. Provide observational data of existing ice processes and modeling results of post-Project ice processes to the fisheries, instream flow, riparian instream flow, fluvial geomorphology, and groundwater studies.

ICE-33 The primary role of the ice process study is to provide ice processes information and effects analysis to other studies. Changes to ice processes, including the changes of timing and ice extent and thickness may alter many of the other riverine processes such as geomorphologic processes, groundwater exchange, water quality, and instream flow. The resulting modeling results of post-Project ice processes will be limited in providing analysis to the fisheries, instream flow, geomorphology, water quality, and groundwater studies; this limitation must be described.

ICE-34 The PSP clearly indicates a need for integration. The PSP does not explicitly define a plan for informing and integrating with the other studies. While the importance for integration may be implied within the various individual PSPs, the project would benefit if there was a clear plan describing the strategies for information exchange and integration between the various studies. This plan should discuss how the model results will be documented and how the information will be provided in a format that is clear and accessible to the other studies. The plan should acknowledge the potential challenges that may be encountered and strategies for dealing with these challenges.

ICE-35 In the Geomorphology (AEA 2012, 5.9.4.2.2.4) proposed study plan the applicant describes the interaction between the geomorphology studies and the ice processes study as, "*Ice processes influence both the channel morphology and riparian vegetation. For example, ice can prevent vegetation from establishing on bars by annually shearing off or uprooting young vegetation. Similarly, ice can scour vegetation from the banks, increasing their susceptibility to erosion. In both examples these influences affect channel morphology. Ice jams can also directly influence the channel morphology by diverting flows onto floodplain where new channels can form, particularly when the downstream water surface elevations are low, allowing the return flows to headcut back into the floodplain. Ice can also move bed material that would normally not be mobilized by rafting large cobbles and boulders. There will be close collaboration between the Geomorphology and Ice Process studies to identify the key physical processes that interact*

between the two. Working together to analyze the conditions at the detailed study sites will be a key part of this collaboration. A significant portion of the influences of ice processes on morphology are directly related to their effects on riparian vegetation. Additionally, influences of ice processes beyond the riparian vegetation issues that may be incorporated directly into the fluvial geomorphology modeling may include:

- *Simulating the effects of surges from ice jam breakup on hydraulics, sediment transport and erosive forces using unsteady-flow 2D modeling with estimates of breach hydrographs.*
- *Simulating the effect of channel blockage by ice on the hydraulic and erosion conditions resulting from diversion of flow onto islands and the floodplain.*
- *Use of the detailed 2D model output to assess shear stress magnitudes and patterns in vegetated areas, and the likelihood of removal or scouring.*
- *Use of the detailed 2D model output to assess shear stress magnitudes and patterns in unvegetated areas, and the likelihood of direct scour of the boundary materials."*

But in the ice processes study plan there is no description of simulating the effects of surges from ice jam breakup; or simulating the effect of channel blockage (which would likely require two-dimensional ice process modeling); or the ability of the ice processes modeling and winter hydraulic flow routing to provide adequate data to populate the 2D geomorphic models during winter conditions.

Literature Cited

Alaska Energy Authority (AEA). 2012. Proposed Study Plan Susitna-Watana Hydroelectric Project FERC No. 14241. July 15, 2012.

Northwest Hydraulic Consultants Ltd (NHC). 2012. Alaska Department of Natural Resources Topic 7 Ice processes and Winter Flow Routing Study Plan Review (DRAFT October 2012).

U.S. Fish and Wildlife Service. 2012. Letter and study requests to Secretary Bose, Federal Energy Regulatory Commission. May 31, 2012.

5. Water Resources

5.11. Glacial and Runoff Changes Study

General Comments:

The U.S. Fish and Wildlife Service (Service) has adopted and presents these comments as provided by the National Marine Fisheries Service (NMFS) on the Alaska Energy Authority (AEA) proposed study plan (PSP) for glacial and runoff changes as it purports to address in part, NMFS's request for a comprehensive study of Susitna River Project effects under changing climate.

This PSP only partially addresses NMFS' request entitled "Susitna River Project Effects under Changing Climate Conditions." It does not address the main objective of NMFS' climate change study request, which is expressed more fully in §1.3.1 of the request. In brief, the objective of NMFS' request is to assess the potential Project effects combined with impacts of climate change on the Susitna watershed ecosystem in order that a project license can be properly conditioned in anticipation of these changes.

The study plan is incomplete. It addresses some elements of NMFS' study request, but other elements are not addressed in this or any of AEA's other PSPs. Because the proposed Project is designed for long-term utility and is located in an area vulnerable to continued climate change, it is necessary to understand the cumulative impacts from the project and climate change in order to develop license conditions that protect anadromous fish species and their habitat. Some climate change induced effects of the Susitna River and Susitna watershed include continued warming of stream temperatures, reduction in permafrost affecting groundwater storage and discharge and channel incision, and glacier melting and reduction of summer flow. These climate-induced and project influenced changes in habitat would affect fish in the Susitna River. Informing the likelihood of these events will allow NMFS, and the Service, to make decisions on the effects that a dam would have if it were to block the passage of fish from the upper watershed, where refugia from negative effects on habitat may persist. Thus, NMFS seeks information from their requested climate study in order to inform our decision of whether prescription of fish passage is needed. Without such an understanding of climate change, project operations mistakenly would be considered as though future conditions were to be static. The project license would be outdated from the outset.

NMFS, and the Service, seek the information specified in its climate change study request in order to analyze the project effects, in the context of variable and changing climate conditions, on NMFS and Service trust resources. As explained more fully in §1.3.4 of NMFS' request, the main reason for this analysis is to incorporate the results of current climate science into comprehensive decision making, and provide information NMFS, and the Service, can use to develop, and in turn FERC can incorporate into any license order it issues, appropriate and efficiently tailored:

- Federal Power Act (FPA) section 18 fishway prescriptions for passage of anadromous fish;
- FPA section 10(j) recommendations to protect, mitigate damage to, and enhance fish and wildlife resources; and

- FPA section 10(a) recommendations to ensure that the project is best adapted to comprehensive plans for developmental and non-developmental resources.

In order to fulfill their duties under the Federal Power Act and other relevant mandates, NMFS, the Service, and FERC must obtain and apply the best available science, data and techniques to assess the potential effects of the proposed project on riverine processes, fish, and fish habitat. Applying recent advances in climate science, including scenario analysis and projections, to project analysis will result in more accurate and informed resource decision making (Brekke, 2009; Fowler 2007; Vicuna et al., 2010; Viers, 2011).

Recent advances in climate science and its application in other hydrologic risk analyses underscore the need for FERC's licensing process to utilize accurate predictions of the effects of climate change on changes in glacial wasting and on the timing and availability of water in the Susitna River. In the past, FERC has relied on historical data to evaluate project effects; in the context of changing climate a broader approach is needed. However, the best available science now includes the presently observed and projected future impacts of climate change on water resources. Congress recently emphasized the need for a broader scope of understanding, by directing the Secretary of Interior, via the SECURE Water Act, to coordinate with NOAA and its programs to ensure access to the best available information on climate change [(§) 9503 (c)(4) of the SECURE Water Act, (Pub.L. 111-11, Title IX, § 9501 et seq., Mar. 30, 2009, 123 Stat. 1329.)] stating, in part:

> Congress finds that--
> (1) adequate and safe supplies of water are fundamental to the health, economy, security, and ecology of the United States;
>
> (2) systematic data-gathering with respect to, and research and development of, the water resources of the United States will help ensure the continued existence of sufficient quantities of water to support--
> a) increasing populations;
> b) economic growth;
> c) irrigated agriculture;
> d) energy production; and
> e) the protection of aquatic ecosystems;
>
> (3) global climate change poses a significant challenge to the protection and use of the water resources of the United States due to an increased uncertainty with respect to the timing, form, and geographical distribution of precipitation, which may have a substantial effect on the supplies of water for agricultural, hydroelectric power, industrial, domestic supply, and environmental needs.

It is now considered routine for hydropower, dam and water management projects in the United States and around the world to consider projections of climate variability and climate change in project planning and operations (Viers, 2011), and FERC should do so here. In order that FERC may fulfill its duties, AEA should provide the information NMFS has requested.

GLAC-16 FERC has also recognized that when, as is true in for this project, reasonable projections of a range of likely temperature changes are available, projections of future climate and analyses related to future reservoir levels and river flows should include a reasonable spectrum of climate

change impacts. As FERC concluded in the study determination for the Toledo Bend Hydroelectric Project (FERC P-2305-020) such analyses are needed in order to reach informed judgments about likely project impacts on aquatic resources downstream of the project and on recreational resources in and around the reservoir.

FERC likewise determined in the Lake Powell Hydropower and Pipeline Project, that climate change effects on existing and future water supplies should be addressed as the availability of water for the pipeline would affect the ability of the Project to supply water and generate hydroelectric power. As with the Lake Powell project, the availability of water supply is directly related to this Project's purpose.

GLAC-17

Recent advances and applications of the science are described in detail in our study request; see, e.g., §1.3.2 of the climate change study request. FERC should incorporate these developments into the studies it approves, rather than dismiss them. NMFS has provided adequate supporting science, continued climate change scientifically accepted and continued warming is unequivocal. NMFS and the Service request that as part of the study plan determination, FERC order completion of our Comprehensive Study of Susitna River Project Effects under Changing Climate Study Request, filed with FERC on May 31, 2012 pursuant to 18 CFR Section 5.9(b).

FERC should also consider its responsibilities under the National Environmental Policy Act when determining the need for information about potential climate change. In issuing any license order, FERC should be informed about climate change's effect on the Project and its suitability, as well as how the project may affect trust resources already potentially compromised by climate change. NMFS, with support from the Service, seeks assessment of the effects of climate change on the Project and on the resources affected by the Project in order to adequately prepare and support appropriate license terms and conditions, inform the need for fishway prescription and to develop effective measures to protect, mitigate and possibly enhance resources for which we have statutory responsibilities.

NMFS' study request has demonstrated a reasonable nexus between Project operations and effects on resources resulting in cumulative effects of the Project and climate change on important habitat components such as water temperatures, groundwater patterns, timing of fish migration, spawning, hatching and food availability. But to simplify the consideration of nexus, NMFS offers this hypothetical example of a cumulative effect of the project and climate change on the Services' trust resources: Assume that, as projected, glacial recession and wastage continues to the point where summer flows from ice melt are reduced and eventually lost. Without the information NMFS has requested, FERC cannot determine to what extent the natural partial velocity barriers to upstream passage of Chinook salmon would remain barriers to fish passage, independent of the project. In other words, as glaciers melt and contribute less water to summer high flows, lower flows in Devils Canyon might naturally allow more Chinook salmon and possibly other species of salmon to swim upstream through the Canyon and access now marginal habitat. Or, as stream temperatures continue warming, current summer rearing habitat for juvenile salmon may become unsuitable causing species' range to move to higher elevations and/or further upstream. But without information about these possibilities, a license order would likely be unable to account for it. Accordingly, the project could block a natural wildlife response to climate change and create significant future effects unanticipated by a license order based on conditions as they currently appear.

AEA understands that water is the fuel for the proposed Project, and that the amount, timing and variability of flows due to changes in glacial wastage have resulted in documented climate-related changes in recent decades. Models that project future climate, and usually, change, are readily available in currently in use across Alaska and northern latitudes as described in our study request at §1.3.3 and 1.3.5.

GLAC-18 Where NMFS differs from AEA is that NMFS seeks to expand the climate study beyond simply the analysis of glacial retreat and flow into the proposed reservoir, and water quality. We request expanding the analysis to incorporate reasonably foreseeable changes in climate to assess vulnerabilities of natural resources in the project watershed. FERC must understand these vulnerabilities in order to determine how anadromous fish and their habitats may be affected by the Project, and ultimately determine if and how the Project may proceed. We suggest use of several documented methodologies, such as Bryant, 2009, and of using one of the many available and commonly used climate change vulnerability assessment processes.

In particular, we are concerned about the failure to consider the detailed content of this study request by FERC in its Scoping Document 2 (SD2), and the only partial adoption of the request by AEA. In the SD2, FERC states that its common practice is to evaluate a range of flow release alternatives that take into consideration both high and low water years and to condition any license that may be issued to adaptively manage for these variations in water years. FERC asserts that its practice sufficiently addresses NMFS concerns and study request. It does not. NMFS study request addressed the limitations of FERC's practice to analyze historic high and low water years:

> *"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). Given the current trends (described below in 1.3.4), there is need to document the environmental baseline of the project, and to develop a realistic projection of the range of potential future trends in order to effectively evaluate the impacts of the project on NMFS resources and allow NMFS to make accurate conservation recommendations, license terms and conditions, and to develop recommended protection, mitigation and enhancement measures to address likely project effects.*
>
> *Both precipitation and temperatures are projected to increase significantly, resulting in an increase in evaporation and evapotranspiration. In addition, rather than snowpack accumulating over the winter, increased temperatures will result in melting the snowpack "storage." The alteration of rain and snowfall timing and intensity, evapotranspiration and groundwater and surface flows, translates into changes in the annual hydrograph and potentially less water availability. Considering a static environmental baseline in project planning will not capture these projected changes. These changes need to be considered in project planning. Alaska's freshwater resources are increasingly at risk from climate change and preparing for this future is of escalating importance. Thus, studies are needed to connect the trends and projected changes in climate to variables needed for project planning."*

NMFS and the Service disagree with FERC's suggestion that adaptive management can be used for variations in water years for the reasons described in the study request and reiterated above. Adaptive management could, more appropriately, be applied to climate change.

Adaptive management is one way to address the multiple uncertainties in the future faced by the Sustina project – not only climate change. However, an adaptive management framework, including monitoring and experiments, must be built into the Project in the beginning (Gregory et al., 2006) including the issues for which adaptive management is more or less likely to be a viable option.

The Susitna project has characteristics that may make it a good candidate for using adaptive management (in fact, DOI uses the case of re-licensing of the Tallapoosa dam as a case study), but has other characteristics that may make it more difficult. In a recent review by Gregory et al (2006), challenges to an active, experimental, adaptive management approach include:

"(a) designing statistically powerful experiments capable of discerning external effects and effectively considering issues of duration (i.e., using titration designs),
(b) articulating all the costs, benefits, and risks of alternative experimental and non-experimental management plans, and again
(c) ensuring that sufficient staff capacity and institutional flexibility exist."

One of the examples presented by Gregory et al. (2006), as more complex and difficult, involves climate change and a multi-objective project of land planning. Adaptive management does not relieve the need for adequate baseline information in an original licensing proceeding - and in fact requires it. Adaptive management is a decision-making process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.

Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a "trial and error" process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social and economic goals; increases scientific knowledge; and reduces tension among stakeholders. It is vital that adaptive management is the paradigm for both pre-licensing study plans and post-licensing conditions for long-term monitoring.

To be effective, adaptive management requires a deliberate, intentional process, including set up and iterative phases, and within these, decision making, post-decision monitoring, assessment of monitoring data, learning and feedback, and institutional learning, according to Williams and Brown (2012) in a recent DOI guidebook to adaptive management. Monitoring and experiments must be built into the project in the beginning (Gregory et al., 2006), and they lay out a set of criteria that suggest problems for which adaptive management is more or less likely to be a viable option. They also point out the dilemma of *"clearly documenting what we do not know as the basis for experimenting with valued and, in many cases, fragile ecosystems."*

The information on climate change that NMFS has requested is necessary to prior to FERC determining whether the license order should include adaptive management measures. NMFS and the Service recommend FERC order development of an adaptive management approach for all aspects of decision making associated with the proposed Study Plan and license application decisions.

Specific Comments by Subsection:

5.11.4.1. Review Existing Literature.
This literature review should be expanded to include a review of climate projections and glacial regions, permafrost changes, and other existing research relevant to the impacts of climate variability and change on the water dependent resources of the region. This is because the current literature review is limited to physical processes affected by climate change, and does not cover the reasonably foreseeable cumulative effects of those changes on the natural resources that will also be affected by project operations.

5.11.4 Study methods.
GLAC-19 NMFS and the Service appreciate that AEA will consider exploring future runoff projections available from climate models in a qualitative manner. However, the analysis of future runoff should also be assessed quantitatively. Because the PSP is confusing where it discusses study methods, NMFS and the Service request clarification or perhaps clarification of the following details.

The study proposes to analyze changes in glacial systems, temperature, and precipitation, and their impacts on watershed hydrology, including future runoff projections. The changes in runoff will be translated into time series data summarizing changed hydrology and temperature dynamics in the Susitna basin.

GLAC-20 The study also proposes to qualitatively assess the potential effects of "climate change models." This reference is unclear – global climate models (GCMs) are used to simulate the past and project the future climate and, with greenhouse gas forcing, "change," but climate *change* models don't exist. While the glacial study plan does include an analysis of stream flow based on climate projections, it is not clear how this is being conceptualized. The revised study plan should define what is meant by "future runoff projections" as compared to "climate change models." On page 5-153, the PSP mentions, *"This will include no change from current conditions, continuation of current warming trends, and adherence to various climatological scenarios such as SNAP (2011)." "Climatological scenarios such as SNAP"* appears to refer to several downscaled climate projections based on the global climate models, but this needs clarification.

It is unclear what is meant in the PSP by a "qualitative analysis." At a minimum, potential effects of climate change should be evaluated on a relative basis (as in the Lake Powell Pipeline study), with effects on stream flow and water supply associated with climate change being applied to all interrelated and affected Susitna studies and project alternatives. For example, changes in stream flow associated with climate change should be included for each study planned for the project that would be used by NMFS and the Service in making fish passage determinations and prescriptions and its conservation recommendations pursuant to §§18, 10(a) and 10(j) of the FPA and the Essential Fish Habitat provisions of the Magnuson-Stevens Act §305(b)(2), 16 U.S.C. 1855(b)(2). This is true for each project alternative that may be assessed. Including effects of climate change in all potential studied resource areas that are likely to be affected by project construction and operations studies will result in a relative comparison between alternatives where effects of climate change apply equally to each alternative.

5.11.4.2. Develop a Modeling Framework

From the PSP, it is unclear how future hydrologic simulations will be developed. The PSP mentions forcing using *"Max Planck Institute for Meteorology ECHAM5 model (3 hour time steps) and SNAP (daily) models. The SNAP dataset includes the years 1980-2099, with data downscaled to 2 km grid cells. Future projections from SNAP are derived from a composition of the five best ranked General Circulation Models (out of 15 used by the Intergovernmental Panel on Climate Change [IPCC]) models for Alaska. Based on how closely the model outputs matched climate station data for temperature, precipitation, and sea level pressure for the recent past, their individual ranking order for overall accuracy in Alaska and the far north was as follows: 1) ECHAM5, 2) GFDL21, 3) MIROC, 4) HAD, and 5) CCCMA."* The PSP proposed to use a five-model composite from these and three emissions scenarios.

GLAC-21 Calling out the ECHAM5 model separately from SNAP is unclear – ECHAM5 is a global climate model with a large spatial scale not well suited for application at the sub-watershed level as in this Project. A 3-hour time step is mentioned, but this would also be at the large spatial scale of global climate models, ~1.9°**x**1.9° (about 210 km) in the case of ECHAM5. Daily projections from SNAP would be at a 2 km resolution downscaled from global climate models, including ECHAM5. This would be a useful level of resolution for use in this project. It is possible that the climate scientists plan to use simulations of these models of the past (e.g., since 1960 is mentioned) but the explanation of the methods is confusing and needs to be better articulated. Further on, the PSP states that *"Future simulations will be forced by a suite of downscaled IPCC AR4 projection scenarios and, if available, the newer AR5 simulations."* This does not appear to be different from the 5-model SNAP composite. An accurate explanation of the methods is needed in order for NMFS and the Service to understand, and FERC to determine, whether these methods are appropriate for gathering the information necessary to develop a license application.

GLAC-22 NMFS and the Service support the methods selected for analysis of change in stream flow on annual and seasonal basis. But we recommend clarification on how analysis at "single event timescales" could be completed. Perhaps this is an analysis of extremes in the downscaled data. More detail on methods is needed as NMFS climate scientists are unaware of how such an analysis could be made and the PSP does not explain the methodology.

Literature Cited

Brekke, L.D., Kiang, J.E., Olsen, J.R., Pulwarty, R.S., Raff, D.A., Turnipseed, D.P., Webb, R.S., and White, K.D., 2009, Climate change and water resources management—A federal perspective: USGS Circular 1331, 65 p. Available at http://pubs.usgs.gov/circ/1331. Accessed 25 May 2012

Fowler, H.J., Blenkinsop, S., and Tebaldi, C., 2007, Review: Linking climate change modeling to impacts studies—Recent advances in downscaling techniques for hydrologi¬cal modeling: International Journal of Climatology, v. 27, p. 1547–1578.

5. Water Resources

5.12. Mercury Assessment and Potential for Bioaccumulation Study

General Comments:

This Alaska Energy Authority (AEA) proposed study plan (PSP) was developed in response to the U.S. Fish and Wildlife Service's (Service) concerns about the risks posed by mercury to fish-eating wildlife in the project area, as detailed in our study request entitled, "Piscivorous Wildlife and Mercury – Risk Assessment Study". We are encouraged that AEA is planning to conduct a study to predict how project operations may affect future mercury levels in the reservoir's sediments, water and biota. AEA's PSP addresses some, but not all, aspects of our study request. In these comments we identify which study request needs have not been met, and offer suggestions for improvement of the AEA's study plan. First we present over-arching concerns, and then follow with several technical comments related to the PSP.

MERC-08

Adopt the concept of mercury with dynamic background.

The PSP needs to adopt an approach of documenting and assessing the dynamic background concentrations of mercury and methylmercury (MeHg), particularly in fish and biota over time (not just in the landscape prior to construction). In other words, it is stated that enhanced formation of MeHg in reservoirs has been documented (section 5.12.2). The PSP should acknowledge and expect that a response in fish mercury will occur. For mercury, it is not enough to rely on models for the primary method of predicting impacts (***5.6.5. "****Models will be the primary method used for predicting potential impacts to water quality conditions in both the proposed reservoir and the riverine portion of the Susitna basin."*).

MERC-09

Rather, the AEA plan should assume the increase in fish mercury will happen and detail how this risk will be assessed, monitored, and managed as a public health issue. There will be significant concerns regarding human and ecological health and risk assessment and the proposed study needs to outline clearly how these risks will be documented, assessed, and managed.

MERC-10

Mercury modeling is essential, and is currently not addressed in any of the PSPs.

In order to determine the risk posed by project-related mercury inputs to the aquatic system, AEA must quantitatively model mercury inputs to the reservoir, the amounts and rates of mercury methylation, uptake and biomagnification of MeHg in reservoir organisms including concentrations at each trophic level, and transport of mercury downstream from the reservoir, from the date of initial flooding until 20 years post-impoundment. These mercury inputs and dynamics must be quantitated in order to predict project-related risks to ecological receptors in the project area.

MERC-11

In order to quantify new mercury inputs to the reservoir, the study must obtain information about the pre-impoundment surface area to be flooded and characterize the underlying geology, soil type and biomass types and amounts in the zone to be flooded, ***and then translate that information into quantitative amounts of mercury inputs and quantitative rates of mercury methylation using modeling***. The PSP begins to address this need, by *"gathering information"* about these factors and *"assessing mercury components"*. However, the PSP does not necessitate the following:

a) It does not attempt to quantify mercury inputs to the system.
b) It does not attempt to quantify rates of mercury methylation post-impoundment.

c) It does not attempt to quantify uptake and biomagnification of MeHg in reservoir organisms.
d) It does not attempt to quantify levels of MeHg at any trophic level of the reservoir food chain post-impoundment.

It is essential that the PSP both commit to these objectives, and also specify methodology to accomplish each of these objectives. A methodology to model mercury over time within the system must be specified, and the specific parameters needed for the model must be identified, to ensure that the necessary data are collected in an appropriate way.

MERC-12

*Document mercury increases at other hydro projects in boreal forested landscapes***.**

Attempts at modeling mercury methylation in surface waters are constrained by numerous required assumptions (e.g. methylation and demethylation rates, carbon limitations, sulfate and sulfide limitations, microbial community dynamics, parent geology and mercury content/leachability, hydrologic controls, aerobic/anaerobic boundary layer controls, etc.). The costs associated with developing and applying a modeling framework are still met by the need to validate the model with actual site-specific field data (e.g. MeHg in fish over time). To obtain an upper-bound on what the potential increase in MeHg in fish might be as a function of reservoir formation, the resulting increases in MeHg in fish from other Hydro sites needs to be documented. This requires not only reviewing peer-reviewed literature, but contacting directly agencies such as Quebec Hydro, Manitoba Hydro, Environment Canada, and authors of noted peer-review articles on the issue of enhanced MeHg in fish from reservoir formation. These include Vince St. Louis, Mariah Mailman, Britt Hall, K. Kruzikova, Reed Harris, Carol Kelly, John Rudd, S. Castelle, Dave Krabbenhoft and Drew Bodaly among others. There have been many lessons learned on how MeHg increases in fish upon flooding and impoundment and AEA's study plan needs to demonstrate that that knowledge base has been incorporated into their plan. Additional topics that would benefit from this level of communication would be documenting whether the EFDC model (or any other model) has been developed and calibrated for mercury in the context of reservoir formation. Also, Scandinavian countries may have addressed this issue in detail and contacting the list above may provide access to individuals in Sweden, Norway, and Finland who could advance the Project's knowledge base.

MERC-13

Do not assume mercury to be a simple, conservative behaving metal.

It is known that mercury transforms into a more bioaccumulative neurotoxin, MeHg, as waters are flooded in boreal forested landscapes (St. Louis et al., 2004; Mailman et al. 2006; Porvari and Verta, 1995). Incorporating the knowledge base on the key parameters affecting methylation at high latitudes needs to be addressed in detail by AEA's study plan well before construction. The reason for this importance is that watershed-scale amendments (e.g. tree removal, vegetation burning), may be worthwhile for mitigating the MeHg risks. Mailman et al. (2004) identify several strategies that need a thorough review by the proposed study relative to MeHg formation: "Possible strategies reviewed in this article [Mailman] include selecting a site to minimize impacts, intensive fishing, adding selenium, adding lime to acidic systems, burning before flooding, removing standing trees, adding phosphorus, demethylating MeHg by ultraviolet light, capping and dredging bottom sediment, aerating anoxic bottom sediment and waters, and water level management." It is acknowledged that excluding as many wetlands from the inundated area may be a recommendation (following findings from ELA, Ontario), but that may not be possible given the site topography.

MERC-14
AQFUR-2

Baseline mercury levels should be determined in fish-eating birds from the study area, by measuring mercury in feathers. This objective is not contained within any Applicant PSP.

The Service's study request includes an objective to document baseline mercury levels in piscivorous wildlife in the reservoir area, as measured in fur (for mink and river otter) and feathers (avian piscivores). The PSP does include an objective to collect and analyze mercury levels in fur samples from river otters and mink (in PSP 8.11, "Study of Aquatic Furbearer Abundance and Habitat Use). However, it does not include this component for avian piscivores.

Bird feathers are an excellent tissue for determining mercury body burden in birds, and feathers can be collected non-invasively. Please refer to section 1.6.3 of our study request for a complete discussion of this topic. It is very important to document baseline mercury levels in fish-eating birds in the study area, for at least two reasons. First, baseline mercury levels are needed as a foundation for interpreting future feather mercury levels after project operations begin. Baseline feather mercury values are also needed to determine the degree of risk posed by additional mercury inputs to the system. Risk assessors need to know how much "assimilative capacity" exists in fish-eating birds in the project area. Are current body burdens of mercury close to levels causing toxicity, or can the birds be exposed to additional mercury inputs from the project without experiencing toxic effects?

Mercury levels should be characterized in as many piscivorous bird species as possible in the study area, with a focused effort to include representative species for all relevant guilds. Raptors such as eagles and osprey, waterfowl such as loons and mergansers, and smaller birds such as kingfishers should all be assessed. Risks posed by mercury are likely to vary among piscivorous avian species, due to different exposure and dosage rates based on diets and body sizes. There may also be differing thresholds of mercury toxicity among species based on species-specific sensitivities to mercury.

MERC-15

The PSP should perform an ecological risk assessment for mercury toxicity in piscivorous wildlife in the study area.

The AEA's PSP misses the mark in saying that *"detection of mercury in fish tissue and sediment will prompt further study of naturally occurring concentrations in soils and plants and how parent geology contributes to concentrations of this toxic (sic) in both compartments of the landscape."* Abundant scientific literature cited in our study request documents that flooding previously terrestrial environments creates conditions for substantial NEW INPUTS of mercury into the system, and NEW CONDITIONS for methylation of mercury and subsequent bioaccumulation – especially in Northern environments. Therefore, CURRENT mercury content of fish in the Susitna River is not a necessary pre-condition for the need to study future, project-specific impacts of NEW mercury inputs and dynamics.

In order to characterize the mercury-related risks to ecological receptors posed by the project, AEA must perform an ecological risk assessment for each piscivorous species in the project area. The amount of mercury ingested by individuals of each piscivorous species must be estimated based upon dietary information and modeled mercury levels in food items post-impoundment. The ingested mercury levels should be compared to toxic levels, based on species-specific data from the scientific literature, to assess project-related risks to piscivorous wildlife in the study area.

Continuous monitoring.

MERC-16 A one-time, late-summer fish survey is inadequate to monitor dynamic background mercury concentrations. Toxics modeling is cited (5.5.4.4), but this cannot be done on the basis of "…will be conducted…" The toxicity of MeHg in fish and biota must be more pro-actively addressed in terms of:

a) How much increase in MeHg in biota and fish can be expected? (i.e., what has been the range of MeHg increases at other reservoirs?)

MERC-17 b) Studies have acknowledged that MeHg toxicity may be reduced by a number of possible management strategies, many of which would need considered and implemented before construction. These need addressed.

c) How will human and ecological health be considered (i.e. maintaining public health) in light of the likely increase in MeHg in fish?

In summary, AEA's study plan must assume that there will be an increase in fish mercury concentrations as a result of the formation of the reservoir. Managing this risk, modeling it, and monitoring it should be developed in accordance with what has been found at other similar landscapes.

Specific Comments by Subsection:

MERC-18 Page 5-164, first paragraph: discussion does not make sense. The State of Alaska (SOA) measured total mercury in salmon and other freshwater fish species from the Susitna River drainage. Contrary to the discussion, the SOA does not compare fish mercury concentrations to water quality standards. Unlike some other states such as Oregon, SOA does not base mercury water quality standards on fish concentrations. Table 5.12-1 reveals mean concentrations of mercury in several fish species from the Susitna Drainage (arctic char, northern pike, pink salmon and lake trout) that are above levels deemed safe for unlimited consumption by women of childbearing age, as determined by the Alaska Division of Public Health (Verbrugge 2007).

MERC-19 Page 5-163, paragraph 5: The report states *"At Costello Creek only 0.02 percent of the mercury detected (*in what – sediments?*) was found to be methylated. This study suggests, based on limited data, that mercury concentration varies significantly between separate drainages, and that methylation is also tributary specific"*. This may be true for sediments, but is very unlikely to be true for fish. As a general rule, mercury in fish tissue is nearly 100% methyl mercury (Bloom 1992).

MERC-20 Page 5-168, Section 5.12.4.3.2 Fish Tissue: The report states, *"Body size targeted for collection will represent the non-anadromous phase of each species life cycle (e.g., Dolly Varden; 90 mm – 125 mm total length to represent the resident portion of the life cycle.)*" This makes some sense, in order to understand the amount of mercury in the fish that is clearly attributed to the local environment. However, for risk assessment purposes it is also important to sample fish that are representative of those taken for consumption by humans and wildlife receptors. Specifically, large adult fish that are targeted by anglers (and bears) should also be sampled, to determine how much additional mercury can "safely" be added from the project before consumption advisories are warranted.

MERC-21 Page 5-170, Section 5.12.4.5: *"Pathway assessment of mercury into the reservoir…"* The water quality modeling this section refers to (from Section 5.6) does not have the capacity to predict mercury inputs from inundated bedrock, soils and vegetation, mercury fate and transport, mercury methylation, or mercury uptake by biota. Studies 5.6 and 5.12 point to each other, but neither actually does this critical mercury modeling work. A concerted, specific mercury modeling component is essential and must be added.

MERC-22 Section 5.12.6 Schedule: Two additional monitoring activities needs to be added to this table and scheduled: 1) Quantitative modeling of mercury inputs, rates of methylation, and uptake by biota; and 2) Ecological risk assessment for mercury exposure to avian and mammalian piscivores in the study area

Literature Cited

Bloom, Nicholas S. 1992. On the methylmercury content of fish and marine invertebrates. Can. J. Fish Aquatic Sci. 49:1010.

Mailman, M., L. Stepnuk, N. Cicek, and R. A. Bodaly. 2006. Strategies to lower methylmercury concentrations in hydroelectric reservoirs and lakes: a review. Science of the Total Environment 368:224–235.

Porvari P. & Verta M. 1995. Methylmercury production in flooded soils: a laboratory study. Water Air Soil Pollut. 80: 765–773.

St. Louis, V. L., J. W. M. Rudd, C. A. Kelly, R. A. Bodaly, M. J. Paterson, K. G. Beaty, R. H. Hesslein, A. Heyes, and A. R. Majewski. 2004. The rise and fall of mercury methylation in an experimental reservoir. Environmental Science and Technology 38:1348–1358.

Verbrugge, Lori A. 2007. Fish consumption advice for Alaskans: A risk management strategy to optimize the public's health. State of Alaska Epidemiology Bulletin Vol. 14 No. 4, 39 pgs. At: http://www.epi.hss.state.ak.us/bulletins/docs/rr2007_04.pdf

U.S. Fish and Wildlife Service. 2012. Letter and study requests to Secretary Bose, Federal Energy Regulatory Commission. May 31, 2012.

6. Instream Flow Studies: Fish, Aquatics, and Riparian

6.5. Fish and Aquatics Instream Flow Study

General Comments:

On May 31, 2012, U.S. Fish and Wildlife Service (Service) filed a study request with FERC entitled "Susitna River Instream Flow and Habitat Utilization". The stated goals of the study request are to: *(a) characterize the existing flow regime and its relationship to riparian and aquatic habitats and organisms; (b) use this information to quantify potential changes to aquatic and riparian ecosystems due to Project operations over the initial licensing period; and (c) determine effects of the Project on fish, in order to prescribe fishways and recommend mitigation needed to conserve fish populations of the Susitna watershed.* In contrast to the Service's goal, Alaska Energy Authority's (AEA) Instream Flow Proposed Study Plan (PSP) goal is to *"provide quantitative indices of existing aquatic habitats and the effects of alternate Project operation scenarios"*. The intent of AEA's goal is not clear and the PSP lacks the specificity needed to isolate and guide the characterization of fundamental ecological relationships underpinning the river's floodplain ecosystem. Changes (losses of habitat) to the floodplain ecosystem cannot be addressed through *indices* of existing habitat. The AEA study plan must characterize the natural flow regime that creates and maintains habitats. The ability of AEA to quantitatively predict changes/ losses of habitat important to the production of species dependent upon the Susitna River floodplain ecosystem is necessary to specifically address agencies' resource management goals.

USFWS Study Request
In the Service's Instream Flow and Habitat Utilization Study submittal, we requested hierarchical habitat mapping, fish distribution surveys, the characterization of microhabitat utilization patterns, and flow-habitat modeling to predict Project impacts. The Service requested a hierarchal nested habitat mapping (e.g., Frissel et al. 1986) framework to structure fish distribution surveys, the instream flow study and physical process studies.

In addition, we requested fish distribution surveys within the habitat mapping framework to assess the full lateral and longitudinal profile of seasonal fish distribution, life stage periodicity, and identification of micro-habitat criteria that are influential in fish habitat site selection. The Service also requested that site-specific habitat criteria be evaluated in the context of the hierarchical habitat framework, such that habitat criteria are determined and evaluated in all habitats of importance to each agreed-upon target species and life stage. We stated the need to determine what criteria are important to fish habitat site/suitability and selection before we can choose an appropriate flow-habitat model.

Although the Service has participated in the AEA technical work group (TWG) sessions to work through these issues, and some accommodations have been verbally expressed to meet the Service's study request, further collaboration is needed to ensure that AEA's instream flow study plan is amenable to the Service's request. We have not yet had the opportunity to review the most recent draft revised study plan to determine if our issues have been adequately addressed.

IFS-096

Study Duration
The Service maintains that the duration of the proposed studies will not represent the range of environmental (e.g. stream flow, temperature, snow pack, icing) conditions that occur naturally.

Habitat mapping, study site selection, and habitat utilization (fish) surveys need to be conducted over all seasons and over a sufficient period of time (years) to account for intra and inter-annual variability in environmental conditions. All evidence and ecological theory supports the fact that species are locally adapted to this variability and in many ways depend upon it (Mims and Olden 2012).

IFS-093 Habitat-flow relationships should also be developed over a minimum temporal scale to address the dominant age-class of Deshka River (Susitna River tributary; approximately RM 40) Chinook salmon. On average, a five-year period of study would represent one generation of Deshka River Chinook salmon based upon available age-composition information. In some years, 4- or 6- year olds predominate (ADFG 2012; Alaska Chinook salmon GAP ANALYSIS). The Deshka River Chinook salmon stock age-composition currently represents the only one of its kind within the Susitna River basin. Salmon stock age-composition is a well-noted data gap within the ADFG Chinook stock assessment analysis for Cook Inlet. The Service supports the State of Alaska Sustainable Salmon Fisheries Policy (ADFG 2001) calling for a Precautionary Approach to managing salmon stocks and habitats in the face of uncertainty. The Precautionary Approach specifically requires action on a time scale of five years, *"…which is approximately the generation time of most salmon species"*. A minimum of five years of study also allows the developer to account for a substantial range of natural environmental variability that is critical to identify patterns of habitat availability and utilization by fish. If studies are not conducted over a sufficient period of time, the impacts of this Project cannot be adequately assessed.

Study Plan Integration

During the August 16, 2012 technical working group meeting NMFS, USFWS and other attendees requested a more detailed study frame work from AEA to gain understanding as to how the individual studies will be integrated to demonstrate baseline vs. Project- related effects. AEA has made some headway toward this issue by drafting figures depicting study plan interrelationship and interdependencies. The Service has not yet had time to fully vet these figures and cannot comment on their completeness at this time.

IFS-106 Specifically requested was a framework that not only defines and lists the individual study plan objectives, but also includes the full range of proposed study methodologies. This information was then to be further integrated with the May 31, 2012 study requests in order to assess whether or not AEA individual proposed study plans meet the intent of the Service's overall study requests.

The study plan integration should also provide details for: 1) a process schedule (timeline) and methodologies for habitat mapping; 2) selection of the proposed focus areas and study sites; 3) surveys of fish distribution and collection of microhabitat utilization [hierarchically stratified by macro- and meso-habitats]; 4) statistical testing of microhabitat variables that are ecologically relevant to habitat selection; and 5) quantification of flow-habitat relationships. Specific methodologies for surveying anadromous and resident fish distributions should also include temporal and spatial distribution of spawning, summer rearing, and overwintering sites.

Each study component should have clear objectives and methods. Along with the study integration, AEA must state what each study can and will determine, and the degree of relative associated uncertainty in each study component. In other words, AEA must demonstrate how sampling protocols will yield samples that are representative of the full diversity of aquatic habitat. Each study component should explain the expected representativeness (spatial and temporal), precision, and accuracy of data results and model output calculations. If the study

component is dependent on, or supplies another study then the uncertainty analysis must take that into context to report cumulative uncertainty statistics. For example, an assessment of Project operational effects on overwintering fish will rely on an understanding of winter habitat utilization and variables that influence habitat utilization (biologic understanding) and on the winter hydraulic flow routing and water quality models, which will rely on results from ice process modeling. It is unclear how the associated additive and cumulative error of each of these study components is proposed to be quantified. Also unclear, is the degree of certainty surrounding the analysis of the resulting integration of Project-effects.

IFS-042

Alternative Instream Flow Tools/Methods

In addition to AEA's proposed use of the Indicators of Hydrologic Alterations (IHA) and Range of Variability models (TNC 1997; Richter et al. 1996; Richter et al. 1997), we recommend using the concept of natural flow regime (and variation) to maintain biodiversity and ecosystems and to identify ecologically relevant hydrologic indices that characterize the natural flow regime (Henriksen et al. 2006; Olden and Poff 2003; Poff et al. 1997).

The requested natural flow regime characterization is necessary to consider the ecological consequences of altering one or more flow parameters under the Project's proposed operating schedule (Richter et al. 1998). If the inter annual variability of the hydrograph is eliminated or altered, the ecological function of the Susitna River is invariably altered (Trush et al. 2000). The general and specific characterization is critical as the proposed operations may effectively reverse the natural hydrograph of the Susitna River substantially increasing winter base flows, and reducing summer flows.

Existing hydrologic data for the Susitna Watershed has been summarized by MWH (2011), including results from stations operated by the USGS in the Susitna River watershed. Historic, current, and proposed Susitna River watershed gages are summarized in (Table 1) of MWH (2011). The USGS has used these gages with the adjoining Little Susitna watershed, to generate a combination of measured and synthetic streamflows for a 63 year period from 1949 through 2011 (USGS, *in press* 2012).

The characterization of the Susitna River period of record will use the existing data, updated annually with the addition of new information and gages. The characterization of the natural flow regime (Lytle and Poff 2004; Poff et al. 1997) of the Susitna River should include the magnitude, frequency, duration, timing and rate of change of hydrologic conditions; including large and small floods, and high and low flows (Assani et al 2010; Bragg et al. 2005). High, median, and low flow year statistics should be summarized. This characterization will provide baseline conditions and form the basis for setting flow regime targets (Bragg et al. 2005) and resource management objectives.

IFS-045

The following comments are related to the use of Richter's concepts (1996; 1997) and USGS software (Henriksen et al. 2006) to characterize the natural flow regime, and the use of Matthews and Richter (2007) to characterize and isolate ecological flow components of the Susitna River's flow regime. The life histories of floodplain fishes are adapted to the Susitna's flow regime and their seasonal patterns of habitat use require natural flow variability (Mimms and Olden 2012). Mapping of the diversity of aquatic habitats and surveys of seasonal fish distribution within these habitats is needed to identify ecological flow components necessary to maintain fish production.

The use of environmental flow methods that are based on the attribution of seasonal ecological flow components and statistical analysis of the natural flow regimen requires the assessment of fish habitat utilization and hydrologic connectivity. Some aquatic habitats important to fish are seasonal and some are perennial. Interactive use of thresholds of hydrologic connectivity and statistical characterization of the natural flow regime can yield the creation of seasonal habitat series.

IFS-079 Thresholds of lateral connectivity need to be identified and monitored through the use of remotely sensed media and local instrumentation. Aerial and satellite photography can be utilized from a range of seasonal flow conditions (Benke et al. 2000) to assess patterns of hydrologic connectivity across the Susitna River floodplain. LiDAR data can be used interactively with hydraulic modeling to model patterns of hydrologic connectivity with even greater resolution.

IFS-044 Local instrumentation (pressure transducers/depth sensors) is also needed to assess hydrographic relationships between primary and off-channel habitats (sloughs and floodplain ponds/beaver ponds). Since the hydrography of off-channel habitats is primarily a function of discharge in the Susitna's mainstem, instrumentation of these relationships is needed to quantify patterns of lateral connectivity and, through interaction with USGS gages on the Susitna, identify critical thresholds of lateral hydrologic connectivity through surface and groundwater interaction. Local instrumentation of wells and perennial sloughs and ponds is needed throughout the study area in habitats that represent a statistically valid sample of the global distribution of habitats utilized by fish.

Specific Comments by Subsection:

AEA Study Objective 1. Map the current aquatic habitat in mainstem and lateral habitats of the Susitna River affected by Project operations.

The initial subdivision of habitat mapping proposes to occur at a macro-habitat level consistent with those of the 1980s studies. Further refinement and definition of these habitat divisions are described in this study plan and in the Fish and Aquatic Resources study plan (7.9) and in the Geomorphology study plan (5.8).

IFS-023 In the proposed PSP and through subsequent meetings, presentations, and field trips, AEA's focus appears to be limited to study sites used in the 1980's, when this Project was first evaluated. This falls short of AEA's commitment to use a hierarchical method, dividing the study area into reaches by hydrology, then geomorphology, and then by macro-habitat types. The study sites focused on, thus far are representative of side sloughs of the Middle Susitna River. Although these may be good study sites for side sloughs, they only represent one macro-habitat type and were selected without regard to hydrology or geomorphology.

During the September 14, 2012 TWG meetings, an approach to instream flow site selection was presented by AEA. In AEA's PSP for instream flow the idea of "intensive study reaches" (now referenced as "focus areas") was proposed conceptually to examine physical processes at "representative" habitats" (referenced on page 8 of this same document for the list of representative habitats). The intended purpose of selecting specific sites for focused and overlapping studies is to gain an understanding of physical processes at "representative" locations, allowing for covariant analysis of Project-effects on these processes and subsequently on fish and their habitats. During the TWG meeting, selected sloughs from the

1980s studies were proposed by AEA as focus areas. The Service expressed concern with the proposed approach to study site selection. The 1980s approach did not use the hierarchical nesting of habitats and therefore, did not determine the habitat criteria influential to fish habitat site selection. During the 1980s studies, only utilization functions for water depth and velocity, or depth and substrate were captured. Current scientific understanding of criteria influential to fish habitat site selection warrants a more comprehensive consideration of variables. We maintain that the use of hierarchically nested habitats and metrics influential to fish habitat site-selection (micro –habitat) is at a scale more relevant to fish.

IFS-015

IFS-030

Secondly, we are concerned that the 1980s studies focused (sampling bias) on side slough macro-habitats where spawning salmon were observed. This is narrowly limited to habitats with poorly documented high fish density. In our study request, we recommended selection of sites both occupied and unoccupied by fish for assessment to best inform the criteria influential to fish distribution and habitat site selection.

Fish and aquatic instream flow study sites should be selected to be representative of the physical processes that are related to instream flow important to the formation of fish habitat, including habitat-flow relationships, surface/groundwater exchange, geomorphic processes, and ice processes. In other words, selection based on the nested hierarchy of habitats, studied at multiple scales, including macro-, meso- and micro-habitat scale.

IFS-012

AEA has proposed using a hierarchical method, dividing the study area into reaches by hydrology, then geomorphology, and then macro-habitat types. Each geomorphic reach is proposed to include an intensive study site (focus area) with a minimum of one instream flow reach containing all of the representative meso-habitats available in that reach. The Service recommends that AEA proceed further in its classification to include a detailed discussion of micro-habitats with reference to classifications of ecological significance.

This will entail delineation of each of the geomorphic reaches, as well as delineation and spatial mapping of the macro-habitats types, as described at the TWG meetings. Geomorphic reaches are identified as those used in the 1980s studies, but no information regarding how they were delineated during that time have been provided. This remains a concern for the overall Project design and statistical representation of the Susitna River.

We encourage AEA continue to work in collaboration with agencies and stakeholders to develop a scientifically robust study site selection methodology that addresses resource concerns.

AEA Study Objective 2. Select study sites and sampling procedures to measure and model mainstem and lateral Susitna River habitat types.

IFS-027

The objective should be stated more specifically to address the characterization and quantification (i.e. mapping) of the habitat types of the Susitna River at multiple scales. The general process for habitat-specific model development is to use the spatial habitat mapping effort to select transects/study segments with representative habitat conditions based on channel morphology and major habitat features. AEA also proposed selecting additional study "focus areas" to describe distinct habitat features such as groundwater areas, spawning and rearing habitats, overwinter habitats, distinct tributary mouths/deltas, and potential areas vulnerable to fish trapping/stranding (AEA 2012, 6.5.4.5).

IFS-021

Focus area site selection should be representative of the physical processes that are related to instream flow, including habitat-flow relationships, surface/groundwater exchange, geomorphic processes, and ice processes. AEA has proposed using a hierarchal method, dividing the study area into reaches by hydrology, then geomorphology, and then macro-habitat types. Each geomorphic reach would have a site that contained at least one instream flow reach that contained all of the representative meso-habitats available in that reach. During the October site visit, we learned that some of the micro-habitat sites for HSC development are proposed to be within the proposed focus areas of the 1980's slough sites. An additional unknown number of sites for HSC development will be identified outside of the focus areas. This unstructured approach is inadequate to address our study request and the fundamental biological questions contained within. Lacking adequate fish distribution and utilization data, we recommend that 1) study sites be selected randomly within representative delineations; 2) that the delineations be reproducible, 3) that enough sites are selected to capture the variability of each macro-habitat for each geomorphic reach and to allow for sufficient replication. This will require, at a minimum, mapping of the macro-habitat types and delineation of each of the geomorphic reaches.

IFS-088

Study efforts at the focus areas should provide a greater understanding of potential Project-effects on riverine processes. The site extrapolation methods should allow for extending the understanding from the selected reaches to the overall Project area. These methods should be defined prior to selecting focus areas to ensure that focus areas are selected that will work for extrapolation.

IFS-011

Additional sites should be selected that are not necessarily representative of overall riverine processes, but are significant because they support disproportionate or important biologic functions. Potential candidates for this may include Kosina Creek, and Portage and Indian Creeks. Additional site selection should be made using information on species and life stage distribution and aquatic and riparian habitat quantification. Site selection should rely on an understanding of habitat from multiple consecutive years of utilization information starting in 2012. This will likely require additional sites to be selected at the conclusion of the 2013 studies to be implemented in 2014.

AEA Study Objective 3. Develop a hydraulic routing model that estimates water surface elevations and average water velocity along modeled transects on an hourly basis under alternate operational scenarios.

NMFS submitted an independent study request for hydraulic flow routing because the routing model and associated data is the basis for cohesive understanding of many of the instream flow modeling efforts. The Service supports NMFS in the study request for flow routing, and the specific objectives contained within. An understanding of Project operation effects on instream flow from the dam downstream is necessary to understand Project impacts to habitat of fish and other aquatic organisms within the river system. NMFS May 31, 2012 study request, Susitna River Flow Routing Study Request, has four objectives:

1. collect instream flow data throughout all seasons to characterize instream flow and develop a flow routing model;
2. develop and calibrate an ice free period flow routing model that is capable of modeling a range of operating conditions and scales (hourly, daily, weekly, seasonally);
3. develop and calibrate a winter flow routing model that incorporates ice effects that is capable of modeling a range of operating conditions and scales (hourly, daily, weekly, seasonally); and

4. inform and integrate with other studies the Project operation effects on instream flow in the reservoir and downstream of the Project.

Currently, the number of discharge measurements and location of discharge measurement to develop and calibrate the winter hydraulic flow routing model is not well described within AEA's PSP. The natural winter flow regime is stable after ice-up until break-up with very little flow fluctuation relative to the ice-free period. Winter hydraulic flow routing efforts will rely on the ice processes study to incorporate changes to ice cover under Project operations. A detailed description of how that data will be delivered and incorporated into the hydraulic flow-routing analysis is still needed. Also needed is an analysis of the applicability of winter hydraulic flow routing to assess effects of Project operations to fish and their habitat. Winter ice cover and ice processes are significant regulators of winter habitats. Because ice cover and thickness will affect the hydraulic roughness and discharge in the river, it is necessary that discharge measurements appropriately replicate a number of the cross-sections used in the hydraulic flow routing models and over a range of flows to allow for development of winter ice processes and flow routing models that will be relevant to assess Project effects on overwintering fish and their habitat. Additional discharge measurements may be necessary at the USGS gage locations. Model sensitivities, assumptions and limitations should be thoroughly described to allow transparency and accuracy of results. A sensitivity analysis should also be conducted (Turner et al. 2001; Steel et al. 2009).This is important because model results may be used to inform Section 18 (Federal Power Act) decision-making processes related to potential Project impacts to fish and wildlife resources and their habitats. The winter hydraulic flow routing will also incorporate a water quality component that will project downstream changes to flow (timing, quantity, and water quality).

AEA Study Objective 4. Develop seasonal, site-specific Habitat Suitability Curves (HSC) and Habitat Suitability Indices (HSI) for species and life stages of fish selected in consultation with licensing participants. 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 licensing participants.

IFS-064

We recommend AEA assess patterns of habitat utilization within each macro-habitat to identify the appropriate tools for assessing flow-habitat relationships. This is necessary to identify the micro-habitat variables that control the distribution of fish. Habitat availability and patterns of habitat utilization have not yet been systematically assessed in a statistically valid manner in the Susitna River floodplain. It is inappropriate to develop habitat suitability criteria (HSC) without first assessing which habitat criteria influence the distribution of fish. AEA should provide a detailed process for assessing fish species habitat utilization and influential habitat variables that will then inform Project-effects on fish and their habitat.

The objective of the HSI and HSC (micro-habitat utilization) study component is to develop robust site-specific criteria related to fish habitat site-selection. Habitat suitability indices (HSI) and criteria (HSC) should come from an assessment of environmental criteria (physical, chemical, and biological) that are influential to fish distribution in the Susitna River for each species and life stage. Fish surveys need to be conducted throughout their spawning distribution and well outside their spawning distribution (Connor et al 2003) in order to assess the ecological relevance of criteria. Once the relevance of the criteria is demonstrated, curve development may proceed. The Service considers the assessment of habitat influential to fish

habitat site-selection, to be a specific and necessary objective of the Instream Flow and Habitat Utilization study request.

For example, some fish species demonstrate significant population variability in response to environmental heterogeneity. Ruff et al (2011) showed that thermal heterogeneity in an Alaskan sockeye stream promotes spatial and temporal variability in spawning sockeye populations. Because such spatial and temporal variability is also accompanied by variability in traditional habitat suitability criteria (e.g. water depth and velocity; substrate size), it is important that all the environments supporting each target species and life stage are surveyed. This is necessary for statistical discernment of habitat criteria that are influential to habitat selection.

Some fish are known to move great distances or utilize specific habitats on a seasonal basis. As an example Alaskan burbot *(Lota lota)*, in glacial systems, can move extreme distances in association with spawning (Breeser et al 1988). Juvenile salmon that seasonally inhabit shallow margin and off-channel floodplain habitats, where they find important access to terrestrial inputs (Eberle and Stanford 2010), serve as another important example of seasonal movements and habitat use patterns. It is important that surveys be conducted with sufficient replication in both space and time, such that the seasonal distributions of important species and life stages are adequately surveyed. Assessment of criteria influential to habitat selection must also be conducted in all seasons and at all representative flow levels.

IFS-097

With an understanding of fish habitat utilization and the site-specific environmental variables (micro-habitat) that influence fish-use of habitat, variable inputs and model selection will be at a scale relevant to fish habitat. The Service maintains that this understanding can occur with multiple years of assessment and habitat utilization (fish distribution) that allow for detection of patterns in habitat usage with respect to hydraulics, substrate, and cover- all of which are flow dependent (Holm et al 2001). As such, the ecological relevance of criteria must be assessed over a period of multiple years to account for variability in habitat selection as a function of natural variability in environmental flow conditions; as well as reduce the error surrounding these measurements. Multiple years of data will also allow for assessment validation of associated fish abundance (occupied versus unoccupied), seasonal movement and distribution surrounding flow-habitat relationships within selected study sites.

The AEA study plan describes an *order of preference* for information used to develop HSI/HSC (micro-habitat utilization):

1. new site specific data collected for selected target species and life stages (seasonally if possible (e.g., winter));
2. existing site specific data collected from the Susitna River during the 1980s studies;
3. site specific data collected from other Alaska rivers and streams; and
4. HSC curves, data and information from other streams and systems outside of Alaska.

IFS-055

AEA should provide detailed methods on how it proposes to develop site-specific habitat suitability indices/criteria for each species and life stage. Micro-habitat utilization directly informs the ISF decision-making process. To gain understanding of the micro-habitat utilization we request the use of criteria developed specifically for the Susitna River or regional rivers with similar habitats (for example the Talkeetna, Chuitna, Matanuska Rivers). Micro-habitat utilization criteria developed outside of the Susitna River and/or other large south central rivers is not acceptable due to differences in species adaptation to specific riverine habitats and flow regimes. Furthermore, there is a general lack of micro-habitat utilization criteria development for glacial systems like the Susitna River. Any criteria used from other sites or from 1980s literature

must include all likely variables that influence the utilization of the habitat. These variables should include at a minimum water quality (dissolved oxygen, turbidity, and temperature), habitat spatial structure (distance to cover, large wood, bank and bedform characterization), and groundwater upwelling or downwelling in addition to the typical hydraulic variables (flow, depth, substrate).

In addition to collecting environmental information it is necessary to consider behavioral habitat-use strategies of juvenile fish used to minimize risk of predation. Behavioral studies are becoming increasingly important in assessing impacts to aquatic species as a result of proposed hydro projects in both the marine and freshwaters. Lovtang (2005) found that juvenile Chinook would rarely be found in mid-channel during the day but would be found in mid-channel at higher abundance at night, independent of water temperatures, suggesting that the fish were using a strategy to minimize predation. The tendency for salmon to return to their natal site for breeding leads to reproductive isolation, in space and time. It also leads to local adaptation to the local spawning and incubation environment (Doctor and Quinn 2009). More specifically, spawning salmon are thought to select redd sites based on physical variables important to the completion of their intra-gravel life stages (Montgomery et al. 1996; Quinn 2005). Temperature during incubation has been demonstrated as one variable that is important to the distribution of spawning salmon (Connor et al. 2003). In fact, variability in temperature, even within the same stream can lead to genetically distinct populations that spawn in distinct physical environments (Ruff et al. 2011). Habitat utilization functions are not transferrable between these populations because the variability in spawning sites is too great.

IFS-063 The Service's study request specified the need for habitat specific criteria for each species and life stage. If guilds are proposed the habitat utilization data must be shown to support this method. A list of criteria to collect at fish sampling locations and at the focus areas should include hydraulic information, water quality parameters, groundwater information, substrate, spatial structure and arrangement of the habitat, cover availability, and indicators of productivity, etc. The data must be collected at all macro-habitat habitat types, with meso-habitats represented in each macro-habitat with replication. This will result in seasonal curves for each species or subset of species and life stages for each macro-habitat. Criteria to be used must be developed over a range of representative habitats for which they will be used. Also, criteria used in flow habitat analysis of Project effects must be demonstrated to have a statistically significant relationship to habitat utilization for the time of year, life-stage, and habitat for which it will be used.

AEA Study Objective 5. Develop integrated aquatic habitat models that produce a time series of data for a variety of biological metrics under existing conditions and alternate operational scenarios. These metrics include (but are not limited to):

- *water surface elevation at selected river locations;*
- *water velocity within study site subdivisions (cells or transects) over a range of flows during seasonal conditions;*
- *varial zone area;*
- *frequency and duration of exposure/inundation of the varial zone at selected river locations; and*
- *habitat suitability indices.*

IFS-078 The Service agrees that properly chosen, integrated aquatic habitat models can be informative, and with relevant site-specific data this component of operational instream flow analysis can be

biologically meaningful. However, AEA's selection of a traditional hydraulic habitat model to assess the instream flow objectives for this Project may be premature. Environmental criteria that influence patterns of habitat utilization within the greater distributions of target species and life stages need to be identified first. This procedural pre-requisite may demonstrate that hydraulic habitat modeling is not the appropriate tool for use in forecasting the environmental impact of the proposed Project.

For example, burbot *(Lota lota)* is an important sport and subsistence fish species inhabiting the main channel of the Susitna River. Burbot are known to spawn in association with undercut and hollow banks, and the hydraulic micro-habitat associated with these habitat features, where it has been studied, has been demonstrated to be of no relevance to the selection of these features for spawning (Mouton et al 2012). If this general pattern holds true for burbot spawning in the Susitna River, traditional hydraulic habitat modeling (i.e., PHABSIM) will not be an appropriate model to forecast burbot habitat associations brought about by the proposed Project. Similarly, hydraulic habitat data collected by USGS on side sloughs of the nearby Matanuska River (Curran et al 2011) demonstrate that sockeye and chum salmon select spawning sites without regard to water depth and velocity. This would make PHABSIM, or any other traditional hydraulic habitat modeling approach an inappropriate tool for these settings.

IFS-085 Instead we recommend the use of lateral hydrologic connectivity modeling (e.g. Benke et al 2000) in combination with hydrologic-based methods, such as USGS's HIP model, to quantitatively inform natural patterns of hydrologic connectivity with habitats known to be important for target species and life stages.

We also question whether the two-year study period is adequate to develop robust models with relevant site-specific data. The purpose of this objective should be to represent the analysis of Project effects on ecological relevant metrics for fish and aquatic ecosystems.

IFS-089 The Service appreciates the plan to use integrated aquatic habitat models that produce a time series of data for a variety of biological metrics. AEA lists several of these metrics; and each of these should be clearly linked to ecological significance. The Service requested both biologically relevant instream habitat models and spatial scaling of study sites; both the model and study sites should be selected with a thorough understanding of anadromous and resident fish distribution in the Susitna River system, including life history strategies, habitat utilization, and interannual variability. Related to this objective AEA describes an Instream Flow Study analytical framework (AEA, 6.5.4.1). This frame work will result in the development of a series of flow sensitive models that will be able to translate effects of Project operations on the riverine processes and biological resources.

IFS-009 In our study request (May 31, 2012), the Service outlined an integration framework to include all riverine study components. This integration of the following components is necessary for resource management agencies to assess Project-effects on fish and their habitat:

1. Instream Flow routing – The foundation of riverine processes studies depends on the Susitna River flow routing models (HEC-RAS, CRISSP1D) that will provide hourly flow and water surface elevation data at numerous locations longitudinally distributed throughout the length of the river extending from RM 184 downstream to RM 75 (about 23 miles downstream from the confluence with the Chulitna River).

2. Water Quality – This model/study, incorporating flow routing, will provide analysis on flows necessary to maintain stream temperature, turbidity, and other water quality indices within a biologically relevant range for aquatic species, using the baseline information as targets.

3. Geomorphology – Model/study will provide analysis/constraints on flows important to geomorphic processes that form/maintain fluvial morphology and vegetation (including riparian, floodplain and woody debris recruitment functions).

4. Riparian/floodplain function – This model/study will provide an analysis of flows necessary to maintain floodplain function and riparian plant community composition. This study will be directly informed by both the instream flow and groundwater studies.

5. Surface/groundwater interaction – This study/model will analyze the effect of Project operations on the exchange timing, quantity, and quality. This will inform/analyze the instream flow needs to sustain groundwater interaction necessary to sustain habitat quality and quantity.

6. Ice processes – This model/study will provide analysis and identify constraints on flows important to ice freeze-up, ice thickness, persistence, and breakup. The results will inform other studies and winter time instream flow needs, including a description of winter time load following effects.

7. Aquatic habitat models - As described in study component ISF-6. If specific habitat models are not successful in identifying Project effects on habitat and suitability for specific species, then alternative methods may need to be considered including studies of population dynamics and river productivity.

8. Passage/connectivity – This study will encompass accessibility of flow-dependent riverine habitat types throughout the Project area, including tributary confluences; and Devil's Canyon and above.

9. Climate – The framework will incorporate climate variability and climate change projections to assess the cumulative effects of Project operations in consideration of PDO and ENSO climate variation and longer term climate change (the anticipated life of the project – at least 100 years) that are expected to continue to change the hydrograph and water quality, among the many variables influenced by climate change.

10. Biological Cues – Behavioral, population, community, and ecological studies relative to fish distribution, relative abundances, timing, river productivity, and the trophic interactions of the biotic and physical environment.

IFS-047 We also recommend a flow operations analysis that will consist of a range of conditions from baseline (no Project/natural hydrograph) to various proposed scenarios (as described in the PAD), and alternatives suggested by AEA and agencies in a working group setting. The results of the operations analysis will be used in the comparative framework to inform the effects on the natural riverine system and will allow agencies to assess operating conditions and to make recommendations and mandatory conditions on the final license application.

After model selection, population, calibration and scenario runs, a variety of post-processing comparative analyses derived from the output metrics estimated under the habitat specific aquatic habitat models would be provided to resource agencies. These include:

- comparisons of habitat quantity and quality (e.g., habitat exceedance plots)
- ramping rates (e.g., changes in flow versus time);
- juvenile fish stranding/trapping;
- habitat sustainability (effective habitat analysis); and
- distribution and abundance of benthic macro-invertebrates under alternative operational scenarios.

The Service recommends that AEA develop integrated aquatic habitat models that produce a time series of data for biological metrics under existing conditions and alternate operational scenarios. These metrics include:

- water surface elevation at selected river locations;
- water velocity within study site subdivisions (cells or transects) over a range of flows during seasonal conditions;
- varial zone area;
- frequency and duration of exposure/inundation of the varial zone at selected river locations; and
- habitat suitability indices.

AEA Study Objective 6. Evaluate existing conditions and alternate 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.

The Service appreciates the work product *"tabular summaries of selected IHA-type statistics"* and looks forward to working with AEA to develop this list relevant to Susitna River hydrography. The Service's study request includes objectives to characterize the natural flow regime of the Susitna River and tributaries in the Project area and to identify, characterize, and integrate the timing, quantity and function of instream flow to riverine processes. This will require characterization of the relationship between the Susitna River flow regime and climatic PDO. The Service appreciates the description of the various IHA statistics proposed, and emphasizes the need to examine hourly rate and frequency of change for winter flow conditions, to compare to the proposed operations.

AEA Study Objective 7. Coordinate instream flow modeling and evaluation procedures with complementary study efforts including riparian (Section 6.6), geomorphology (Section 5.8 and 5.9), groundwater (Section 5.7), water quality (Section 5.5), fish passage (Section 7.12), and ice processes (Section 5.10). 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.

IFS-007 We recommend that the instream flow modeling demonstrate complete integration of the riverine process analysis (groundwater, instream flow, geomorphology, ice processes, biological response to flow changes), not simply coordinate with the other study areas. The results of an integrated riverine processes analysis should provide an understanding of instream flow changes induced by Project operations and fish behavior as it relates to the associated changes in quality and quantity of fish habitat. The intent of our request is for the flow analysis to be used

to assess Project-effects on anadromous and resident fish and their habitat. This analysis will be used to make specific conservation recommendations by the Service under our applicable authority of Section 10(j) of the Federal Power Act. To facilitate our understanding of the specifics of the study integration, the Service requires a degree of certainty that each of the riverine process components are adequately addressed along with levels of precision and accuracy of overall model integration results. This will become evident with more detailed study plans that refine overall approach, schedule, methods, and contingencies if necessary site-specific information is not collected.

AEA Study Objective 8. Conduct a variety of post-processing comparative analyses derived from the output metrics estimated under aquatic habitat models. These include (but are not limited to):

- *juvenile and adult rearing;*
- *adult holding/adult in-river residence time;*
- *habitat connectivity;*
- *spawning and egg incubation;*
- *juvenile fish stranding and trapping;*
- *ramping rates; and*
- *distribution and abundance of benthic macro-invertebrates.*

This objective should provide a comparative temporal and spatial analysis of riverine process studies and model results for a range of alternative operations. But it is unclear which studies would develop the habitat utilization data proposed for comparative analysis, specifically for the juvenile and adult rearing and egg incubation. AEA's study plan includes riverine processes in its proposal but it is unclear how they will be integrated and at what habitat scale. The issue of scale is of critical relevance to fish and fish habitat

IFS-057

Biological cues are not addressed in AEA's proposed instream flow study. The Service's study request included a component to investigate flow dependent biological cues, which will rely on the detailed study of seasonal habitat utilization by anadromous species and resident fish throughout their life history. Our request included an examination of instream flows that may correlate with historical escapement indices, run timing and seasonal water temperatures and associated biological responses. A periodicity chart for each of the anadromous species should was identified as an information gap related to fish species of the Susitna River. This information should be presented in table form and include the corresponding macro-habitat and hydrologic conditions. We acknowledge that a preliminary periodicity chart was provided to attendees of the October 4th site visit to the Susitna River, and appreciate AEA's effort of to provide the requested information. We look forward to working with AEA to expand the scope and detail of the periodicity chart.

Literature Cited

ADFG 2012. Alaska Chinook Salmon Knowledge Gaps and Needs. Draft GAP Analysis , October 8 2012.

Alaska Energy Authority (AEA). 2012. Proposed Study Plan Susitna-Watana Hydroelectric Project FERC No. 14241. July 15, 2012.

Benke, A. C., I. Chaubey, G. Milton & E. L. Dunn, 2000. Floodpulse dynamics of an unregulated river floodplain in the southeastern U.S. coastal plain. Ecology 81: 2730–2741.

Breeser S. W., F. D. Sterns, M.W. Smith, R. L. West, J. B. Reynolds. 1988. Observations of movements and habitat preferences of burbot in an Alaskan glacial River system. Transactions of the American Fisheries Society. 117: 506-509.

Connor, W.P., C.E. Piston and A.P. Garcia. 2003. Temperature during incubation as one factor affecting the distribution of Snake River Fall Chinook salmon spawning areas, Transactions of the American Fisheries Society, 132:6, 1236-1243.

Curran, J.H., McTeague, M.L., Burril, S.E., and Zimmerman, C.E., 2011, Distribution, persistence, and hydrologic characteristics of salmon spawning habitats in clearwater side channels of the Matanuska River, southcentral Alaska: U.S. Geological Survey Scientific Investigations Report 2011–5102, 38 p.

Doctor, K.K. and T.P. Quinn. 2009. Potential for adaptation-by-time in sockeye salmon (*Oncorhynchus nerka*): the interactions of body size and in-stream reproductive life psan with date of arrival and breeding location. Can. J. Zool. 87: 708-717.

Dunning, J. B., B. J. Danielson, H. R. Pulliam. 1992. Ecological processes that affect populations in complex landscapes. Oikos 65:169-175.

Eberle L. C. and J. A. Stanford. 2010. Importance and seasonal availability of terrestrial invertebrates as prey for juvenile salmonids in floodplain spring borrks of the Kol River (Kamchatka, Russian Federation). River Research and Applications. 26: 682-694.

Forman, R. T. and M. Godron. 1986. Landscape Ecology. John Wiley and Sons, New York 619 p.

Frissell, C. A., W. J. Liss, C. E. Warren, and M.D. Hurley. 1986. A hierarchical framework for habitat classification: viewing streams in a watershed context. Environmental management 10(2): 199-214.

Henriksen, J.A, J. Heasley, J.G. Kennen, and S. Nieswand. 2006. Users' manual for the Hydro-ecological Integrity Assessment Process software (including the New Jersey Assessment Tools): U.S. Geological Survey Open-File Report 2006-1093. 72 p.

Holm C. C., J. D. Armstrong, D. J. Gilvear. 2001 Investigating a major assumption of predictive instream habitat models: is water velocity preference of juvenile Atlantic salmon independent of discharge? Journal of Fish Biology. 59: 1653-1666.

Lovtang, J.C. 2005. Distribution, Habitat Use and Growth of Juvenile Chinook Salmon in the Metolius River Basin, Oregon. MSc Fisheries Science. Oregon State University.

Matthews, R. and Richter, B.D. 2007. Application of the indicators of hydrologic alteration software in environmental flow setting. Journal of the American Water Resources Association. 43: 1400-1413.

Mims M. C. and J. D. Olden. 2012. Life history theory predicts fish assemblage response to hydrologic regimes. Ecology 93(1), pp. 35-45.

Montgomery, D. R., Abbe, T. B., Peterson, N. P., Buffington, J. M., Schmidt, K. M., and J.D. Stock. 1996**.** Distribution of bedrock and alluvial channels in forested mountain drainage basins. *Nature*, v. 381, 587-589.

Mouton, A.M., A. Dillen, T. Van den Neucker, D. Buysse, M. Stevens. J. Coeck. 2012. Impact of sampling efficiency on the performance of data-driven fish habitat models. Ecological Modeling (online, early view).

MWH. 2011. Watana Hydroelectric Project: Susitna Watershed Historical Hydrology. Technical Memorandum No. 3, Alaska Railbelt Large Hydro Engineering Services. Prepared for Alaska Energy Authority by MWH, Bellevue Washington, June 1, 2011.

Olden, J.D., and N.L. Poff. 2003. Redundancy and the choice of hydrologic indices for characterizing streamflow regimes. *River Research and Applications* 19:101-121.

Pichon, C. L., G. Gorges, P. Boet. 2006. A spatially explicit resource-based approach for managing stream fishes in riverscapes. Environmental Management 37(4):322-335.

Poff, N.L., J.D. Allen, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The Natural Flow Regime. BioScience, V.47, No. 11, 769-784.

Poff, N.L. and J.K. H, Zimmerman. 2010. Ecological responses to altered flow regimes: a literature review to inform environmental flows science and management. Freshwater Biology 55:194-20.

Pollock, Michael M., George Press, Timothy J. Beechie, and David R. Montgomery. 2004. The Importance of Beaver Ponds to Coho Salmon Production in the Stillaguamish River Basin, Washington, USA. North American Journal of Fisheries Management 24:749-760

Poole, G. C., S. J. O'Daniel, K. L. Jones, W. W. Woessner, E. S. Bernhardt, A. M. Helton, J. A. Stanford, B.R. Boer, and T. J. Beechie. 2008. Hydrologic spiraling: the role of multiple interactive flow pathways in stream ecosystems. River Research Applications 24: 1018-1031.

Poole, G. C. 2002. Fluvial landscape ecology: addressing uniqueness within the river discontinuum. Freshwater Biology. 47:641-660.

Quinn, T.P. 2005. The behavior and ecology of pacific salmon and trout. The University of Washington Press.

Richter, B.D., J.V. Baumgartner, J. Powell, and D.P. Braun. 1996. A Method for Assessing Hydrologic Alteration Within Ecosystems. Conservation Biology 10:1163-1174.

Richter, B.D, J.V. Baumgartner, R. Wigington, and D.P. Braun. 1997. How Much Water Does a River Need? Freshwater Biology 37, 231-249.

Ruff, C.P., D.E. Schindler, J.B. Armstrong, K.T. Bentley, G.T. Brooks, G.W. Holtgrieve, M.T. McGlauflin, C.E. Torgersen, J.E. Seeb. Temperature-associated Population Diversity in Salmon Confers benefits to Mobile Consumers. Ecology, 92(11), 2073-2084.

Schlosser, I. J. 1995. Critical landscape attributes that influence fish population dynamics in headwater streams. Hydrobiologia 303:71-81.

Steel, E. A., P. McElhany, N. J. Yoder, M. D. Purser, K. Malone, B. E. Thompson, K. A. Avery, D. Jensen, G. Blair, C. Busack, M. D. Bowen, J. Hubble, and T. Kantz. 2009. Making the best use of modeled data: multiple approaches to sensitivity analysis of a fish-habitat model. Fisheries 34:7.

The Nature Conservancy (TNC). 1997. Indicators of Hydrologic Alteration Users Manual. http://conserveonline.org/library/iha_man.pdf/view.html

Trush, W.J., McBain, S., and L.B. Leopold. 2000. Attributes of an alluvial river and their relation to water policy and management. Proceedings of the National Academy of Sciences, 97(22):11858-11863.

Turner, M.G., R. H. Gardner, and R. V. O'Neill. 2001. Landscape ecology in theory and practice. Springer-Verlag, New York. Chapter 3, Introduction to Models.

United States Fish and Wildlife Service. 2012. Letter and study requests to Secretary Bose, Federal Energy Regulatory Commission. May 31, 2012.

USGS 2012. *In press*

6. Instream Flow Studies

6.6. Riparian Instream Flow Study

General Comments:

RIFS-14 The U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled *Instream Flows for Floodplain & Riparian Vegetation Study* resembles Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) title, except "floodplain" is included in our study-plan title. Riparian areas and floodplains are often the same; however, many people visualize riparian areas as a narrow band immediately adjacent to streams and rivers. We envision this study including the entire floodplain, and not simply a narrow zone along the Susitna River. To help minimize this potential misconception, we recommend revising the study plan title to include the word "floodplain."

Many of the PSPs rely upon or provide data from/for other studies. Recognizing these relationships is an important part of the Integrated Licensing Process (ILP); however, the study providing the data should describe the methodology and oversee the data collection and analyses, while the study requiring the results should restrict its discussion to the types of data/results required from other PSPs. Repeating the methods in a study not responsible for the data collection and analyses is unnecessary and risks confusion if the methods differ or are inadequate in one of the studies. Since the Riparian Instream Flow Study will rely upon data from the Groundwater Study, among other studies, the Riparian Instream Flow Study Plan should describe only the results required from the Groundwater Study, and then describe how those results will be used in the Riparian Instream Flow Study (e.g., 5.7 Groundwater PSP should be the only study describing groundwater methods). This applies to other studies, such as the habitat mapping studies, providing data for the Riparian Instream Flow Study Plan.

RIFS-15 At the 24 October 2012 Riparian Instream Flow Technical Workgroup (TWG) meeting, AEA provided a draft study interdependency figure showing which additional studies would provide data for the study, the expected information produced by the study, and which studies will rely upon output from the study. Given the complex integration of the various studies, we appreciate this figure and recommend including figures like these along with a narrative in the introduction for each study. Additionally, the main introduction covering all the studies should include a more general interdependency figure showing how all the various studies interrelate. We have not had time to evaluate this draft interdependency figure, but we look forward to reviewing additional drafts as the study plans mature.

RIFS-16 Besides interdependency figures, please provide timelines showing how the various study components (both among major studies and within studies) feed into other studies and study components. The Service is concerned the sequencing of some study components may be out of sync with the required products from other studies and study components.

The methods should be described in sufficient detail so others can duplicate the study. Citing methods from other studies or accepted industry standards is encouraged, but not in lieu of providing sufficient detail so the methods can be evaluated without having to refer to the citation. The July 2012 PSP provided few referenced methods, some methods with references lacked citations in the Literature Cited so their appropriateness could not be evaluated, and some methods lacked focus or duplicated methods from other objectives. Since the PSP, AEA

hosted TWG meetings and site visits, including the most recent 24 October 2012 TWG meeting, which provided additional opportunities for discussion and clarification. We look forward to these improvements in the Revised Study Plan (RSP).

RIFS-17 Unlike the fisheries component of the Aquatic Instream Flow Study where potential future Susitna-Watana Hydroelectric Project (Project) impacts may be compared with other locations in the state because fish populations are routinely surveyed, evaluating potential Project impacts on riparian/floodplain resources without an "untreated" spatial reference (i.e., similar rivers without a dam) risks a significant change may be attributed to an unrelated impact. Green (1979) outlines four prerequisites for an optimal impact study design: 1) the impact must not have occurred; 2) the type, time and place of impact must be known; 3) all relevant biological and environmental variables must be measured; and 4) an area unaffected by the impact must be sampled to serve as a control. The first three prerequisites are included in the PSPs if they are designed and implemented so potential Project impacts can be evaluated by post-dam resampling. We recommend the Riparian Instream Flow Study also include the fourth component (un-impacted rivers), otherwise AEA risks what Green (1979, p 71) refers to as *"… executing statistical dances of amazing complexity around their untestable results"* to show the Project did or did not have a potential impact on riparian/floodplain resources.

Specific Comments by Subsection:

The following review of AEA's proposed Riparian Instream Flow Study Plan uses the most recent structure of the plan (24 October 2012 TWG meeting), which closely resembles the Service's study request structure. AEA's original PSP included objectives that were wholly, or at least partially, the objectives for other PSPs, and did not address all our study request objectives. This new study plan structure and proposed methods are based on a combination of both AEA's and the Service's proposed methods, as well as additional insights gained during the TWG meetings and site visits. Although some of these improvements have not yet been fully documented, our review below is based on the expectation they will be included in the RSP, and what we believe will be carried forward from the original PSP requiring additional revision.

RIFS-18 *AEA Study Goals and Objectives*: The Service requested a specific goal that includes quantifying the frequency, timing and duration of surface-water and groundwater levels required to establish, maintain, and promote floodplain and riparian plant communities. Two ancillary goals were also requested: 1) to quantify the frequency and rate of sediment deposition required to promote soil development; and 2) to quantify the effect of river ice on the establishment and persistence of riparian plant communities. Although the text of AEA's draft revised goal was not presented at the 24 October 2012 TWG meeting, we expect the RSP will include a goal similar to ours. While goals can be very general in nature, the specifics in our goal sets the stage for a rigorous study plan designed to evaluate potential Project effects on floodplain plant communities.

AEA Study Area: The study area includes the Susitna River active valley that would be affected by the operation of the Project downstream of Watana Dam. The active valley is the geographic area that is flooded with a frequency and duration corresponding with current unregulated conditions.

RIFS-19 The Service recognizes the downstream limit of the study area is still under discussion, and we look forward to participating in this discussion. In addition to the longitudinal dimensions of the study area and the width of surface-water flooding, we recommend including the area of groundwater potentially influenced by Project operations. For the riparian study, the width should be at least as wide as the expected area of groundwater within the maximum depth of all plant roots and influenced by Project operations.

AEA & Service Objective 1 and Methods: Synthesize historical physical and biological data for Susitna river floodplain and riparian vegetation, including the1980s studies and other hydro projects that may provide insights for project operation.

The goal of this objective is to review existing information on physical and biological data (e.g., seedling establishment requirements, effects of river ice, relationship between sediment deposition and plant succession, and required surface-water / groundwater regime) for Susitna River floodplain and riparian vegetation. Although this is really a task rather than a research objective, this is still an important study component. We also appreciate AEA honoring our 11 September 2012 email recommendation to include a review of relatively undisturbed riverine systems.

AEA & Service Objective 2 and Methods: Select and design study sites.

RIFS-20 The goal of this objective is to select sites necessary for this study, and to ensure these sites will also complement and take advantage of the information from the other studies (e.g., flow routing, groundwater, fluvial geomorphology, and ice processes). For the focus areas where multiple study disciplines will focus and complement their work, we recommend the Riparian Instream Flow Study **first** develop criteria required for selecting their study sites independent of the other studies. Next, develop a list of study products from the Riparian Instream Flow Study that other studies require, and then work with the other studies and stakeholders to select focus areas. A master matrix of studies, data needs and data products would greatly facilitate this process and stakeholder acceptance.

RIFS-21 Riparian Instream Flow study sites should reflect the full range of riparian and floodplain plant communities along the Susitna River. The Riparian Botanical Resources (Mapping) Study (PSP Section 9.6) will likely need to be substantially completed before the Riparian Instream Flow study sites can be selected with confidence that the full range of plant communities are studied. Similarly, the process-domains (Montgomery 1999) should be defined before focus areas are selected. The range of plant communities and process-domains should be part of the master matrix mentioned above for selecting focus areas.

RIFS-22 Study sites should include areas where Project operation is expected to cause early channel bed degradation or aggradation (11 September 2012 Service email request). AEA has since proposed to select focus areas between the dam and Devils Canyon; the river segment most likely to experience channel bed degradation. Focus areas should also be located in areas likely to experience channel bed aggradation.

RIFS-23 The number of study sites should provide sufficient replication to address the needs of the objectives (11 September 2012 Service email request). AEA's TWG meeting response (24 October 2012) that *"Focus Areas will be **representative** (emphasis added) of specific riparian process domains and their channel / floodplain characteristics (ice process domains,*

channel plan form, channel slope, channel confinement)" does not address our concern about pseudoreplication (Hurlbert 1984). Study sites are typically the experimental unit where replication is used for true statistical analysis. All other sampling (e.g., within the study site) is really subsampling used to obtain a better average value for that one replicate. As envisioned by many of the PSPs, the "representative" focus areas are really only one replicate for each process-domain. If transects within the focus areas will be used as the experimental unit, then the focus areas should be large enough to assure at least minimal dispersion of transects representing the river segment, and all stakeholders will need to be comfortable with the focus areas "representing" the river segment. AEA's Response 3 (TWG meeting 24 October 2012) that the Riparian Botanical Resources (Mapping) Study (Section 9.6) will provide additional dispersion of sample sites outside the focus area is an important addition to the focus areas, but only for the study products that rely on these additional field data. One of the most important contributions of the riparian mapping study includes using these data to help upscale predicted Project-related plant community responses.

AEA & Service Objective 3 and Methods: Characterize seed dispersal timing, water-level regime required for establishment, and frequency of establishment, and then predict potential plant community change resulting from project operations.

The goal of this objective is to characterize the seed dispersal timing, the required water-level regime for establishment, and the frequency of establishment for dominant riparian species (e.g., balsam poplar, willows). This objective has two primary components. The first is to characterize the requirements for seedling germination and establishment, and the second is to characterize the frequency of survival and recruitment into the plant community. The methods for the second component (recruitment into the population) were sufficiently described in the PSP.

RIFS-24

In an email (11 September 2012), the Service asked the following questions relating to seedling germination and establishment. How will the Susitna River bimodal peak flows be addressed? How will the fate of "second peak" seedlings be addressed? How will the role of precipitation in maintaining favorable soil moisture conditions be evaluated? Will soil texture be considered? If so, how will the soil profile be described? AEA responded (TWG meeting 24 October 2012) with the following replies. Bimodal peak flows will be addressed by measuring and modeling such flows at each Focus Area. "Second peak" seedling fate will be assessed in the seedling recruitment plot study by aging woody seedlings and quantifying these "recruitment flow regime" characteristics. The role of precipitation in maintaining favorable soil moisture conditions will be evaluated by measuring precipitation at each Focus Area meteorological station and soil surface moisture at each Focus Area. Further methodological details will be provided in the Groundwater Study RSP Sec 7.5. Soil texture will be considered by sampling, measuring and describing soil stratigraphy using standard NRCS soils survey protocols (Field Book for Describing and Sampling Soils by Schoeneberger, Wysocki, Benham, and Broderson, 2002). These are appropriate responses; however, the Service believes following the fate of a cohort of second-peak germinated plants will likely be more sensitive than aging woody seedlings and attempting to relate their survival to past bimodal peaks. Aging woody seedlings is likely more appropriate for mature plants where past flow regimes are the only option for estimating recruitment and not establishment. We also are concerned that a two-year study will likely be insufficient to determine the survival after germination, since three years is often considered necessary to evaluate successful survival and recruitment into the reproductive population.

RIFS-25

For seedling germination and establishment, the Service is concerned the groundwater model MODFLOW is not sensitive enough to quantify hydroperiod relationships for seedlings (11 September 2012 email). We also asked what other metrics will be used to quantify/separate surface water, groundwater, soil moisture, precipitation, and other potential hydrological process supporting seedling establishment and recruitment? AEA responded (TWG meeting 24 October 2012) with the following replies. Seedling plot groundwater regime will be both modeled with MODFLOW and a subset of wells will be located within seedling areas allowing for groundwater seedling response curves to be developed to check precision of MODFLOW results with local well data. Detailed groundwater / surface water modeling metrics necessary to assess seedling establishment and recruitment conditions will be provided in the Groundwater RSP. Metrics will include: met stations at each Focus Area to measure local precipitation, and measurements of the height of the capillary fringe relative to the groundwater surface at well points to measure effective soil pore water availability to seedlings. The Service is satisfied that wells will be located within the seedling areas. We believe MODFLOW is much less accurate than onsite wells equipped with recording pressure transducers for detailed studies such as seedling germination. MODFLOW for this study component would only be required if the germination sites are located some distance from the river and the groundwater connection to the river may be questioned.

RIFS-29

The Service also asked how the results from this objective will be used to predict potential Project-related changes in seedling establishment and recruitment into the population (11 September 2012 email). AEA responded (TWG meeting 24 October 2012) with the following satisfactory response, and we look forward to the details in the RSP. Natural seed dispersal hydro and sediment regime relationships will be measured in the field (individual studies). Project operational changes to the natural hydro and sediment regimes will be assessed and changes to the natural seedling recruitment and establishment "physical template" will be assessed. Potential Project-related changes to seedling recruitment and establishment sites will be compared first at the Focus Area sites and then throughout the Project Area to model potential Project-related changes in the recruitment "safe site" conditions (Harper, J. 1977. Population Biology of Plants), as described in draft RSP Sec 8.6.3.5 and Sec 8.6.3.7.

RIFS-26

The Service has the following outstanding questions from PSP Section 6.6.4.3.1.4 relating to this objective, and we expect they will be addressed in the RSP:

- Is "abundance" density appropriate or will some other metric be applied?
- What is the "elevation" reference: ASL, an arbitrary datum, or some elevation that can be linked to the local river or groundwater stage (keep in mind the river drops downstream, so that must be accounted for also)?
- Is there a citation for others using 2-meter square plots?
- What is the shape of these plots? A square plot may not be appropriate for a narrow band of seedlings along a specific elevation in the gradient above the river.

AEA & Service Objective 4 and Methods: Characterize the role of river ice in the establishment, survival and recruitment of dominant riparian species, and then predict potential plant community change resulting from project operations.

The goal of this study objective is to characterize the role of river ice in the establishment (colonization), survival (first 3 years) and recruitment (into the future reproductive population;

RIFS-27

Rood et al. 2007) of dominant riparian species (e.g., balsam poplar, willows). The discussion in the PSP on ice processes (Section 6.6.4.4.1) was unfocused, and essentially provided no discernible methods: *"Final details of the geomorphology and ice processes modeling … will be developed as the 2012 studies are obtained."* AEA provided a substantial update for the proposed draft RSP methods at the 24 October 2012 TWG meeting. The steps proposed by AEA are:

1. One goal of this study will be to characterize the role of river ice in establishment, survival and recruitment of dominant riparian species. There has been limited research into this question on boreal rivers: Engstrom et al., Effects of River Ice on riparian vegetation. (Freshwater Biology 2011, 56: 1095-1105).

2. A similar study approach and methods will be developed and is presented in the RSP.

3. The magnitude, frequency and longitudinal distribution of ice events affecting riparian species/communities will be assessed by a combination of on-the-ground surveys of tree ice scar distribution (mapping and aging with dendrochronology) and the results of the ice processes modeling.

4. A geospatial analysis of the modeled, and empirically mapped, locations of ice floodplain interactions will be conducted.

5. Tree ice scars will be used to map ice floodplain interaction zones along the river.

6. Ice process modeling will also be used to identify the vertical and lateral extent of ice floodplain vegetation interaction zones.

The Service believes this is a reasonable approach for characterizing the role of river ice in plant communities. We look forward to the RSP also describing how the role of river ice will be used to predict the potential plant community change resulting from project operations.

AEA & Service Objective 5 and Methods: Characterize the role of sediment deposition in the formation of floodplain and riparian soils, and then predict potential plant community change resulting from project operations.

The goal of this study objective is to characterize the role of sediment deposition in the formation of floodplain and riparian soils, and how sediment deposition affects the rate and trajectory of plant community succession.

RIFS-28

The proposed soil sampling techniques are included in PSP Section 6.6.4.3.1.5, but based on these techniques it is unclear how our requested objective to characterize the role of sediment deposition in the formation of floodplain and riparian soils will be met, and how sediment deposition affects the rate and trajectory of plant community succession (email 11 September 2012). This objective should investigate the rate of deposition, depth of sediment, and soil profile development required for natural floodplain plant community succession, and then use the predicted sediment deposition characteristic from the Fluvial Geomorphology Study to predict the effects of Project operation on floodplain plant communities.

AEA provided the following response to our concern (TWG meeting 24 October 2012), which we find satisfactory for now and look forward to the details in the RSP. The characterization of the

role of sediment deposition in the formation of soils will be conducted in three ways:

1. Sediment rates will be determined throughout the project area by dating floodplain sediments to determine rates of sedimentation.

2. Sediment dating techniques will include dendrochronology (tree age of alluvial surface), and sediment isotopic analyses (Cs^{137}, Pd^{210}), and soil stratigraphic descriptions and vertical profile measurement.

3. Probabilistic models will be developed characterizing the relationship between plant community successional stage, soil type and sediment depositional history.

Additional details provided by AEA include stratified random sampling in the focus areas and entire project area, excavating soil trenches from surface to gravel (historic channel bed), and describing soil stratigraphy and grain size by sieve analysis for the entire sediment profile. The fluvial geomorphology 2-D sediment transport models will be used to predict the effects of Project operations on sediment transport and depositional patterns. The rate of deposition, depth of sediment, and soil profile development required for natural floodplain plant community succession will be characterized, and then the predicted sediment deposition characteristics from the Fluvial Geomorphology Study will be used to predict the effects of Project operation on floodplain plant communities.

AEA & Service Objective 6 and Methods: Characterize the water-level regime required to maintain floodplain and riparian plant communities, and then predict potential plant community change resulting from Project operations.

RIFS-44

The goal of this study objective is to characterize the relationship between floodplain water levels (surface-water and groundwater) and floodplain plant communities, and then use this understanding to predict Project-operation effects on floodplain vegetation. This is a critical objective that has not been sufficiently discussed in past workgroup meetings, possibly due to lack of time, and the PSP methods are insufficient to evaluate if the Service's requested objective will be met. In our 11 September 2012 email we suggested discussing this objective near the beginning of future meetings to allow sufficient time for discussion. At the 24 October 2012 TWG meeting, however, this objective was again discussed last and with insufficient time to discuss the topic. Although this may be listed as the last objective, this is not the least important objective. The health and survival of plants is likely to express a response to Project-regulated flows long before the other objectives such as succession and sediment deposition changes are observed. For example, the preliminary estimated three to four foot decrease in peak growing season river stage near Gold Creek due to Project-regulated flows (AEA 2012) could potentially cause a substantial change in plant community composition and/or landform position if the change in plant-community water levels (surface-water and groundwater) respond similar to river stage and the herbaceous species respond similar to other regulated rivers (e.g., Henszey et al. 2004).

Objective 6 combines hydrologic information from the groundwater study (PSP 5.7) and the plant community information from this study (PSP 6.6) and possibly the habitat mapping studies (PSPs 9.6 and 9.7) to produce plant species/community response curves. Our Objectives 3 to 5 target critical stages in plant community succession, while Objective 6 targets critical instream

flows required for maintaining plant communities as succession progresses (i.e., both succession and maintenance are important).

RIFS-45

Although this objective relies on groundwater information, the groundwater methods described in the Riparian Instream Flow study plan belong in the Groundwater methods study plan (PSP 5.7). AEA plans to comply with our request (11 September 2012 email) and move the groundwater methods to the Groundwater Study Plan (24 October 2012 TWG meeting). We have not discussed the surface-water component of floodplain "water levels," but the surface-water information will be required for communities that experience flooding and for wetland communities where the water-levels routinely cycle between surface-water and groundwater.

At the 1 October 2012 Riparian Instream Flow Study TWG meeting, we briefly discussed potential methods for developing plant community water-level response curves, but the notes for this meeting have not been posted on AEA's website and this portion of the objective was not discussed in the more widely attended 24 October 2012 TWG meeting. We understand methods similar to Henszey et al. (2004) will be employed, and we look forward to seeing these methods in the RSP. PSP Section 6.6.4.7 (Succession Models and Flow Response Guilds) appears to potentially address our Objective 6. The concept of response guilds is similar to our request to develop plant community response curves, but the PSP methods are insufficient to evaluate if our requested Objective 6 will be met. We requested evaluating specific water-level summary statistics (e.g., growing season cumulative frequency, 7-day moving average, 10-day moving average, 14-day moving average, and arithmetic mean) with a rigorous curve-fitting technique similar to Henszey et al. (2004). The methods should provide sufficient detail to construct quantifiable (not qualitative) hydrologic (surface-water and groundwater) gradients showing the optimum and range of favorable water levels required for maintaining floodplain species/communities.

It may also be possible to pool results across process-domain focus areas (i.e., increased sample size) if there is no statistical difference between response-curve coefficients (e.g. Henszey et al. 2004), potentially producing more broad-based response curves. Hydrology is likely the most dominant physical factor influencing floodplain plant communities across the various process-domains, and baring some other dominant physical factor (e.g., soil parent material, ice scour, etc.) it may be possible to use data from additional sample areas to build response curves (see Henszey et al. 2004, Figure 7 for an indication of the number of data points required to build a response curve).

Literature Cited

Alaska Energy Authority (AEA). 2012. Preliminary Susitna River pre-project and post project flow stages. Prepared by MWH. Technical Work Group Meetings 23-25 October 2012. (*http://www.susitna-watanahydro.org/wp-content/uploads/2012/10/Downstream-Stages-TWG-Oct-16-2012-R1-pptx.pdf*).

Henszey, R.J., K. Pfeiffer, and J.R. Keough. 2004. Linking surface- and ground-water levels to riparian grassland species along the Platte River in Central Nebraska, USA. Wetlands 24(3):665-687. (*ne.water.usgs.gov/platte/reports/wetlands_24-3.pdf*)

Green, R.H. 1979. Sampling Design and Statistical Methods for Environmental Biologists. John Wiley and Sons, New York. 257 pp.

Hurlbert, S.H. 1984. Pseudoreplication and the Design of Ecological Field Experiments. Ecological Monographs 54:187–211. (*http://dx.doi.org/10.2307/1942661*)

Montgomery, D. 1999. Process domains and the river continuum. Journal of the American Water Resources Association 35(2):397-410.

Rood, S.B., L.A. Goater, J.M. Mahoney, C.M. Pearce, and D.G. Smith. 2007. Floods, fire, and ice: disturbance ecology of riparian cottonwoods. Canadian Journal of Botany 85(11):1019-1032. 10.1139/B07-073.

U.S. Fish and Wildlife Service. 2012. Letter and study requests to Secretary Bose, Federal Energy Regulatory Commission. May 31, 2012.

7. Fish and Aquatic Resources

7.5. Study of Fish Distribution and Abundance in the Upper Susitna River

General Comments:

The overall stated goal of Alaska Energy Authority's (AEA) Fish Distribution and Abundance Proposed Study Plans (PSP) is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous species (e.g., Bering cisco, Dolly Varden, humpback whitefish, northern pike, and Pacific lamprey), and freshwater rearing life stages of anadromous fish (fry and juveniles) in the Middle and Lower Susitna River, as well as the Upper River, above Devils Canyon.

The creation of a reservoir when full will inundate 39 miles or more of the Susitna River and tributary streams. This will directly affect the abundance of fish residing in flowing waters. The reservoir could inundate important spawning habitat for resident fish, and Chinook salmon and other anadromous fish that currently migrate through Devils Canyon. Alternately, the reservoir could provide rearing habitat for resident Arctic grayling, which often migrate downstream from spawning areas to low velocity habitats for rearing. The quality of this reservoir habitat is unknown, particularly during the winter. Creation of a reservoir could provide habitat for lake trout—a predatory species that could affect the abundance and distribution of other resident fish.

Upper River fish studies should be directed toward quantifying the total amount of tributary habitat that will be converted to a reservoir. Information regarding the population or relative abundance of selected fish species within the inundation zone should be obtained to determine the significance of direct effects. Lower tributary reaches, tributary mouths, and mainstem locations within the inundation zone may provide important seasonal habitat for resident and anadromous species. For example, resident Dolly Varden and grayling overwinter in the mainstem Susitna River and tributary mouths may provide important Dolly Varden summer habitat. Studies should be developed to determine how the inundation will affect the suitability of these locations for spawning and rearing. Studies should determine if the remaining stream reaches will continue to support resident fish populations. The U.S. Fish and Wildlife Service (Service) recommends that the Upper River study objectives be refined to reflect specific information needs for evaluating potential Project effects to the fish community.

FDAUP-49

Specific information needs include:

FDAUP-50

- Proportion of juvenile and adult salmon populations produced upstream of the proposed dam site;
- Timing of juvenile salmon and resident fish migration from Upper river tributaries and main channel habitats to downstream of the proposed dam site;
- Proportion of fish populations (e.g., Dolly Varden and Arctic grayling) in the Upper reach contributing to populations in downstream reaches;
- Location, life cycle, and species of resident fish and non-anadromous salmon within the Upper reach;
- Distribution and availability (quantity and quality) of habitats for juvenile and adult resident and non-salmon anadromous fish upstream and within the proposed reservoir.

Specific Comments by Subsection:

AEA Study Objective 1. Describe the seasonal distribution, relative abundance (as determined by CPUE, fish density, and counts), and fish-habitat associations of resident fishes, juvenile anadromous salmonids, and the freshwater life stages of non-salmon anadromous species;

This objective is broad suggesting that methods will be developed to quantify the seasonal distribution, relative abundance, and fish habitat associations of all fish within the Upper River study area. Seasonal distribution as stated in the objective will be determined by catch per unit of effort (CPUE), density and counts. The need for this information and the purposes of these studies is not provided. The primary objective of Upper River studies should be to determine resident and anadromous fish use of the inundation zone for key life history periods (i.e., spawning and overwinter). Documenting Chinook salmon spawning and rearing habitats is especially important. Determining fish-habitat relationships will require analyses of fish community metrics (e.g., relative abundance, growth rates) as a function of physical, chemical, and biological habitat characteristics. However, methods to accomplish this objective are not provided.

The PSP provides only a brief review of previous studies conducted on fish species likely to be observed within this river segment and its tributaries. Study methods including sample collection, sampling locations, sample timing and frequency do not support the stated objective. The PSP does not identify collection methods for selected fish species or life stages. Data analytical methods and the statistical design are not provided. It is unclear how the results of these studies will be used to evaluate or mitigate potential impacts to the Upper River fish community.

FDAUP-51 The study plan does not identify which species will be targeted for sampling. Resident species within the Upper River include Dolly Varden, rainbow trout, Arctic grayling, Chinook salmon, humpback whitefish, burbot, longnose sucker, and lake trout. Except for lake trout, most of these species are thought to use the mainstem Susitna and lower tributary reaches within the inundation zone for some portion of their life cycle and could be affected by Project construction and operation. Life histories and habitat requirements vary among these species. Species-specific sampling methods will need to be developed. Fish collection methods vary for each species and life stage, and appropriate sampling is needed to provide useful information.

FDAUP-52 The PSP describes a plan for eight tributary streams to be sampled during 2013 and 2014. These will be chosen with a focus on Chinook salmon distribution, selecting all tributaries in which Chinook salmon juveniles or adults were observed previous. Studies found Chinook salmon in four tributaries: Fog Creek (RM 173.9), Kosina Creek (RM 202.4), Tsusena Creek (RM 178.9), and the Oshetna River (RM 226.9) (Buckwalter 2011). The remaining four tributaries for the current study are to be selected, as described in the PSP, at random. Within each selected tributary, up to three meso-habitat types (pool, riffle, backwater) will be selected at random for sampling, and physical habitat measurements of length, width, and habitat type will be collected.

FDAUP-53 Sample timing and frequency should be developed to support the Upper River study objective. In 1981 and 1982, peak juvenile Chinook salmon abundance in Middle River tributaries was from June through August. For example, in Portage Creek few juvenile fish were captured in June, with peak Chinook salmon catches occurring in August (ADF&G 1981). Tributary catches decreased in August and September and mainstem juvenile Chinook salmon abundance

increased. Therefore, Middle River juvenile Chinook salmon likely overwinter in the mainstem and thus sample timing and frequency should be developed to determine if this same movement pattern is observed in the Upper River.

FDAUP-54

Sampling locations should be selected to address specific questions for fish species and life stages and to evaluate potential Project effects. For example, sample site selection to document the distribution of burbot will likely be different than site selection to document the distribution of Dolly Varden. Additionally, by choosing sites based on suitability for Chinook salmon, the plan may bias the capture of different species, relative to the degree of sympatry among species. The PSP does not appear to be designed to document the distribution or abundance of the resident fish species. Lake trout, for example, will probably not be found near the mouths of these tributaries, but they have been found in Sally Lake and Deadman Lake (ADF&G 1981a). If sites similar to these lakes are not sampled, this study could miss a species that potentially could move or be transported into a reservoir (functionally a large lake) and could have a large effect on the potential reservoir fish community.

FDAUP-55

The PSP for the Lower and Middle river (Section 7.6) describes sampling efforts in the mainstem, tributary mouths, side sloughs, upland sloughs, and side channels. Sloughs and side channels may not be as common in the Upper River as they are in the Middle River. Off-channel habitat, which provides rearing habitat in the Upper River, should be sampled to evaluate the relative importance of these locations to Upper River fish communities. Additionally, because tributaries in the impoundment zone have the potential to be affected miles upstream of their current mouths, we recommend including tributary-sampling efforts up to and above the predicted elevations of inundation to determine the availability, quality, and type of habitats that would be altered, and those habitats that will be unaltered, by permanent reservoir-filling.

FDAUP-56

The PSP states that sampling will be based on Chinook salmon distribution, with surveys above the 2,200-foot elevation focusing on locating Chinook salmon, and studies above the 3,000-foot elevation only conducted at sites where Chinook salmon were found. It is unclear if there will be any habitat measures associated with sampling the streams to be inundated. This is necessary in order to measure fish habitat lost to reservoir-creation and to measure habitat alternatives. Schmidt and Stratton ADF&G (1984) found that inundation would remove some passage barriers, such as Deadman Creek falls. Additionally, fish and habitat sampling efforts should be conducted in the many small lakes and ponds in the Upper River drainage to look for anadromous salmon and resident fish overwintering habitat.

FDAUP-57

Proposed fish collection methods are similar to the Middle and Lower river resident fish study (Section 7.6), with monthly sampling from May to September (and two events in August), no sampling October-November, and two sampling events between December and April. As with Section 7.6, methods will involve active and passive capture methods and biotelemetry, to identify seasonal timing, distribution, and abundance of fish. This section will also determine the effect of fluctuating reservoir levels on fish movement into and out of tributaries.

A combination of gill netting, electrofishing, angling, trot lines, minnow traps, snorkeling, outmigrant traps, beach seines, fyke nets, DIDSON, and video camera techniques will be used to sample or observe fish. The level of effort, water temperature, and DO at sampling locations will be recorded. All captured fish will be identified to species, measured, weighed, and scanned for a PIT tag. Comments on general methods for each species are described below (Section 7.6, Objective 2).

As described in the PSP, sampling methods do not include measurement of habitat variables to determine fish distribution among sites and among sampling events. A general classification of "pool, riffle, or backwater" will likely not provide enough information to characterize fish-habitat relationships or to evaluate potential Project effects. Determining Dolly Varden, Artic grayling, or burbot spawning habitat characteristics and their distribution relative to the inundation zone will be important for the evaluation of potential Project effects. This will likely require more information than differences in water velocities. Other habitat variables that may explain resident fish distribution, and should be measured concurrent with fish sampling, include water velocity, discharge (of the mainstem and sampled tributaries), turbidity, availability of cover, pH, conductivity, groundwater, and invertebrate drift and productivity.

FDAUP-58 This study plan also does not describe how it intends to determine effects of fluctuating reservoir levels on fish passage between tributaries and the mainstem Susitna River. It is unclear if this will be based on data collected during this study, or as part of another study, such as the Study of Fish Passage Barriers (Section 7.12). As there are no methods described as to how this objective will be accomplished, we are assuming that it will be part of Study Section 7.12. We recommend the Upper River resident fish study coordinate with the fish passage barriers study to determine which species will likely be affected by passage barriers, and what the physical limits are to passage for each migrating life stage and species.

FDAUP-59 Sampling methods, site selection, and sampling timing and frequency should be developed based on the life history of fish species and potential Project effects. The PSP provides little information on the methods that will be used to determine winter habitat selection by resident and anadromous fish in the Upper River. The primary Project effect will be the inundation of the mainstem and lower reaches of tributary streams. Project effects are likely to be greatest to those fish that spawn or overwinter within these reaches. Tributaries at this elevation may freeze to the stream bed requiring fish migration to overwintering locations. Many resident fish present in the Upper River (e.g., Dolly Varden, Arctic grayling, whitefish), migrate to the mainstem of larger rivers to overwinter. Therefore, methods should be developed to determine if resident and anadromous fish migrate to the mainstem in late fall and the overwintering habitat provided in tributary streams. The only winter sampling methods proposed in the Upper River are the use of DIDSON and video cameras. Surveys will be conducted in 10 "selected" sloughs and side channels. These proposed sampling methods and proposed locations are not likely to provide the necessary information to document overwintering habitats or potential Project effects to overwintering fish.

AEA Study Objective 2. Determine whether Dolly Varden and humpback whitefish residing in the upper river exhibit anadromous or resident life histories;

The PSP states that otoliths will be collected from Dolly Varden and humpback whitefish >200 mm to test for marine derived elements indicative of an anadromous life history pattern (Objective 2) with a target of 30 for each species.

FDAUP-60 The methods do not describe which marine derived elements will be tested for, or methodology for sample collection and analyses. It is our understanding that this a stable isotope study, but this needs to be clarified and more detail provided. Analyses of stable isotopes in tissue samples and otoliths are known to be effective methods for determining anadromy in salmonids and other fishes (Kline et al. 1998; Limburg 1998; Doucett et al 1999; Zimmerman 2005).

Zimmerman (2005) found that strontium (Sr) or strongtium-to-calcium (Sr:Ca) ratios in otoliths are linearly correlated to salinity and environmental Sr concentrations. This method is sensitive enough to discriminate between fresh water, brackish water, and seawater life stages, but Sr uptake is species-specific and possibly population-specific. Testing of otoliths can provide information on the timing of transitions between fresh water and salt water, and distinguish between sympatric populations of anadromous and nonadromous fishes (Thibault et al. 2010). If testing for Sr or ratios of Sr:Ca, then ratios should be compared to known resident upper river fish and known marine species. Larger individuals of each species are most likely to exhibit anadromous life-stages and should be selected for sampling as proposed.

FDAUP-61

In contrast to testing otoliths for marine derived elements, samples could also collect non-lethal tissue samples or fin clip effects. Kline et al. (1998) and Doucett et al. (1999) looked at stable carbon isotopes in tissue samples and compared them to samples collected from other fish known to be resident in fresh water or resident in the marine environment. Fish known to be resident and marine should be sampled to provide values for comparison. By using a non-lethal sampling approach, more samples could be collected, which would provide a more thorough test for anadromy in fish populations in the Upper River. Tissues are analyzed for carbon isotope ratios (Kline et al. 1998; Doucett et al. 1999). Non-lethal sampling methods should be considered, if they can provide valuable data for assessing anadromy in these populations. If redd sites are located for Dolly Varden and humpback whitefish, newly-emergment fry can also be tested for marine-derived elements. The tissue of juveniles will be composed mainly of elements in their yolk sac (Doucett et al. 1999). This method requires sampling before fresh water feeding dilutes the marine-derived elements.

AEA Study Objective 3. Collect tissue samples to support the Genetic Baseline Study for Selected Fish Species (Section 7.14);

See comments on Section 7.14 Genetic Baseline Study for Selected Species.

AEA Study Objective 4. Determine baseline metal concentrations in fish tissues for resident fish species in the mainstem Susitna River (see Mercury Assessment and Potential for Bioaccumulation Study, Section 5.12);

See Comments on Section 5.12 Mercury Assessment and Potential for Bioaccumulation Study.

AEA Study Objective 5. Use biotelemetry (PIT and radio tags) to describe seasonal movements of selected fish species (including rainbow trout, Dolly Varden, whitefish, northern pike, burbot, and Pacific lamprey if present) with emphasis on identifying spawning and overwintering habitats within the hydrologic zone of influence upstream of the project;

This objective was developed to provide an understanding of the seasonal migration patterns of resident fish species found in the Upper River. Specifically, studies should determine migration timing and locations of spawning and overwintering. However, the PSP does not describe how this will be accomplished. Sampling methods have not been developed based on what is currently understood about the migration patterns and life histories of the selected fish species, but appear to be a by-product of other study plans. The study plans contain no information on how the efficiency of the study methods will be evaluated. PIT tagged fish often pass antennae arrays without being detected (Bryant et al. 2009) and an array can detect a tagged fish in close proximity that may not be moving into or out of a study location. There is no discussion of the study statistical design or how migration data will be analyzed or applied to evaluating or

FDAUP-62

mitigating (i.e., avoiding or minimizing) potential Project effects. Understanding resident fish use of the impoundment zone, and affected tributaries for critical life stages including spawning and overwintering is an essential information need. The distribution of these habitats, relative to permanent and seasonal inundation zones, is necessary to evaluate effects to the Upper River fish community.

The PSP states that all captured fish will be identified to species, measured, weighed, and scanned for a PIT tag, with crews installing PIT tags in all untagged fish >60 mm. Antenna arrays will be installed at up to six sites, shortly after ice-off in 2013, and three swim-over arrays will be installed prior to ice-over on an experimental basis. Radio tags will be surgically implanted in up to 30 individuals of each species. Locating radio tagged fish will be via fixed receiver stations and aerial surveys, with up to four fixed receivers established at tributary mouths along the mainstem of the Upper Susitna River and serviced in conjunction with the Salmon Escapement Study (July through October). The Salmon Escapement Study will provide weekly aerial surveys. At other times of the year, the frequency of aerial surveys of the study area will be at least monthly.

FDAUP-63

The Upper River study proposes to radio tag up to 30 individuals of each species, whereas the Middle and Lower river study (Section 7.6) proposes to tag up to 10 of each species. It is unclear what species will be tagged, what age class, where or when fish will be captured for tagging and how selection of age class, tagging location, and timing of tagging would be selected to identify movement or migration patterns. The PSP does not identify why more fish will be tagged in the Upper, compared to the Middle and Lower River sites.

FDAUP-64

With a sampling schedule based on the timing of anadromous salmon spawning, July through October; the study likely will miss movements of resident fish species. Spring migration from overwintering locations or to spawning sites have been predicted or observed for many of the Susitna River resident species, including rainbow trout, Arctic grayling, round whitefish, and longnose suckers (ADF&G 1981b, 1983). If receivers are not operational until July, resident spring migrations will be missed in the first study year. Monthly measures may not be frequent enough to document seasonal migration patterns and will not assess movements during winter months. Tracking fall movement is necessary to identify Dolly Varden spawning locations, and winter movement is to identify burbot spawning locations, or early spring migrations that often occur under the ice.

AEA Study Objective 6. Document the timing of downstream movement and catch for fish species via outmigrant traps;

FDAUP-65

This objective addresses the migration of fish past the dam site, but limits quantification of downstream movement to one method. This is a modification of the Sevice requested objective that stated, "*Document the timing of downstream movement and catch for all juvenile fish species, and outmigration timing for anadromous species*". The PSP does not provide a purpose or information need for this objective. Methods are limited to one trap and one trap type which may or may not be sufficient, depending upon the purpose of the study. The PSP contains no description of the effectiveness of the methods at capturing fish that may be migrating downstream at this location. There is no description of data analyses or a discussion of how the results will be applied to Project operation.

FDAUP-66

The construction and operation of the proposed Project would potentially create a migration barrier, modify downstream migration rates, or result in increased fish mortality. Determining

species outmigration and timing is an important Upper River objective. Sample methods, location, timing and frequency of sampling for upstream and downstream movements may be different for each fish species under investigation. We recommend the use of mark-recapture methods to determine the total number of migrating fish or determine the accuracy of "catch" at estimating total migrating population by species. The study plan should clearly identify how the data will be analyzed and used. Migrant traps can miss some species depending on when they are deployed, their location relative to spawning sites, and proximity to the shore (Thedinga et al. 1994). Therefore, the absence of fish cannot be used to indicate that a given fish species or life stage is not migrating unless a study is designed to determine the probability of fish capture by life stage.

AEA Study Objective 7. Document the presence/absence of northern pike in all samples.

FDAUP-67

This objective is unclear, and the reason for its inclusion is not identified. The PSP already states that all captured fish will be identified to species, measured, and weighed. Therefore, the inclusion of this study objective implies that independent methods will be developed to determine the presence or absence of northern pike within the Upper River.

It is possible that northern pike have already been introduced to shallow lakes or streams along the Denali Highway and within the Upper Susitna River drainage. Increased access following Project construction along with the creation of a reservoir could result in the introduction or increased distribution of pike. If pike are not currently present, pike found in post-Project monitoring could be due to Project construction. Determining if pike are present may be a necessary objective and appropriate sampling methods should be developed.

FDAUP-68

To our knowledge, intensive sampling for northern pike within this segment of the Susitna River has not been conducted. We recommend working with the Alaska Department of Fish and Game (ADF&G) to develop a sampling plan that identifies Upper River sampling locations, sample timing and frequency, and collection methods to determine if northern pike are present. Analytical methods should calculate the probability of pike presence even if not captured given the level of sampling effort.

Literature Cited

ADF&G (Alaska Department of Fish and Game). 1981a. Subtask 7.10: Resident Fish Investigation on the Upper Susitna River. Phase 1 Final Draft Report for Acres American Inc., Buffalo, New York.

____. 1981b. Phase 1 final draft report. Subtask 7.10. Resident fish investigtion on the Lower Susitna River. ADFG/Susitna Hydro Aquatic Studies. Anchorage.

____. 1983. Resident and Juvenile Anadromous Fish Studies on the Susitna River Below Devil Canyon, 1982. Volume 3 of Phase II Basic Data Report. ADFG/ Susitna Hydro Aquatic Studies Program. Anchorage.

____. 1985. Resident and Juvenile Anadromous Fish Investigations, May-October 1984 Report No. 7. ADFG/Susitna Hydro Aquatic Studies Program. Anchorage.

Beechie, T.J., Liermann, M., Beamer, E.M. and R. Henderson.Transactions of the American Fshieries Society Bryant, M.D. M.D. Lukey, J.P. McDonnell, R.A. Gubernick, and R.S. Aho.

2009. Seasonal movement of Dolly Varden and Cutthroat trout with respect to stream discharge in a second-order stream in Southeast Alaska. North American Journal of Fisheries Management 29: 1728-1742.

Buckwalter, J.D. 2011. Synopsis of ADF&G'sADFG's upper Susitna drainage fish inventory, August 2011. Alaska Department of Fish and Game, Anchorage.

Doucett, R. R., Hooper, W. & Power, G. 1999. Identification of anadromous and non-anadromous adult brook trout (Salvelinus fontinalis) and their progeny in the Tabusintac River, New Brunswick, using multiple stable-isotope analysis. Transactions of the American Fisheries Society 128: 2, 278-288.

Kline, T. C., Jr, Wilson, W. J. & J.J. Goering. 1998. Natural isotope indicators of fish migration at Prudhoe Bay, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 55(6): 1494–1502. Limburg, K.E. 1998. Anomalous migrations of anadromous herrings revealed with natural chemical tracers. Can. J. Fish. Aquat. Sci. 55: 431-437.

Rutz, D.S. 1999. Movements, food availability and stomach contents of northern pike in selected susitna river drainages 1996-1997. Alaska Department of Fish and Game, Fishery Data Series No. 99-5, Anchorage.

Schmidt, D. and M. Stratton. 1984. Population dynamics of Arctic grayling in the upper Susitna basin. 1984 Report No. 4, Part 2. Alaska Department of Fish and Game, Anchorage.

Suchanek, P.M., R.L. Sundet, and M.N. Wenger. 1984. Part 6: Resident fish habitat studies. 1984 Report No. 2, Schmidt, D.C., Hale, S.S., Crawford, D.L. and P.M. Suckanek (eds). ADFG/Susitna Hydro Aquatic Studies, Anchorage.

Thedinga, J. F., M.L. Murphy, S. W. Johnson, J. M. Lorenz and K. V. Koski. 1994. Determination of Salmonid smolt yield with roatary-screw traps in the Situk River, Alaska, to predict effects of global flooding. North American Journal of Fisheries Management 14:4, 837-851.

Thibault, L., R.D. Hedger, J.J. Dodson, J.-C. Shiao, Y. Lizuka, W.-N. Tzeng. 2010. Anadromy and the dispersal of an invasive fish species (*Oncorhynchus mykiss*) in Eastern Quebec, as revealed by otolith microchemistry. Ecology of Freshwater Fish 2010: 19, 348-360.

Zimmerman, C.E. 2005. Relationship of otolith strontium-to-calcium ratios and salinity: experimental validation for juvenile salmonids. Canadian Journal of Fisheries and Aquatic Sciences 62: 1, 88–97.

7. Fish and Aquatic Resources

7.6. Study of Fish Distribution and Abundance in the Middle and Lower Susitna River

General Comments:

This individual Alaska Energy Authority (AEA) proposed study plan (PSP) addresses parts of several U.S. Fish and Wildlife Service (Service) study requests related to anadromous and resident fish, fish distribution and juvenile fish, that we provided to FERC, May 31, 2012. The overall stated goal of AEA's Fish Distribution and Abundance PSP is to characterize the current distribution, relative abundance, run timing, and life history of resident and non-salmon anadromous species (e.g., Bering cisco, Dolly Varden, humpback whitefish, northern pike, and Pacific lamprey), and freshwater rearing life stages of anadromous fish (fry and juveniles) in the Middle and Lower Susitna River, as well as the Upper River, above Devils Canyon. However, for the distribution and abundance of fish in the Middle and Lower River, the PSP is not yet sufficiently developed for all seasons, species and life stages to reflect the effort that will be directed and is needed for these studies.

The Service maintains that documenting juvenile anadromous fish-habitat and resident fish-habitat relationships is one of the most important Project-related studies. The proposed Project can directly and indirectly affect the fish community through multiple pathways. Understanding how the proposed Project may alter the fish community is essential to developing protection, mitigation, and enhancement measures.

Although progress has been made in AEA's technical work group (TWG) meetings, since the July 16th filing of the PSP, in fully addressing our study request, several study methods are still not sufficiently developed to meet the intent of the Service's objectives, and appropriate study designs have not been fully established. For instance, a one-year pilot study to assess winter fish sampling methods has been proposed, but does not appear adequate to address sampling of post-emergent fish less than 60 mm, which as stated in our study request is a critical period in the life history of salmonid populations. In addition to missing or not collecting potentially important information on a critical life stage, the pilot study essentially eliminates a year of study under the Integrated Licensing Process (ILP) timeframe. There is also only minimal review of related species-specific or site-specific studies and in many cases species life history information is not included in the proposed study. General fish sampling techniques are listed but specific methods that will be used to sample different species or life stages are not presented.

Sampling locations refer to the different geomorphic classification types but there is only recent indication at the October TWG meetings that sampling locations may be selected in proportion to the distribution of classification types and that sample locations will be randomly selected among all available sites with similar classification types. There is no mention of variability in sampling efficiency among habitat types and how this variability will be accounted when evaluating differences in fish distribution or habitat associations. Monthly sampling and, more recently, some semi-monthly sampling is proposed, but this sampling frequency may not be adequate to address many of our study request objectives. There is no indication of how habitat characteristics will be measured or the metrics that will be used to evaluate causal factors influencing habitat selection and habitat quality. The analytical methods have not been provided to date, so it is not yet clear which statistical tests, if any, will be applied to determine if there are

differences in fish community metrics between geomorphic classification types. There is no indication of how the data from these studies will be used to evaluate potential project effects.

The Service recommends AEA provide more detailed information on the development of the Habitat Suitability Curves (HSC). Instream flow analysis of habitat suitability is proposed as the analytical method to be applied. This requires development of species and life-stage specific habitat suitability curves. The development and application of habitat suitability curves has been a subject of debate since publication of the instream flow increment methodology (Mathur et al. 1985, Kondolf et al. 2000). However, the methods that will be used to develop HSC and how they will address the limitations of this methodology are not provided. There is mention of HSC in Study 6.5, but the study request objective is not addressed in the Upper, Middle, or Lower River studies for juvenile salmonids, resident fish, and non-salmonid anadromous fish. It is still unclear how HSC information will be collected, particularly in winter for post-emergent fish up to 60 mm when fish would be most vulnerable to load-following operations (stranding and trapping). There are no empirical studies described to evaluate potential Project effects or for inclusion in habitat modeling efforts. There is also a general reference to developing HSC models in Study 6.5 for these species and life stages, but the source of that information is unclear.

The study area for the Middle and Lower River fish studies in the PSP is from the Watana Dam site downstream to river mile 28. However, during a fall TWG meeting, it was suggested that the study area could initially be limited to the downstream extent of estimated flow effects as determined through the flow-routing studies. Limiting the studies based on estimated extent of flow modification would ignore potential indirect Project effects. The Service and National Marine Fisheries Service (NMFS) believe that Lower River fish studies are necessary to evaluate potential biotic effects due to species displacement from Middle River habitats and to document the relative contribution to fish production and use between these two river segments. It would also provide replicate measures of fish-habitat relationships and provide information for post-project comparisons and monitoring.

Habitat quality and differences in growth rates or fish condition among habitats can be related to fish density. Higher fish densities can increase intra- and inter-specific competition. Project operations, like winter load-following operations, could displace Middle River fish thereby increasing fish densities at Lower River sites. Higher fish densities in the Lower River could exceed available resources thereby reducing fish fitness and survival. Similarly, concentrations of transported organic matter or macronutrients may differ between the Susitna, Talkeetna, and Chulitna Rivers, and changes in Susitna River concentrations could extend Project-related effects downstream. The differences in dissolved and transported matter between the Susitna, Talkeetna, and Chulitna Rivers should be determined to see if Project effects beyond flow and sediment would change Lower River habitat quality.

Lower River fish and aquatic studies are necessary to documents the relative importance of these two stream segments. Differences in chemical and physical water characteristics could result in differences in habitat quality. For example, in the 1980s greater numbers of juvenile Chinook salmon were found overwintering within the Middle River compared to Lower River sites; even though total available habitats were more limited (ADF&G 1981).

Lower River sampling may be necessary to provide adequate replication of macrohabitats to determine fish-habitat relationships. Tributary mouths have been identified as one of the geomorphic classification types that may provide important juvenile salmon overwintering

habitat. However, there are considerable biological, water quality, and physical differences among tributaries. For example, Whiskers Creek is a moderately sloped stream characterized by low pH, high dissolved carbon, coho spawning, and coho and Chinook overwintering habitat. However, it is the only Middle River tributary with these characteristics. Therefore, replication of this tributary type will require selection of similar Lower River sites (e.g., Trapper Creek, Cache Creek, Rabideux Creek, Moose Creek, Greys Creek, or Kroto Creek/Deshka River) to determine if the characteristics of these tributary mouths are important components of fish habitat. A similar discussion could be applied to Indian River and Portage Creek, which together accounted for most of the Chinook salmon spawning in the 1980s, but these would provide only two sample replicates of this stream type. Additional replicate sites could be found in the Lower River including Montana Creek, Willow Creek, Sheep Creek, and possibly the Kashwitna River.

Proposed study plans for post-Project monitoring are not provided. However, Lower River sites could be selected as long-term monitoring locations. Lower River sites may have many of the same biological, chemical, and physical characteristics as Middle River locations. Lower River sites could be used to differentiate between changes in relative abundance due to escapement or marine survival and Project-related effects. Without pre-Project Lower River studies, any post-Project changes in Susitna River fish and aquatic resources may be assumed to be due to Project construction and operation. Without pre-Project Lower River studies, decisions regarding Project mitigation including hydropower operations would need to be made with little or no information on fish and aquatic resources in the Lower River.

Specific Comments by Subsection:

AEA Study 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;

FDAML-19

This study objective is broad and includes the spatial and temporal distribution of multiple fish species with different life histories, their relative abundance, and factors influencing habitat associations. The purpose of this study objective is only briefly defined by AEA. There is only a cursory review of existing information and methods have not been developed for specific study objectives. Proposed sampling frequency and potential locations are provided but may not be appropriate for the study objective. The study does not include an evaluation of sampling efficiency, accuracy, precision, or representativeness. There is also no description of how the study results will be analyzed or the metrics used to evaluate potential Project effects.

The Service recommends the methods include three study components for each fish species. The first is to describe the seasonal distribution of juvenile anadromous salmonids, non-salmonid anadromous fishes, and resident fish. The second study component is to describe the relative abundance of fish species, and the third is to describe the fish-habitat associations. Methods for all three of these study components can vary among species and their life stages and with environmental conditions. The stated purpose for this study in the PSP is to support the physical modeling and provide supporting information for the instream flow modeling study. Therefore, specific detailed quantitative information is necessary for all three study components. In addition, this objective should characterize all factors that influence the seasonal distribution and abundance of juvenile anadromous and resident fish and not simply support physical and instream flow modeling.

Juvenile Salmon Seasonal Distribution

FDAML-20

It is important to understand the distribution of fish species by life stage both spatially and temporally. The direct effects of the construction and operation of the proposed Project will be limited to those fish species present within the affected area. The Project could also indirectly affect fish species by altering the physical, chemical or biological habitat characteristics. However, identification of the seasonal distribution of fish species is presumed to be related to direct Project effects. Direct Project effects can vary over time based upon different operational scenarios, and the response to those effects can vary by fish species and life stage. In addition, the magnitude of Project effects likely will decrease with distance from the dam site, and among different geomorphic reaches and physical habitat types.

The change in the spatial and temporal distribution of fish is due to movements or migration of fish among habitats during different life stages which can be influenced by environmental variables. Adult resident and anadromous fish migrate to spawning areas, and juvenile fish emerge and migrate to seasonal summer, fall, and winter rearing areas. These movement patterns often are influenced by environmental factors. Adult salmon migration can be influenced by water temperatures or flows (Macdonald et. al. 2000; Torgersen et. al. 1999). Embryo development and fry emergence is dependent on thermal energy (Murray et. al. 1988; Wangaard et al. 1983) but can be influenced by flows (Milner 1985), and juvenile migration to winter habitats and smolt outmigration can be related to changing flows or light (Bustard and Narver 1975, McDonald 1960). The temporal distribution of fish may vary from year to year due to environmental conditions which can be influenced by Project operations. Therefore, we not only need to understand the spatial and temporal distribution of fish species by life stage, but also those factors than initiate and modify movement or migration rates.

The seasonal distribution of adult anadromous salmon and salmon eggs will be determined through the Adult Escapement Studies (Section 7.7). However, the temporal distribution of salmon fry will be influenced by egg development rates. The presence of chum, sockeye, or other salmon fry within the Susitna River or off-channel habitats will depend upon egg development and emergence timing. The Service's request for the evaluation of spawning and egg development is not addressed in the PSP and has not been fully addressed in subsequent TWG meetings, but is the subject of multiple agency study plan objectives outlined below.

Juvenile Salmon Distribution and Movement from Spawning to Rearing Locations

FDAML-21

Understanding the timing and influence of environmental variables on juvenile salmon migration from spawning to rearing habitats is critical to the Service's evaluation of the Project. Newly emergent salmon fry are weak swimmers and the availability and access to low velocity nearshore habitats and off-channel locations can be affected by changing flows. The distribution of resident fish species and other predators may be due to the presence of migrating salmon fry. Understanding the seasonal distribution of juvenile salmon will likely require multiple sampling methods, sampling locations, and sampling frequency for different species.

Environmental conditions such as temperature, discharge and water velocity influence the timing of sockeye and chum migration to sea or Lower River rearing habitats. Studies have shown a stronger positive response to discharge by sockeye and chum fry compared to Chinook and coho fry (Hoar 1954). Chum had the highest correlation (r=0.89) with discharge in the 1980s studies at mainstem inclined plane trap locations (Roth et al 1986). Less is known about juvenile river-rearing sockeye and their dependence on discharge ,but results from 1980s studies suggest that large numbers of age 0+ sockeye migrated out of the Middle River in late May and June coinciding with high spring time flow. The percentage of migrants travelling to

Cook Inlet or to Lower River rearing habitats was not known (Schmidt et al 1985). The PSP does not indicate where fyke nets or other migrant traps should or will be used to capture migrating juvenile salmon. Migrant traps such as fyke nets and inclined plane traps should be used with a sufficient level of effort and frequency to determine the timing and conditions (e.g., water temperature and flow) of chum and sockeye migration.

The Service recommends that placement of migrant traps (i.e., fyke nets, screw or incline plane traps) occur near adult salmon spawning locations in such a manner as to document timing of fry migration relative to environmental conditions, the size class distribution of migrating fry, and abundance estimates to evaluate potential spawning success (i.e., fry per spawning female x fecundity). The use of migrant traps for sockeye salmon fry may be preferable to other sampling methods (electrofishing, beach seines, and minnow trapping) based on results of 1980s studies. The results of proposed adult salmon spawning and potential incubation, and emergence studies should be used to identify sampling locations and the timing of migrant trap operation.

Migrant traps near the confluence of tributaries or near other identified spawning areas and Susitna River should be used with other methods to document juvenile Chinook and coho salmon movement from spawning to rearing areas. In addition to providing detailed run timing information, migrant traps could allow for population estimates (if needed) using mark-recapture methods and provide a method to calculate spawning success in tributary streams.

FDAML-22

Juvenile Salmon Distribution among Summer Rearing Habitats

The seasonal distribution of juvenile salmon within the Middle and Lower Susitna River during summer rearing likely will be determined using the relative abundance or catch per unit effort (CPUE) among sampling locations. Our understanding of the distribution of juvenile salmon among habitats can be influenced by the locations sampled, when samples are collected, the frequency of sampling, and differences in catchability due to sampling methods. The Service recommends that timing and frequency of sampling, sample locations, and sampling methods be appropriate to species life histories and to address specific project-related questions.

Sampling locations should be stratified among physical geomorphic classification types including turbid mainstem and side channels, and off-channel sloughs and tributaries. However, sampling locations should also consider the relationship to spawning areas and microhabitat characteristics as well as the timing of fry movement from spawning to rearing areas. Sampling mainstem habitats immediately upstream and downstream of spawning areas before or after fry move from spawning to rearing areas would result in substantial differences in CPUE. Similarly, if salmon spawning locations are predominantly on one bank (e.g., Slough 8A and Slough 11), then salmon fry CPUE may differ considerably between samples collected on the left or right bank. If these two locations are treated as replicate mainstem habitats then CPUE will be highly variable and would be less likely to determine differences among habitat types. Whereas, if these were discrete sampling areas based upon a stratified sampling approach, it would provide a much better understanding of salmon fry distribution among mainstem habitat locations. At the October 2012 TWG meetings, a stratified random approach was outlined and an initial schedule presented for fish sampling. However, a description of the methods, the link from methods to the study objectives, the analytical approach, and the metrics used for the analysis are still unknown and should be described in the revised study plan.

FDAML-23

Specific sampling locations among macrohabitat types, should also consider microhabitat variability within a habitat type (e.g., woody debris, substrate size, bank cover, riparian cover,

temperature). For example, juvenile fish CPUE likely may vary considerably among mainstem sampling locations adjacent to point bars, along outside bends, or within the mid-channel (Beechie et. al. 2005). Similarly, CPUE from samples collected at or near the confluence of sloughs and the mainstem could be different from those collected greater distances up sloughs due to variable water quality or physical conditions. Microhabitat sampling locations should be identified to interpret sample results designed to evaluate the temporal distribution of juvenile salmon among macrohabitat types.

FDAML-24

A similar process should be applied to identifying sampling locations for tributary spawning species. As mentioned previously, Chinook spawning in the 1980s occurred primarily in two right bank tributary streams in the Middle Susitna River: Indian River and Portage Creek (upstream of River Mile 138). Whereas, coho salmon spawning occurred primarily in tributaries near below river mile 110. Thus, early season sampling in locations closer to tributaries used by spawning adults would likely have higher CPUE values. Therefore, the Service recommends that sampling locations for juvenile salmon be stratified spatially and temporally by proximity to spawning areas including river mile and bank (i.e., left or right), geomorphic classification types, and then meso-habitat characteristics (see comments on habitat classification) to understand the seasonal distribution of juvenile salmon within the Middle and Lower Susitna River.

An alternate approach would be to develop specific hypotheses regarding distribution and develop a sampling approach to test these hypotheses. For example, studies could address whether juvenile sockeye salmon use mainstem habitats in summer for rearing or use mainstem habitats primarily as a transportation corridor from spawning to rearing habitats (*sensu* Galat and Zweimuller 2001). Studies could determine if there is a difference in juvenile sockeye salmon residence times among macrohabitat locations, and if there is a difference in juvenile sockeye salmon abundance between left and right bank macrohabitats.

The timing and frequency of sampling can also influence our understanding of juvenile salmon distribution within the Susitna River and should be specific for each species or for specific Project-related objectives. For example, if the objective is to determine when and how long juvenile sockeye salmon are present in mainstem habitats, then sampling could be initiated in early June, and weekly or semi-weekly sampling may be necessary to document sockeye salmon residence times within mainstem habitats. For Chinook and coho salmon, sampling of mainstem habitats could also begin in June, with initial monthly sampling, but more frequent weekly or semi-weekly sampling in August and September to determine if mainstem habitats are migration corridors or are important fall and winter rearing areas.

FDAML-25

It may also be necessary to develop a sampling frequency that is linked to changes in chemical or biological characteristics, or otherwise relevant to proposed Project operations. If juvenile salmon distribution is related to changes in turbidity because of seasonal increases in flow from glaciers, then sampling frequency should provide measurements over a range of mainstem conditions. Similarly, if mainstem turbid waters provide cover (Gregory and Levings 1998, Ginetz and Larkin 1976) and influence fish distribution in sloughs as water levels rise, then sampling locations and frequency should provide measures that encompass these changes in habitat characteristics. The direct effects of the Project on fish will likely vary under different operational scenarios. At a minimum, sampling frequency should provide a measure of fish distribution when Project effects are expected to be greatest. For example, if changes in flow are expected to influence fish movements, then sampling frequency should document fish movement prior to, during, and following similar natural variations in flow.

Juvenile Pacific Salmon Migration to Overwintering Habitats

FDAML-26

The objective for the distribution of juvenile salmon during winter should determine if fish maintain site fidelity from summer through winter, or if and when they emigrate from summer rearing locations, and the locations that they select for overwintering. PIT tagging of salmon juveniles in tributaries with stationary antennae arrays near the Susitna confluence could be used to determine the portion of fish migrating out of these streams as water temperatures and light levels declined or in response to fall storms. PIT tags could also be used to determine site fidelity within upland and side sloughs with tag detection at stationary arrays near the slough mouth.

Based upon 1980s Susitna River sampling, juvenile salmon in winter were found in tributary mouths, mainstem, and off-channel habitats. Monthly winter fish sampling at sites randomly stratified by geomorphic classification types could be used to identify distribution during winter. However, a variety of sampling methods are likely needed to infer differences in relative importance of overwintering habitat locations. The use of video and PIT tagging may be useful to document the presence or absence of juvenile salmon at multiple sampling locations, but it is unknown whether video observations of fish are proportional to fish densities or would otherwise provide useful quantitative information.

Juvenile salmon emigrate from summer rearing to fall and winter rearing habitats. Juvenile sockeye, Chinook, and coho salmon overwinter in the Susitna River and associated off-channel habitats. Juvenile salmon may move to winter rearing locations or remain in summer rearing locations if characteristics are favorable in winter. Migration is often associated with declining water temperatures but may be linked to changes in discharge or light levels (Bjorn 1971, McMahon and Hartman 1989). Movement from summer rearing areas may be initiated by low flows in fall, winter freshets, or the loss of open water as small tributaries freeze to the bottom (Prowse 1994). Juvenile salmon generally select winter habitats with cover, low water velocity, and relatively warmer water due to springs or upwelling groundwater (Giannico and Hinch 2003, Hillman et al. 1987, Cunjak 1996). Winter habitat selection is based on the need to minimize energy expenditure and avoiding adverse physical or chemical conditions (e.g., anchor ice, floods, low oxygen) (Cunjak 1996).

Chinook and coho salmon likely prefer different winter habitats, but little is known about winter habitats used by stream-type sockeye salmon. Substrate with interstitial spaces that provide cover and lower water velocities may be important for overwintering Chinook salmon (Hillman et al. 1987, Bjorn 1971). Bjorn (1971) found fewer juvenile Chinook salmon migrated out of streams with large cobble substrates than those with gravel or finer substrates. Juvenile Chinook salmon were found in association with macrophytes and undercut banks during winter and the addition of cobble substrate increased overwinter abundance (Hillman et al. 1987) in the Lemhi River (Northern Idaho). Juvenile steelhead and Chinook were found overwintering in deep pools and the interstitial spaces of riprap cover in a large river in British Columbia (Swales et al. 1986). Bustard and Narver (1975) found juvenile coho salmon and steelhead trout in waters less than 0.15 cm/s when water temperatures were below 8°C whereas Hillman et al. (1987) found Chinook salmon in water velocities less than 20 cm/s during winter with larger fish using higher water velocities.

Seasonal Distribution of Resident Fish

See comments under AEA Objective 2 of Section 7.6.

FDAML-27

Relative Abundance

The use of relative abundance data are not explained in the PSP, but differences in CPUE could be used to identify important fish habitat characteristics and may also be used to develop habitat suitability criteria for instream flow analyses. However, relative abundance for juvenile salmon in particular, can vary with proximity to spawning areas, catchability among habitat types, and with differences in flow, and should be considered when evaluating habitat quality.

Underwater video could potentially have less sampling bias based on flow, cover or depth, but could be affected by poor visibility from turbidity and may be limited to providing only qualitative information such as fish presence/absence, fry emergence times, or diel fish activity. However, the sampling methods for underwater video are only mentioned for winter use in the PSP (detailed in Mueller et. al. 2006). Use of video during the open water season in clear water sloughs or tributaries could also provide an additional method for observing juvenile sockeye salmon that may not otherwise be captured using other gear types.

FDAML-28

Juvenile Salmon Habitat Associations

Determining habitat characteristics that are important for fish species in the Susitna River and evaluating how construction and operation of the proposed Project may alter those habitat characteristics is a fundamental purpose of the proposed studies. The development and completion of extensive studies to measure and model geomorphological changes, ground water flow paths, productivity, and water quality may have little utility if a relationship between physical and biotic processes and fish habitat characteristics is not clearly understood.

One PSP objective is to describe fish-habitat relationships for juvenile anadromous, non-salmonid anadromous, and resident fish species. However, the PSP does not outline how these data would be used, how habitat characteristics would be measured, or how statistical methods would be used to determine the relationships between fish and characteristics of their habitats. Therefore, critical evaluation of the PSP is difficult. As potential habitat suitability criteria and indices have not been identified, there is no indication of what parameters may be included to develop weighted usable area for instream flow analyses.

The Service recommends that AEA review the numerous published studies available to determine the characteristics that define habitat quality from egg deposition through juvenile summer and winter rearing for most fish species present in the Susitna River (See summaries in Bjorn and Reiser 1991, Quinn 2006). There are few studies that evaluate juvenile salmon and resident fish-habitat characteristics in large glacial rivers (Murphy et al. 1989). Although these sources may not provide the information necessary to define fish-habitat associations, they can provide an understanding of those parameters that should be incorporated into the revised study plans.

The important characteristics of fish-habitat relationships can be physical, chemical, or biological. Physical, chemical and biological characteristics used to define fish-habitat relationships should be measured and not obtained from model estimates. Fish-habitat characteristics should define conditions when fish are sampled at the microhabitat scale (m2); however, sampling frequency and locations should be based upon the variability of the measured parameter. For instance, channel geometry will not likely change within a season so annual measures should be adequate; however, water velocity and water depth, and most water quality parameters should be measured at the same time as fish sampling. Similarly, sample locations should be representative of the physical habitat sampled for fish.

AEA Study Objective 2: Describe seasonal movements of selected fish species such as rainbow trout, eulachon, Dolly Varden, whitefish, northern pike, Pacific lamprey, and burbot) using biotelemetry(PIT and radio-tags) with emphasis on identifying foraging, spawning and overwintering habitats within the mainstem of the Susitna River and its associated off-channel habitat;

This PSP study objective partially addresses the Service's study requests for resident fish species. Our study objectives for resident fish included the following:

1. *"Characterize the seasonal (spring, summer, fall, winter) distribution, relative abundance, and habitat utilization in the Susitna River mainstem (RM 0-RM 233) for all life stages of non-salmon anadromous, resident, and invasive fish species. [Documenting both hierarchal nested habitat type and use-type as described in the resource agency Instream Flow Study and Habitat Utilization Study Request].*
2. *Characterize the seasonal (spring, summer, fall and winter) movement patterns of all subject fish species and life stages as they relate to foraging, spawning, rearing and overwintering habitats. The characterization of seasonal movements includes run timing (immigration and emigration) and extent (periodicity) of non-salmon anadromous species in the Susitna River (RM 0-RM 233) and movement into and out of tributary streams. [Interface with resource agency Instream Flow and Habitat Utilization Study Request hierarchal nested habitat types and habitat mapping].*
3. *Characterize the flow-related or synchronized life history strategies (migration, movement, spawning, rearing, hatching, emergence) of non-salmon anadromous, resident and invasive species, and their biological behavorial response (e.g., potential for false attraction, delayed migration or increased holding time, synchrony of spawning, relative hatching and emergence timing) to Project-affected flow alterations (flow, temperature, habitat, water quality).*

This study objective also only partially addresses the Service's study requests for juvenile anadromous, and juvenile resident fish. Our study objectives for juvenile fish included the following:

FDAML-29

1. Describe the seasonal movements and migratory patterns of juvenile anadromous and resident juvenile fish species among mainstem habitats and between tributaries and mainstem habitats with emphasis on identifying foraging and overwintering habitats.. [Enclosure 13: Early Life History and Juvenile Fish Distribution and Abundance in the Susitna River].

The PSP objective is to characterize seasonal distribution, relative abundance, and habitat associations of resident fish and their migration. However, PSP methods do not support the intent of the Service's study request. The PSP has not been developed to characterize flow-related, or synchronization of resident fish migration and life histories to other physical, chemical, or biological environmental variables. Specific methodologies will need to be designed to accomplish these objectives. Incidental catches of fish through seasonal samples will not be sufficient, nor will the resulting data be useful for evaluating Project effects.

The fish collection methods do not appear to be related to this project objective, but are merely a list of sampling techniques. The objective states that biotelemetry and tracking of PIT tagged fish will be used to document migration patterns of resident fish. The specific methods should clearly identify how target species are to be captured for tagging or for the recapture of tagged fish (although this is not discussed). For example, trot lines can result in high fish mortality for

some species, therefore, it may not be an appropriate method to collect fish for tagging and tracking.

The PSP study methods do not clearly identify those species that will be evaluated. However, a partial list of potential species is provided, which, in part is covered under other study objectives (i.e., seasonal movement of northern pike). The PSP provides only cursory information on the general life-history patterns of the potential fish species and does not include any site-specific information. Study methods do not adequately identify when, where, or how specific fish species will be captured. The location and operation of receivers does not appear to consider the life history patterns for many species. PIT tagging is identified in the study objective, but the limitations on installation and operation of arrays could limit the results. PIT tagging is also limited to fish >60 mm, and therefore, will not provide any information on the early life stages that will be most vulnerable to Project operations. The study does not identify any of the other biological, chemical, or physical characteristics that may explain movement patterns. There is also no description of how the analyses of the data obtained from this study will be conducted to meet the study objective.

FDAML-30

The methods described to address this objective include using biotelemetry to identify seasonal movements of juvenile anadromous and resident fish; however, it is not clear how this will relate to the habitat characterization studies or the instream flow models. Methods mention ways biotelemetry can be used to measure growth rates and calculate population estimates, but there is no objective that describes why these data will be collected or how it will be used. It is assumed that growth rates and abundances will be used to characterize preferred seasonal habitats for each species, which might then be combined with instream flow analyses to determine how these habitats might change thereby quantifying effects to fish populations. However, there is no description of whether physical (depth, velocity, temperature), chemical (pH, conductivity, dissolved oxygen), or biotic variables (primary and secondary productivity) will be measured in conjunction with fish capture and tracking efforts, particularly if spawning or overwintering habitats are located outside the reaches included in habitat characterization or river productivity studies. Without accompanying measures of fish-habitat characteristics or parameters influencing fish movement, it is unclear how distribution trends can be estimated or extrapolated out to similar, non-sampled areas. Presence/absence information is not sufficient to provide necessary information to make decisions on how a hydroelectric project could influence fish survival and distribution or movement among foraging, spawning or overwintering habitats.

FDAML-31

Sampling habitats based on equally measuring the “major habitat [geomorphic classification] types” assumes that the distribution of geomorphic habitats is equal throughout the drainage. Many factors, such as water chemistry and productivity will also influence the distribution of fish among these sites, beyond this geomorphic characterization. Classifying fish as preferring side channels versus side sloughs may miss the habitat variables influencing fish distribution. Therefore, it is important to measure habitat variables at each sample site and event to determine if use of macrohabitats is in proportion to availability when evaluating fish distribution and abundance.

FDAML-32

The number of fish to be tracked in the PSP may not be sufficient to document spawning migration patterns, summer foraging areas, and overwintering habitats to meet the study objective. The use of radio receivers has not been designed to track resident species. Radio transmitters are proposed to be *“surgically implanted in up to 10 fish of sufficient body size of each species from five geomorphic types in the Middle and Lower River.”* The description of

methods in the PSP is not detailed enough for the Service to provide meaningful evaluation. More information is needed regarding: which fish species will be tagged; what determines "sufficient" sizes for radio transmitters; and how movements of smaller, juvenile fish (<60 mm) will be monitored. If fish selection is stratified equally among five different habitat types, this would only provide information on movements for two fish from each habitat type below Devils Canyon. It is unclear if this level of effort will be sufficient to understand general movements and seasonal habitat utilization by species. The plan to maintain fixed receiver stations during July through October, to coincide with adult salmon migrations will miss fish species movements or migrations that occur in the spring. If the objective for the biotelemetry studies is to include tracking seasonal movements of resident and non-salmonid anadromous fish, the observation period should not be based solely on adult salmon migration periods. Monthly winter and spring aerial surveys have the potential to miss movements and migration timing from spawning areas to juvenile fish rearing habitats. Therefore, more frequent surveys are likely needed. In addition, because radio-tagging can have high failure rates from tagging-induced mortality, expulsion of tags, or tag malfunction (Chisholm and Hubert 1985; Ridder 1998), tagging 10 or fewer fish may be an inadequate sample size.

FDAML-33

The PSP maintains that up to 10 sites will be selected for deploying PIT tag antenna arrays to detect movements into or out of selected sites and will be deployed shortly after ice-off in 2013. Additionally, swim-over antennas are planned to be deployed at five sites prior to ice-over, on an experimental basis. The target species in this study and the criteria used for site selection of antenna arrays has not been clearly defined. Information on large and fine scale movements of fish will be dependent on site selection for antenna arrays and tagging sites. There is a large sample area to cover with only 10 or fewer observation sites, especially considering that it will only register movements into and out of relatively small tributaries and sloughs.

AEA Study Objective 3: Document the timing of downstream movement and catch for all fish species using outmigrant traps;

FDAML-34

This study objective is broad, with no stated purpose, and is limited to a single method. One purpose could be to document outmigration timing and abundance of anadromous salmon smolt from the Susitna River. However, "all fish species" are listed as the study objective. The PSP states that sites within side channels that are open continuously throughout the ice-free season will be selected for outmigrant traps and traps will be operated for 48 hours off. As described, it appears that two traps will be deployed and all captured fish will be recorded, but there is no discussion of how these data will be used.

Although we agree that documenting the timing of downstream movement of fish should be a study objective, the objective should be expanded and the purpose clarified. This will ensure that appropriate methods are selected and avoid collecting data that cannot be used in the evaluation of Project effects. For example, salmon smolt migration is likely different than downstream movement of emergent fish to rearing locations. Also, the velocities used by out-migrating smolt may be species specific. Therefore, the timing and location of out-migrant traps will depend upon specific study objectives.

AEA Study Objective 4: Characterize the age structure, growth, and condition of juvenile anadromous and resident fish by season;

An understanding of the seasonal age structure, growth, and condition of anadromous and resident fish is needed by the Service to provide baseline information and to evaluate or monitor potential Project effects.

FDAML-35

The PSP does not provide information on why age structure, growth rates, or condition factors are being collected or calculated, or how these metrics will be used in Project evaluation. The recapture of PIT-tagged fish is the only method that is suggested for measuring growth rates. Specific objectives will affect study design, sampling locations and frequency, the sample size and data analyses. Therefore, specific study objectives must be identified with appropriately selected sampling and analytical methods. For example, flow fluctuations and the potential for stranding may vary in relation to proximity to the dam site and channel morphology. A Project objective may be to determine if there are longitudinal differences in juvenile salmon growth rates. Study designs could be developed to test for differences in growth rates or condition factors among groups of different geomorphic classification (i.e., mainstem, sloughs, side channels, and tributaries). In this case, growth rates will need to be calculated for each of these replicate locations. Growth rates and condition factors are an indication of habitat quality, thus regressions with habitat characteristics will require measuring growth rates at locations with variable habitat characteristics. Growth during winter may be an important measure of habitat quality and differences in growth and condition among overwintering sites should be determined at multiple replicate locations throughout the winter. In addition, growth rates may be used in addition to juvenile salmon density or relative abundance when determining weighted usable area for instream flow analyses (Beecher et al. 2010).

In collaboration with the Services, AEA should identify the specific objectives and information needs that require juvenile anadromous and resident fish growth rates. Based upon these objectives, study designs should be developed to document the species, locations, and methods that will be used to calculate growth rates and the analyses that will be applied to the data. Site selection and the use of growth rates without considering data analyses and application likely will not result in useful data.

AEA Study Objective 5: Document the seasonal distribution, relative abundance, and habitat associations of invasive species (northern pike);

FDAML-36

This AEA objective is directed toward any invasive species but refers specifically to northern pike, therefore, it is unclear whether other invasive species are anticipated or should be considered in the evaluation of this objective. If the intent is to document the seasonal distribution, relative abundance, and habitat associations of other invasive species, then detailed procedures should be provided on how this would be accomplished.

The PSP does not describe the purpose for this objective or how the proposed Project may influence the distribution or relative abundance of northern pike (or other invasive species). The PSP states only that northern pike have been observed in the Lower River, but does not provide a synopsis of known distribution, relative abundance where present, or known habitat associations. The study plan should review information on northern pike and habitat associations and identify how the proposed Project may affect current distribution, relative abundance, and available habitats. The PSP should outline the limitations of our current understanding of northern pike distribution within the Susitna River drainage and how the proposed study will build upon this information.

FDAML-37 The PSP provides no description of the sampling locations, timing, frequency, or methods (passive or active) that will be used to document northern pike (or other invasive species) distribution, relative abundance, or habitat associations. A review of methods employed previously by Alaska Department of Fish and Game (ADF&G) should be provided and a description of how and where these methods would be used to accomplish the stated objective.

FDAML-38 The PSP does not provide information on data analyses or how information on northern pike would be incorporated into the evaluation of potential Project-related effects. It appears that evaluation of northern pike distribution, relative abundance, and habitat associations will consist of reporting when and where there are incidental catches of northern pike through other sampling efforts.

FDAML-39 A clear understanding of the distribution of northern pike is important for the interpretation of biotic effects to the distribution and abundance of juvenile salmon and other resident salmonid and non-salmonid anadromous species. This may be of particular importance for lower gradient streams that have similar physical characteristics to those where northern pike are currently present. These could include tributaries that will likely be influenced by Project operations including Whiskers Creek, Birch Creek and slough, Trapper Creek, Cache Creek, and Rabideux Creek, that provide spawning and rearing habitat for Chinook and coho salmon and rearing habitat for Chinook, coho and sockeye salmon. In addition, as pike distribution increases, the importance of moderate-sloped clear water tributaries to glacial rivers may become more important for salmon as locations where pike are absent. The Middle Susitna River provides important rearing and overwintering habitat for Chinook salmon and displacement of these fish due to Project operations could make them more susceptible to predation by northern pike. Similarly, flow fluctuations during winter could displace overwintering fish from mainstem habitats to backwater locations and increase risk of pike predation. The loss of flushing flows due to Project operations could increase physical habitat characteristics that give northern pike a competitive advantage.

AEA Study Objective 6: Collect tissue samples from juvenile salmon and opportunistically from all resident and non-salmon anadromous fish to support the Genetic Baseline Study.

The evaluation of the effectiveness of the PSP in meeting this objective is discussed in section 7.14: Genetic Baseline Study for Selected Species.

Related USFWS/NMFS (Services) Study Objectives

Services Study Request Objective 7. Evaluate salmon incubation (embryo development, hatching success, and emergence times) and monitor associated water quality conditions (e.g., temperature, DO, pH) at existing spawning habitats (slough, side channel, tributary, and mainstem) in areas with and without groundwater upwelling in the middle and lower reaches of the Susitna River.

FDAML-40 This Study Request Objective was not addressed in the PSP, but has been discussed at TWG meetings. The Services anticipate that most portions of this objective will be included in the Revised Study Plan as part of the Instream Flow Study, however we cannot comment on the details of what this may entail at this time. Characteristics of suitable spawning habitat vary by species but include water depth, velocity, temperature, flow, space, upwelling and downwelling, substrate size, and percent fine sediment (see review in Bjornn and Reiser 1991). Habitat characteristics that affect incubation (rates and success) and emergence (dates and times)

include dissolved oxygen, water temperature, biochemical oxygen demand, substrate size, percent fines, channel gradient, water depth, flow, velocity, stream bed porosity, and velocity of water through the redd (Bjornn and Reiser 1991). An evaluation and monitoring of spawning and incubation habitat as described below in the *Services' Study Request Objective 9* will be included in the intragravel study. The evaluation of existing emergence times is still being developed and may include the use of migrant traps in areas with open leads and possibly with the use of video. Although some discussion of the methods has occurred, detailed methods should be provided in the methods of the Instream Flow Study.

Services Study Request Objective 8. Evaluate the potential for stranding of juvenile fish and stranding mortality under proposed operational conditions.

FDAML-41

Although stranding (and trapping) of juvenile fish is mentioned in the Instream Flow Study, this objective was not addressed in the PSP. This objective has been presented and discussed at subsequent TWG meetings and there has been a commitment by AEA to include this in the Habitat Specific Varial Zone modeling. There has also been some discussion at TWG meetings and during the October 2012 site visit of empirically evaluating juvenile fish stranding and trapping under natural flows. Because fish stranding was observed during our October 2012 site visit, the Service maintains there is a need for more detailed discussion of empirically evaluating stranding and trapping in relation to assessing pre- and post-Project effects.

Agency Study Request Objective 9. Measure intragravel water temperature in spawning habitats and winter juvenile fish habitats at different surface elevations and different depths to determine the potential for freezing of redds, freezing of juvenile fish, and their habitats.

FDAML-42

This Study Request Objective was not addressed in the PSP, but has been presented at recent TWG meetings and will be added in the Revised Study Plan as part of the Instream Flow Study. Although some discussion of the methods has occurred, more detailed methods should be provided in the revised Instream Flow Study.

Literature Cited

ADF&G (Alaska Department of Fish and Game). 1981a. Adult anadromous investigations, sockeye, pink, chum, and coho report. ADFG/Susitna Hydro Studies. Anchorage, Alaska.

ADF&G. 1981b. Juvenile Anadromous Fish Study on the Lower Susitna River. Phase I Final Draft Report. ADFG/Su Hydro Aquatic Studies Program. Anchorage, Alaska.

ADF&G 1981c. Phase 1 final draft report. Subtask 7.10. Resident fish investigation on the Lower Susitna River. ADFG/ Susitna Hydro Aquatic Studies. Anchorage, Alaska.

ADF&G. 1983a. Susitna Hydro Aquatic Studies phase II final report, volume 2; Adult anadromous fish studies, 1982, ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

ADF&G. 1983b. Resident and juvenile anadromous fish studies on the Susitna River below Devil Canyon, 1982. Phase II Basic Data Report, Vol. 3. ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

ADF&G. 1983c. Susitna Hydro aquatic studies Phase II data report. Winter aquatic studies (October 1982 - May 1983). ADFG/ Susitna Hydro Aquatic Studies. Anchorage, Alaska.

ADF&G. 1983d. Susitna Hydro aquatic studies phase II final report. Adult anadromous fish studies, 1982, volume 2. Susitna Hydro Document No. 588, Anchorage, Alaska.

ADF&G. 1983c. Susitna Hydro Aquatic Studies; Phase II report: synopsis of the 1982 aquatic studies and analysis of fish and habitat relationships-Appendices. Alaska Department of Fish and Game, Susitna Hyrdro Aquatic Studies, Anchorage, AK.

ADF&G. 2012. Fish Resource Monitor; Available URL: "http://gis.sf.adfg.state.ak.us/FlexMaps/fishresourcemonitor.html?mode=awc" [Accessed 10/23/2012]. Alaska Department of Fish and Game, Division of Sport Fish.

Barrett, B.M., F.M. Thompson, and S.N. Wick. 1984. Report No. 1: Adult anadromous fish Investigations, May - October 1983. ADFG/ Susitna Hydro Aquatic Studies. Anchorage, AK.

Barrett, B.M., F.M. Thompson, and S.N. Wick. 1985. Report No. 6: Adult salmon investigations (May-October 1984). ADFG/ Susitna Hydro Aquatic Studies. Anchorage, Alaska.

Beechie, T.J., Lierman, M., Beamer, E.M. and R. Henderson. 2005. A classification of habitat types in a large river and their use by juvenile salmonids. Transactions of the American Fisheries Society 134:717-729.

Bjorn, T. C. 1971. Trout and salmon movements in two Idaho streams as related to temperature, food, stream flow, cover and population density. Transactions of the American fisheries society, 100:3, 423-438.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 in W. R. Meehan (editor) Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication 19, Bethesda, MD.

Breeser, S. W., F. D. Stearns, M. W. Smith, R. L. West, and J. B. Reynolds. 1988. Observations of movements and habitat preferences of burbot in an Alaskan glacial river system. Transactions of the American Fisheries Society 117(5):506-509.

Brown, R. J. 2004. A biological assessment of whitefish species harvested during the spring and fall in the Selawik River Delta, Selawik National Wildlife Refuge, Alaska; Alaska Fisheries Technical Report Number 77. U. S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, AK.

Brown, R. J. 2006. Humpback whitefish Coregonus pidschian of the Upper Tanana River drainage; Alaska Fisheries Technical Report Number 90. U. S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, AK.

Brown, R. J., C. Lunderstadt, and B. Schulz. 2002. Movement patterns of radio-tagged adult humpback whitefish in the Upper Tanana River drainage; Alaska Fisheries Data Series Number 2002-1. U. S. Fish and Wildlife Service, Region 7, Fishery Resources, Fairbanks, AK.

Bustard, D.R. and D.W. Narver. 1972. Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of Fisheries Research Board of Canada 32: 667-680.

Chisholm, I.M., and W.A. Hubert. 1985. Expulsion of dummy transmitters by rainbow trout. Transactions of the American Fisheries Society 114(5):766-767.
Culp, J.M. and N.E Glozier. 1989. Experimental evaluation of a minnow trap for small lotic fish. Hydrobiologia 175: 83-87.
Cunjak, R.A. 1996. Winter habitat of selected stream fishes and potential impacts from land-use activity. Canadian Journal of Fisheries and Aquatic Science 53 (supplement 1): 267-282.

Curran, J.H., McTeague, M.L., Burril, S.E. and C.E. Zimmerman. 2011. Distribution, persistence, and hydrologic characteristics of salmon spawning habitats inclearwater side channels of the Matanuska River, southcentral Alaska. Scientific Investigations Report 2011-5102 for the United States Geological Survey.

Evenson, M. J. 1988. Movement, abundance and length composition of Tanana River burbot stocks during 1987. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 56, Juneau.

Evenson, M. J. 1989. Biological characteristics of burbot in rivers of interior Alaska during 1988. Alaska Department of Fish and Game, Division of Sport Fish. Fishery Data Series No. 109, Juneau.

Foerster, R. E. 1937. The Relation of Temperature to the Seaward Migration of Young Sockeye Salmon. Fisheries Research Board of Canada 3, 5: 421-438.

Giannico, G.R. and S.G. Hinch. 2003. The effect of wood and temperature on juvenile coho salmon winter movement, growth, density and survival in side-channels. River Research and Applications 19:219-231.

Ginetz, R. M., and P. A. Larkin. 1976. Factors affecting rainbow trout (Salmo gairdneri) predation on migrant fry of sockeye salmon (Oncorhynchus nerka). Journal of the Fisheries Resources Board of Canada 33:19-24.

Gregory, R.S., and C.D. Levings. 1998. Turbidity reduces predation on migrating juvenile pacific salmon. Transactions of the American Fisheries Society 127:275-285.

Hesse,W. 1993. The status of Nebraska fishes in the Missouri River. 2. Burbot (Gadidae: Lota lota). Transactions of the Nebraska Academy of Sciences 20:67-71.

Hillman, T.W., Griffith, J.S. and W.S. Platts. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. Transactions of the American Fisheries Society 116:185-195.

Hoar, W. 1954. The Behavior of Juvenile Pacific Salmon, with Particular Refernce to the Sockeye. Journal of the Fisheries Research Board of Canada 11, 1: 1954.Jackson, D.A and H.H. Harvey. 1997 Qualitative and quantitative sampling of lake fish communites. Canadian Journal of Fisheries and Aquatic Sciences 54:2807-2813.

Kepler, P. 1973. Population studies of northern pike and whitefish in the Minto Flats complex with emphasis on the Chatanika River. Federal Aid in Fish Restoration, Annual Performance Report, 1972-1973, Project F-9-5, 14 (G-II-J). Alaska Department of Fish and Game, Division of Sport Fish, Juneau, AK.

Kondolf, G.M. and Larson, M. 1995. Historical channel analysis and its application to riparian and aquatic habitat restoration. Aquatic Conservation: Marine and Freshwater Ecosystems 5:109-126.

LaPerriere, J.D. 1983. Alkalinity, discharge, average velocity, and invertebrate drift concentration in subarctic Alaskan streams. Journal of Freshwater Ecology 2:141-151.
Larsson, K. 1985. The food of northern pike *Esox lucius* in trout streams. Medd. Danm. Fiskeri- og Havunders. (Ny Ser.) 4(9):271-326.

Macdonald, J.S., M.G.G. Foreman, T. Farell, I.V. Williams, J. Grout, A. Cass, J.C. Woodey, H. Enzenhofer, W.C. Clarke, R. Houtman, E.M. Donaldson, and D. Barnes. 2000. The influence of extreme water temperatures on migrating fraser river sockeye salmon (oncorhynchus nerka) during the 1998 spawning season. Can. Tech. Rep. Fish. Aquat. Sci. 2326: 117.

McDonald, J. 1960. The Behavior of Pacific Salmon Fry during their downstream migration to freshwater and saltwater nursery areas. Fisheries Research Board of Canada 17, 5: 655-676.

McMahon, T.E. and G.F. Hartman. 1989. Influence of cover complexity and current velocity on winter habitat use by juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences, 46: 1551-1557.

Mecklenburg, C. W., T. A. Mecklenburg, and L. K. Thorsteinson. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, MD.

Milner, A. M. 1985. The influence of water temperature and streamflow on sockeye salmon fry emergence and migration in Black Bear Creek Southeastern Alaska. Proceedings of the Symposium on Small hydropower and Fisheries. 54-58.

Mueller, R.P., Brown, R.S., Hop, H. and L. Moulton. 2006. Video and acoustic camera techniques for studying fish under ice: a review and comparison. Review in Fish Biology and Fisheries 16: 213-226.

Murray, C. B. and J. D. McPhail. 1988. Effect of incubation temperature on the development of five species of Pacific salmon embryos and alevins. Canadian Journal of Zoology. 66: 266-273.

Paragamian, V.L., R. Hardy, and B. Gunderman. 2005. Effects of regulated discharge on burbot migration. Journal of Fish Biology 66:1199-1213.

Peterson, N.P. 1982 Immigration of juvenile coho salmon (*Oncorhynchus* kisutch) into riverine ponds. Canadian Journal of Fisheries and Aquatic Sciences 39: 1308-1310.

Prowse, T.D. 1994. Environmental significance of ice to streamflow in cold regions. Freshwater Biology 32, 241-259.

Reist, J. D., andA. Bond. 1988. Life history characteristics of migratory coregonids of the lower Mackenzie River, Northwest Territories, Canada. Finnish Fisheries Research 9:133-144.

Ridder, W. P. 1998. Radio telemetry of Arctic grayling in the Delta Clearwater River 1995 to 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-37.

Roth, K.J., Gray, D.C., Anderson, J.W. Blaney, A.C. and J.P. McDonell. The migration and growth of juvenile salmon in the Susitna River, 1985. Report No. 14 ADFG/Susitna hydro Aquatic Studies. Anchorage, Alaska.

Russell, R. 1980. A fisheries inventory of waters in the Lake Clark National Monument Area. Alaska Department of Fish and Game, Division of Sport Fish, King Salmon, AK.

Rutz, D.S. 1999. Movements, food availability and stomach contents of Northern Pike in selected Susitna River drainages, 1996-1997. . Fishery data series no. 99-5, ADFG/Division of Sport Fish. Palmer, Alaska.

Scheuerell, M. D., J. W. Moore, D. E. Schindler, and C. J. Harvey. 2007. Varying effects of anadromous sockeye salmon on the trophic ecology of two species of resident salmonids in southwest Alaska. Freshwater Biology 52(10):1944-1956.

Schmidt, D.C., Hale, S.S., Crawford, D.L. and P.M. Suckanek. 1984. Report No. 2 Resident and Juvenile Anadromous Fish Investigations, May-October 1983. ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

Scott,B., and E. J. Crossman. 1998. Freshwater fishes of Canada. Galt House Publications Ltd., Oakville, Ontario.

Steinhart, G.B. and W.A. Wurtsbaugh. 2003. Winter ecology of Kokanee: Implications for Salmon Management. Transactions of the American Fisheries Society 132: 1076-1088.

Stott, B. 1970. Some factors affecting the catching power of unbaited fish traps. Journal of Fisheries Biology 2:15–22.

Suchanek, P.M., R.L. Sundet, and M.N. Wenger. 1984. Resident fish habitat studies. 1984 Report No. 2, Part 6. ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

Sundet, R.L, and M.N. Wenger. 1984. Resident fish distribution and population dynamics in the Susitna River below devil canyon. 1984 Report No. 2, Part 5. ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

Swales, S., Lauzier, R.B. and C.D. Levings. 1986. Winter habitat preferences of juvenile salmonids in two interior rivers in British Columbia. Canadian Journal of Zoology 64: 1506-1514.

Thompson, F. M., S. Wick, and B. Stratton. 1986. Adult Salmon Investigations, May–October 1985. Report No. 13. ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

Torgersen CE, Price DM, Li HW, McIntosh BA. 1999. Multiscale thermal refugia and stream habitat associations of chinook salmon in northeastern Oregon. Ecol Appl 9:301-309.

Underwood, T., K. Whitten, and K. Secor. 1998. Population characteristics of spawning inconnu (sheefish) in the Selawik River, Alaska, 1993-1996, Final Report; Alaska Fisheries Technical Report Number 49. U. S. Fish and Wildlife Service, Fairbanks Fishery Resource Office, Fairbanks, AK.

Van Whye, G. L., and J. W. Peck. 1968. A limnological survey of Paxson and Summit lakes in interior Alaska, Informational Leaflet 124. Alaska Department of Fish and Game, Division of Sport Fish, Juneau, AK.

Vincent-Lang, D., and I. Queral. 1984. Investigation of eulachon spawning habitat in the lower Susitna River. 1984 Report No. 3, Chapter 11. ADFG/Susitna Hydro Aquatic Studies. Anchorage, Alaska.

7. Fish and Aquatic Resources

7.7. Salmon Escapement Study

General Comments:

The U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled Adult Salmon Distribution, Abundance, Habitat Utilization and Escapement in the Susitna River is addressed in part by Alaska Energy Authority (AEA) Proposed Study Plan (PSP), Section 7.7 Salmon Escapement Study. The purpose of the Salmon Escapement Study, as proposed by AEA, is to assess the current run timing and distribution of each of the five species of salmon among different habitat types in the lower and middle Susitna River, with emphasis on the middle reach. As previous studies have been unsuccessful in consistently measuring spawning in the mainstem channel, this objective should be considered a priority for this study plan. Additionally, habitat characteristics such as water chemistry and physical habitat measurements will be important for determining factors influencing current salmon spawning distribution patterns. This information will be necessary for evaluating the potential for post-Project effects on distribution patterns, availability of spawning habitat, and access to spawning sites.

ESCAPE-13

Specific Comments by Subsection:

AEA Study 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 and coho salmon in the lower Susitna River.

The Service recommends that AEA provide additional detail in describing methods for selecting fish for tagging and how the tagging effort will be stratified throughout the migration/spawning season. Since fish wheel captures may not be representative of migrating populations (e.g., larger individuals may be less likely to be captured), we recommend that tagging efforts be non-random in order to selectively tag fish that are not equally represented.

ESCAPE-24

Additionally, it is unclear why only Chinook and coho salmon will be tagged in the lower Susitna River, whereas all five salmon species will be tagged at Curry Station (RM 103). There should to be justification for what appears to be unequal sampling and tagging efforts among species.

ESCAPE-08

AEA Study Objective 2: Characterize the migration behavior and spawning locations of radiotagged fish in the lower, middle, and upper Susitna River.

The methods proposed here will miss fish migrating to spawning sites within the Middle River that are downstream of the Curry Station (RM 103) sampling site. Whiskers Creek (RM 101.4) is a major spawning location for coho salmon, with some spawning by Chinook and chum salmon as well (Barrett et al. 1985), but this tributary will be missed or minimized due to the location of the tagging site 20 miles upstream. Thompson et al. (1986) found that only a portion of fish that spawned downstream of Curry reached this station during milling, and this proportion was directly related to the distance from Curry Station. The further downstream of Curry that spawning areas were located, the fewer fish from these lower river spawning areas were captured by the fish wheels at Curry. Chinook salmon spawn in three tributaries in the Middle River downstream of Curry Station (RM 103); coho salmon spawn in seven downstream tributaries; pink salmon spawn in seven downstream sloughs and 12 downstream tributaries; chum salmon spawn in five tributaries and 8 sloughs downstream; and sockeye salmon spawn

ESCAPE-11

in 7 sloughs downstream of Curry Station (Barrett et al. 1985). For Chinook, chum, and sockeye salmon, these sloughs and tributaries did not make up a substantial portion of their total escapement to the Middle River, but roughly 78% of the Middle River coho and 28.3% of pink salmon escapements to tributaries were downstream of Curry Station.

ESCAPE-34

There is no description of methods to test for effects of radio tagging on fish survival and behavior. Radio tags can potentially have lethal effects or non-lethal behavioral effects on tagged fish, which could lead to changes in speed or direction of movements (e.g., Yanusz et al. 2011, Keefer et al. 2010). A portion of fish above the radio-tagging goals will also be spaghetti-tagged, including all Chinook and coho captured. This less-intrusive tagging method is proposed to provide additional movement data beyond the radio-tagged fish movements, but it is not clear if it can be used to test the effects and accuracy of radio tagging efforts. Fish movements observed with both methods should be compared to make an assessment of radio tag effects. However, even spaghetti tags can be stressful to the fish, causing altered migration patterns due to stress (Thompson et al. 1986).

ESCAPE-06
ESCAPE-10

It is unclear why coho and Chinook salmon will be tagged more intensively than other species. It is mentioned that additional marking of sockeye and chum with spaghetti tags could be useful for this study. If these fish will be tagged to determine if fish wheel captures are random, then this needs to be described in a revised study plan. The number of tagged fish necessary to address these concerns needs to be identified to provide a clear objective.

The 1985 salmon escapement study found that fish captured and tagged at the fish wheels were non-random, and thus non-representative of the population (Thompson et al. 1986). Data were stratified for the escapement estimates at the Flathorn Station due to recapture of numbered tags, but estimates for the other stations did not have enough data for this approach. This can greatly bias escapement estimates to the Middle River. Thompson et al. (1986) suggests that length data be collected for individuals (as compared to a subsample of each days catch) to stratify by size groups because larger fish are less susceptible to fish wheel capture.

AEA Study Objective 3: Characterize adult salmon migration behavior and timing within and above Devils Canyon, and AEA Study Objective 4: If shown to be an effective sampling method during the 2012 study, and where feasible, use sonar to document salmon spawning locations in turbid water in 2013 and 2014.

Tiffan et al. (2004) described DIDSON as a useful tool for identifying fall Chinook salmon redds in the Columbia River, but stated that this method is unable to detect smaller redds and may mis-identify bottom features other than redds if the river bottom is not generally smooth. In that study, they were able to verify results with video, a method not feasible in the highly turbid Susitna River mainstem. The Columbia River mainstem and Susitna River, are very different, and may reduce the effectiveness of sonar surveys for spawning locations. Even when conditions are good, this method could miss large portions of present spawning populations. Additionally, it is not clear if this method can accurately provide results by species or simply give a count of total fish in an area. The study plan must define how DIDSON results will be verified for accuracy, and how this method be assessed for use in 2013 and 2014. If this method is determined ineffective, an alternative method should be proposed for sampling the turbid mainstem for spawning aggregations.

ESCAPE-28

AEA Study Objective 5: Compare historical and current data on run timing, distribution, relative abundance, and specific locations of spawning and holding salmon, and AEA Study Objective 6: Generate counts of adult Chinook salmon spawning in the Susitna River and its tributaries.

ESCAPE-22 It is unclear how the aerial counts conducted for this study will be used to obtain escapement numbers. The Service recommends that ground surveys or fish sampling methods be conducted to ground-truth these counts or to determine if sites were spawning or holding sites. Accuracy and precision of aerial counts varies with conditions, reducing counts in areas with high turbidity or depths or overhanging riparian vegetation. Additionally, smaller individuals, such as "jacks" are more difficult to see with aerial surveys, due to their size and lighter coloration (Neilson and Geen 1981). AEA does not provide sufficient justification regarding why this methodology has been developed to count Chinook salmon and not the other four species of Pacific salmon spawning throughout the Susitna River drainage.

AEA Study Objective 8: Estimate system-wide Chinook and coho salmon escapement to the Susitna River and the distribution of those fish among tributaries of the Susitna River.

ESCAPE-20 The methods described do not address this objective. There is no clear description of how many weirs will be operated for this study, or how locations for these weirs will be chosen. Looking at mark-recaptures in a few tributaries does not address distribution throughout the Susitna River and its tributaries. Observations, through weirs, foot surveys, or fish sampling methods should be conducted at more tributaries than this study describes. Additionally, no weirs are located within the Middle River. As this section of the river has the greater potential for impact by a hydroelectric project than the Lower River, it is important to know the distribution and escapement of salmon into these Middle River tributaries.

The Service recommends that AEA expand this objective to include all five species of salmon.

ESCAPE-16 To determine run apportionment, all macrohabitat types used for spawning (mainstem, tributaries, and sloughs) will also need to be included, not just select tributary counts.

ESCAPE-27 Capture methods for tagging, through fish wheels, may be non-random and disproportionally capture fish of certain sizes or from certain populations (Thompson et al. 1986).

Related USFWS/NMFS Study Objectives not addressed by the PSP

Measure critical habitat characteristics (e.g., channel type, flow, substrate, and groundwater) at reaches used for spawning and compare these characteristics with those in adjacent reaches that do not contain spawning adults.

ESCAPE-18 This study request objective is not addressed in the PSP nor is any objective that looks at characterizing use, availability, or quality of potential spawning habitats. There appears to be no empirical baseline information being collected; only semi-quantitative surveys to determine distribution and potential abundance of redds. Also, there is a reference to studies evaluating potential dewatering or scouring of redds in Section 6, but no empirical baseline information to assess the potential for daily load-following operations to cause redd dewatering or freezing. At recent TWG meetings, a habitat quality component was added in Section 6, but it is still unclear if or how areas without spawning will be characterized.

Determine the availability and accessibility of spawning habitats by adult salmon to mainstem and tributary locations based upon flow regime.

ESCAPE-14

It is unclear if this specific objective is being addressed anywhere in the PSP. It will be important to identify potential barriers to spawning habitats at current flow regimes and how access might change with a modified flow regime. Successful migration into tributaries can be strongly related to water levels at the mouths of the tributaries, with high rates of stranding mortalities in years of low water (Carlson and Quinn 2007). As the proposed flow regime is for increased base flows and increased fluctuating flows during winter months and reduced flows during summer months, when adult salmon are migrating and spawning, stranding mortality could become an important factor in spawning success. This concern needs to be addressed in the study plan. Flows necessary for salmon access into tributaries, sloughs, and side channels needs to be determined for each of the five species.

Literature Cited

Barrett, B.M., F.M. Thompson, and S.N. Wick. 1985. Adult salmon investigations6 May-October 1984 Susitna Hydro Aquatic Studies. Prepared for Alaska Power Authority. Anchorage, Alaska. Carlson, S.M., and T.P. Quinn. 2007. Ten years of varying lake level and selection on size-at-maturity in sockeye salmon. Ecology 88(10): 2620-2629.

Keefer, M.L., C.C. Caudill, E.L. Johnson, C.T. Boggs, B. Ho, T.S. Clabough, M.A. Jepson, and M.L. Moser. 2010. Adult pacific lamprey migration in the lower Columbia River: 2009 radiotelemetry and half-duplex PIT tag studies. For U.S. Army Corps of Engineers. Portland Oregon. Study Code ADS-P-00-8.

Neilson, J.D., and G.H. Geen. 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Transactions of the American Fisheries Society 110(4):554-556. Thompson, F. M., S. Wick, and B. Stratton. 1986. Adult Salmon Investigations, May–October 1985. Report No. 13. Susitna Hydro Document No. 3412, Anchorage, Alaska.

Tiffan, K.F., D.W. Rondorf, and J.J. Skalicky. 2004. Imaging fall Chinook salmon redds in the Columbia River with a dual-frequency identification sonar. North American Journal of Fisheries Management 24:1421-1426.

Yanusz, R., R. Merizon, M. Willette, D. Evans, and T. Spencer. 2011. In river abundance and distribution of spawning Susitna River sockeye salmon *Oncorhynchus nerka*, 2008. Alaska Dept. of Fish and Game, Fishery Data Series No. 11-12. Anchorage, Alaska.

7. Fish and Aquatic Resources

7.8. River Productivity Study

General Comments:

Although this Proposed Study Plan (PSP) has the same title as the U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request, it does not adequately address river productivity as a whole but is primarily limited to addressing macroinvertebrates and algal abundance. Studies that document the variability in the sources of carbon and energy transfer to higher trophic levels are the most important for understanding fish distribution and production, and are most likely to be directly affected by project construction and operation. Within-stream primary production, organic matter from terrestrial plants, and adult salmon carcasses provide the food base for all aquatic life within the Susitna River. There is a substantial body of literature directed at understanding factors influencing primary productivity, the delivery, storage, and processing of organic matter, and the influence of carbon sources and production on macroinvertebrate community composition, production, and density.

Over the past 30 years, there has been an increasing number of studies documenting a shift in our understanding of fish distribution from one based solely on reducing energy costs (habitat based on water temperature, and velocity) and avoiding predation (proximity of cover), and competition, toward one that maximizes food intake while minimizing energy lost and the risk of predation (Dill and Fraser 1984, Fausch 1984, Dolloff 1987, Duncan et al. 1989, Adams and Breck 1990). In some cases the abundance of macroinvertebrate drift alone has explained the distribution and growth of salmonids (Lovetang 2005, Urabe et al. 2010). Food availability can affect the depths and velocities selected by drift-feeding fish which has implications toward the validity of habitat suitability indices based on these parameters (Rosenfeld et al. 2005, Rosenfeld and Taylor 2009).

Primary productivity, benthic organic matter, and macroinvertebrate abundance can be modified by hydroelectric development and, therefore, should be addressed by Alaska Energy Authority (AEA) as part of the Federal Energy Regulatory Commission (FERC) license application. Suspended sediment can limit light available for primary production (Davis-Colley et al. 1992, Lloyd et al. 1987) particularly in turbid glacial rivers (LaPerriere et al. 1989, Davis et al. 2009). Sediment storage within a reservoir can reduce turbidity and increase primary productivity immediately downstream (Blinn et al. 1998); however, even in clear water, nutrients can be lost within the reservoir through biotic uptake or adsorbed to sediment and deposition thereby limiting downstream productivity (Snyder and Minshall 1995). Primary productivity can vary with changes in water depth (Bensen et al. 2012) or be reduced due to varial zone flow fluctuations (Binn et al. 1998). Transported organic matter is retained within reservoirs reducing downstream carbon availability (see below) and transport and storage can be further affected by flow modifications. The macroinvertebrate community can be altered due to modifications in food sources or food availability or directly through changes in flow and habitat modification.

Primary productivity and benthic organic matter provide the energy base for stream ecosystems. Macroinvertebrates transfer energy from autotrophs or heterotrophs to higher fish and other secondary consumers. Macroinvertebrate drift densities play a large role in fish habitat selection and production and can modify the use different water velocities and depths. Hydroelectric development can directly or indirectly modify productivity rates, organic matter input and storage, and macroinvertebrate production (Gislason 1985), particularly in a glacial

system where suspended sediment plays such a large role in species distribution and abundance. If we are to make informed decisions regarding this proposed project, understanding these relationships should be a priority.

Specific Comments by Subsection:

AEA Study Objective 1: Synthesize existing literature on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities.

RIVPRO-18

This objective should include a literature review and annotated bibliographies of hydropower development and operation on benthic and transported organic matter, and ecosystem productivity, not just algal biomass. The study plan should outline the steps that will be used to accomplish this task (i.e., data base searches, key words, resulting product). The literature review should result in annotated bibliographies. All data bases searched and key words should be listed. The bibliography should contain the author's abstract as well as AEAs interpretation of the study relative to the proposed project. Electronic copies of all publications should be provided along with the annotated bibliography. The AEA synthesis should identify all potential project effects and show how AEAs study plans have been developed to adequately evaluate and monitor these potential Project effects on the Susitna River.

AEA Study Objective 2: Characterize the pre-project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the lower, middle and upper Susitna River.

As stated in the PSP and above, ecosystem productivity from autochthonous or allochthonous derived organic matter, along with import of marine nutrients, provides the energy sources for the productivity of all other upper trophic levels. Macroinvertebrates transfer energy from primary producers or heterotrophic communities to fish and other secondary consumers. Variability in macroinvertebrate abundance in the drift can be directly linked to the distribution and production of drift-feeding fishes. In addition, macroinvertebrate community composition on the benthos or in drift has been used to evaluate changes in water quality, biotic communities, and physical habitats.

Measures of macroinvertebrate emergence timing and biomass among macrohabitat locations have been suggested by AEA as an additional project objective. As invertebrate development and emergence is influenced by water temperature and emergence and survival of juvenile fry are linked to this food source, this appears to be a useful addition to this study sections. More information will need to be provided on insect emergence sampling methods, design, and data analyses.

Sampling Locations
The PSP states that benthic and algal samples will be collected at 9 mainstem and 18 off channel habitats above and below the proposed dam site, stratified by geomorphic reach and macro-habitat classification, side channel, side slough, upland slough, tributary, and tributary mouth [study plan only identifies mainstem, side channels, and sloughs]. Six replicates will be collected at each sampling location, and samples will be collected on three sampling dates from April through September. "Woody snags" would be removed from the stream and invertebrates collected from the snags and identified. Measures of depth, water velocity, turbidity, and

substrate would be collected at all algal sampling locations. Samples would be collected on three sampling events for two years.

RIVPRO-19 Sampling locations should be selected to obtain replicate measures documenting the range of project effects among main channel and off-channel locations and in order to evaluate the influence of macroinvertebrate and algal abundance on fish distribution and production. The PSP has located 3 of the proposed 9 mainstem sampling locations within and just above the inundation zone. Project effects are likely to be greatest within the tributaries above the inundation zone, where current resident fish populations will be concentrated into a smaller area potentially exceeding production capacity. In addition, these streams will be providing a large portion of the food resources to the fish community likely to develop within the reservoir. Determining the area and quality of remaining stream habitat following project construction is an important project objective. Quantifying macroinvertebrate and algal production and invertebrate drift relative to the abundance of resident fish in tributaries above the inundation zone should be an additional objective and the site of Upper River sampling locations.

RIVPRO-20 Three of the remaining mainstem sites are located below the dam site, but above Devils Canyon. The purpose for selecting these locations is unclear, although likely to characterize distinct geomorphic reaches. Project effects likely will be greatest within these reaches, but they do not overlap with known fish distribution. We agree that documenting changes in the biotic community immediately below the dam is an important objective; however, the PSP should expand upon the reasons sites were selected within this reach, and how these sites be used to determine mainstem and off-channel effects. The PSP should identify the number of sites and replicates that are needed for the statistical design and how the analyses will be conducted.

RIVPRO-21 Most resident and anadromous fish spawning and rearing locations and the areas for greatest potential project impacts are between Portage Creek and the three-rivers confluence near Talkeetna. However, AES has identified only one mainstem and two associated off-channel sampling locations to “characterize” the macroinvertebrate and algal communities within this ~60 miles of river. The Service recommends sampling locations be selected in proportion to the distribution of main channel and off-channel habitats and micro-habitats within these areas. Sampling locations should be selected so that they can be used to evaluate Project effects and fish distribution and abundance, and growth rates. Sampling locations should be located above and below major tributaries to evaluate tributary influence on local invertebrate communities and their contribution to total invertebrate drift. We recommend a minimum of 10 mainstem sampling sites between the Indian River and Talkeetna. Additional mainstem sampling sites should be selected to replicate the meso- and microhabitat within the main channel. These meso- and microhabitats should represent differences in substrate (woody debris, boulder/cobble, cobble/gravel, sand/silt), proximity to vegetated banks, point bars, and velocities. Extrapolation of habitat values to upper classification levels will require sampling relative to, or quantification of, the abundance of these habitat characteristics within each macro-habitat.

RIVPRO-22 A similar thought process should be applied to the selection of sites to adequately characterize off-channel habitats. The PSP is currently classifying 4 different off-channel habitats: tributaries, tributary mouths, side sloughs, and upland sloughs. However, there is considerable differences in the productivity among sites of the same classification (i.e. the relative contribution of invertebrate drift to the main channel from the Indian River compared to Whiskers Creek likely is large). Obtaining 3 replicates of these off-channel sites would result in 12 off-channel sampling

locations and a minimum of 5 replicates is recommended. Replicate sampling within these locations to document differences in invertebrate abundance among different meso-habitats including variations in flow, substrate, depth, and velocity, and macrophytes beds, all of which can be modified by Project operation (e.g., flushing flows), would require additional sampling effort.

RIVPRO-23 Algal sampling locations within the Middle River, including meso- and microhabitats should be selected independent of macroinvertebrates, as algae respond to different environmental variables and project effects will vary. However, results should be able to provide information that can be used to evaluate macroinvertebrate and fish distribution as a function of algal abundance, and sampling locations may overlap. Algal growth will vary with differences in light availability (turbidity), water velocity, and nutrient concentrations. Algal biomass likely will vary considerable between tributaries, the main channel, and clear off-channel habitats. Nutrient concentrations could be very different below sloughs and tributaries compared to upstream locations, and nutrients and light can vary within a slough as turbid mainstem water levels increase and decrease with stage height.

RIVPRO-24

RIVPRO-25 In order to calculate the production potential within sampling locations, samples also must be stratified by meso- and microhabitats. For example, collection of algal samples only on cobbles within Slough 8A would overestimate the productivity of that location. Samples will need to be collected on different substrate types and then the relative abundance of those habitat types determined in order to estimate production potential for that location. This goes beyond measuring water depth, velocity, and substrate at sampling locations, but requires selecting sampling locations based upon the distribution of water velocities, depths, and substrates. Similarly, Slough 6A (below the beaver dam) more closely resembles a small lake, and phytoplankton (and zooplankton) may explain the apparent high productivity and quality of fish habitat at that location. Measures of ecosystem metabolism may be a simpler and more direct approach (Young et al. 2008) and should be considered as a method to measure differences in productivity.

RIVPRO-26 Many of the concerns addressed previously apply to site selection in the Lower River below the three-rivers confluence. Sampling to explain fish habitat distribution should consider previous comments. However, an important Lower River objective is to determine the current and post-Project contribution of Benthic Organic Matter (BOM) and invertebrate drift to Lower River sites. Current and post-Project productivity could be much different in the Susitna River than in the Chulitna River due to differences in channel form, substrate, nutrient concentrations, temperature, and turbidity. Therefore, current and post-Project changes in organic matter and invertebrate drift to the Lower River could extend Project effects downstream. The Service recommends a sampling plan be developed around this objective, which will require sampling locations in the Chulitna and Talkeetna Rivers as well as Susitna River sites below the confluence.

Sample Timing and Frequency

Benthic macroinvertebrate sampling for monitoring purposes is generally conducted in early spring prior to emergence and in late fall to allow for summer growth. Summer sampling will be used to estimate differences in food availability among locations, which is important for understanding the distribution of juvenile bottom-feeding resident fish (e.g. burbot and longnose suckers). Additional sampling would be necessary to measure secondary production or to determine if there are multiple cohorts in a season. Sample collection frequency should document potential project effects, particularly changes in flow and temperature. Sampling prior

to and following storm events could be used to evaluate the response of the community to the flow regime.

RIVPRO-27

Algal sample timing and frequency should be developed to evaluate changes relative to parameters that influence growth. The availability of solar energy and nutrients is greater in early spring. Turbidity is lower during the early spring, increasing with the contribution of glacial flow. Solar input is greater prior to leaf-out and nutrient concentrations often are higher due to reduced uptake by terrestrial vegetation. The Service recommends that algal sample timing begin in early spring with frequent sample collection in order to measure the change in biomass relative to changing solar radiation, turbidity, and nutrient concentrations. This information will be important for the evaluation of post-Project effects as project construction likely will alter all three of these variables. Water depth and storm flows are the other two variables that can influence algal sloughing and production, and should be accounted for when selecting sample timing and frequency. Sample locations at multiple depths across the channel could be used to estimate changes in algal biomass due to seasonal or project-related changes in water depth. Algal biomass will vary considerably before and after flushing flows, so samples must be collected prior to and following storm events. Reduced turbidity in the late fall may also provide a brief period of algal production. The Service recommends that algal sampling be collected in the fall to document this period of potential increased production. As an alternative, AEA should consider seasonal measures of ecosystem metabolism that integrate the effects of multiple different parameters influencing algal productivity.

Sampling Methods

The PSP states that benthic macroinvertebrates will be collected from riffles within each macrohabitat unit. Samples will be collected with a Hess, Surber, or Slack sampler. Six replicates will be collected at each sampling location.

RIVPRO-28, 60

The Service does not agree that sample collection of riffle habitats only is adequate. As stated previously, this represents only one meso-habitat and will bias characterization of invertebrate communities. In addition, most of the locations referenced do not contain riffles to sample.

RIVPRO-29, 61

Sampling methods should be used that are quantitative and appropriate for fine and coarse substrates. Alaska Stream Condition Index (ASCI) methods (Major and Barbour 2001) are based upon a composite of 20 samples collected in proportion to habitat availability (including woody debris, roots, and macrophytes beds) using a “D” frame kick net. Mesh size is important as the community is made up of many small organisms (~300 µm mesh is standard). This methodology; however, does not allow for determining invertebrate density which is an important metric. One possibility would be supplementing benthic samples using a Hess sampler with qualitative samples of unique habitats. Multiple samples at one sampling site should not be considered replicates of that habitat type, but metric means calculated (or samples composited) to obtain one value for that site, unless they are replicating mesohabitats within a site. Field sorting of macroinvertebrates is not recommended. Any proposed sub-sampling method should be included in the study plan.

RIVPRO-30, 62

The PSP does not provide any details on algal sample collection methods or sample handling and processing. Stating that methods will follow unspecified state protocols and a list of citations is not sufficient for evaluating the proposed PSP methodology. The methods should describe how samples will be collected from the multiple different available substrates, including:

- Sample substrate must be based upon predetermined criteria;

- Determine whether entire substrate be cleared of algae or a portion of the substrate delineated for sampling;
- Define measurements for the area to be sampled;
- Address duplicate sampling from the same substrate to allow for species identification, AFDM, and chlorophyll-*a* analyses;
- Describe field sample be preservation methodologies, i.e., avoid degrading chlorophyll-*a*;
- Describe replicate sampling representative of each site and each meso-habitat within each site;
- Provide procedures that will address patchy distribution of algae within a macro-habitat;
- Describe procedures for laboratory sub-sampling occurring prior to algal species identification.

AEA Study Objective 3: Estimate drift of benthic macroinvertebrates in habitats within the lower, middle and upper Susitna River to assess food availability to juvenile and resident fishes.

A large number of studies have shown the importance of macroinvertebrate drift in explaining the distribution, abundance, and growth of drift-feeding fishes including most salmonids. Project operations including direct effects of variable flows and indirect effects on primary production and organic matter storage can influence invertebrate drift density. Therefore, understanding the relationship between Project operations, drifting invertebrates, and fish distribution is an important project objective.

RIVPRO-31

The AEA study objective, to "estimate" drift of benthic macroinvertebrates, does not reflect the importance of this topic in understanding project effects to the biotic community. Sampling locations, timing and frequency should be selected to quantify differences in drift among habitats and be used to evaluate seasonal and spatial fish distributions and differences in potential project effects. We believe that documenting invertebrate drift in tributaries above the inundation zone may be important to evaluate food available to the resident and anadromous fish remaining in these reaches and as a contribution to the reservoir.

RIVPRO-32

Sampling Locations

A single sampling location for invertebrate drift between Devils Canyon and Talkeetna will be inadequate for accomplishing study plan objectives. Invertebrate drift sampling locations should be adjusted to coincide with juvenile and resident fish sampling. Mainstem sampling locations should be located above, within, and below major tributaries. These sampling locations will be used to document the contribution of tributaries to mainstem drift and to determine if food availability is related to rearing-fish abundance at these locations. Macroinvertebrate drift (or plankton tows) should be replicated at all macro habitat locations concurrent with fish sampling. Replicate samples should be collected within each macro-habitat; however, drift abundance does not likely vary with the same meso-habitat characteristics that influence benthic macroinvertebrate distribution. Terrestrial invertebrates in the drift likely vary with proximity to riparian vegetation and must be considered when sampling locations are selected (Johansen et al. 2005). Macroinvertebrate drift should be measured in the Chulitna and Talkeetna Rivers near the confluence to determine the relative contribution of the Susitna River to downstream food resources.

Sample Timing and Frequency

RIVPRO-33 Drift sample timing and frequency should be based upon life history and habitat use of drift-feeding fish and to evaluate potential Project effects. For example, AEA should evaluate drift density during sockeye fry migration from spawning locations to summer rearing habitats. Tributary drift should be measured to account for relative productivity among sites during summer and to determine if changes coincide with late summer Chinook and coho salmon migrations. Invertebrate drift should be used to document summer rearing and overwintering habitat quality for juvenile salmonids. Sample collection should occur in the early morning and evening to document densities during peak fish feeding activity.

RIVPRO-34 Drift sampling should be conducted in a manner to inform potential Project effects. Variations in flows and flows that breach the upper end of side sloughs alter macroinvertebrate drift densities. Flood flows may capture many terrestrial insects and result in increases in invertebrate drift. The PSP should reflect a review of relevant literature to determine other potential Project effects on invertebrate drift and incorporate this information into the study design.

RIVPRO-35 *Sampling Methods*
Methodologies for macroinvertebrate drift sample collection, preservation, and processing should be fully described in the study plan. Mesh size, area of sampler, and sample depth (surface and depth) can influence the composition of drift. Mesh size should be fine enough to capture *Chironomids* and early instars of other taxa. Mesh size of approximately 300 µm is recommended. Due to the high concentration of fines within the mainstem, drift nets could clog within minutes resulting in the loss of samples. Therefore, samplers should be monitored during sample collection. Multiple samples may need to be collected in order to get an accurate measure of drift abundance (portion of day sample represents). Measures of water velocity when installing and removing the nets (along with the area of the net opening) will not provide an accurate measure of the volume of water flowing through the net as changes in velocity during this time may not be linear; the use of flow meters (e.g., General Oceanics) within the net opening that document total flow would provide greater accuracy.

RIVPRO-36 Stream water turbidity and inorganic suspended sediment should be measured concurrent with fish and drift sampling. Changes in visibility caused by sediment can reduce fish capture efficiency and should be accounted for in analyses relating fish distribution with invertebrate drift abundance among macro-habitat types.

RIVPRO-37 The methods for sample storage, preservation, sorting, and identification should be fully described. Drift samples should not be subsampled for identification. Weight and length/weight relationships should be obtained for all taxa and instars so that the biomass of drift can be calculated. Invertebrate biomass data will be necessary for analyses of fish feeding studies and trophic analyses if mass-balance methods are used.

RIVPRO-38 *Data Analyses*
The PSP does not provide sufficient information on drift data analysis, statistical design, or use of the data to assess differences in fish distribution and production or in evaluation of potential Project effects.

AEA Study Objective 4: Conduct a literature/data search to identify existing river systems that could act as surrogates in evaluating future changes to productivity in the Susitna River.

RIVPRO-39 The Service recommends that sampling locations, including replicate macro and micro-habitat types, be identified on the Talkeetna River and be used to provide reference data for post-

Project evaluation. AEA should develop a study plan for post-Project monitoring that includes an assessment of Susitna River productivity.

AEA Study Objective 5: Conduct a review on the feasibility of a trophic analysis to describe potential changes in the primary and secondary productivity of the riverine community following Project construction and operation;

Hydroelectric facilities have the potential to reduce the carbon food base which effect fish production. Dam effects to the organic matter base have been found to be responsible for the decline in Kootenai River sturgeon (Perry and Perry 1991, Snyder and Minshall 2005) and in productivity in the Colorado River (Minkley 1991, Blinn et al. 1999). Pre- and post-Project trophic analyses would provide a method to evaluate potential Project effects to the Susitna River. We believe that a thorough review prior to developing monitoring plans would be beneficial. All of the information requested under Study Objective 1, should be provided as a product of this review.

RIVPRO-40

AEA Study Objective 6: Generate habitat suitability criteria (HSC) for Susitna River benthic macroinvertebrate and algal habitats to predict potential changes in these habitats downstream of the proposed dam site.

RIVPRO-41

The Service believes that the PSP does not provide enough information to evaluate whether the stated objective will be met. The PSP states that habitat suitability criteria would be determined concurrent with macroinvertebrate and algal sampling at the 27 sampling locations above and below the dam stratified by macrohabitat type and collected three times from April to September. HSC would be determined from measures of water velocity, substrate, and depth concurrent with macroinvertebrate and algal sampling.

As stated previously, the level of effort (sampling locations, replication among macro and meso-habitats, and sampling frequency) described within the PSP is insufficient to provide an adequate HSC. The sampling plan needs to be more developed to evaluate the response of the macroinvertebrate community to changes in these three parameters and to include, and control for, the numerous other parameters that influence invertebrate community composition, richness, or diversity.

Macroinvertebrate communities are composed of multiple different species that occupy areas of variable velocity and depth. Within the Susitna River, tolerance for highly turbid waters or differences in dissolved oxygen could result in shifts in macroinvertebrate habitat preferences. Diet preferences of target fish in the Susitna River should be used to determine macroinvertebrate species for HSC in order to determine changes to food availability for fish. Macroinvertebrates in the diet of burbot and longnose suckers and juvenile whitefish are likely much different than those selected by drift-feeding fishes. The portion of terrestrial invertebrates also will vary among drift-feeding fishes (e.g., juvenile sockeye salmon versus Dolly Varden).

HSC for fish are generally not transferable among stream locations (Persinger 2003, Guay et al. 2001) and this generalization is likely true for macroinvertebrates as well, particularly when there are large differences in physical and chemical stream characteristics. The HSC objective should be modified to define the purpose for HSC development in relation to macroinvertebrates and algae, and provide methods on field site selection, sampling timing and frequency that will be used to meet this objective. Water velocity at 0.6 x water depth is unrelated to the velocity,

sheer stress, and boundary conditions experienced by macroinvertebrates. Therefore, methods to measure velocity at scales applicable to organisms under investigation should be established. Alternately, Froude number or sheer stress could be used to represent stream bed flow conditions

AEA Study Objective 7: Characterize the benthic macroinvertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component).

RIVPRO-42

This study objective differs from the Service's study objective to: *"Characterize trophic interactions using seasonal diets (stomach content analysis) of all age classes of non-salmon anadromous, resident and invasive fish species."*

The importance of this objective is to determine the food resources used by fish within the Susitna River. The Service recommends that the study plan methodology select sampling locations based upon the objective rather than in association with sampling conducted to meet other objectives. Target fish species and life stages should first be identified. These should include all age-classes of non-salmon anadromous, resident, and invasive fish species as proposed by the Service. Fish sampling locations should represent the macrohabitats used by the target fish species and life stage. An appropriate sample size should be determined *a priori*. Sampling methods for each species and life stage should be identified, along with sample handling, preservation, and analyses. Invertebrate weight data should be used to determine biomass in addition to numbers of each species consumed. The analytical methods should be described as well as how the results will be applied to evaluating potential Project effects.

AEA Study Objective 8: Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including course particulate organic matter, fine particulate organic matter, and suspended organic matter in the lower, middle, and upper Susitna River.

Benthic organic matter is likely the most important source of carbon within the Susitna River. Bacterial colonization increases the nutrient content and quality of BOM and initiates decomposition thereby facilitating macroinvertebrate ingestion and metabolism. Construction and operation of hydroelectric facilities can influence the transportation, storage, and processing of BOM through multiple different pathways.

RIVPRO-43

A partial review of the literature raises a number of questions that should be addressed through studies being developed and implemented in support the FERC license application.

1. What is the current change in concentrations of BOM in the mainstem from the dam site to the confluence?
2. Are there significant differences in BOM among and within macro-habitat sites and is this related to the adjacent plant community?
3. How does the magnitude of overtopping flows affect BOM storage within side channels and side sloughs or the flushing of organic matter?
4. How important are beaver and woody debris dams on the retention of organic matter in side channels, side sloughs, and upland sloughs?
5. How will variable ramping rates influence the transport (flushing) of organic matter from upland and side-sloughs?
6. Is there a relationship between BOM, macroinvertebrates density, and rearing juvenile fish abundance or distribution?

7. How does the variation in water temperatures and water chemistry among macro-habitats influence BOM decomposition rates? Will these rates change with different plant species?
8. Could high concentrations of BOM result in anaerobic conditions in sloughs during winter?
9. How important are flood flows for the accrual of BOM relative to other lateral inputs and the total carbon budget?
10. What role do tributaries play in the delivery of organic matter to the Susitna River?

The PSP states that in order to quantify the amounts of organic matter available in the Susitna River for river productivity, Coarse Particulate Organic Matter (CPOM) to Fine Particulate Organic Matter (FPOM) (specifically FBOM) will be collected concurrently with all benthic macroinvertebrate sampling (Objective 2, Section 7.8.4.2.1). Suspended FPOM (Seston) [27 locations 3 times from April through September] will be collected at same time and alongside invertebrate drift sampling (Objective 3, Section 7.8.4.3). Organic matter collection will be conducted using methods compatible with other Alaska studies, to allow for comparable results. State and federal protocols will be considered as study plans are developed, in consultation with resource agencies.

While perhaps not all of the list of questions raised in regard to BOM can be addressed, it is unclear how the PSP will address any of them. The purposes for BOM sampling are not clear, nor are the reasons behind the selection of sampling locations, sample timing, or sampling frequency. Sample collection methods and analyses are not provided and there is no discussion on how the resulting data would be used to evaluate Project effects.

RIVPRO-44

Many of these questions regarding Project-effects could be addressed through careful site selection, sample timing and frequency. Sample sites located in the mainstem above and below major tributaries and within those tributaries could evaluate mainstem longitudinal changes and, along with measures of Transported Organic Matter (TOM) and tributary discharge, the role of tributaries in the organic matter budget. Replicate seasonal samples within each macro-habitat and at replicate macro-habitat locations could be used to test for significant differences among sites and between seasons. BOM and TOM sample collection at select sites prior to and following storm events along with data from flow routing studies (over topping flows) and geomorphology studies (bed sheer stress) could be used to test for flow-effects on organic matter retention in sloughs. Sites with and without beaver dams and quantification of debris dams could help identify the influence of these structures on organic matter retention. TOM sampling at the mouth of upland sloughs following storms could be used to estimate the effects of ramping rates on BOM flushing.

The use of leaf packs to measure organic matter processing at sloughs is a standard method (Young et al. 2008) that could be used to evaluate influences of temperature and nutrient concentrations on food processing. Alternately, measures of ecosystem respiration relative to BOM standing stocks and TOM could be used to assess organic matter processing and carbon spiraling lengths (Thomas et al. 2005).

BOM and TOM collection methods need to be described. The methods should identify the number of replicate samples at each site. Mesh sizes (Ultrafine Particulate Organic Matter (UPOM), FPOM, and CPOM) and whether nets will be nested should be clarified. The methods should state whether benthic samples will be open to transported material during sample collection. Methods should describe the depth the substrate will be disturbed and how sample

loss will be avoided in cobble and boulder substrate. Methods for collecting samples in fine substrate without measureable velocity should be provided. Organic matter deposition can be patchy, so the process for selecting a site to place the sampler or to deal with unequal distribution of organic matter within a habitat should be explained. How samples will be preserved, stored, processed, and analyzed should be described.

AEA Study Objective 9: Estimate benthic macroinvertebrate colonization rates in the middle and lower reaches to monitor baseline conditions and evaluate future changes to productivity in the Susitna River.

Project operations will modify the daily and seasonal hydrograph. Flow fluctuations will be greatest during winter periods of load-following. Dewatering of substrates can result in the loss or reduction of macroinvertebrate density (Perry and Perry 1986, Hunter et al. 1992). The effects of flow fluctuations will vary with differences in channel morphology. Determining colonization rates is an important objective and colonization time lags have been incorporated into instream flow analyses (Hardy and Addley 2003).

Using a stratified sampling approach, a field study proposed to be conducted by AEA will estimate potential benthic macroinvertebrate colonization rates for different seasons in the Susitna River. Sets of three to five preconditioned artificial substrates will be deployed incrementally for set periods of colonization time (e.g., 12, 8, 6, 4, 2, and 1 weeks) and then pulled simultaneously at the conclusion of the colonization period. Artificial substrates will be deployed at three depths at fixed sites along the channel bed. Benthic macroinvertebrate colonization rates may be conducted in a variety of habitats (e.g., turbid vs. non-turbid areas, groundwater upwelling areas vs. areas without groundwater upwelling). Benthic macroinvertebrate processing protocols would be identical to those used in sampling.

RIVPRO-45

The study plan currently does not provide enough information to determine how proposed methods would allow for “monitoring baseline conditions” or “changes in productivity.” While the overall approach appears sound, site selection and the disturbance regime should more closely resemble potential Project effects. The effects of dewatering and recolonization will be much greater during the winter when load following is proposed. Short-term exposure to temperatures well below freezing may result in macroinvertebrate mortality. Effects will vary by species and frequency and duration of exposure. Exposure duration may not mimic currently operational flows that may dewater a site twice a day throughout the winter. Project effects and varial zone area will change with distance from the dam and channel geomorphology. Therefore, sampling locations should be selected to evaluate different levels of potential Project effects.

RIVPRO-46

Unaddressed Service objective

An additional benthic resource that the PSP does not yet address is the primary food source, *Macoma balthica*, of overwintering Rock Sandpipers in the Susitna River Flats. While most shorebirds migrate outside of Alaska for the winter, the intertidal habitats of Upper Cook Inlet, and chief among them the Susitna River Flats area, support virtually the entire population (ca. 25,000 birds) of the nominate race of the Rock Sandpiper (*Calidris ptilocnemis ptilocnemis*) during the winter (Gill et al. 2002). Because of its highly restricted distribution (breeding and wintering), this subspecies is listed as a species of high conservation concern in both the U.S. Shorebird Conservation Plan (Brown et al. 2001) and the Alaska Shorebird Conservation Plan (Alaska Shorebird Group 2008), and is one of only three ‘red list’ North American shorebird species of global conservation concern in the National Audubon Society’s Watchlist program

(Butcher et al. 2007). It is also listed as a Bird of Conservation Concern by the Service (U.S. Fish and Wildlife Service 2008).

The food supply that supports this unusual overwintering population is the bivalve *Macoma balthica*. Gill and Tibbitts (1999) suggest that these birds prefer the Susitna River Flats because of the overall high densities of clams, with tidal currents in this part of the Inlet affecting benthic community productivity through ice scour. They have found densities of 2,000-3,000 clams per square meter in the area. Any Project operations that were to adversely impact this population of bivalves, whether via changes in sedimentation patterns or other effects, could have substantial adverse impacts on this important migratory bird population. Therefore, it is an important objective of the Service's to study potential Project impacts to the *Macoma balthica* population of the Susitna River Flats.

The Service recommends that AEA develop a study plan to:

- survey *Macoma balthica* in the Susitna River Flats,
- better understand the factors influencing their abundance, distribution, and availability for overwintering shorebirds (e.g., ice, wind, and tidal conditions), and
- determine how Project operations may affect their abundance and distribution.

To aid in this, we suggest consultating with local Rock Sandpiper experts including Bob Gill and Dan Ruthrauff of the U.S. Geological Survey's Alaska Science Center, and literature reviews of potential impacts of hydro-electric dam operations on downstream populations of *Macoma balthica.*

Literature Cited

Adams, S. M., and J. E. Breck. 1990. Bioenergetics. Methods for Fish Biology. Carl B. Schreck and Peter B. Moyle, editors: 389-415.

Alaska Shorebird Group. 2008. Alaska Shorebird Conservation Plan Version II. Alaska Shorebird Group, Anchorage, AK. [Online.] Available at http://alaska.fws.gov/mbsp/mbm/shorebirds/plans.htm.

Angradi, T.R. and D.M. Kubly. Concentration and transport of particulate organic matter below Glen Canyon dam on the Colorado River, Arizona. Journal of the Arizon-Nevada Academy of Science 23: 12-22.

Behn, K. E., T. A. Kennedy, and R. O. Hall. 2010. Basal resources in backwaters of the Colorado River below Glen Canyon Dam - effects of discharge regimes and comparison with mainstem depositional environments. Open-File Report. U.S. Geological Survey. no. 2010-1075: 1-25.

Benenati, E. P., J. P. Shannon, J. S. Hagan, and D. W. Blinn. 2001. Drifting fine particulate organic matter below Glen Canyon Dam in the Colorado River, Arizona. Journal of Freshwater Ecology 16(2):235-248.

Benson, E. R., M. S. Wipfli, J. E. Clapcott, and N. F. Hughes. 2012. Relationships between ecosystem metabolism, benthic macroinvertebrate densities, and environmental variables in a sub-arctic Alaskan River. Hydrobiologia , September 2012.

Blinn, D. W., J. P. Shannon, P. L. Benenati, and K. P. Wilson. 1998. Algal ecology in tailwater stream communities: the Colorado River below Glen Canyon Dam, Arizona. Journal of Phycology 34(5):734-740.

Blinn, D. W., J. P. Shannon, K. P. Wilson, C. O'Brien, and P. L. Benenati. 1999. Response of benthos and organic drift to a controlled flood. Geophysical Monograph 110: 259-272.

Davis, J.C. G.A. Davis, and N.R. Ettema. 2009. Water Quality Evaluation of the Lower Little Susitna River: July 2008 through June 2009. Final Report for the Alaska Department of Environmental Conservation. ACWA 09-02. Talkeetna, AK..

Davies-Colley, R. J., C. W. Hickey, J. M. Quinn, and P. A. Ryan. 1992. Effects of clay discharges on streams 1. optical properties and epilithon. Hydrofiologia 248:215-234.

Dill, L.M. and A.H.G. Fraser. 1984. Risk of predation and the feeding behavior of juvenile coho salmon (*Oncorhynchus kisutch*). Behavioral Ecology and Sociobiology 16: 65-71.

Dolloff, C.A. 1987. Seasonal Population Characteristics and Habitat Use by Juvenile Coho Salmon in a Small Southeast Alaska Stream, Transactions of the American Fisheries Society 116:6, 829-838

Duncan, W.F.A., Brusven, M.A. and T.C. Bjornn. 1989. Energy-flow response models for evaluation of altered riparian vegetation in three southeast Alaskan streams. Water Resources 23: 8, 965-974.

Fausch, K.D. 1984. Profitable stream positions for salmonids: relating specific growth rate to net energy gain. Canadian Journal of Zoology 62: 441-451.

Gislason, J.C. 1985. Aquatic Insect Abundance in a Regulated Stream under Fluctuating and Stable Diel Flow Patterns. North American Journal of Fisheries Management 5: 1,39-46.

Jakob, C., Robinson, C.T. and U. Uehlinger. 2003. Longitudinal effects of experimental floods on stream benthos downstream from a large dam. Aquatic Sciences 65: 223-231.
Johansen, M., Elliot, J.M., and Klemetsen, A. 2005. Relationships between juvenile salmon, Salmo salar L., and invertebrate densities in the River Tana, Norway. Ecology of Freshwater Fish 14: 331-343.

LaPerriere, J. D., E. E. Van Nieuwenhuyse, and P. R. Anderson. 1989. Benthic algal biomass and productivity in high subarctic streams, Alaska. Hydorbiologia 172:63-75.

Lieberman, D. and T. Burke. 1991. Limnology and drift of particulate organic matter through the lower Colorado River. Technical Report REC-ERC-91-1. Bureau of Reclamation.

Lieberman, D. M., and T. A. Burke. 1993. Particulate organic matter transport in the lower Colorado River, southwestern USA. Regulated Rivers 8: 323-334.

Lovtang, J.C. 2005. Distribution, habitat and growth of juvenile Chinook salmon in the Metolius River Basin, Oregon. Masters Thesis. Oregon State University, Corvallis, OR.

Lloyd, D. S., J. P. Koenings, and J. D. Laperroiere. 1987. Effects of turbidity in fresh waters of Alaska. North American Journal of Fisheries Management 7: 1, 18-33.

Lytle, D.A. and Poff, N.L. 2003. Trends in Ecology and Evolution (Article in Press edition).

Major, E.B., and M.T. Barbour. 2001. Standard operating procedures for the Alaska Stream Condition Index: A modification of the U.S. EPA rapid bioassessment protocols, 5th edition. Prepared for the Alaska Department of Environmental Conservation, Anchorage, Alaska.

Matter, W., P. Hudson, J. Nestler, and G. Saul. 1983. Movement, transport, and scour of particulate organic matter and aquatic invertebrates downstream from a peaking hydropower project. AD-A-130379/1: Army Engineer Waterways Experiment Station, Vicksburg, MS.

Minkley, W.L. 1991. Native Fishes of the Grand Canyon region: an obituary? Colorado River Ecology and Management. G.R. Marzolf ed. pp 124-177. Natl. Acad Press. Washington, D.C.

Perry, S.A. and W.B. Perry. 1986. Effects of experimental flow regulation on invertebrate drift and standing in the Flathead and Kootenai, Montana, USA. Hydrobiologia 134: 171-182.

Perry, S.A. and W.B. Perry. 1991. Organic carbon dynamics in two regulated rivers in northwestern Montana, USA. Hydrobiologia 218: 193-203.

Rehn. A.C. 2008. Benthic macroinvertebrates as indicators of biological condition below hydropower dams on west slope sierra Nevada streams, California, USA. River Research and Applications (2008).

Robinson, C. T., U. Uehlinger, and M. T. Monaghan. 2004. Stream ecosystem response to multiple experimental floods from a reservoir. River Research and Applications 20: 359-377.

Rosenfeld, J.S., Leiter, T., Linder, G., and L. Rothman. 2005. Food abundance and fish density alters habitat selection, growth, and habitat suitability curves for juvenile coho salmon (*Oncorhynchus kisutchI).* Canadian Journal of Fisheries and Aquatic Sciences 62: 1691-1701.

Rosenfeld, J.S. and J. Taylor. 2009. Prey abundance, channel structure and the allometry of growth rate potential for juvenile trout. Fisheries Management and Ecology 16: 202-218.

Snyder, E.B. and G.W. Minshall. 2005. An energy budget for the Kootenai River, Idaho (USA), with application for management of the Kootenai white sturgeon, *Acipenser transmontanus*. Aquatic Sciences 67: 472-485.

Shannon, J. P., D. W. Blinn, P. L. Benenati, and K. P. Wilson. 1996. Organic drift in a regulated desert river. Canadian Journal of Fisheries and Aquatic Sciences. 53: 1360-1369.

Thomas, S.A., T.V. Royer, E.B. Snyder, and J.C. Davis. 2005. Organic carbon spiraling in an impacted Idaho River. Aquatic Sciences 67: 424-433.

Urabe, H., M. Nakajima, M. Torao, and T. Aoyama. 2010. Evaluation of habitat quality for stream salmonids based on a bioenergetics model. Transactions of the American Fisheries Society 139:1665-1676.

Ward, J.V. and J.A. Stanford. 1983. The serial discontinuity concept of lotic ecosystems. Chapter two in: T.D. Fontaine and S.M. Bartell (eds). Dynamics of lotic ecosystems. Ann Arbor Science Publishers, Ann Arbor: 29-42.

Webster, J. R., E. F. Benfield, and J. Cairns, Jr. 1979. Model predictions of effects of impoundment on particulate organic matter in a river system. In: J. V. Ward and J. A. Stanford (eds.) The Ecology of Regulated Streams. Plenum Press, New York: 339-364.

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R. and C. E. Cushing. 1980. The river continuum concept. Canadian Journal of Aquatic Sciences 37: 130-137.

Young, R.G., Matthaei, C.D. and C.R. Townsend. 2008. Organic matter breakdown and ecosystem metabolism: functional indicators for assessing river ecosystem health. Journal of North American Benthological Society 27: 605-625.

7. Fish and Aquatic Resources

7.9. Characterization of Aquatic Habitats in the Susitna River with Potential to be Affected by the Susitna Watana Project

General Comments:

The goal of this Alaska Energy Authority (AEA) proposed study plan (PSP) is to *"characterize 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"* for the Susitna Watana Hydroelectric Project (Project). Due to the size of the study area, the PSP proposes to use different data collection methods at different locations, based upon the degree of potential impact and hence, differences in data quality. Study objectives subdivide the study area into mainstem and tributary habitat in the middle and the lower river (River Mile (RM) 28), the reservoir inundation zone, and the upper river tributary and lakes upstream from the dam site to the Oshetna River currently accessible to fish or that will be accessible from the reservoir.

AQHAB-04 In general, the U.S. Fish and Wildlife Serve (Service) is concerned with AEA's approach of using geomorphic and hydrologic classifications as a means of defining "fish habitat". Although the Service is not opposed to the geomorphic and hydrologic classification of the Susitna River and its tributaries, it should be clear that the relationship between these classification types and the distribution or abundance of any fish species has not been established. For example, classification of a site as a side slough does not imply that these sites provide unique fish habitat characteristics. It should be clear that the classification of these sites is based upon the degree of connection to the main channel. This will have some effect on fish habitat characteristics within this classification type, but by no means defines fish habitat and should not be referred to as a "habitat classification".

Initial habitat classifications have been based upon descriptions developed previously by the Alaska Department of Fish and Game (ADF&G) including main channel, side channel, off-channel, tributary mouth, and tributary (in AEA Table 7.9.1, but not in Figure 7.9.10). Off-channels would be further classified as side sloughs, upland sloughs, and other off-channel types in Figure 7.9.10, but subdivided differently in the Table, with three types of "other off-channel types" listed.

The difference and importance of differentiating between main channel and side channel is not defined, but is presumed to be due to the portion of flow in each. Similarly, the differences between side sloughs, upland sloughs, and other off-channel habitat are not defined, but may be retaining the initial ADF&G system and be based upon a connection to the main channel at a defined flow or stage. To this point, the classification is based upon differences in geomorphic and hydrologic process and to some extent water quality (portion of main channel turbid flow). All of these locations provide habitat for different fish species and life stages, and should not be used as a "habitat" classification for any given species. Fish distribution at this scale is likely more related to different levels of tolerance to turbid water, which varies among these locations but also seasonally within the main channel. Upper River tributaries are not further classified geomorphically based on slopes, confinement, width/depth, or substrate (*sensu* Rosgen 1994) or by stream order or link (Strahler 1957).

AQHAB-05 The next level of classification is defined as "meso-habitat" and the PSP argues that meso-habitat classification is important because, *"it is at this level that fish selectively use different habitats to support different life stages and functions,"* and it is at this level that Project effects will be evaluated. The PSP further splits the classification is into fast versus slow water. Fast water includes riffles and runs, and slow water includes pools, which are further subdivided. There is no indication that this classification based on water velocity is related to fish habitat selection. This classification of flow types may be applicable to Upper River tributaries, but is not applicable to most of the other classifications. That is, it is not applicable to classify main-channels, side channels, tributary mouths, or upland sloughs into riffles runs or pools. Classification to this level is likely unrelated to "mesohabitats" selected by fish within the Susitna River.

AQHAB-06 The Service recommends AEA develop a series of definitions for river habitat classifications (geomorphic, hydrologic, and fish-related) that will be used consistently within and across all individual studies throughout the PSP. The classification approach outlined in this PSP is considered totally different from meso- and microhabitat classification to be used in the instream flow analyses. The distribution of meso- and microhabitats used in instream flow analyses and developed from fish-habitat relationships is described in our comments on the Instream Flow Study Plan. Since the distribution of meso- and microhabitats is unrelated to AEA's proposed geomorphic classification type (i.e., main channel, side-slough, upland slough, etc.), measures of microhabitat or Weighted Useable Area (WUA) within a geomorphic type cannot be extrapolated to represent all similar geomorphic classification types and summed to obtain a value for the Middle River. Thus, the proposed classification is unrelated to environmental variables relevant to fish distribution and habitat site-selection.

AQHAB-07 Although aerial video may be useful for habitat mapping, the scale of delineation must be described in order to determine its usefulness in conjunction with ground surveys. The frequency and number of sites surveyed on the ground will also be determined by the objective's definition of scale.

AQHAB-08 The remote imagery will only be used to cover the mainstem channel and larger tributaries. It is unclear whether an attempt will be made to cover sloughs and side-channels off the mainstem with remote imagery even if there is sufficient open canopy. In addition ground surveys in the upper reach will only be conducted on the mainstem and tributaries. It is again unclear what is meant by mainstem, does this include sloughs and side-channels in the Upper River? The accuracy and statistical significance of the data collected for habitat mapping would be compromised if some habitats are missed due to the inability of aerial imaging to capture them.

AQHAB-09 Ground surveys will be an important supplement to aerial video mapping. Not only will ground surveys provide data for habitats unidentifiable by aerial video mapping (due to vegetative cover) but they will also be useful in evaluating video mapping accuracy. Although it is mentioned in the methodology that a subset of sites will be used to refine video mapping and verify its accuracy, a standard of accuracy is not specified. A standard of accuracy must be set before initiation of sampling that determines the amount of ground-truthing data that must be collected. Ground-truthing must also be conducted during a similar flow as when the video was obtained or else it may show more inaccuracies than actually exist.

AQHAB-10 It is most concerning that the video mapping data will only be collected in mid to late September when flows are expected to be low and waters relatively clear. Although these conditions may be the best for image quality (lack of vegetative cover), sampling only during these conditions

will alter the classification results. Inundated habitats that are only present during high flow would not be properly classified. A classification scheme should be designed to be flow independent and have sampling that occurs at both high and low flows. This is especially important if these data are to be combined with data from other studies to assess project effects on aquatic habitat.

Specific Comments by Subsection:

AEA Study Objective 1: Characterize the existing upper mainstem Susitna River and tributary habitat within the proposed inundation zone.

AQHAB-11 AEA's purpose in applying this classification method to Upper river tributaries and mainstem locations within the inundation zone is unclear. Once fish-habitat associations are understood, it will be important to map the distribution of those habitats to determine the percent of total available habitat lost due to the impoundment. However, this may be at a larger scale. The proportional distribution of fish habitat for different life stages within or out of the inundation zone would be more important, as this is the scale of impact, as opposed to impacts that may modify reach-level habitat characteristic (i.e., pools/riffles, undercut banks, w:d ratios, LWD, etc.)

The objective only addresses the mainstem and tributaries of the upper reach. It is unclear whether off-channel habitats will be further characterized by aerial methods as side sloughs, upland sloughs, backwaters, ponds, or relic channels (as listed in table 7.9-1 of AEA's PSP) or if they will be further classified into meso-habitats. If off-channel habitats are not being further delineated and mapped, then the reasons for this limitation within the objective must be detailed. Although there may be a limited number of off-channel habitats compared to the middle reach they may contain unique and abundant suitable habitat for a variety of species and should be addressed. Previous impoundment studies in the upper river have caught burbot, longnose suckers and round whitefish in backwaters and sloughs off the main channel (ADF&G 1983).

The PSP does not contain any review of the time-based frequency method proposed.

AEA Study Objective 2: Characterize the middle (RM 98 to RM 184) and the lower (RM 28 to RM 98) mainstem Susitna River channel margin and off-channel habitats using the Susitna-Watana Project habitat classification system and standard USFS protocols, with modifications to accommodate site-specific habitats.

AQHAB-12 The Fish and Aquatics Technical Work Group (TWG) is developing a Susitna River classification system based on the U.S .Forest Service (USFS) Aquatic Habitat Surveys Protocol (USFS 2001). The Service previously recommended the use of habitat classifications for large rivers, such as Beechie (2005). Although this habitat classification scheme will be useful for a possible framework, the uniqueness of the Susitna River system must be kept in mind. The USFS habitat classification is based on data collected from Southeastern Alaskan streams (USFS 2001) and will likely require many modifications to be suitable for the Susitna River, its associated tributaries, and off-channel habitats.

If AEA's objective is to apply a classification method that can be used to describe the distribution of fish, then other criteria must be considered. Sources of water and water quality appear to be important characteristics of fish distribution in glacial rivers (Curran et al. 2011, Murphy et al. 1989, Lorenz et al. 1989). Classification of main channel, tributary, and off-

channel locations should be used as a macro-habitat level classification, as described in Service-recommended hierarchal nested habitat table. Differences in spawning locations are primarily clear-water tributaries, groundwater dominant side channels, and the mainstem (including side channels dominated by turbid mainstem water). Spawning is limited within the mainstem, presumably due to high turbidity and high percent fines, when spawning gravels are present. Similarly, mainstem rearing increases in the winter months when turbidities are low. Summer juvenile rearing occurs in tributaries and off-channel habitats with surface-water connections. Tributaries could be further classified using traditional geomorphic methods but could include water quality measures to separate out lower-sloped stream with high dissolved carbon and more moderate sloped clear-water streams. Moderate slope clear-water tributaries (Indian, Portage, and Gold Creek) have much higher specific conductivity and dissolved oxygen concentrations and are important Chinook spawning streams. Brown-water tributaries which drain wetland soils with much lower conductivity and high dissolved carbon concentrations, and lower pH and dissolved oxygen, are warmer and support coho spawning and rearing and some Chinook rearing.

A well-defined, lateral main-channel habitat classification may be most important for characterizing the distribution of fish. Juvenile salmonid abundance is likely greater along the stream margins than in mid-channel, and greater along vegetated banks with a complex distribution of velocities and depths than adjacent to unvegetated point bars. Fish use of off-channel habitats appears to vary with water source. Groundwater dominated side sloughs support sockeye and chum salmon spawning, side sloughs and upland sloughs with a surface water connection appear to provide important rearing habitat, while upland sloughs habitat quality may vary with concentration of dissolved oxygen.

Lastly, State and Federal agencies have resource responsibilities and authorities that extend below RM 28. These include, but are not limited to the aquatic resources within the Susitna Flats State Game Refuge, beluga whales and their habitats, and anadromous and resident fish and their habitats. The Service remains concerned with the stunting of the proposed Project-effects boundary at RM 28. AEA refers to RM 28 as the *"potential zone of Project hydrologic influence"* without adequate documentation of this claim. The Service recommends that this be confirmed through study prior to finalizing this characterization.

AEA Study Objective 3: Characterize the tributary and lake habitat upstream from the proposed Watana Dam site to the Oshetna River (RM 184 to RM 233.4) that is currently accessible to fish from the Susitna River or that would be accessible due to inundation of existing fish passage barriers after the reservoir is filled.

AQHAB-13 AEA's purpose for pursuing this objective is unclear and should be provided for adequate evaluation of the proposed methodologies, data collection, and analysis.

The level of classification includes main channel and side channel, tributaries, off-channel locations and lakes. Classification of lakes is not provided but should include lake surface area, perimeter, bathymetry and whether or not there is a surface water connection to Susitna River tributaries. As with the Middle River, we recommend initial classification of tributaries using the Rosgen Classification method (Rosgen 1994), similar to the USFS Tier II habitat classification described. This level of classification will be more useful than classification of flows types. More specific habitat classification should be based upon characteristics of fish-habitat relationships important for fish within these tributaries. The purpose and applicability for Tier III classification for Susitna River tributaries should be clarified.

AQHAB-14

Related USFWS/NMFS Study Request Objectives

This PSP for aquatic habitat survey and characterization is insufficiently designed to account for the basic ecology of floodplain fishes or the diversity of aquatic habitats in the Susitna River, or any large floodplain system at these latitudes. These systems are characterized by a dynamic ground and surface water hydrology and geomorphology that interact with cold climates. Upon these fundamental layers of complexity, the distributions of fish species shift seasonally between ground and surface water dominated habitats and between channel networks of the primary and off-channel environments. Surveys and classifications (characterizations and delineations) of these seasonal distributions and habitats should pursue a strict hierarchical habitat classification that allows for the separation and comparison of the basic physical drivers of habitat selection.

AEA proposes to characterize (delineate and map) habitats of the project area by mesohabitats and states that fish distributions are primarily structured at this level. This is not entirely correct for large floodplain systems at these latitudes. Mesohabitat delineation is based on the hydraulic continuum of a channel's riffle-pool sequence. Characterization of habitat, at this level, ignores the fundamental influences of ground and surface water exchanges and the dramatic differences in habitat that are found amongst the various macro-habitats of the river's floodplain. It is at this level, that the distributions of fish are primarily structured (e.g., spawning in side sloughs, overwintering in the mainstem). Within these macro-habitat levels, the distributions of fish are responsive to mesohabitats, but perhaps of greater importance are the local manifestations of hydrology and geomorphology at the microhabitat level. The Service finds that a systematic assessment of the ecological relevance of local variables requires a hierarchical characterization of habitat. We recommend the habitat be characterized through the following hierarchy:

1. **Geomorphic units:** Large-scale geomorphic and hydraulic controls.
   a. Bedrock controlled single-channel units with shallow hyporheic exchange and thermal homogeneity.
   b. Unconfined, multiple channel floodplain units with expansive hyporheic exchange and thermal heterogeneity.
2. **Macrohabitats**: Primary, flood, and spring channel networks.
   a. Primary channels—Perennial channels.
   b. Flood channels—seasonally connected channels.
   c. Spring channels (clear water)—Disconnected sloughs that discharge groundwater.
   d. Floodplain ponds—Ponded spring channel networks.
   e. Tributary mouths
3. **Mesohabitats:** Bed and bank morphological controls; hydraulic features.
   a. Riffle-pool sequences—Run, riffle, pool, glide, tailout.
   b. Backwaters, alcoves, shallow meander margins.
4. **Microhabitats:** Hydraulics, water quality, substrate, cover.
   a. Water depth, velocity, bulk flow characteristics (e.g., Reynolds and Froude #'s).
   b. Vertical hydraulic exchange (ground and surface water exchange).
   c. Bed, or intragravel temperature and dissolved oxygen.
   d. Substrate size, heterogeneity.
   e. Elements of wood, vegetation, and rock structure.

The PSP states that the mesohabitat scale is the most meaningful to fish and that macro-habitat delineations will only be considered to perform *"some level of comparison over time*". Though we agree that the mesohabitat level is indeed important to fish, exchanges of ground and surface water operating at the macrohabitat scale, and manifesting themselves locally at the microhabitat scale, should not be ignored and habitat mapping should occur pursuant to the necessary hierarchical model we have proposed.

The habitat hierarchy referred to in the PSP is inconsistent with the text of the PSP and was seemingly developed for high-gradient forested streams of the temperate coastal region. It confuses scales of organization (e.g., refers to beaver complexes and ponds as meso-habitats and uses a different hierarchy than that referred to in the PSP. It contains meso-habitats that are not well represented, or absent in large floodplain systems (e.g., pools and cascades), and omits those that are (e.g., glides and tail-outs), but it contains habitat categories that aren't relevant to a large floodplain systems. AEA needs a habitat hierarchy that is developed for large northern floodplains and directs the systematic characterization of habitats important to the distributions and life history patterns of fishes of the Susitna River. The Service recommends that AEA adopt the hierarchical model developed and supported by the agencies.

Literature Cited

ADF&G (Alaska Department of Fish and Game). 1983. Phase II Basic Data Report Vol. 5: Upper Susitna Impoundment Studies 1982. ADF&G/Susitna Hydro Studies. Anchorage, Alaska.

Beechie, T. J., M. Lierman, E. M. Beamer, and R. Henderson. 2005. A classification of habitat types in a large river and their use by juvenile salmonids. Transactions of the American Fisheries Society. 134: 717-729.

Curran, J.H., McTeague, M.L., Burril, S.E., and Zimmerman, C.E., 2011. Distribution, persistence, and hydrologic characteristics of salmon spawning habitats in clearwater side channels of the Matanuska River, southcentral Alaska: U.S. Geological Survey Scientific Investigations Report 2011–5102, 38 p.

Lorenz, J.M., and J.H. Eiler. 1989. Spawning habitat and red characteristics of sockeye salmon in the glacial Taku River, British Columbia and Alaska. Transactions of the American Fisheries Society 118:495-502.

Murphy M. L., J. Heifetz, J. F. Thedinga, S. W> Johnson, and K. V. Koski. 1989. Can. J. Fish. Aquat. Sci. 46

Rosgen, D.L., 1994. A Classification of Natural Rivers. Catena 22:169-199.

Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology. Transactions of the American Geophysical Union 8 (6): 913–920 .

U.S Forest Service (USFS). 2001. Chapter 20-Fish and Aquatic Stream Habitat Survey. FSH 2090-Aquatic Habitat Management Handbook (R-10 Amendment 2090.21-2001-1).

7. Fish and Aquatic Resources

7.11. Study of Fish Passage Feasibility at Watana Dam

General Comments:

On September 24 and 25, 2012, the National Marine Fisheries Service (NMFS) convened Fish Passage meetings and began to informally resolve study issues with Alaska Energy Authority (AEA) and other state and federal agencies, including U.S. Fish and Wildlife Service (Service), and stakeholders per Section 5.11 of the Federal Energy Regulatory Commission (FERC) Integrated Licensing Process (ILP). This process is ongoing. On October 31, 2012, AEA posted a draft Revised Study Plan (RSP) on its website. A cursory review of the draft RSP indicated that AEA has revised their July 2012 Fish Passage Feasibility Proposed Study Plan (PSP). Notably, the PSP has been revised to include development of three conceptual alternatives for fish passage. This fish passage consideration and evaluation process that has begun is nearly a year earlier than AEA had initially proposed. However, the Service has not yet had sufficient time to review the draft RSP that was provided less than two weeks before comments on the PSP are due to FERC. Thus, our comments are based upon AEA's July 16, 2012, PSP and how well they address the goals and objective of the May 31, 2012, Fish Passage study request.

While efforts have been made to mention some of the revisions developed at and since our September Technical Work Group (TWG) meetings, the Service is adhering to the FERC mandated ILP process. Cursory review of the draft RSP indicates that AEA is referring to results from some of the 2012 fisheries studies. These reports have not yet been provided to the Service for review. Lacking these reports limits our ability to begin adequate review of the RSPs.

The Fish Passage Feasibility PSP proposes to address information needs for the Service to determine the feasibility of developing mandatory fishway prescriptions. This differs from the Service's objectives in the Fish Passage Study Request which also includes, if warranted, developing preliminary fishway prescriptions, as described in the Interagency Guidance for the Prescription of Fishways Pursuant to Section 18 of the Federal Power Act (USFWS and NMFS 2002).

Section 18 of the Federal Power Act (FPA) states that FERC *"shall require the construction, maintenance, and operation by a licensee at its own expenses of such…fishways as may be prescribed by the Secretary of the Interior or the Secretary of Commerce, as appropriate (16 U.S.C. § 811)."* Section 18 authority is delegated to the NMFS within the Department of Commerce and to the Service within the Department of Interior. For resources under its jurisdiction, the Service may prescribe fishways as necessary to maintain all life stages impacted by the project. Congress has provided guidance that fishway prescriptions are limited to physical structures, facilities, or devices necessary for such protection; and project operations and measures related to structures, facilities, or devices necessary to ensure effectiveness. Pub. L. 102-486, title XVII, § 1701(b), Oct. 24, 1992, 106 Stat. 3008. The Commission shall incorporate these mandatory conditions in a hydropower project license, or the Services may reserve their authority to include a fishway prescription in the future.

Discussion

The central features of the proposed project are the 750 foot high dam at river mile 184 and the reservoir extending about 43 miles upriver of the dam. The dam as proposed would block the upstream and downstream passage of Chinook salmon (*Oncorhynchus tshawytscha)*, possibly other salmon species and resident fish that migrate through and use the proposed Susitna-Watana dam site; and upstream habitat in the river and its tributaries. The reservoir would inundate some tributary spawning habitat, alter or remove rearing habitat, affect migration both up- and down-stream for juveniles and adults, isolate tributaries from the mainstem as water levels rise and fall, and change the bioenergetics, temperatures, turbidity and physical and biological characteristics of the river below the dam as the natural hydrograph is altered by project operations.

Chinook salmon are known to migrate to the Upper Susitna River as far above the proposed dam site as the Oshetna River and to successfully spawn and presumably rear there. The upstream extent of Chinook migration is not known definitively, nor is use of tributary or mainstem habitats. It is unknown but suspected that some Chinook salmon that are spawned in the upper river migrate downstream and rear in the middle river. Little else is known about anadromous species use above the dam site in either the Susitna River or its tributary streams. The Service adopted AEA's 2012 baseline data collection study objectives for the distribution of Chinook salmon and other fish species above Devils Canyon in its study request for fish passage. This baseline data collection effort is planned as a multi-year fish study that includes data collection beginning in 2012 as pre-ILP studies, with two additional years proposed by AEA under the ILP study process.

The Service requested the following modifications to the 2012 and ILP baseline data collection study objectives:

- Fish surveys should be conducted for at least one average life span of each salmon species, which is an average of five years for Chinook salmon (range to seven years). This is necessary to obtain the minimum amount of biological information about the population to develop and design mitigation, and determine the need for fish passage.
- Fish surveys should be designed and conducted to determine the occurrence and timing of all species and life stages of anadromous and resident fish that migrate both upstream and downstream of the proposed dam site. Data without all species and life-stages is insufficient to inform passage due to the variability in year-class strength as evidenced by the recent Alaska-wide downturns in productivity and abundance of Chinook salmon stocks.
- Genetic samples collected from Chinook salmon should be analyzed to assess the genetic makeup and viability of this population, and thus inform the need for fish passage of Chinook salmon for this project. It is necessary to collect and analyze sufficient numbers of genetic samples from Chinook salmon adults and juveniles from tagging sites, spawning sites and rearing sites to determine if they are differentiated from other Susitna Chinook salmon populations. It is unknown whether fish migrating into the upper river are genetically distinct from fish spawning elsewhere in the Susitna watershed. It is also unknown if fish spawned in the upper river rear in the upper river habitat or migrate downstream to rear in the middle or lower river areas. Collection and analysis of genetic material from these fish is needed for the Service to determine the contribution of upper river Chinook salmon to the Susitna River populations.

PASS-04 The Service provided generic guidance on methodology and information needs for determining fish passage feasibility and design from NMFS's Anadromous Salmonid Passage Facility

Design document (NMFS 2011). Given the height of the proposed dam however, we advised it would be prudent to involve resource agencies fish passage engineers directly in determining the feasibility of fish passage at the Susitna-Watana dam. NMFS and the Service offered to be available to discuss the criteria in general and in the context of the specific site. AEA was encouraged to initiate coordination with NMFS fish passage specialists early in the development of the preliminary design to facilitate an iterative, interactive, and cooperative process.

NMFS and the Service requested that feasibility planning for fish passage facility design begin with early coordination with resource agencies Fish Passage Engineers, starting with site reconnaissance and review of preliminary engineering designs. Collection of baseline biological information, site information, and project operations information essential to determine the need to prescribe fish passage for the proposed project was described and requested as follows:

Design Development Phases:

1) Conduct a reconnaissance study - An early investigation of one or more options for project design, siting and suitability of the proposed project design and construction of some type of fish passage facility.
2) Conceptual alternatives study - List the types of facilities that may be appropriate for accomplishing objectives at the proposed project site. It should result in a narrowed list of alternatives that merit additional assessment or explain the need for development of a novel alternative.
3) Feasibility study - An incrementally greater amount of development of each design concept (including a rough cost estimate), which enables selection of a most-preferred alternative.
4) Preliminary design - Additional and more comprehensive investigations and design development of the preferred alternative, and results in a facilities layout (including some section drawings), with identification of size and flow rate for primary project features. Cost estimates are also considered to be more accurate. Completion of the preliminary design commonly results in a preliminary design document that may be used for budgetary and planning purposes, and as a basis for soliciting (and subsequent collating) design review comments by other reviewing entities. The preliminary design is commonly considered to be at the 20% to 30% completion stage of the design process.
5) Detailed design phase - Use the preliminary design as a springboard for preparation of the final design and specifications, in preparation for the bid solicitation (or negotiation) process. Once the detailed design process commences, the Service must have the opportunity to review and provide comments at least at the preliminary design, 30%, 60% and 90% design completion stages. If substantial changes are still needed beyond the 90% stage, the Service will review and comment on these as well. These comments usually entail refinements in the detailed design that will lead to operations, maintenance, and fish safety benefits. Electronic drawings accompanied by 11 x 17 inch paper drawings are the preferred review medium.

Preliminary Design Development – Required Site Information:

1) Functional requirements of the proposed fish passage facilities as related to all anticipated operations and river flows. Describe median, maximum, and minimum monthly flow rates through the planned hydro facility, plus any special operations (e.g., use of flash boards, seasonal storage or drawdown etc.) that modify forebay or tailrace water surface elevations or river flows. Identify proposed project operational information that may affect fish migration (e.g., powerhouse flow capacity, period of operation, etc.).
2) Site plan drawing showing potential location and layout of the proposed downstream and upstream passage facilities relative to planned project features facilities.

3) Topographic and bathymetric surveys, particularly where they might influence locating fishway entrances and exits, and personnel access to the site.
4) Drawings showing elevations and a plan view of planned flow diversion structures, including details showing the intake configuration, location, and capacity of project hydraulic features.
5) Basin hydrology information, including daily and monthly streamflow data and flow duration exceedence curves at the proposed fish passage facility site based on the entire period of available record. Where stream gage data is unavailable, or if a short period of record exists, appropriate synthetic methods of generating flow records may be used.
6) Project forebay and tailwater rating curves encompassing the entire operational range.
7) Predict river morphology trends. Because the fish passage facility is proposed at a new diversion, describe the potential for channel degradation or channel migration that may alter stream channel geometry and compromise fishway performance. Use results from the instream flow and geomorphology studies to describe whether the stream channel is stable, conditionally stable, or unstable. Estimate the rate of lateral channel migration and change in stream gradient that has occurred over the last several decades. Describe what effect the proposed fish passage facility may have on existing stream alignment and gradient and the potential for future channel modification due to either construction of the facility or continuing natural channel instability.
8) Special sediment and/or debris problems. Describe conditions that may influence design of the fish passage facility, or present potential for significant problems, such as glacial silt loads.
9) Provide other site-specific or species-specific information that will inform the fishway designs and operations, such as accretion, earthquake fault zones, and permafrost conditions.
10) Derive hydrographs showing daily average river flow over the entire period of record for the proposed project area extrapolated for future projected change in hydrology.
11) Measure and report the stream bed profile (feet per mile) and composition, including the river from its mouth (River Mile (RM) 0) to the proposed project site for each species listed above. In the vicinity of the proposed project impoundment, provide three-dimensional topography/bathymetry including proposed location of the dam (spillway, power intakes, non-flow areas) and reservoir up to the maximum inundation expected.

Preliminary Design Development – Required Biological Information:
1) Identify each species and life stages to be passed downstream.
2) For each downstream migrating species and life stage, estimate the start and end date of the downstream migration. Identify how future project operations (reservoir storage, powerhouse flow and spillway flow) may alter migration timing. Identify effects of future project features, such as altered prey or predator concentrations, temperature changes, lighting changes, flow alteration and other physical, chemical and biological parameters.
3) For each downstream migrating species and life stage, determine the range of fish size, swimming ability (darting, sustained and cruising speeds) over the range of environmental conditions, run size, operational conditions and behavioral constraints to downstream fish passage.
4) Derive the standard downstream fish passage design flows for the passage season by calculation of the 5% (high design flow for fish passage) and 95% (low design flow for fish passage) exceedence flows (based on daily average flow) for the downstream passage season for each species and life stage.
5) Identify each species and life stages to be passed upstream.
6) For each annual upstream migrating species/life stage, determine the start and end date of the upstream migration.

7) For each upstream migrating species and life stage, determine the range of fish size, swimming ability (darting, sustained and cruising speeds) over the range of environmental conditions, run size, operational conditions and behavioral constraints to upstream fish passage. Identify spawning location for each salmonid species present at the site.
8) Identify other anadromous species and their life stages that are present at the proposed project site that also require intermittent passage.
9) Identify predatory species (avian, terrestrial, and aquatic) that may be present and prey on juvenile or adult anadromous species, and describe how the proposed project could affect populations or concentrations of these predators.
10) High and low design passage flow for periods of upstream fish passage. Derive the upstream fish passage design flows for the passage season by calculation of the 5% and 95% exceedence flows (based on daily average flow) for the passage season for each species and life stage to be passed upstream.
11) Identify any known behavioral factors that might affect salmonid passage. For example, most salmonid species pass upstream through properly designed orifices, but other species that are unable to pass through orifices may impede salmonid passage. In addition, some salmonid species may not pass through orifices. Other examples of behavioral factors that should be considered include schooling behavior, migration depth, preferred water temperatures, potential reaction to natural and artificial vertical structure and cover, reaction to lighting, diel passage patterns, reaction to flow velocity gradients and others.
12) Identify what is known and what needs to be researched about upstream and downstream fish migration routes approaching the proposed project.
13) Compile available information on the minimum and maximum streamflow that will allow upstream migration up to the proposed project.
14) Describe the degree of activity (fishing/bears/otters) in the area of the proposed project and the need for measures to reduce or eliminate fishing activity.
15) Identify water quality factors that may affect fish passage at the site. For each species/life stage migration, estimate the start and end date of the migration and assess the potential variation in migration season based on environmental factors (e.g., Changes in water temperature, impoundment effects, forebay delay, water temperature (average and reservoir profile), egg hatch timing, dissolved oxygen, low river flow, high river flow, etc.). Fish may not migrate if water temperature and quality are marginal, and may instead seek holding zones until water quality conditions improve.

Assessment of Operational Impacts on Fish Passage for the proposed project will require the following project-specific information:

1) Forebay rating curve - Provide the expected operation of the forebay for the migration season for each species and life stage to be passed downstream. Include expected operations for future years given the climate forecasting hydrology study results (snow pack, stream gaging, glacial meltwater). The rating curve should display day of year as the independent variable and forebay elevation as the dependent variable, and should also include appropriate bands identifying each migration season.
2) Tailwater rating curve - Provide the expected tailwater operation for the extent of the upstream migration season. The rating curve should display day of year as the independent variable and tailwater elevation as the dependent variable, and should also include appropriate bands identifying each upstream migration season.
3) Turbines - Turbine design should maximize fish survival through the turbine, and minimize turbulence and total dissolved gas uptake in the tailrace. Derive the expected effects of passage through turbines for the range of sizes of fish expected in the project forebay. Include blade strike, scraping of fish (between the blades and hub and between the blade tips

and turbine housing), the pressure change within the turbine, and the pressure profile from fish migration depth through the turbine intake, through the turbine, through the draft tubes and into the tailrace.

4) Draft tube velocity - Calculate draft tube velocity range for all standard operations, including turbine up ramp rates and turbine shut down rates. Identify turbine intake locations, in elevation relative to the range of forebay elevation. Identify draft tube discharge depth and locations in relation to tailrace.
5) Sediment capacity - By collection of stream samples over the entire range of expected stream flows, model the change in reservoir bathymetry over a 50-year period in annual increments.
6) Reservoir hydraulics - By computational fluid dynamic model, demonstrate the reservoir velocity contours in increments of 0.01 feet/second (or as appropriate) for each forebay level expected over the downstream migration season, in five foot increments. Include powerhouse flows, spillway flows and seasonal flow storage volumes. Include the entire reservoir, but data is most important and therefore should be the most detailed around the dam structure.
7) Flow continuation - Identify means of providing continuous instream flow if turbine and/or spillway becomes inoperable.
8) Upstream passage flows downstream of the project – Identify minimum instream flow that will provide optimal upstream passage up to the proposed project, including habitat impacts from proposed project revising the flow regime downstream of the project.
9) Describe range of forebay fluctuation, relative to preliminary plans for power operations.
10) Describe range daily tailrace fluctuation, relative to preliminary plans for power operations.
11) Describe river ramping rates, relative to preliminary plans for power operations.
12) General layout of planned hydro project. Include dam layout (in plan, elevation and typical cross sections), flow direction (for the entire operational scenario), powerhouse location, spillway location, top, submerged spill routes (include longitudinal profile and cross sections of conveyance structures) and any appurtenant structures.
13) General operating plan. Identify expected power production on an annual basis, based on the expected water use for power production and spill. For the spillway, derive from flow records the expected frequency, duration and seasonal occurrence of spill. For the powerhouse, derive the hourly and seasonal operation schedule, in terms of flow used for power production. For the reservoir, based on the expected operation schedule, identify daily and seasonal changes in storage.
14) Describe design capacities for hydraulic conveyance structures.

The PSP does not address the Service's study request and information needs in sufficient detail to determine what parts of our study request are adopted, what parts are not, and if not, why not. The Service recommends AEA identify the differences between our study request and their PSP and provide an explanation where, and why, they did not address our request.

Specific Comments by Subsection:

7.11.1.1 Study Goals and Objectives

The study plan articulates fish passage study goals and states *"A variety of engineering, biological, sociological, and economic factors may need to be considered."* The study plan further indicates that feasibility analysis of fish passage alternatives (last bullet under first paragraph in 7.11.4 page 7-92) will be conducted. This section also states that AEA will "generally follow" NMFS 2011 guidance in the Anadromous Salmonid Passage Facility Design document.

With regard to *"economic factors,"* the referenced NMFS guidance document states: "*Instances will occur where a fish passage facility may not be a viable solution for correcting a passage impediment, due to biological, sociological, or economic constraints. In these situations, removal of the impediment or altering operations may be a suitable surrogate for a constructed fish passage facility. In other situations, accomplishing fish passage may not be an objective of NMFS because of factors such as limited habitat or lack of naturally occurring runs of anadromous fish upstream of the site. To determine whether NMFS will use its various authorities to promote or to prescribe fish passage, NMFS will rely on a collaborative approach, considering the views of other fisheries resource agencies, Native American Tribes, nongovernment organizations, and citizen groups, and will strive to accomplish the objectives in watershed plans for fisheries restoration and enhancement.*"

This guidance is intended for the *restoration* of fish passage, not for the initial blockage of fish passage through construction of a new dam. The guidance indicates that economic factors may be used to evaluate various alternatives that all achieve fish passage should the agencies determine that fish passage is necessary and thus prescribe fish passage under authority of the Federal Power Act. This guidance does not indicate in any way that cost-benefit analysis can be used to determine whether fish passage is necessary on the basis of benefits exceeding costs. The proposed study plan should be revised to clarify that the consideration of economic factors is limited to evaluating the cost effectiveness of various fish passage alternatives and will not be a factor in the Service's determination of whether fish passage will be prescribed.

PASS-05 The three-year limit of the study period is inadequate to understand adult salmon migrations especially at a time when stocks, particularly Chinook salmon, are low and their abundance above the project may be drastically reduced. We recommend that fisheries surveys be conducted for at least one average life span of each salmon species, which is an average of five years for Chinook salmon (range to seven years). This is needed to obtain the minimum amount of biological information about the population that is necessary to develop and design mitigation, and determine the need for fish passage.

PASS-06 *7.11.2. Existing Information and Need for Additional Information*
The PSP states that there is currently no specific engineering information and little biological information to provide a basis for determining the need for and feasibility of passage at the proposed dam. The biological need for passage is an issue independent of the engineering feasibility; these issues should be analyzed separately. While the Service agrees that there is little biological information for the upper river, it has been known since 1982 that Chinook salmon pass upstream of the Devils Canyon and spawn successfully in the upper Susitna River. It is the professional judgment of the ADF&G Susitna Hydro Aquatic Studies Team made in 1982 that juvenile Chinook salmon are produced in the upper Susitna River (ADF&G 1983). The outstanding biological questions relate to the population size, productivity, and habitat availability and use, rather than whether there is a biological need for Chinook salmon, possibly other salmon species, and other anadromous and resident species to migrate through the proposed dam site to habitat used for spawning, incubation, rearing, and migration.

PASS-07 *7.11.4.1. Compile, Review and Summarize Information*
The Service has not concurred with AEA's suggested use of target species for fish passage, in large part due to the paucity of information regarding the species, life stages and timing of fish passage at Watana. The following information has not been provided or reviewed:

- the 2012 Upper Susitna River Fish Distribution and Habitat Study;
- the Salmon Escapement Study;
- the Middle and Lower River Fish Production Study, and
- the Fish Passage Barriers Study; along with
- any outstanding historical data and reports that are not yet available from the 1980s historical studies; and
- a comprehensive literature review,

Once the above information is provided, it may be desirable and possible to select a smaller range of target species and life stages. The target fish species should include both anadromous and non-anadromous and resident species that require passage at the site (juvenile and adult passage both upstream and downstream passage and the timing) because fishways by definition consist of the physical structures, facilities, or devices necessary to maintain all life stages of fish by enabling fish to safely bypass the dam. In addition to the general physical information at the project site, specific hydrologic and hydraulic (including project operations) information should be provided for the fish passage season (for both upstream and downstream passage).

PASS-08

7.11.4.3. Define and Document a Development Process

The Service agrees that a process should be discussed to establish appropriate evaluation criteria for different fish passage alternatives. However, it is inappropriate to unduly limit the range of fish passage options under consideration from a biological and engineering standpoint by including estimated costs associated with facilities into a weighted comparison matrix. In determining which alternatives are considered for further analysis of fish passage, the biological goals, objectives and concerns and the technical issues such as constructability, climate and logistical considerations, operations, etc. should be assessed. This could be a valuable tool to decide between various alternatives.

At this stage, biological information and criteria should be gathered, and a full-range of engineering options should be pursued, including novel ones. No alternative should be rejected based on cost at the feasibility stage. If that process were to be followed, then the ability to develop and prescribe fish passage would be seriously limited or even excluded from the onset. The process to develop a fishway feasibility assessment should be constructed in a manner that helps federal fishery agencies make decisions regarding fishway prescription without eliminating options prematurely and diminishing the authority of federal fishery agencies to require FERC licenses to include fishway prescriptions.

PASS-09

Section 7.11.6. Schedule

There appears to be a disconnect regarding when some of the biological information from the studies will be available and the initiation of the conceptual design process. For example, a lot of the biological information on juvenile, adult or smolt passage will not be available until the 2013/2014 time frame and the conceptual alternative are supposed to be completed by 2013. This means that it may be necessary to revisit the conceptual alternative design assumptions based upon any new data and update the designs as necessary.

<u>Outstanding Information Needs and Unresolved Issues</u>

Study reports from AEA's 2012 Fisheries Studies are expected to add to the available information; this information is not yet available for agency review and is a serious constraint on the agency's ability to timely and effectively assess the proposed studies. These reports should

be made available, even if in draft form, as soon as possible to facilitate a more informed and effective study plan development process.

NMFS has initiated involvement of their Fish Passage Engineers in the project, beginning with a series of meetings and a site visit to the Susitna River in late September. NMFS Senior Fish Passage Engineer from the Northwest Region, Ed Meyer, traveled to Anchorage and met with Alaska Region staff, AEA, and the Service on September 24, 2012. On September 25, NMFS convened a meeting of state and federal agency staff and the applicant to discuss Section 18 Fish Passage Authority, fish passage at other hydro facilities, and the formation of a Fish Passage Technical Working Group. On September 26 NMFS conducted a site visit to the proposed Watana dam site. NMFS developed an information-needs list working with AEA's Fish Passage Engineering contractor, Dennis Dorratcague of Montgomery Watson/Harza. The Service supports and agrees with NMFS steps to address our agencies fish passage concerns pursuant to our joint federal authorities under the FPA.

In these meetings on September 24 and 25, NMFS, AEA, the Service and ADFG agreed to hold brainstorming meetings as a first step to identify and discuss potentially viable fish passage design concepts for the Susitna-Watana Project. A group of experienced fish passage engineers will convene to develop design concepts for both upstream and downstream fish passage. Project concepts will be developed during the course of studies for two alternative approaches listed below, to compare with the current proposal, which does not include passage structures.

1. Develop concept designs for fish passage facilities integral with the design development of the dam and outlet works.
2. Develop fish passage concept designs that could be added to the preferred design for the dam and outlet works later.

It was also decided in the meetings that upstream passage may likely be trap and haul. However, design specifications have not been provided to support the feasibility of this concept relative to the topography of the Susitna River basin. Brainstorming sessions will address both downstream and upstream passage. This approach conforms to the PSP, Section 7.11.

Much of the data required for the concept designs of the passage facilities is listed in 7.11.4.1 of the PSP. Therefore, it is anticipated that the design proposals will be informed by early results of data gathering efforts, lessons learned from other streams, and results from early runs of the project operations model. Any and all assumptions will be stated and validated. Additional information and guidance will be obtained from NMFS, Northwest Region, "Anadromous Salmonid Passage Facility Design", July 2011 and other accepted fish passage design books and topical scientific literature.

<u>USFWS Recommendations</u>

PASS-10 1. The study plan should be organized to address the Service's information needs and study requests in sufficient detail to determine what parts of our study request are adopted, what parts are not; and if not, why not. AEA has not identified the differences between our study request and their study, nor explained where and why they did not address our requests.

PASS-11 2. The Service continues to recommend that fisheries surveys be conducted for at least one generation of each salmon species, which is an average of five years for Chinook salmon (range to seven years). This is needed to obtain the minimum amount of biological

information about the population that is necessary to develop and design mitigation, and determine the need for fish passage for this project.

PASS-12

3. The proposed study indicates that the biological need for fish passage will be determined, and that this is linked to the economic costs of providing passage. The biological need for passage exists: anadromous fish are known to spawn and rear upstream of the proposed dam. The biological information requested is necessary to determine the engineering feasibility of designing effective up and downstream passage of fish and to determine the ecological and socioeconomic losses that would result from not providing passage. This determination must be informed by fish surveys consisting of at least one average life-span of each salmon species.

PASS-13

4. The study plan should be revised to investigate the ability to design, construct and operate up- and down-stream fish passage into a new project from the ground up rather than as if fish passage facilities were being considered to retrofit an existing dam that already blocks fish. The Susitna-Watana dam would be a new project on a free-flowing glacial salmon river, with no preexisting facilities, thus the project must incorporate features into its initial design and operations that increase the likelihood of successful fish passage. The RSP should include three dam design alternatives at the site:
   (1) A design that incorporates fish passage facilities as an integral part of the design,
   (2) The currently proposed design with fish passage retrofitted into the project and,
   (3) The current design with no fish passage.

   With this in mind, we recommend that the list of necessary baseline data be revised to provide information necessary for the design of all three project options. To aid in this development, we recommend that the Fish Passage Workgroup be convened at the earliest opportunity to help identify the necessary baseline data. The proposed schedule (7.11.6) delays development of conceptual alternatives until August of 2013. This is too late in the engineering design process for this dam and operations to allow for a full range of options for fish passage to be considered without adding unnecessary expense and delays into the project. AEA has agreed with the Service's request that the study plan for fish passage begin with early and regular consultation with agency fish passage engineers and the TWG.

   As part of the Fish Passage Workgroup, a group of experienced fish passage experts should be convened for an initial multi-day (3 to 4 day) "brainstorming session" to help identify any additional baseline information needs, as well as ideas for fish passage alternatives for the project. We recommend scheduling this meeting as early as possible, ideally in early January 2013.

PASS-14

5. In addition to the general physical information at the project site, specific hydrologic and hydraulic (including project operations) information should be provided for the fish passage season (both upstream and downstream passage) along with other physical information such as expected debris loading, ice conditions, expected sediment transport (as it affect passage facilities), expected forebay and tailwater rating curves, project operation information (rule curve, restrictions, etc.), river morphology trends, predatory species expected, downstream sites for a barrier dam/trap and haul operation, size of upstream and downstream migrants (fry versus smolt), etc.

PASS-15

6. The Service requests that AEA provide a comparison of our study request with their draft RSP, and identify any unaddressed study request components. The Service also requests

that AEA identify the relationships among the 2012 pre-ILP studies, the suggested ILP studies, define the timing of related studies, and explain how these studies will be completed within the ILP study planning, study dispute, and study completion schedules. Completing these tasks would greatly benefit the licensing process.

Literature Cited

Barrick, L., B. Kepshire, and G. Cunningham. 1983. Upper Susitna River Salmon Enhancement Study. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation Enhancement and Development. 156 pp.

NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

Interagency Guidance for the Prescription of Fishways Pursuant to Section 18 of the Federal Power Act,May 2002. Prepared by: The U.S. Fish and Wildlife Service and National Marine Fisheries Service. 19 pp.

7. Fish and Aquatic Resources

7.14. Genetic Baseline Study for Selected Fish Species

General Comments:

These comments address the Genetic Baseline Study for Selected Fish Species Proposed Study Plan (PSP) submitted by Alaska Energy Authority (AEA) for the Susitna Watana Hydroelectric Project (Project). The U.S. Fish and Wildlife Service (Service) and National Marine Fisheries Service (NMFS) submitted a general request for baseline fish genetics to FERC on May 31, 2012 for anadromous and resident fish. The Alaska Department of Fish and Game (ADF&G) also submitted a Fish Genetic study request relevant to their fisheries management goals. Both the Service and ADF&G have fish conservation genetics laboratories; collaboration and partnering between the two agencies and other resource organizations is critical to the success of the genetic programs. Alaska's conservation genetics laboratories emphasize characterization of population structure and mixed-stock analysis. Because ADF&G has management authority over the waters of the Susitna River basin they are the resource agency that is responsible for developing and maintaining the genetic stock analysis (GSA) for fisheries resources of the basin. The Service supports ADF&G in this effort to conserve biodiversity of Alaska's fisheries resources.

It is from this perspective that the Service comments on the PSP, with occasional reference to the ADF&G Fish Genetics study request. Our comments are based on PSP review findings, coupled with those from recent AEA's preliminary 2012 study efforts specifically related to adult Chinook salmon above Devil's Canyon near the proposed Watana dam site (River Mile (RM) 184).

Historically, it was assumed that Chinook salmon were not capable of navigating above Devil's Canyon and beyond the proposed dam site. However, ancillary reports support 2012 field effort findings that adult Chinook salmon do indeed migrate above the proposed dam site. Relative abundance of these Chinook salmon is unknown. During the 2012 field work, 84 Chinook were visually observed above the proposed dam site. In light of this recent information, and with consideration given to its potential relevance to federal agencies mandatory conditioning authority under the Federal Power Act (FPA), we emphasize the need for the baseline fish genetics study for Chinook salmon. Specifically, the Service recommends AEA focus on the detail contained within ADF&G's study request, along with additional objectives for adult Chinook salmon.

We recognize that the Devil's Canyon area likely creates a fish passage impediment during a range of flows, however, the specific range of flows that restrict fish passage are not known, nor have they been investigated. It is not known whether the adult Chinook salmon that migrate above Devil's Canyon to spawn are an established spawning population, or whether they are comprised of annual strays able to navigate the canyon during opportunistic flows. Acquiring baseline biological information to answer these questions are key to informing our decision-making process pursuant to the FPA.

GENE-01 In light of AEA's 2012 findings of numbers of Chinook salmon capable of navigating above the proposed dam site, and in order to adequately inform federal fishway prescription authorities under the Federal Power Act, we refine our genetics study request to determine:

1) whether or not Chinook salmon above Devil's Canyon are genetically distinct;

2) the effective Chinook spawning population size above Devil's Canyon; and
3) the proportional contribution of the genetically distinct Chinook salmon above Devil's Canyon to the Susitna River spawning population.

This more detailed request is in addition to our prior request for the development of a repository of genetic samples for anadromous and resident fish species within the Susitna River drainage. The impetus for this additional information comes from preliminary results of the 2012 fish sampling efforts. These results, some of which are a direct result of newer technologies, provide specific information requirements for resource agency review of the proposed project. Low returns for Susitna River salmon in recent years provide additional justification for resource concern. During the 2012 season, Northern Cook Inlet area Chinook salmon runs were well below average leading to significant restriction of the Northern District set gillnet fishery and the in-river Chinook sport fisheries. Restriction of the sport and commercial fisheries had significant economic impact on commercial fishers, processors, guides, lodges and other businesses that depend on these fisheries.

Specific Comments by Subsection:

AEA Objective 1. Develop a repository of genetic samples for fish species captured within the Susitna River drainage, with an emphasis on those species found in the middle and upper Susitna River.

GENE-02

The Service agrees with this objective to support the GSA database for resident and anadromous fish species of the Susitna River. AEA plans to take these samples "opportunistically" during capture events. Acquiring genetic samples opportunistically at capture sites and at sites using differing gear types is reasonable for an initial season (2012) in order to identify species and their spatial and temporal utilization of riverine habitats. However, beyond the first season (2012), a more formal sampling design should be established by resource agency fish biologists, geneticists, and AEA in order to develop a scientifically sound operational plan for continued sampling. The sampling design should state needed sample sizes by species, methodologies, along with temporal and spatial sampling considerations.

Alaska lacks baseline genetic samples for most of its fish species and consequently the Service has specific resource concerns related to several of the Susitna River fish species. In our prior study request, the Service noted our concerns for Pacific lamprey. Since that time, our Regional Director has signed the Pacific Lamprey Conservation Initiative. The recent development of the Service Region 1 Pacific lamprey Conservation Initiative, which includes Alaska, highlights conservation concerns related to Pacific lamprey across their range. The Pacific Lamprey Conservation Initiative is the Service's specific strategy to improve the status of Pacific Lamprey throughout their range by helping implement research and conservation actions. This initiative specifically states the need for genetic information and analyses related to Pacific Lamprey. Lamprey species are also state species of concern described in Alaska's Comprehensive Wildlife Conservation Strategy (ADF&G 2006).

The Susitna River Bering cisco comprises one of only three Bering cisco populations worldwide. The Susitna River Bering cisco is the most genetically distinct of the three populations (R. Brown, Service, personal communication). Consequently, they are a state species of concern (ADF&G 2006) based on significant biological data gaps related to the species. There is also an increasing commercial interest in this species nationally.

Eulachon are known to spawn in the lower river, but the upper extent of their distribution is unknown. There are two eulachon runs annually. The first initiates after ice break-up in late May, and the second migration occurs in early June. A study conducted in1983 recorded several hundred thousand eulachon during the first run, and several million returning eulachon during the second run (Barrett et al 1984). The documented upper extent of these return runs is approximately RM 50 of the Susitna River. Some of the returning eulachon enter tributaries including the Yentna River (Barrett et al 1984). In addition to supporting local fisheries, eulachon are a major prey item for the federally listed Cook Inlet beluga whale, and a significant source of marine-derived nutrients to the Susitna River. There is no genetic baseline for eulachon.

Susitna River rainbow trout support a valuable trophy sport fishery in the middle river. ADFG acquired recent telemetry data for one year of adult rainbow trout; however, the results of this information have not yet been summarized. Data gaps exist for rainbow trout related to spawning locations, overwintering areas, hatching and emergence timing, and rearing habitat (Rich Yanusz, ADF&G, personal communication). Currently, there is no genetic baseline for Susitna River rainbow trout.

Additional resource concerns for Susitna River resident and andromous species are outlined in part in the Service's adult and juvenile non-salmon anadromous, resident and invasive species study request (Service Study Request 14.1) previously submitted to FERC on May 31, 2012.

GENE-03 Finally, AEA's genetic sampling efforts should be stated to clearly include fish species found to be utilizing the *lower*, middle and upper Susitna River (RM 0-233).

AEA Objective 2. Contribute to the development of genetic baseline markers for each of the five species of Pacific salmon spawning in the Susitna River drainage.

GENE-04 The addition of genetic "markers" in this objective makes this a different study than intended; as well as a more expensive study. This objective should be rewritten to state that this study will "contribute to the development of genetic baselines for each of the five species of Pacific salmon spawning in the Susitna River drainage". Genetic markers are used to differentiate between species, or for use in differentiating a new species that does not already have markers developed.

ADF&G does have genetic markers, genetic samples, and completed analysis for Chinook salmon which should be considered as a limited baseline. Although this existing Chinook salmon genetic baseline is not complete, it does indicate that there is variation among populations of Susitna River Chinook salmon. There are eight genetic reporting groups for Upper Cook Inlet Chinook salmon. The eight reporting groups are further grouped into 2 broad-scale regions: 1) Northern (West, Susitna, Yentna, Knik and Turnagain groups, and 2) "Southern" (Kenai, Kasilof, and south Kenai Peninsula groups). Overall, within the Northern region, the Susitna group has the most divergent populations (Barclay et al 2012). And within the Susitna River genetic analysis demonstrate that Chinook salmon from Portage Creek and the Chulitna River are the most genetically unique in the basin (C. Habicht, ADF&G fisheries geneticist, personal communication).

Currently, there are no baseline genetic markers for coho salmon. ADF&G has a few Susitna River genetic coho salmon samples, but markers have not yet been developed in order to

differentiate between coho salmon populations. There are no existing genetic markers for chum or pink salmon. ADF&G has a limited genetic baseline for Susitna River sockeye salmon.
AEA Objective 3. For 2013 and 2014, quantify the genetic variation among upper and middle river Chinook salmon for use in mixed-stock analyses, including analyses of lower river samples of the entire Susitna Chinook salmon population.

GENE-05 This objective attempts to answer the question, "Are the Chinook salmon that spawn above Devil's Canyon genetically distinct?" AEA's (and ADF&G) Objective 3 cannot occur without some baseline distribution and biological information about the Chinook spawning in the extreme upstream areas of the Susitna, Talkeetna, and Chulitna River where the greatest genetic divergence is expected to occur. It is important to understand the biology of the [target] species so that potential sampling issues can be avoided as much as possible (Waples and Gaggiotti 2006). This information is a data gap for Susitna River Chinook salmon. Once the needed distribution and biological baseline is available, we recommend AEA follow a robust genetic sampling design in cooperation with the state and federal fish geneticists' recommendations.

If the Chinook salmon above Devil's Canyon are determined to be a genetically distinct spawning population, then a mark recapture study is needed to get a population estimate in order to identify the proportion Susitna basin Chinook passing/migrating above Devil's Canyon (above the dam site). A minimum of three years of mark-recapture data is necessary to determine an average number of fish migrating above the dam site. Multiple years of data are also needed in order to assess 1) temporal variation, 2) and run timing variation.

GENE-06 To assess population genetics stability, AEA should consult with Service and ADFG fisheries geneticists to establish a recommended number of genetic samples and number of years required to establish a temporal stability of allele frequencies. For smaller populations, such as the Chinook salmon above Devil's Canyon, more information is needed in order to answer that question. High statistical power is necessary when attempting to estimate the contribution of stocks which contribute, at small proportions, to a mixture in order to detect the presence of these stocks (Jasper et al 2009). Generally, statistical power is increased by increasing sampling sizes within strata. However, for small populations, sampling across one to two generations (e.g., 10 years) is more powerful in establishing generational and environmental effects and the effects of genetic drift (Waples 1990).

GENE-07 Susitna River Chinook salmon have a 5-7 year overlapping life history, so changes in gene frequency are relatively slow. This is because Chinook salmon age-at-return is widely spread out, such that spawning returns from any given year overlap with those from other year classes. Therefore, we recommend that genetic samples be collected for a minimum of five consecutive years in order to capture one generation of the Chinook salmon dominant 5-year age class (ADF&G 2012).

GENE-08 Some knowledge of effective population size (Waples 1990a; Waples 1990b) is also required to estimate proportional rates of exchange from allelic frequency data (Allendorf and Phelps 1981). Estimates of the effective spawning population of Chinook salmon above Devil's Canyon are needed to sort out the genetic differentiation. In order to best inform Federal resource agencies FPA authority, we recommend a generational timeframe for genetic sample collections in order to analyze:

1) stability of allele frequencies (Allendorf and Phelps 1981)

2) variation in effective parental numbers; as a means of estimating the number of spawners above Devil's Canyon (Waples 1990).

During the 2012 field season, genetic sampling efforts for Susitna River Chinook salmon above the proposed dam site were to occur through reconnaissance and structured collaboration between ADF&G and AEA. However, ADF&G staff was only able to collect one day (July 31, 2012) of Chinook salmon genetic samples. This one day of effort resulted in the collection of genetic samples from 10 (of 16 observed that day) Chinook salmon from Kosina Creek, located above the proposed dam site (ADF&G trip report memo, September 20, 2012). Additional collaborative opportunities exist for future genetic sample collection.

GENE-09 Genetic samples limited to 10 Chinook have heightened probability of indicating a high degree of variation from Chinook above the dam site. It is therefore, in AEA's best interest to support the request for adequate sample sizes over appropriate temporal and spatial scales. To support and ensure better collaboration toward this common goal, the Service urges AEA to meet with state and federal fisheries experts to develop robust sampling efforts that address resource agencies respective management authorities. This is also needed to appropriately inform the proposed Project of potential considerations related to facility design and construction.

AEA Objective 4. In 2013 and 2014, estimate the annual percent of juvenile Chinook salmon in selected lower river habitats that originated in the middle and upper Susitna River.

GENE-10 Similar to Objective 3, AEA's (and ADF&G) Objective 4 cannot occur without acquisition of baseline distribution and biological information about the Chinook salmon spawning in the extreme upstream areas of the Susitna, Talkeetna, and Chulitna River where the greatest genetic divergence is expected to occur. Without this baseline information, we do not know where the level of genetic distinction may exist or how to structure sampling efforts. ADF&G requested information specific to habitat utilization below Devil's Canyon by Chinook salmon progeny originating upstream of Devil's Canyon.

If the results of the Chinook salmon genetics studies conducted during the summer of 2012 indicate that the Chinook salmon spawning upstream of Devil's Canyon can be characterized as an identifiable genetic reporting group, then the Service recommends AEA conduct a study to estimate the percent of juvenile Chinook salmon downstream of Devil's Canyon that originated from upstream of Devil's Canyon by taking sufficient and representative genetic samples of these juveniles. Juvenile Chinook salmon have recently been observed above the proposed dam site (Buckwalter 2011), further substantiating study requests for juvenile Chinook salmon. The Service recommends this genetics-based approach over a traditional passive integrated transponder (PIT) tag study, where fry are marked upstream of Devil's Canyon with PIT tags, because there is no need to address mark–recapture handling and tag loss assumptions.

Additionally, we support ADF&G's request for a traditional mark-recapture study to be used to assess downstream movement of juvenile Chinook salmon from above Devil's Canyon, if the Chinook salmon upstream of Devil's Canyon are not an identifiable genetic reporting group.

Objectives not included in AEA's Fish Genetics PSP:

GENE-11 *ADF&G Objective 3: For 2 years, annually estimate the minimum adult escapement of Chinook that spawn upstream of Devil's Canyon.*

The Service recommends that this study objective be included in the project study request determination. We also request that annual spawning escapement estimates be conducted for a minimum of 3 years in order to assess: 1) temporal variation, and 2) run timing variation. Escapement numbers are so variable between years that a minimum of three years is necessary in order to provide some sense of this variation.

ADF&G Study Request # 1 Adult Chinook and coho salmon spawner distribution and abundance studies, requested specific objectives related to Susitna River coho salmon.

GENE-12

The Service supports and reiterates the request which addresses basic spatial and temporal biological information needed to begin to address genetic studies for Susitna River coho salmon. The related objectives should be included as follows:

> *Objective 5. "Estimate the in-river abundance of adult coho salmon in the Susitna River upstream of the confluence of the Yentna River for a minimum of three years."*
> *Objective 6. "Identify coho salmon spawning locations in the mainstem of the Susitna River upstream of the confluence with the Yentna River for a minimum of three years."*

The Service recommends that these objectives will be incorporated into the PSP in order to inform genetic sampling efforts should coho salmon be found to migrate above the proposed dam site. Like Chinook salmon, coho salmon are known to breach significant gradient and velocity impediments to reach spawning grounds.

Literature Cited

ADF&G (Alaska Department of Fish and Game). 2012. Draft Gap Analysis. Alaska Chinook Salmon Knowledge Gaps and Needs. October 08, 2012.

ADF&G (Alaska Department of Fish and Game). 2006. Our wealth maintained: a strategy for conserving Alaska's diverse wildlife and fish resources. Alaska Department of Fish and Game. Juneau, Alaska. xviii+824 p.

ADF&G (Alaska Department of Fish and Game) 1985. Genetic Policy. ADFG, FRED.

Allendorf, F. W. and S. R. Phelps. 1981. Use of allelic frequencies to describe population structure. Can. J. Fish. Aquat. Sci. 38: 1507-1514.

Barrett, B. M., F. M. Thompson and S. N. Wick. 1984. Adult anadromous fish investigations: May-October 1983. Susitna Hydro Aquatic Studies, report No. 1. APA Document No. 1450. Anchorage: Alaska Department of Fish and Game.

Barclay, A., C. Habicht, R. A. Merizon, and R. J. Yanusz. 2012. Genetic baseline for Upper Cook Inlet Chinook salmon: 46 SNPs and 5, 279 fish. Alaska Department of Fish and Game. Divisions of Sport Fish and Commercial Fisheries.

Buckwalter, J. D. 2011. Synopsis of ADF&G Upper Susitna drainage fish inventory, August 2011.

Jasper, J., C. Habicht, and W. Templin. 2009. Western Alaska salmon stock identification program, Technical Document No. 3. September 10, 2009.

Waples, R. S. 1990a. Temporal changes of allele frequency in Pacific salmon: implications for mixed-stock fishery analysis. Can. J. Fish. Aquat. Sci. 47.

Waples, R. S. 1990b. Conservation genetics of Pacific salmon. II. Effective population size and the rate of loss of genetic variability. 81: 267-276 p.

Waples, R. S. and O. Gaggiotti. 2006. Molecular Ecology. 15: 1419-1439.

8. Wildlife Resources

8.14. Waterbird Migration, Breeding, and Habitat Study

General Comments:

The U.S. Fish and Wildlife Service (Service) stated three primary objectives within our waterbird study request. These objectives are listed here along with a brief summary of how they are addressed within Alaska Energy Authority's (AEA) proposed study plan (PSP), with further detail below:

WTRBRD-06
- Objective 1 – Breeding Bird Use: Document, measure, and analyze occurrence, distribution, abundance, productivity, habitat use, and indices of waterbird numbers breeding in the Project area, so that potential impacts of habitat loss and disturbance on breeding bird number, by species, can be quantified. Most aspects of this objective, with the exception of Harlequin Duck, appear to be on track towards being met.

WTRBRD-07
- Objective 2 – Migration Use: Document, measure, and analyze occurrence, distribution, abundance, habitat use, and seasonal timing of waterbirds migrating through the Project area so that potential impacts of habitat loss, disturbance, and collision with infrastructure on birds flying across and/or using the Project area as stopovers during migration may be estimated. Stop-over use is being addressed, but unless a radar study occurs, the objectives concerning over-flying birds will not be met.

WTRBRD-08 MERC- 01
- Objective 3 – Mercury Risk Assessment: Support other related Susitna-Watana Project studies as needed, including the Piscivorous Wildlife and Mercury Risk Assessment. This objective is not being met at this time, which is of considerable concern to the Service.

Specific Comments by Topic

BREEDING SEASON

WTRBRD-09
We believe, that as of the October 4, 2012, interagency meeting on the Waterbird PSP, we have reached general agreement on most aspects of the breeding season survey, except with regard to Harlequin Duck. For most other species, and given that much of the Project-area terrain is difficult for flying transects and that there are a relatively finite number of lakes, we are in general agreement on the adequacy of a lake-to-lake pattern of aerial surveys to be run continuously and with the same methodology as the migration surveys. Surveys are planned for a minimum of 7-day intervals once breeding season is determined to have commenced, and will continue until more frequent surveys begin for fall migration.

We have not yet seen a detailed survey plan, but have the following requests:

WTRBRD-10
- Clearly describe how actual survey area and extent will be determined (e.g., how many lakes and which lakes?)

WTRBRD-11
- All actual flight lines should be recorded. It is critical that the boundaries and sizes of all surveyed lakes and any other survey areas be clearly delineated so that survey area can be calculated.

WTRBRD-12
- Use brood surveys and other data to back-date and estimate actual timing of spring migration's end, and commencement and end of breeding season each year. Take into account inter-species differences in timing.

WTRBRD-13
- Ensure that careful analyses address the relationship between the numbers or indices obtained and the actual populations targeted. How will such issues as timing and behavioral differences among species, turn-over rates, and variable visibility conditions be addressed?

WTRBRD-14 With regard to Harlequin Duck, this species is not reliably surveyed by the aerial survey methods proposed. While it is possible that we may come to agree that some aerial survey methodology will have to be considered adequate, further discussion about this species is warranted. Some ground-based surveys may be necessary, and may potentially be combined with riparian landbird/shorebird surveys, depending on timing and other factors. Survey effort and timing has been generally discussed as including two surveys sometime in May and two later in July or August for broods, but we expect that actual timing will be determined based on observed annual environmental conditions and breeding phenology indicators.

WTRBRD-15 There is general agreement between AEA and the Service, that the waterbird study area will likely be modified for Harlequin Ducks to include portions of streams that extend outside of the 2-mile buffer of the Project area. All potential Harlequin breeding streams that cross the Project area (i.e., footprint plus 2-mile buffer) should be surveyed entirely along the lengths of suitable habitat, whether or not that habitat (i.e., particular stream reach) extends outside the project area. This is because breeding birds may travel up and down their stream, and may be located off-site during a given survey.

MIGRATION USE

WTRBRD-16 The Service believes that as of the October 4, 2012, meeting we have reached agreement on the basic aspects of the sub-study that will target waterbirds using the Project-area habitats during migration. AEA and the Service generally agree that:

- the study area (Project footprint and same 2-mile buffer as described in the landbird/waterbird PSP comments) is appropriate as described;
- the concept of a "lake-to-lake" study pattern is appropriate, but details are still pending;
- survey intensity of every 5 to 7 days beginning in approximately mid-May for spring migration and early to mid-July through October for fall migration (with initial spring survey dates based on thaw degree days or other careful analysis of current local weather data, and, for fall, the timing results of the preceding breeding season surveys) is agreeable.

WTRBRD-17 The study area will be the same as that for breeding birds, and, as noted above, details remain to be worked out regarding the precise extent of lake coverage (i.e., how many and which waterbodies, and minimum size cut-off of waterbody to be surveyed). Analysis details also need to be discussed, including derivation of detectability indices and estimates of abundance, etc.

WTRBRD-18 The Service recommends that AEA develop and expand a draft proposal for a radar study that addresses birds flying across the Project area (with coordinated visual surveys). As discussed in the comments on the landbird/shorebird PSP, one of the Service's primary objectives is to survey birds flying across the Project area during migration. Because of the risk of collisions to birds in flight, including substantial long-term cumulative impacts, we continue to recommend

that surveys be conducted to identify and characterize migratory pathways in the Project area. We recognize that the geographic scale will be difficult to tackle with limited radar capabilities. At the October meeting, the use of radar at the dam site was verbally proposed by AEA contractors. This would presumably target all species, including landbirds, shorebirds, raptors and others, as well as waterfowl. With further discussion, the Service may find limiting the radar studies to the dam area as proposed sufficient, IF coupled with: a) appropriate analyses of existing information to help locate transmission lines in bird-safe areas, b) commitment to a well-researched and detailed plan to mark and micro-site all transmission lines in a bird-safe manner (i.e., avoiding cliffs or drainages, etc., that may be used by migrating birds), and c) commitment to a well-researched bird-safe lighting operations plan at all Project facilities.

PISCIVOROUS WILDLIFE AND MERCURY RISK ASSESSMENT

WTRBRD-19
MERC-02
WILD-3

The Service has requested that feathers of piscivorous birds using the Project area, including Belted Kingfisher and other species, be collected to provide the baseline information on current levels of mercury critical to a wildlife and mercury risk assessment. The Service has also requested that a study be conducted to determine enough details of these birds' diets (e.g., amount or percent fish) to sufficiently inform this risk assessment. We are not yet aware that these studies are being planned by AEA.

8. Wildlife Resources

8.15. Survey Study of Eagles and Other Raptors

RAPT-1 Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) addresses the U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled the same. The goal of our study request was to address Bald and Golden Eagles and other tree- and cliff-nesting raptors in order to characterize population, productivity, habitat use and other important aspects of local raptor species' life histories, so as to (1) inform predictions and quantifications of potential impacts that may result directly and cumulatively from the proposed Susitna-Watana Hydroelectric Project, and to (2) provide information required for a possible application(s) for federal Eagle Take (lethal or disturbance take – see below) and/or Eagle Nest Take Permits.

General Comments:

RAPT-2 The Service is satisfied that most objectives will be adequately met by following the basic study outline proposed in AEA's PSP. Two exceptions where objectives are not adequately addressed yet are the lack of intent to survey for early nesting owls, and the lack of any study plan to collect feathers, dietary information, or other data necessary to conduct a mercury risk assessment for fish-eating birds, including Bald Eagles.

Specific Comments by Subsection:

RAPT-3 MERC-03 *Mercury toxicity*
The most important issue that remains to be addressed is that there has been no intent reflected in any of the Migratory Bird study plans, including the Raptor study plan, to collect feathers and dietary information about Project-area fish-eating birds, including Bald Eagles, a species that may be at risk from accumulation of mercury. See PSP Section 5.12. Mercury Assessment and Potential for Bioaccumulation Study.

RAPT-4 *Owl surveys*
We have also requested meeting with AEA during the winter to finalize the details of the overall raptor study plan. Details regarding owl-related issues left to consult on include:

- Further discussion of surveys for early nesting owls (and how these may be combined with the landbird surveys).
- The selection of specific study areas for migration routes that may occur along planned transmission line routes.

RAPT-5 *Eagle surveys and permits*
Further refinement may be required for survey and analysis details for all aspects of the study plan, including information gleaned from 2012 survey experience and results, and any new information regarding the National Eagle Take Permit program. While no substantive new information is available today on the Permit Program, it is a new and evolving Program, and additional information may come from the Service's Washington D.C. Headquarters over the coming winter.

8. Wildlife Resources

8.16. Breeding Survey Study of Landbirds and Shorebirds

General Comments:

BREED-09 The U.S. Fish and Wildlife Service's (Service) objectives, as outlined in our May 2012 study request, include conducting field surveys and in-house assessments to aid estimation of potential Project impacts on migratory shorebirds and landbirds and their habitats, including birds breeding in the Project area, migrating across it, and over-wintering there. A final important objective is to support other Susitna-Watana Project studies including a Piscivorous Wildlife and Mercury Risk Assessment. The July 2012 Alaska Energy Authority (AEA) proposed study plan (PSP) did not include objectives to study birds migrating across the study area, or over-wintering birds. The AEA PSP also does not adequately meet the shared (between the Service and the AEA) objectives for breeding bird studies or the Piscivorous Wildlife and Mercury Risk Assessment.

AEA, the Service, and other stakeholders met on September 6, 2012, to discuss differences regarding the landbird and shorebird studies. While we have not yet had an opportunity to review details of a revised written document, we currently believe that some important differences were verbally resolved as of the end of that meeting, including: the intensity of breeding season surveys; the use of distance estimation techniques in order to estimate densities; and appropriate objectives and basic survey methodologies regarding "over-wintering" birds. It appears that other important study plan components may still be missing or inadequate, including, but not limited to: a documented plan or agreement to survey birds migrating across the area in order to help assess risk of collision with Project infrastructure; an adequately detailed plan to survey riparian-associated breeders; and appropriate support for the Mercury Risk Assessment. Details of these and other remaining differences are specified below.

Specific Comments by Topic

BREEDING BIRD SURVEYS

BREED-10 *Wildlife Habitat Mapping.*
The PSP proposes to use Viereck et al. (1992) to classify vegetation, which may be insufficient to address migratory bird habitat use. We recommend that a combination of Kessel's bird habitat classification and Viereck et al.'s systems may be more appropriate, and recommend utilizing Alaska Landbird Monitoring Survey (ALMS) developer Colleen M. Handel's (USGS) experience with this.

WLDHAB-2 Also, AEA proposes to calculate average occurrence figures for each bird species in each habitat type, and to derive 4 habitat categories – low, mid, high, and negligible. It should be noted that, when deriving these habitat values, it will be important to avoid confusing "not seen" and "not surveyed" with "not present" and "not using" data results.

BREED-11 *Study Area.*
We are in agreement that the primary study area is within a modified 2-mile buffer zone around the Project footprint. Modifications include shortening the buffer width in a few areas where there are prominent barriers or boundaries on the landscape, such as not crossing the Chulitna River.

BREED-12 It would be beneficial to set up comparison plots for field surveys in off-site areas such as Denali or the Copper River Basin for purposes of examining relative abundances and even estimations of habitat availability for calculations of Project impacts on long-term productivity. We will forego a formal request for this, although AEA should recognize that this may mean that any future assertions about relative "values" of Project-area habitat to birds may not be scientifically supported.

BREED-13 *Estimations of Breeding Bird Densities.*
It is critical that an objective of this study be a quantification of breeding birds using the Project site that is more rigorously supported than merely an estimation derived from assumed habitat associations. At the end of our September discussion it appeared that AEA had agreed to the use of distance estimation methodology in order to achieve this quantification.

BREED-14 Incorporation of detection probabilities according to habitat types will be needed in order to address some of the deficiencies of distance estimation methodologies. Further discussion and work is needed in order to ensure survey and analysis details are clear and agreed to prior to the initiation of the first field season.

BREED-15 *Survey Timing and Level of Effort.*
Unfortunately, it does not appear that an analysis has been conducted to determine the ideal number of point counts per habitat type actually needed to provide necessary data per species. In the absence of that analysis, however, we believe that an agreement has been tentatively reached to conduct daily early-morning surveys for fifteen days in April and then basically continuously (with allowances for weather days) from early to mid-May through mid-June. A minimum of four two-person crews will each conduct at least eight point surveys per morning.

BREED-16 It is expected, and was generally agreed to, that exact timing of onset of surveys will be based each year on careful examination of local conditions (e.g., snowmelt, current reports of bird movement and nesting timing locally and off-site, etc.).

BREED-17 Timing and effort protocol issues that may remain as sources of difference between the Service and AEA include our recommendations for double count observer methodology to help address detectability biases, and for subsets of points to be replicated within a year and between years to help account for local inter-annual variation in timing of bird-breeding. Also because of the potential magnitude of inter-annual variation, we stress that two years of data is not likely to be sufficient to best meet study objectives.

BREED-18 *General Methodology.*
It is expected that ALMS protocol for conducting surveys be followed. For example, surveys should commence within 30 minutes of local sunrise and cease within 4-5 hours of initiation.

BREED-19 *Collection of Vegetation Data.*
Collection of vegetation data during point counts, especially for two-person crews using double observer methodology, is not appropriate. We are unclear at this time how or when AEA plans to collect per-point vegetation data or precisely what variables will be collected.

BREED-20 *"Over-Wintering" Birds.*
We have come to general agreement that collection of over-wintering use will not occur, but that resident birds (including woodpeckers, owls, chickadees, etc.) will be targeted for breeding

surveys during appropriate (i.e., for each given year, based on actual local peaks of resident bird breeding activity) spring (April and May) dates. Exact level of effort for these birds has not yet been determined, but we recommend at least two additional weeks of survey (prior to those identified above in *Survey Timing and Level of Effort*).

BREED-21 *Species of Conservation Concern.*
Rusty Blackbird, Olive-Sided Flycatcher, and several shorebird species are Service Species of Conservation Concern for Bird Conservation Region 4, which includes the Project site. Special attention should be paid in development of survey plan details to target these species (i.e., their preferred habitat types) as much as practical, given their relatively sparse distribution across the landscape. We appeared, based on general discussion at the September meeting, to be in agreement on this point but further detailed discussion is necessary as point count locations are being pre-mapped.

BREED-22 *Swallows.*
Because cliff-nesting swallow species are known to breed in the banks of the Susitna River (and potentially elsewhere in the Project footprint) where Project inundation will occur, yet the general point-count methodology to be employed for most other landbirds and shorebirds are not recommended for surveying such birds, we recommend that survey methods be employed to specifically target these colonies, including the use of boat surveys of the Susitna River banks. It is unknown whether or not AEA has agreed to this.

BREED-23 *Other Riparian-Associated Birds.*
We have jointly agreed that several species of locally-significant (i.e., regularly using or dependent upon habitats that will be lost or otherwise impacted by the Project) landbirds and shorebirds are not commonly recorded in the standard point-count methodology, and that it is important to conduct additional surveys to target these species. Besides swallows as discussed above, these include Belted Kingfisher, American Dipper, Semipalmated Plover, Solitary Sandpiper, Spotted Sandpiper, and Wandering Tattler.

It is therefore expected that additional surveys will be conducted to target these species. The additional surveys should include, at minimum, appropriately-timed point count *and linear* surveys along all impacted streams in appropriate habitat. Details and agreement, including precise list of species to be targeted, and any use of linear surveys, remain to be worked out.

BREED-24 *Owls and Hawks.*
Small owls and hawks, including Short-Eared Owl which is a *Partner- in-Flight* species of conservation concern due to apparent continental population declines, are also not adequately surveyed by the standard point-count methodology proposed. We expect that sufficient efforts will be made to survey these species so that, at minimum, an adequate measure of abundance can be obtained, but details of the AEA plan on this point are not yet clear.

BREED-25 *MIGRATION SURVEYS*

One of the Service's primary objectives is to survey birds flying across the Project area during migration, and using the area for stop-overs during migration. Identifying and describing flight path use is critical for determining risk of direct mortality from collisions with Project infrastructure (e.g., power transmission lines and the dam itself, which may have lights that compound random collision risks with a disorienting attractant). At this time, no agreement has

been reached to conduct surveys either to identify numbers/species of landbirds or shorebirds a) flying across the proposed transmission corridors and dam site during migration or b) using the Project area as migratory stop-over(s).

Because of the risk of collisions to birds in flight, including substantial long-term cumulative impacts, we continue to recommend that surveys be conducted to identify and characterize migratory pathways in the Project area. Because most of the species in question are primarily nocturnal migrants, the use of radar is warranted. We recognize that the geographic scale will be difficult to tackle with limited radar capabilities. At the October 4, 2012, meeting to discuss the Project waterfowl surveys, the use of radar at the dam site was verbally proposed by AEA contractors. This would target all species, including landbirds and shorebirds. The Service may find limiting radar studies to the dam area sufficient, IF these studies are coupled with: a) appropriate analyses of existing information to help locate transmission lines in bird-safe areas; b) commitment to a well-researched and detailed plan to mark and micro-site all transmission lines in a bird-safe manner (i.e., avoiding cliffs or drainages, etc., that may be used by migrating birds); and, c) commitment to a well-researched bird-safe lighting operations plan at all Project facilities.

Regarding stop-over site research, undoubtedly many birds (species and individuals) use the large Project footprint and general Project area for stop-overs during migration. We are, however, unaware of any particular local site of concentration, and acknowledge the tremendous effort that would be required to identify and quantify stopover habitat use (particularly for landbirds), given the vast and previously-unstudied scale of the Project area. Therefore we will agree that surveys focused on describing landbird and shorebird stop-over habitat use may not be conducted at this time.

PISCIVOROUS WILDLIFE AND MERCURY RISK ASSESSMENT.

BREED-26
MERC-04

The Service has requested that feathers from piscivorous birds using the Project area, including Belted Kingfisher and other species, be collected to provide the baseline information on current levels of mercury critical to a wildlife and mercury risk assessment. The Service has also requested that a study be conducted to determine enough details of these birds' diets (e.g., amount or percent fish) to sufficiently inform this risk assessment. We are still in the process or working with AEA to adequately develop this study.

9. Botanical Resources (RSP 11.)

9.1 to 9.4. Introduction to Summary of Consultation (RSP 11.1 to 11.4.)

General Comments:

The U.S. Fish and Wildlife Service's (Service) did not request this introduction to the Botanical Resources, however, this introduction helps set the stage for the Botanical Resources studies and we appreciate Alaska Energy Authority (AEA) including these introductory sections. Our comments are based on the Proposed Study Plan (PSP) and, in part, on AEA's Draft Revised Study Plan (Draft RSP) dated 23 October 2012. Since we have not had sufficient time to fully evaluate these recently available Draft RSPs, we reserve the opportunity for additional comment. Section numbering follows the PSP for consistency with our other PSP comments, but includes the revised Draft RSP numbering in parentheses.

The section numbering for the Draft RSPs 11.5, 11.6, and 11.7 all start with 11.1, which is confusing and suggests the automatic numbering needs to be reset for each of these studies. Please use the correct section numbers in future drafts. Our comments will be based on the correct number, substituting 11.x with the correct section number.

Please spell-out the first reference to acronyms in major sections (e.g., "RSP" referenced in the second sentence of Draft RSP Section 11.3, and "PSP" referenced in the first sentence in the Draft RSP Section 11.1).

Some sections of text are nearly identical across Draft RSPs 11.5, 11.6, and 11.7 (the sections reviewed by the Service for PSP comments). This is necessary so the studies can stand alone. However, if we provide comments in one study that shares nearly identical text with other studies, we request these comments be addressed in the other studies also, even if we did not repeat our comments in the other studies.

Specific Comments by Subsection:

9.1. Introduction (RSP 11.1.): The introduction refers to five studies with a brief summary starting with: "Two of," "A third," "A fourth, and "a fifth" study. It would be helpful if the study sections were included in parentheses. This is especially the case for the first reference to "Two of these studies," which is followed by a description involving three study elements that could be confused with the three Draft RSPs 11.5, 11.6, and 11.7.

Much of the discussion between AEA and the stakeholders to date has focused on the mapping aspect of the Botanical Resources studies, leaving the impression the Botanical Resources is solely a mapping effort. Lost in the detailed discussions of the many AEA studies has been the modeling and predictive component of the Botanical Resources studies. For example, the Service was under the impression the Riparian Instream Flow Study (PSP 6.6 / RSP 8.6) would be predicting potential riparian community changes resulting from Project operations. However, the "third study" in the Botanical Resources section appears to involve modeling efforts to predict potential changes. Perhaps the Botanical Resources section with its substantial mapping effort would be the study best suited to predicting Project effects, but this needs to be made very clear in both studies. The Service's preference would be to retain the predictive component for the riparian resources in the Instream Flow Studies like the aquatic resources.

Similarly, this may also be the case for predicting wildlife habitat changes due to Project operations.

9.3. Resource Management Goals and Objectives (RSP 11.3): The third paragraph references the Aleutian shield fern (*Polystichum aleuticum*) as the only plant species in Alaska listed as endangered under the federal Endangered Species Act (please include underlined text).

9.4. Summary of Consultation with Agencies, Alaska Native Entities and Other Licensing Participants (RSP 11.4):

Table 9.4-1. Summary of consultation on Botanical Resources study plans (RSP Table 11.4-1): We appreciate this consultation summary, but the Draft RSP table only includes comments since the PSP. The table title should be revised to be more specific, or the table should be inclusive since consultation began. Our comments regarding the Comments/Responses in this table are included in their respective Draft RSP sections.

9. Botanical Resources (RSP 11.)

9.5. Vegetation and Wildlife Habitat Mapping Study in the Upper and Middle Susitna Basin (RSP 11.5.)

General Comments:

The U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled *Vegetation and Wildlife Habitat Mapping Study* is identical to Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) title, however, the Draft Revised Study Plan (RSP) title listed above more accurately describes the study scope. Our comments below are based on the PSP and, in part, on AEA's Draft RSP dated 23 October 2012. Since we have not had sufficient time to fully evaluate this recently available Draft RSP, we reserve the opportunity for additional comment. Section numbering follows the Proposed Study Plan (PSP) for consistency with our other PSP comments, but includes the revised Draft RSP numbering in parentheses.

VWHAB-01 A number of terms are used to qualify the resolution of aerial/remote-sensed imagery (high-, moderate-, fine-scale) throughout the study plan. Please provide a pixel resolution the first time each term is used. Besides image resolution, the type and wavelength bands used for photo interpretation, such as true color, false color and color infrared, should be discussed.

The section numbering for the Draft RSP 11.5 all start with 11.1, which is confusing and suggests the automatic numbering needs to be reset for this study. Please use the correct section numbers in future drafts. Our comments will be based on the correct number, substituting 11.1.x with the correct section number (11.5.x).

Specific Comments by Subsection:

The following review of AEA's proposed Vegetation and Wildlife Habitat Mapping Study plan uses the structure of the plan and compares the plan to the USFWS's study-request objectives to determine if our intent is met, where improvements can be made, and which requested objectives are not addressed.

AEA General Description of the Proposed Study (Draft RSP):

VWHAB-02 The general description of the study sets the stage for the study objectives, methods and products. The description, however, describes a mapping study and does not include the second objective to quantify potential impacts to vegetation and wildlife habitats. This information should be included in the general description to more adequately describe the full scope of the study.

AEA Study Goals and Objectives (Draft RSP): The overall goals of the vegetation and wildlife habitat mapping study are to prepare baseline maps of the existing vegetation and wildlife habitats in the upper and middle Susitna basin (upstream of Gold Creek).

The Service did not provide an overall goal, and instead merged the goals and objectives into a

bulleted list similar to the AEA's objectives discussed below. The scope of AEA's PSP included mapping the entire Susitna-Watana Hydroelectric Project (Project) area, which could be interpreted as including the entire Lower, Middle and Upper Susitna River. This refinement in the Draft RSP scope to the middle and upper Susitna basin upstream of Gold Creek is appropriate, although it might also help to mention the Riparian Study (PSP 9.6 / Draft RSP 11.6) will map the floodplain below the proposed dam.

VWHAB-03 AEA's Draft RSP objectives have changed somewhat from the PSP objectives, possibly due to refinements in the scope of this and the other Botanical Resources studies. The two Draft RSP objectives (map vegetation and wildlife habitat, and quantify impacts to vegetation and wildlife habitats) are similar to three of our five study request objectives. Our fifth requested study objective (develop mitigation measures) is likely more appropriate for a later stage in the licensing process.

VWHAB-04 Not addressed in AEA's Draft RSP objectives is our 31 May 2012 study request to compare the vegetation mapping results with the 1987 vegetation mapping study conducted in the original Susitna Hydroelectric Project area. The Service is concerned that vegetation and wildlife habitat changes during Project operations may be attributed incorrectly to either Project operations or to some other less obvious influence. The Botanical Resources Draft RSPs provide numerous examples where the 1980s data will be used as a starting point, but these data will need to be updated due to landscape changes over time such as fires, insect outbreaks, and permafrost degradation. The justification for AEA not including this objective was discussed at subsequent technical work group (TWG) meetings (e.g., different methods and study areas), and the Service agreed this objective could be addressed at a later date if subsequent vegetation and wildlife habitat changes may be due to less obvious influences. However, without knowing the trajectory of gradual vegetation and wildlife habitat change before the Project, the cause for any changes during Project operation may be questioned.

VWHAB-05 *AEA Study Area (Draft RSP): The proposed study area for the mapping of vegetation and wildlife habitats consists of a 4-mile buffer zone surrounding those areas that would be directly altered or disturbed by Project construction and operations…[, and] include the proposed reservoir impoundment zone, areas for infrastructure of the dam and powerhouse and supporting facilities, the proposed access route and transmission-line corridors, and materials sites (Draft RSP 11.5.3).*

The Service concurs with reducing the buffer zone from our suggested 5 mile width in our study request to 4 miles. We also appreciate the reference to the Riparian Study (Draft RSP Section 11.6) addressing potential impacts in the floodplain downstream of the proposed reservoir. For the RSP, the word "proposed" should be used only sparingly for the few remaining technical details still under discussion in the TWGs (and the "proposed" dam). Any detail still referred to as "proposed" in the RSP suggests the study plan is still under development.

AEA Methods (Draft RSP):

VWHAB-06 AEA's methods do not clearly follow the objectives, making it difficult to evaluate the appropriateness of the methods. The methods appear adequate; however, we recommend

AEA reorganize the methods to address the objectives. Our comments below are organized by objective, with references to AEA's section numbers in the Draft RSP.

VWHAB-07 If the units of ecological importance mentioned in the introductory paragraph for the methods will be defined in another study, this study should be referenced to help set the stage for collaboration between studies. Please spell-out the first reference to acronyms in major sections (e.g., "ITU" referenced in the second paragraph of Draft RSP Section 11.5.4).

AEA Objective 1 and Methods (Draft RSP): Identify, delineate, and map vegetation and wildlife habitat types in the upper and middle Susitna basin using the vegetation map prepared in the 1980s for the Alaska Power Authority's Susitna Hydroelectric Project (APA Project) as a starting point, and updating that mapping to reflect current conditions as indicated on recent aerial imagery for the study area.

VWHAB-08 Objective 1 is addressed in the Draft RSP sections for ITU Mapping and Derivation of Wildlife (11.5.4.2), and Field Surveys (11.5.4.3). There is substantial detail in the first section discussing how the 1987 data will be updated, but the final product is unclear. We understand the final product at the end of the study will be based on a combination of ITU (citation required), a Viereck Level IV (Viereck et al. 1992) classification, and wetland delineation (Environmental Laboratory 1987, U.S. Army Corps of Engineers 2007), using 2013 high-resolution imagery for the entire study area with a minimum mapping polygon size of 1.0 acres for vegetated areas and 0.25 acres for waterbodies. For consistency with the Wetland Mapping Study (Draft RSP 11.7), the wetlands classification should also include the Cook Inlet classification (Gracz 2011) with modifications as required for the Susitna River basin. The data collected at ground-reference plots will follow the methods required to delineate wetlands (Environmental Laboratory 1987, U.S. Army Corps of Engineers 2007) for wetlands, and the methods described in this section for non-wetlands. The methods for ground-reference plots in wetlands is well documented, however, the categories used for classifying non-wetlands such as visual cover, plant community structure, physiography, surface form, microtopography, site disturbances, and plant phenology should be described so they can be evaluated.

VWHAB-09 The methods for deriving wildlife habitat types need additional detail. What wildlife species will be chosen, how will their habitat criteria be defined, and who will be involved in this process? Including elements of Kessel's bird habitat classification system for Alaska (Kessel 1979) would help, but how will other wildlife habitat needs for other species be determined? The Service has concluded a potential report by the USGS comparing Kessel's classification with Viereck's Level IV classification was never prepared, so AEA's proposal to prepare a "crosswalk" between the two classification systems will be a valuable addition to this portion of the methods.

AEA Objective 2 and Methods (Draft RSP): Quantify the potential direct, indirect, and cumulative impacts to vegetation and wildlife habitats from Project construction and operations.

VWHAB-10 WLDHAB-1 Objective 2 is addressed in the Draft RSP section for Impact Assessment (11.5.4.4). The GIS component of this analysis is straightforward. The methods for ranking habitat value for each bird and mammal species of concern are described in the Evaluation of Wildlife Habitat Use Study (Draft RSP Section 10.19), which is appropriate if one of the objectives for that RSP is to provide this ranking. Addressing the downstream effects on riparian habitats in the Draft RSP Section 11.6 may also be appropriate, however the Service was under the impression the

RIP-02

Riparian Instream Flow Study (PSP 6.6 / RSP 8.6) would be predicting potential riparian community changes resulting from Project operations (See our comments in that section for additional details).

AEA Reporting and Data Deliverables (Draft RSP):

VWHAB-11 For the pdf vegetation and wildlife habitat map deliverables, the Service recommends providing these products in geospatial pdf, so a sophisticated GIS program would not be required to readily identify coordinates on the maps.

AEA Schedule and Study Interdependencies (Draft RSP):

VWHAB-12 Will 2014 include additional field sampling in areas without high-resolution imagery until late 2013? Perhaps including a rough estimate of the area without high-resolution imagery would suggest how much additional work would be required?

VWHAB-13 Why is 2012 included in the timeline for Draft RSP Table 11.5-1 if no activities are scheduled or performed in 2012?

VWHAB-14 The Draft RSP methods suggest the Study Interdependencies figure (Draft RSP Figure 11.5-2) should include an input from the Evaluation of Wildlife Habitat Use Study (Draft RSP Section 10.19) for the bird and mammal species of concern habitat ranking. This figure suggests the GIS data layer for wildlife habitats will be developed without interaction with the Evaluation of Wildlife Habitat Use Study.

Literature Cited

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, U.S. Army Engineer Waterway Experiment Station, Vicksburg, MS. 90 pp + appendices.

Gracz, M. 2011. Cook Inlet Lowland Wetlands. Available from http://cookinletwetlands.info/ Accessed September 2012.

Kessel 1979. Avian Habitat Classification for Alaska. The Murrelet 60(3):86-94. *http://www.jstor.org/stable/3534270?origin=JSTOR-pdf*

U.S. Corps of Engineers (USACE). 2007. Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region Version 2.0. Wetlands Regulatory Assistance Program, U.S. Army Engineer Research and Development Center, Vicksburg, MS. 72 pp. + appendices.

Viereck, L.A., C.T. Dyrness, A.R Batten, and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 pp.

9. Botanical Resources (RSP 11.)

9.6. Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam (RSP 11.6.)

General Comments:

RIP-03 The U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled *Riparian Habitat Mapping Study* suggests a much stronger emphasis on mapping than Alaska Energy Authority's (AEA) Draft Revised Study Plan (RSP) title listed above. Our 31 May 2012 Riparian Habitat Mapping Study request envisioned primarily a mapping effort using products from other studies to visually display, in map format, the type and aerial extent of predicted riparian habitat changes resulting from operations of the Susitna-Watana Hydroelectric Project (Project). The Proposed Study Plan (PSP) and the Draft RSP go beyond the inventory and display of riparian resources by collecting *"the necessary data to enable predictions of how development of the Project could alter downstream riparian areas."* Collecting data to enable predictions of riparian and floodplain changes is a crucial objective in our 31 May 2012 study request entitled *Riparian Instream Flow Study*, and is in line with the data collection objectives to predict Project effects in AEA's Fish and Aquatics Instream Flow Study (Draft RSP 8.5). Moreover, collecting data to enable Project-related predictions in this Botanical Resources study is not in line with AEA's other Botanical Resources studies which rely upon products from other studies to spatial map potential Project-related effects on botanical and habitat resources.

At the 24 October 2012 Technical Workgroup (TWG) meeting, AEA stated their Riparian Instream Flow Study Plan would follow the structure of the Service's study request, which included an objective to characterize the water-level regime required to maintain floodplain and riparian plant communities, and then predict potential plant community change resulting from Project operations. Although informal remarks by AEA that the Riparian Instream Flow research team was working closely with the Riparian Botanical Resources research team to address our study request objective, it was not made clear our study request objective had been moved to the Botanical Resources. Subsequently, this objective was never discussed in the Botanical Resources TWG meetings, and there was never sufficient time in the Instream Flow TWG meetings to adequately discuss this objective's methods. The USFWS recommends assigning the data collection and analysis portion of this objective to the Riparian Instream Flow study like the Fish and Aquatic Instream Flow study. The Instream Flow TWG meetings have been where these topics have been discussed in detail, not the mapping efforts in the Botanical Resources TWG meetings. Upscaling the riparian habitat predictions from the Riparian Instream Flow study to the entire riparian and floodplain downstream of the proposed dam, however, could be a legitimate element of the Riparian Botanical Resources study like the Draft RSPs for the Vegetation and Wildlife Study and for the Wetlands Study. However AEA eventually chooses to

RIP-04 assign this objective, the Service recommends that AEA conduct a TWG meeting with sufficient time allocated to discuss the proposed methods for predicting riparian habitat changes before they are finalized in the RSP.

RIP-05 Riparian areas and floodplains are often the same; however, many people visualize riparian areas as a narrow band immediately adjacent to streams and rivers. We envision this study including the entire floodplain, and not simply a narrow zone along the Susitna River. To help minimize this potential misconception, the Service recommends revising the study plan title and discussion to include the word "floodplain."

RIP-06 A number of terms are used to qualify the resolution of aerial/remote-sensed imagery (high-, moderate-, fine-scale) throughout the study plan. Please provide a pixel resolution the first time each term is used. Besides image resolution, the type and wavelength bands used for photo interpretation, such as true color, false color and color infrared, should be discussed.

Since we have not had sufficient time to fully evaluate this recently available Draft RSP, we reserve the opportunity for additional comment. Section numbering follows the Proposed Study Plan (PSP) for consistency with our other PSP comments, but includes the revised Draft RSP numbering in parentheses. The section numbering for the Draft RSP 11.6 all start with 11.2, which is confusing and suggests the automatic numbering needs to be reset for this study. Please use the correct section numbers in future drafts. Our comments will be based on the correct number, substituting 11.2.x with the correct section number (11.6.x).

Specific Comments by Subsection:

The following review of AEA's proposed Riparian Vegetation Study Downstream of the Proposed Susitna-Watana Dam uses the structure of the plan and compares the plan to the Service's study-request objectives to determine if our intent is met, where improvements can be made, and which requested objectives are not addressed.

AEA General Description of the Proposed Study (Draft RSP):

The general description of the study sets the stage for the study objectives, methods and products. Our concern about which RSP will be assigned the second activity to collect data to enable Project-related riparian habitat changes is discussed above in the General Comments.

RIP-07 *AEA Study Goals and Objectives (Draft RSP): The overall goals of the riparian vegetation study are to prepare baseline maps of local-scale riparian ecosystems (riparian ecotypes), wetlands, and wildlife habitat types in areas downstream from the proposed ~~for the~~ Project dam site, and to assess the extent to which the Project will alter vegetation succession, wetlands, and wildlife habitats in riparian areas of the Susitna River.* (strikethrough for suggested deletion)

The Service did not provide an overall goal, and instead merged the goals and objectives into a bulleted list similar to AEA's objectives discussed below. To help minimize potential confusion about the scope among studies, it might be helpful to expand upon the sentence describing assessment of impacts to riparian ecotypes, wetlands, and wildlife resources.

RIP-08 The Draft Botanical RSPs make a distinction between their study area boundaries, including Gold Creek and the proposed dam site. How does this study differ from the Vegetation and Wildlife Habitat Mapping Study and the Wetland Mapping Study (Draft RSPs 11.5 and 11.7)?

RIP-09 AEA's Draft RSP first and third objectives are similar to three of the four objectives in our 31 May 2012 study request (identify and map riparian communities, quantify potential loss of riparian habitats, and assess potential changes in riparian habitats). Although our 31 May 2012 study request included elements in our objectives similar to AEA's second objective (characterize riparian physical and ecological processes), as the study plans evolved during TWG discussions, the Service now believes AEA's second objective would be more appropriate in other studies focused on characterizing physical and biological processes. The products from

these studies would then be used by the Botanical Resources studies to upscale and map the predicted plant community/habitat changes potentially affected by the Project. Our fourth requested study objective (develop mitigation measures) is likely more appropriate for a later stage in the licensing process.

AEA Study Area (Draft RSP): [The] downstream location [of the study area] will be determined (in the riparian instream flow study … As a starting point for delineating the lateral extent of the riparian vegetation study area, the extent of riverine physiography along the Susitna River will be mapped. Riverine physiography includes those areas of the valley bottom directly influenced by semi-regular to irregular overbank flooding (~5–25 year intervals), and will include off-channel water bodies).

RIP-10 The Service recognizes the downstream limit of the study area is still under discussion, and we look forward to participating in this discussion. For the lateral extent of the study area we requested the 100-year floodplain plus an additional buffer in our 31 May 2012 study request. The Draft RSP lateral extent proposed above for about a 5- to 25-year floodplain study area is likely barely equal to the effective recurrence interval for riparian forest establishment, and based on the 2012 flood event shortly before our October TWG site visit, would not extend very far into or even into some floodplain forest communities. Few critical structures are engineered for these relatively frequent and less damaging (environmentally rejuvenating) events. Critical structures are often engineered for 100-year or more events, so we don't understand why the environmental health cannot also be conservatively engineered by extending the study area to at least the 100-year floodplain width. In addition to considering surface-water flooding to determine the study area width, we recommend including the area of groundwater potentially influenced by Project operations. For the riparian study, the width should be at least as wide as the expected area of groundwater within the maximum depth of all plant roots and influenced by Project operations.

AEA Methods (Draft RSP):

AEA's methods do not clearly follow the objectives, making it difficult to evaluate the appropriateness of the methods. The methods appear adequate; however, we recommend AEA reorganize the methods to address the objectives. Our comments below are organized by objective, with references to AEA's section numbers in the Draft RSP.

RIP-11 Please spell-out the first reference to acronyms in major sections (e.g., "ITU" referenced in the first paragraph of Draft RSP Section 11.6.4). We understand the wetlands in this study will be classified in the same manner as wetlands in Draft RSP Section 11.7 (Wetland Mapping Study), except without the functional analysis. If this is the case, please clarify in the RSP.

RIP-12 *AEA Objective 1 and Methods (Draft RSP): Identify, delineate, and map riparian ecotypes, wetlands, and wildlife habitats downstream from the Watana Dam site.*

Objective 1 is addressed in the Draft RSP sections for Developing Mapping Materials (11.6.4.1), Field Surveys (11.6.4.2, excluding the unnumbered Intensive Study Reaches and Sediment Aging sections), and ITU Mapping (11.6.4.3). We understand the final product at the end of the study will be based on a combination of ITU (citation required), a Viereck Level IV (Viereck et al.

1992) classification, and wetland delineation (Environmental Laboratory 1987, U.S. Army Corps of Engineers 2007), using 2013 high-resolution imagery for the entire study area with a minimum mapping polygon size of 1.0 acres for vegetated areas and 0.25 acres for waterbodies. These methods are essentially identical to the methods in the Vegetation and Wildlife Mapping Study (Draft RSP 11.5). For consistency with the Wetland Mapping Study (Draft RSP 11.7), the wetlands classification should also include the Cook Inlet classification (Gracz 2011) with modifications as required for the Susitna River basin. Although a formal wetland determination and functional analysis will not be conducted downstream of the propose dam, the wetlands methods and classification will be essentially identical to the methods in the Wetland Mapping Study (Draft RSP 11.5).

AEA Objective 2 and Methods (Draft RSP): In coordination with the instream flow, ice processes, and riverine geomorphology studies, characterize the physical and ecological processes downstream from the Watana Dam site that are likely to affect vegetation succession in riparian areas.

RIP-13 Objective 2 is addressed in the Draft RSP section for Field Surveys (11.6.4.2, unnumbered Intensive Study Reaches and Sediment Aging sections). For readers unfamiliar with the complex details of the various RSPs, the methods presented here may seem out of place. There is no justification for "Intensive Study Reaches" (now referred to as Focus Areas). For reasons like this and the ones discussed above, the Service recommends this section be moved to the Riparian Instream Flow Study (Draft RSP 8.6). Our comments here are preliminary and will likely be updated after reviewing Draft RSP 8.6, which was released too late to review. Whichever study takes the lead for this objective, the lead study should provide the detailed methods, and the supporting study/studies should not include much more than brief summary of the methods and a reference to the lead study. Repeating the methods in a study not responsible for the data collection and analyses is unnecessary and risks confusion if the methods differ or are inadequate in one of the studies.

RIP-14 Phrases like "Presently, the … methods are…" are unacceptable for what will become the RSP. At this stage the methods should be finalized, or a reasonable justification provided for why the TWGs are still working on the final details.

RIP-15 Where possible, references should be provided for methods and categories such as variably-sized circular plots. Without references with additional details, duplicating this study will likely be very difficult.

RIP-16 Line intercept is a standard method for sampling shrub cover, and not often used for shrub density. Transect lengths are also typically much longer than the sum of the two 6-meter transects. The PSP included forest canopy cover. Has forest canopy cover been dropped for the RSP?

RIP-17 Root depth studies that account for all the fine roots that might penetrate deep into the soil are notoriously difficult to conduct with confidence. Still, it might be informative to qualitatively note the root density and depth in the shallow soil pits.

RIP-18 As envisioned in the Service's 31 May 2012 Riparian Instream Flow request, the ground-surface elevation will also need to be surveyed so the depth to groundwater regime (not static water level) can be determined from the Groundwater Study (Draft RSP 7.5).

The sediment aging methods essentially duplicate what was presented at the 24 October 2012 TWG meeting for the Riparian Instream Flow study and demonstrate our concern for duplicating study methods in the lead and supporting studies. Our comments for sediment aging are provided in our Riparian Instream Flow PSP 6.6.

AEA Objective 3 and Methods (Draft RSP): Predict potential changes in riparian areas due to Project construction and operations, including changes to vegetation successional pathways, riparian ecotypes, wetlands, and wildlife habitats, which could result from alterations in instream flow, ice processes, and riverine geomorphology.

RIP-19 Objective 3 is addressed in the Draft RSP section for Impact Assessment: Predicting Changes in Riparian Areas (11.6.4.4). The methods in this section are not nearly as well developed as the methods described in the Vegetation and Wildlife Habitat Mapping Study (Draft RSP 11.5) and the Wetlands Mapping Study (Draft RSP 11.7). There is no mention of using GIS to upscale predicted habitat changes derived from this and supporting studies to the study area. How will predictions and rankings from the various supporting studies be incorporated into a GIS from the supporting studies such as riparian instream flow, ice process, and riverine geomorphology? The Service envisions this objective providing maps of the study area showing predicted changes under various Project operation scenarios.

AEA Reporting and Data Deliverables (Draft RSP):

RIP-20 For the pdf vegetation and wildlife habitat map deliverables, the Service recommends providing these products in geospatial pdf, so a sophisticated GIS program would not be required to readily identify coordinates on the maps.

AEA Schedule and Study Interdependencies (Draft RSP):

RIP-21 Will 2014 include additional field sampling in areas without high-resolution imagery until late 2013? Perhaps including a rough estimate of the area without high-resolution imagery would suggest how much additional work would be required?

RIP-22 The Study Interdependencies figure (Draft RSP Figure 11.6-2) suggests the Riparian wildlife habitat mapping component will not rely upon any insights gained from the Wildlife Resources (Draft RSP Section 10). These inputs should be included in the figure if they will be used. How is the "wildlife habitats" in the Predictions of change in riparian vegetation, wetlands, and wildlife habitats different than the element to the right in the figure for Riparian wildlife habitat mapping?

Literature Cited

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, U.S. Army Engineer Waterway Experiment Station, Vicksburg, MS. 90 pp + appendices.

Gracz, M. 2011. Cook Inlet Lowland Wetlands. Available from http://cookinletwetlands.info/ Accessed September 2012.

U.S. Corps of Engineers (USACE). 2007. Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region Version 2.0. Wetlands Regulatory Assistance Program, U.S. Army Engineer Research and Development Center, Vicksburg, MS. 72 pp. + appendices.

Viereck, L.A., C.T. Dyrness, A.R Batten, and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 pp.

9. Botanical Resources (RSP 11.)

9.7. Wetland Mapping Study in the Upper and Middle Susitna Basin (RSP 11.7.)

General Comments:

WETLND-03 The U.S. Fish and Wildlife Service's (Service) 31 May 2012 study request entitled *Wetland Mapping and Functional Assessment Study* differs from Alaska Energy Authority's (AEA) Proposed Study Plan (PSP) title by including the additional study component (underlined) in our title. At the time of our study request, the habitat mapping Technical Work Group (TWG) was concerned about which functional analysis to use, so emphasizing this in the study title seemed appropriate. The functional analysis question has now been resolved, and the new Draft Revised Study Plan (RSP) title (above) qualifying the study area is more appropriate. Our comments below are based the PSP and on AEA's Draft RSP dated 24 October 2012. Since we have not had sufficient time to fully evaluate this recently available Draft RSP, we reserve the opportunity for additional comment. Section numbering follows the Proposed Study Plan (PSP) for consistency with our other PSP comments, but includes the revised Draft RSP numbering in parentheses.

WETLND-04 A number of terms are used to qualify the resolution of aerial/remote-sensed imagery (high-, moderate-, fine-scale) throughout the study plan. Please provide a pixel resolution the first time each term is used. Besides image resolution, the type and wavelength bands used for photo interpretation, such as true color, false color and color infrared, should be discussed.

The section numbering for the Draft RSP 11.7 all start with 11.3, which is confusing and suggests the automatic numbering needs to be reset for this study. Please use the correct section numbers in future drafts. Our comments will be based on the correct number, substituting 11.3.x with the correct section number (11.7.x).

Specific Comments by Subsection:

The following review of AEA's proposed Wetland Mapping Study in the Upper and Middle Susitna Basin uses the structure of the plan and compares the plan to the Service's study-request objectives to determine if our intent is met, where improvements can be made, and which requested objectives are not addressed.

AEA General Description of the Proposed Study (Draft RSP):

WETLND-05 The general description of the study sets the stage for the study objectives, methods and products. The lower extent of the study area, however, is inconsistent with the descriptions that follow. The General Description (Draft RSP Section 11.7.1) defines the lower limit as the proposed dam, while the Study Goals and map (Draft RSP Section 11.7.1.1 and Figure 11.7-1) define the lower limit as Gold Creek. This is roughly a 47-river mile discrepancy, which needs to be clarified. Although a careful review of the General Description sentence: "Wetlands in riparian areas along the Susitna River below the proposed dam will be mapped in a separate study, …" may be technically correct (emphasis added), open-ended references to the lower limit of the study area elsewhere in the RSP can be confusing.

AEA Study Goals and Objectives (Draft RSP): The overall goal of the wetland mapping study is to prepare a baseline map of the existing wetland habitats in the upper and middle Susitna basin (upstream of Gold Creek).

WETLND-06 The Service did not provide an overall goal, and instead merged the goals and objectives into a bulleted list similar to the AEA's objectives discussed below. The scope of AEA's PSP included mapping the entire Susitna-Watana Hydroelectric Project (Project) area, which could be interpreted as including the entire Lower, Middle and Upper Susitna River. This refinement in scope to the middle and upper Susitna basin is appropriate, although it might also be helpful to qualify the middle Susitna basin as upstream of Gold Creek and mention the Riparian Study (PSP 9.6 / Draft RSP 11.6) will map wetlands in the floodplain below the proposed dam.

WETLND-07 AEA's three Draft RSP objectives are similar to the first three of our five objectives in our 31 May 2012 study request (map wetlands, determine functional values, and quantify impacts to wetlands). Our fifth requested study objective (develop mitigation measures) is likely more appropriate for a later stage in the licensing process.

Not addressed in AEA's Draft RSP objectives is our fourth 31 May 2012 study request objective to evaluate potential changes to wetlands and wetland functions from Project operations, maintenance and related activities. The intent of this objective was primarily to evaluate Project operation effects on wetlands downstream of the proposed dam. As the study plans evolved, we understand this objective will now be addressed in the Riparian Instream Flow and Botanical Resources Riparian studies (Draft RSPs 8.6 and11.6). If our understanding is incorrect, please address our fourth 31 May 2012 study request objective.

AEA Study Area (Draft RSP): The proposed study area for wetlands mapping consists of a 2-mile buffer surrounding those areas that would be directly altered or disturbed by development of the Project. … The alteration of wetland habitats downstream of the dam (due to changes in instream flow, ice processes, and riverine geomorphology in the Susitna River) will be addressed in the riparian study (see Section 11.6).

WETLND-08 The Draft RSP study area description is essentially the same as the PSP, with a few minor updates to reflect changes in the evolving study plans. The Service concurs with the study area, and we appreciate the detail provided making the distinction between the Wetland and Riparian Botanical studies.

AEA Methods (Draft RSP):

AEA's methods generally follow the order of the objectives, with a section added to describe field surveys. Our comments below are organized by objective, with references to AEA's section numbers in the Draft RSP.

AEA Objective 1 and Methods (Draft RSP): Identify, delineate, and map wetlands in the upper and middle Susitna basin in GIS.

WETLND-09 Objective 1 is addressed in the Draft RSP sections for Wetlands Classification (11.7.4.1) and Field Surveys (11.7.4.2). Although mentioned here, presumably the updated 1987 habitat

mapping work described in the Vegetation and Wildlife Habitat Mapping Draft RSP 11.5 will also be used as a starting point for the wetlands mapping also.

The minimum mapping polygon size will be smaller than for the Vegetation and Wildlife Habitat Mapping Study (Draft RSP 11.5) and the Riparian Vegetation Study (Draft RSP 11.6): 1.0 acres for vegetated areas and 0.25 acres for waterbodies, versus 0.5 acres for most upland and wetland habitats and 0.1 acres for waterbodies and other wetlands of ecological importance. Since the 2-mile buffer Wetland Mapping study area is entirely contained within the 4-mile buffer Vegetation and Wildlife Habitat Mapping study, the Service is curious how the two different minimum mapping polygon sizes will be addressed where the studies overlap?

The field data collected for delineating wetlands is well documented (Environmental Laboratory 1987, U.S. Army Corps of Engineers 2007). What additional field data will be collected to delineate Viereck Level IV and Cook Inlet basin habitats (Viereck et al. 1992, Gracz 2011)?

AEA Objective 2 and Methods (Draft RSP): Determine functional values for the mapped wetland types.

WETLND-10 Objective 2 is addressed in the Draft RSP section for Wetland Functional Assessment (11.7.4.3). The methods adequately outline a very complex process potentially fraught with value judgments and incorporating a mix of documented functional analyses (Magee 1998) and project-specific wetland functional analyses. After AEA has had a chance to work with the data, and before progressing too far with the functional analysis, the Service recommends that AEA conduct a TWG meeting to review the details of the analysis to ensure the products will meet stakeholder needs.

AEA Objective 3 and Methods (Draft RSP): Quantify the potential direct, indirect, and cumulative impacts to wetlands and wetland functions from Project construction and operations activities, which will include any new wetlands that may be created by the proposed reservoir.

WETLND-11 Objective 3 is addressed in the Draft RSP section for Wetland Impact Assessment (11.7.4.4). The GIS component of this analysis is straightforward. Before the size and number of indirect disturbance buffer(s) are finalized based on the final specifications for Project construction, operations and maintenance activities, the Service requests a TWG meeting to ensure the products will meet stakeholder needs.

AEA Reporting and Data Deliverables (Draft RSP):

WETLND-12 For the pdf wetland map deliverables, the Service recommends providing these products in geospatial pdf, so a sophisticated GIS program would not be required to readily identify coordinates on the maps.

AEA Schedule and Study Interdependencies (Draft RSP):

WETLND-13 Why is 2012 included in the timeline for Draft RSP Table 11.7-1 if no activities are scheduled or performed in 2012?

The Service has not extensively reviewed the Draft RSPs to ensure the studies providing input to the wetland functional assessment completely overlap their study areas with the wetlands study (top row in Draft RSP Figure 11.7-2, Study Interdependencies). How will incomplete overlap be addressed if input studies do not completely overlap with the wetland study?

Literature Cited

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, U.S. Army Engineer Waterway Experiment Station, Vicksburg, MS. 90 pp + appendices.

Gracz, M. 2011. Cook Inlet Lowland Wetlands. Available from http://cookinletwetlands.info/ Accessed September 2012.

Magee, D.W. 1998. A rapid procedure for assessing wetland functional capacity based on hydrogeomorphic (HGM) classification. Bedford, NH.

U.S. Corps of Engineers (USACE). 2007. Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region Version 2.0. Wetlands Regulatory Assistance Program, U.S. Army Engineer Research and Development Center, Vicksburg, MS. 72 pp. + appendices.

Viereck, L.A., C.T. Dyrness, A.R Batten, and K.J. Wenzlick. 1992. The Alaska vegetation classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 pp.

Document Content(s)