# UPPER SUSITNA RIVER FISH DISTRIBUTION AND HABITAT STUDY – DRAFT FINAL

## INTRODUCTION

The Alaska Energy Authority (AEA) is preparing a License Application that will be submitted to the Federal Energy Regulatory Commission (FERC) for the Susitna-Watana Hydroelectric Project (Project). The application will use the Integrated Licensing Process (ILP). The Project is located on the Susitna River, an approximately 300 mile long river in the South-central region of Alaska. The Project's dam site will be located at River Mile (RM) 184. The results of this study and of other proposed studies will provide information needed to support the FERC's National Environmental Policy Act (NEPA) analysis for the Project license.

Construction and operation of the Project as described in the Pre-application Document (PAD, AEA 2011a) will modify the flow, thermal, and sediment regimes of the Susitna River, which may alter the composition and distribution of fish habitat. This study plan outlines the goals, objectives, and methods for characterizing fish distribution and habitat in the upper Susitna River in order to provide data relevant to establishing an environmental baseline and potential Project-related effects to fish and their habitats. This study will initiate a multi-year effort, which will include data collection activities beginning in 2012. A comprehensive set of fisheries study plans (2013-2014 Fish Study Plans) will be developed during 2012 as part of the Project licensing process. The 2013-2014 Fish Studies will be used to describe the fisheries resources and their habitat within the Project area.

## STUDY GOALS AND OBJECTIVES

Goal 1: Characterize aquatic habitat in the Susitna River and its tributaries/lakes above Devils Canyon upstream to and including the Oshetna River.

Objective 1.1: Develop and implement a habitat mapping approach to characterize the mainstem Susitna River above Devils Canyon upstream to the Oshetna River.

Objective 1.2: Develop and implement a habitat mapping approach to characterize Susitna River tributaries and lakes above Devils Canyon upstream to and including the Oshetna River.

Objective 1.3: Characterize the type and amount of aquatic habitat within the reservoir inundation zone below an elevation of 2,200 feet.

Objective 1.4 Identify the locations of potential fish barriers in tributaries above Devils Canyon (upstream to and including the Oshetna River).

Goal 2: Determine the distribution and relative abundance of adult Chinook salmon in Indian River, Portage Creek, and the Susitna River and its tributaries above Devils Canyon (upstream to and including the Oshetna River).

Objective 2.1: Determine the distribution and relative abundance for adult Chinook salmon in the mainstem Susitna River and tributaries above Devils Canyon (upstream to and including the Oshetna River).

Goal 3: Determine the distribution and relative abundance of juvenile Chinook salmon and other fish species present in the Susitna River and its tributaries/lakes above Devils Canyon upstream to and including the Oshetna River up to 3,000-ft elevation (includes reservoir inundation area).

Objective 3.1: Determine the distribution and relative abundance of fish species residing in tributary and lake habitats downstream of barriers, up to 3,000-ft elevation.

Objective 3.2: Determine the distribution and relative abundance of fish species residing in accessible mainstem Susitna River habitats within the reservoir inundation zone, including those in the main channel, side channels, side sloughs, upland sloughs, and tributary mouths.

Objective 3.3: Support Instream Flow Studies by opportunistically collecting fish habitat utilization data for Chinook salmon.

Objective 3.4: Support the ADF&G Chinook salmon population analysis by collecting tissue samples from individual salmon .

Objective 3.5: Determine whether Dolly Varden and humpback whitefish in the study area have anadromous life histories.

Objective 3.6: Determine baseline levels of metal contaminants for fish species in the study area.

## STUDY AREA

The general study area includes the Susitna River and its tributary streams above Devils Canyon upstream to and including the Oshetna River (Figure FS4-1). The specific areas to be surveyed in 2012 vary with respect to the three main components of this study, which include: 1) aquatic habitat characterization and mapping; 2) adult Chinook salmon spawning distribution; and 3) fish species distribution (juvenile Chinook and other species).

Efforts to document the distribution of Chinook salmon (and other species) will occur in 16 major tributaries in the general study area as identified in Figure FS4-1, upstream to an elevation of 3,000 feet. Additionally, adult salmon spawning surveys will be conducted in the Indian River and Portage Creek. Sampling to document fish species composition and distribution will be conducted in 11 lakes in 2012, as shown in Figure FS4-1. Additional detail on sampling locations is provided in the methods section below.

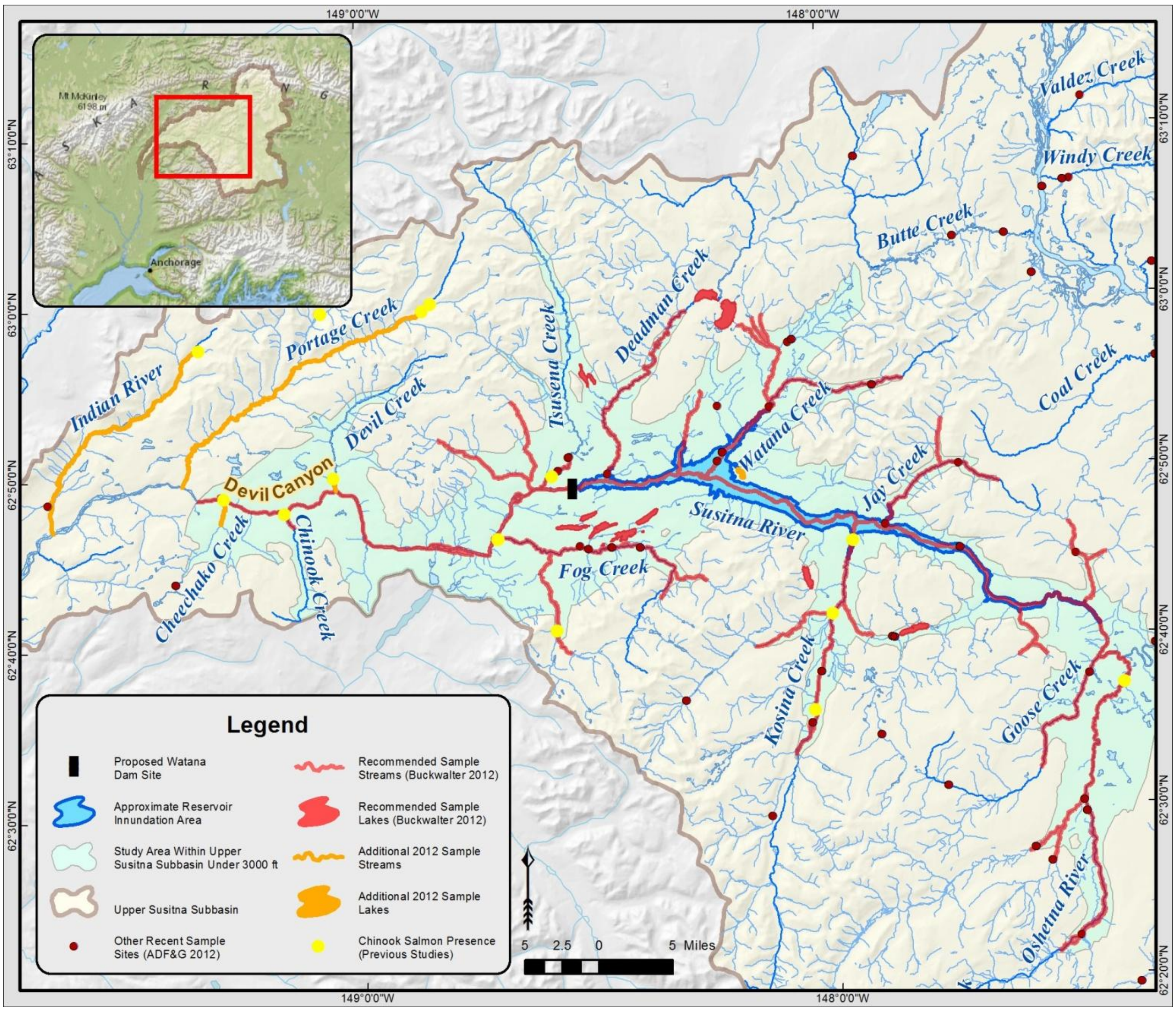


Figure FS4- 1. Study area and sample locations for the 2012 field effort

## EXISTING INFORMATION

Existing information includes recent and historic aerial photography of the study area, fish spatial and temporal distribution, and relative abundance information from existing recent and early 1980s studies. The Aquatic Resources Data Gap Analysis (AEA 2011b) and PAD (AEA 2011a) summarized existing information and identified data gaps for adult salmon, resident and rearing fish, and aquatic habitats in the Upper Susitna River Reach. These data and reports are available to use to help refine study design and provide information on potential changes in fish communities and habitats over time.

The licensing effort of the 1980s APA Project generated a substantial body of literature, some of which will be used to support the 2012-2014 data collection efforts. Results of ADF&Gs studies in the Upper Susitna River Reach, including resident fish and habitat characterization (Schmidt et al. 1984; ADF&G 1983a; ADF&G 1984a) and adult salmon habitat utilization studies are summarized in Exhibit E of the 1985 License Application (Harza-Ebasco 1985ff). However, much of these data are not digital and must be evaluated as data are made available. A synthesis of these data will be provided as a deliverable under study F-S1.

In recent years, ADF&G has conducted sampling in the Upper Susitna River Subbasin as part of their Alaska Freshwater Fish Inventory (AFFI) program. In 2003, the ADF&G conducted a reconnaissance inventory in 19 reaches upstream of Devils Canyon. In 2011, ADF&G returned to the Upper Susitna River subbasin and completed a standard AFFI fish inventory, with an emphasis on anadromous fish. During this effort, ADF&G sampled for fish presence using an electrofisher, recorded aquatic and riparian habitat characteristics at each fish sampling site, and conducted surveys to identify locations of spawning Chinook salmon. ADF&G prepared a synopsis of the 2011 fish inventory in November 2011 (Buckwalter 2011). The ADF&G Fishery Data Series (FDS) report that will describe these efforts in detail is currently being prepared (Buckwalter 2011).

In summary, Chinook salmon is the only anadromous species whose presence has been confirmed upstream of Devils Canyon to date[1] (AEA 2011a; Buckwalter 2011). The abundance and distribution of adult and juvenile Chinook salmon in the upper Susitna River has not been extensively studied. In addition to Chinook salmon, previous studies have documented that the 9 fish species listed below were present within stream and lake habitats upstream of Devils Canyon (ADF&G 1983a, Buckwalter 2011, and AEA 2011a).

- Arctic grayling (*Thymallus arcticus*)
- Longnose sucker (*Catostomus catostomus*)
- Round whitefish (*Prosopium cylindraceum*)
- Humpback whitefish (*Coregonus oidschian*)
- Burbot (*Lota lota*)
- Dolly Varden (*Salvelinus malma*)
- Lake trout (*S. namaycush*)
- Rainbow trout (*O. mykiss*)[2]
- Slimy sculpin (*Cottus cognatus*)

A summary of our initial review of information relative to fish distribution above Devils Canyon is presented in Appendix A, along with maps and tables generated from some of the existing

[1] In 2011, ADF&G extracted otoliths from whitefish captured above Devils Canyon to determine migration history; results are pending (Buckwalter 2012).
[2] Rainbow trout were documented in High Lake and Little High Lake in the Devils Creek drainage (Schmidt et al., 1984)

studies. Additionally, photographs for some of the major streams in the study area, where available, are provided in Appendix B. This summary information is based on an initial review of a limited portion of the existing information and, as such, is considered a preliminary summary.

## METHODS

### *AQUATIC HABITAT CHARACTERIZATION AND MAPPING*

The previous information collected for the upper Susitna River is limited and, thus, there remain uncertainties with respect to the total area of habitat that is utilized by Chinook salmon as well as the accessibility and feasibility of conducting standard aquatic surveys in these habitats. Because of the uncertainties associate with distance of habitat to be surveyed as well as the ruggedness, and remoteness of the study area, both aquatic habitat mapping and barrier identification will be accomplished using remote videography and photographic imagery coupled with aerial reconnaissance surveys and ground surveys in accessible areas. This combination of methods will allow for efficient characterization of river habitats and fish barriers while ensuring safety during ground-based surveys. Sources of remote imagery will include Lidar and aerial photo products from the Matanuska-Susitna Borough Lidar & Imagery Project and low elevation aerial video of the mainstem and larger tributary corridors. Video and aerial reconnaissance will be done by helicopter.

Habitat mapping using video imagery is a proven technique that will allow for increased coverage of upstream aquatic habitats as compared to foot surveys. Habitat can be easily typed and delineated with quality video imagery. However, both weather and site-specific conditions can affect the quality of the video and the ultimately the utility of the method. Therefore, field efforts will be shifted from remote to on-the-ground mapping as appropriate if low-elevation aerial video does not provide the quality coverage that is expected. The field survey teams will be flexible to ensure that quality data is gathered and presented. Implementation of the 2012 habitat mapping effort will be refined as necessary during 2012 and into 2013-2014

Ground-based surveys will be conducted to ground truth the aerial video, in areas with, poor aerial visibility, and in certain important stream sections, such as known or suspected Chinook spawning sections. While the remote habitat mapping will be applied where feasible throughout the study area, ground-based surveys will be focused on collecting data in wadeable streams and river reaches with closed canopies; i.e. not a good candidate for aerial video.

Aquatic habitat in the mainstem Susitna River above Devils Canyon will be mapped primarily by helicopter with ground-truthing. Ground truthing will follow a modified version of the USFS 2001 habitat mapping protocol. Aquatic habitat survey protocols and a habitat classification system will be adapted from the United States Forest Service (USFS) Aquatic Habitat Management Handbook (USFS, 2001). The USFS methodology includes a 3-tiered approach to account for datasets that require multiple levels of resolution, which is necessary for a study area of this magnitude. Tier 1 represents the broadest level of classification across a watershed, while Tiers 2-3 include finer levels of classification, at the channel and habitat unit scale, respectively. However, the USFS habitat classifications likely will need to be modified for application to this Project area and to ensure consistency across fish and instream flow study programs. To ensure consistency in habitat-related terminology and data collection across studies, a Project-specific classification system for reach, channel type, and habitat units will need to be developed.

The Project-specific aquatic habitat classification system will be as consistent as possible with mesohabitat type classifications from USFS (2001). This typing system may be used in whole or in part for various habitats encountered in upper river surveys. An initial system to identify mesohabitats is presented in Table FS4-1. .

**Table FS4- 1. Example of mesohabitat types and descriptions (adapted from USFS 2001) to classify stream habitats**

| | |
|---|---|
| Riffle | Fast water habitat (2—4% gradient) |
| Glide | Fast water habitat (0—2% gradient) |
| Cascade | Fast water habitat (>4% gradient) |
| Pool–scour | Slow water habitat with finer substrates |
| Pool–backwater | Slow water habitat off of main channel |
| Pool–slough | Slow water habitat off of main channel |
| Island Complex (IC)–Riffle | Fast water habitat around an island (2—4% gradient) |
| IC–glide | Fast water habitat around an island (0—2% gradient) |
| IC–cascade | Fast water habitat around an island (>4% gradient) |
| IC–pool–scour | Slow water habitat around an island with finer substrates |
| IC–pool–backwater | Slow water habitat around an island off of main channel |
| IC–pool–slough | Slow water habitat around an island off of main channel |

Where possible, surveys will be conducted to document and quantify existing habitats in the reservoir area at the mesohabitat level. If resolution of the video is not sufficient and ground surveys are not feasible for safety or time/budget limitations, habitats will be typed to the lesser scale; e.g. fast and slow, island complex, single thread channel, etc.

*Ground Survey Method*

Habitat units will be mapped to the mesohabitat level. Habitats will be classified into designated mesohabitat classifications based on characteristics of that unit. Islands will be considered an island complex if they are at least 30.5 meters (100 feet) in length and vegetated. Some sections of stream may contain two or more different habitat units. These parallel habitats will be delineated to the mesohabitat level, denoting a primary and secondary unit, and recorded correspondingly.

The habitat survey for each stream will be conducted by a two-person field team walking upstream. A global positioning system (GPS) point will be used to collect the upstream boundary of each mesohabitat unit. Maximum depth and pool crest depth will be recorded in meters and measured with a stadia rod. Wetted and bankfull widths will be recorded in meters and measured with a laser range finder. Dominant substrate type will be estimated by visual identification based on the USFS (2001) classifications.

The amount of large woody debris (LWD) observed will be counted for each habitat unit. For a piece of wood to be considered LWD, it must be at least 0.1 meters (4 inches) in diameter and at least 1.0 meters (39 inches) of the LWD had to be below the water's surface at bankful flow (USFS 2001).

The amount of undercut bank (UCB) on each side of the stream will be measured to the nearest meter for each habitat unit. A bank will be considered undercut if the undercut is greater than or equal to 0.3 meters (12 inches) incised into the bank and greater than 1.0 meters (39 inches) long. If, at bankful stage, the bank would be considered undercut, then it will be measured even if it is above the current surface of the water (USFS 2001).

*Video Method*
Video equipment will consist of a professional high resolution camera with integrated onscreen GPS. All video will be collected by a senior technician who has flown and successfully documented habitats in over 50 stream systems. An example of the visual quality of a screen capture from a previous low elevation aerial video is displayed below for reference (Figure FS4-2). Note that this video was shot under ideal conditions. Similar quality may or may not be possible under different climate or topographic conditions. The video will also provide an important presentational tool to bring outside participants a perspective and view of the system that would otherwise require visiting the stream.

The video will be shot during a period of high water clarity. Notably clearer tributaries will be filmed in June or July 2012 and more turbid streams will be taped in lower flow conditions in September 2012. The video will be shot from the right rear of the helicopter, with its cabin door off to allow for maximum direct viewing. A narrator/navigator will be positioned in the left front next to the pilot. The video elevation will be shot from 75 to 125 feet to allow for safe navigation, but sufficient resolution. The collected video will be post-processed into a navigable DVD that can be played on either an office computer or a home DVD player. The DVD will include a GPS stamp so that the viewer can reference the location on topography maps or with other existing aerial imagery databases. Video stills will be collected to also expand the available aerial imagery and support habitat mapping reporting.

AEA has a high level of confidence in the expected quality of the aerial video and its ability to translate into the required deliverables as it is analyzed. However, if during initial surveys it appears that the video may not provide a high enough level of resolution, habitat mapping emphasis will be shifted to on-the-ground mapping.


**Figure FS4- 2. Example of expected image quality from an aerial video still also displaying onscreen GPS and time stamp.**

Aerial video mapping will be used to quantify the frequency of mesohabitat types and, if needed, to map woody debris and riparian vegetation. Video mapping will be used where there is no canopy or topographic cover hiding the channel. In combination, video mapping and ground-based mapping should cover 100% of the mainstem Susitna River. However, tributary habitats may or may not be visible from the aerial video so the tributary assessments may rely more heavily upon ground-based mapping in accessible segments. Tributary junctions should be visible and will be noted during the aerial video fly-over. The results of the remote mapping will be used to develop a mesohabitat unit frequency. This cumulative frequency sampling approach is an extremely efficient way to inventory mesohabitats over long distances. .

Mesohabitats (Table FS4-1) for the mainstem Susitna and for visible tributaries or tributary sections will be assessed using a time-based frequency method. The video will be stopped at a predetermined time interval and the habitat type that is directly across the channel at the middle of the computer screen will be defined and documented. A line drawn across the video screen determines the dominant habitat at that "point." The time interval is usually within a range of 3-5 seconds depending on the stream width and mesohabitat length, e.g., sections with short habitat units will use 3-second intervals, while sections with long habitat units will use 5 second intervals. Ground-truth data for every unit that is seen in the video and mapped on the ground will be used to "calibrate the eye" so that features seen in the video have a ground-based reference. Some reaches may use both video and ground-based habitat mapping data to calculate mesohabitat frequency for the entire reach. The video will not be used to measure channel dimensions; ground-based mapping will provide channel characteristics.

The larger tributaries and "open sky" sections of tributaries will be mapped primarily by aerial video. The extent of the ground-based habitat mapping surveys will be determined based on access, the visibility of the stream from the aerial video, and gradient/confinement class (e.g., two ground-based mapping sections for each gradient/confinement class). The initial classification can serve to focus effort on accessible and more responsive segments of the tributaries. Effort will be focused on tributary streams within the reservoir inundation zone and downstream of Chinook salmon passage barriers, which in some cases may be located well upstream of the inundation zone. Ground-based mapping will be done in stream segments where habitat characteristics are not adequately discernible in the aerial video, are accessible, and generally less than 8% gradient (for safety and channel responsiveness). Poor visibility in the video is usually due to thick overhead vegetation, steep topographic relief, or small channel size. Ground-based mapping will also be conducted in stream segments that are conducive to mapping using aerial video. Ground-based mapping in streams visible in the video is used to "calibrate the eye" by physically measuring and typing specific habitat units observed in the video. Mesohabitat units assessed on the ground can then be "typed" in the remainder of the stream sub-reach using the video.

Habitats within the floodplain of the mainstem Susitna River that may support salmon spawning and rearing upstream to the Oshetna will be identified as part of the initial classification. These areas will later be targeted during fish presence and distribution surveys. The habitat surveys will target low flow conditions in mid to late summer. Mainstem and tributary habitat in the inundation zone will be characterized using the same general approach and habitat classification scheme described above for Objectives 1.1 and 1.2.

The mainstem from the proposed Watana dam site to and including the Oshetna River and the tributaries assigned for evaluation as set out in FS4-1 will be habitat mapped. Additional tributaries will be mapped later and as deemed necessary based on initial 2012 habitat and fisheries investigations. The primary method for the mainstem will be aerial video, and GIS aerial imagery, and ground-truthing.

*Potential Fish Barriers*

Aerial imagery photography and video collected under Objectives1.1 and 1.2 will be combined with topographic maps and 1980's data to help evaluate potential fish barriers in the upper Susitna River basin. After potential barriers are identified ground surveys will be conducted to evaluate potential barriers. The lead surveyor will review aerial video of each of the identified tributaries beginning at the mouth looking for and photographing potential barriers. The location of potential barriers will be marked on an aerial photograph and GPS coordinates will be recorded from the helicopter GPS. Ground surveyors will use this information for maximum efficiency of ground work. If a feature can be unequivocally identified from the helicopter as the first barrier, ground verification of this barrier may not be necessary. Ground verification may also not be necessary if the stream gradient beyond the first potential barrier and up to the headwaters simply becomes too steep for Chinook salmon passage or suitable Chinook salmon spawning (ADNR 2007).

Locations of the potential barriers will be identified and evaluated using protocol described by Powers and Orsborn (1985) and ADNR (2007). Given the discrepancies evident in these protocols (Figure FS4-3) one option is to evaluate potential barriers using the most conservative approach. For example, using Powers and Orsborn an adult Chinook salmon cannot pass a barrier height of approximately 8 feet whereas ADNR criteria indicate a height of 11 feet (Figure FS4-3) constitutes a barrier. Using the most conservative approach, we will document the actual height of the obstacle and designate it as complete passage barrier to adult salmon if the height is 11 ft. In addition, the pertinent barrier dimensions (e.g., fall height, plunge pool depth, horizontal distance) will be recorded so that an independent analysis can be completed if necessary. Barriers surveys will be conducted during summer/fall low flow conditions either by wading, overland, or both. GPS location, photographs, drawings, and dimensions of all potential barriers will be obtained.

Field implementation of this task will be initiated in 2012 and completed in 2013. The timing and sequence of which streams are surveyed for barriers will be coordinated with Chinook salmon sampling effort in tributaries.

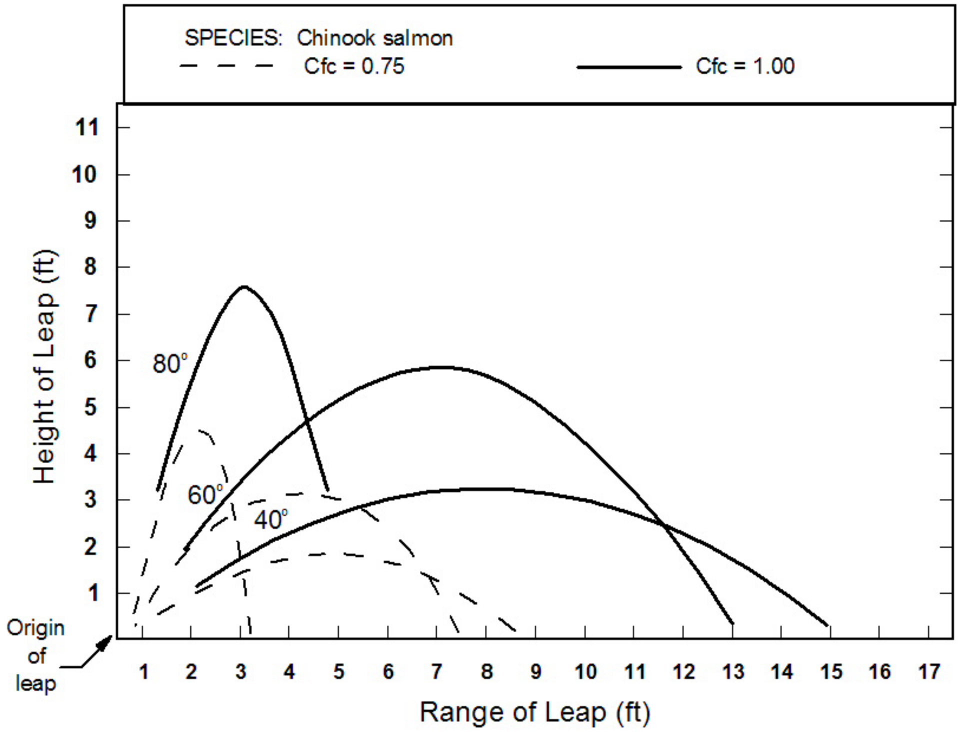


**Figure FS4- 3. Chinook salmon leaping capabilities based on coefficient of fish condition (Cfc). Cfc = 1 corresponds to a fish in bright condition fresh out of salt water, Cfc = 0.75 corresponds to a fish in the river a short time with spawning colors apparent and still migrating upstream (Powers and Orsborn 1985). ADNR 2007 height of leap criteria is 11 feet.**

*Data Collection 2013 – 2014*

The results of the initial effort in 2012 will be reviewed and refined at the end of the study year. The initial findings will help to refine data collection efforts in 2013 and 2014. It is anticipated that this refinement will be coordinated with AEA and regulators to ensure sufficient information is gathered to address all study objectives. Further, it is planned that additional coordination between other study leads may help to refine study methods to benefit or supplement data gathering for other resource areas.

### ADULT CHINOOK SALMON SPAWNING DISTRIBUTION

Habitat and fish presence studies that rely on direct observation are difficult to accomplish in glacially turbid streams. This study will employ visual observation methods which are largely restricted to clear-water areas. The 2012 efforts to determine the distribution of adult Chinook salmon will focus on tributaries above Devils Canyon upstream to and including the Oshetna River. Chinook are the only salmon expected to be upstream of Devils Canyon however; observers will identify all other salmon species observed during the Chinook salmon spawning surveys. Additionally, the team will conduct aerial surveys for Chinook salmon in Portage Creek and Indian River. These surveys will be used to estimate numbers of Chinook salmon in the Project area. In addition, observer training and efficiency testing in an area of known Chinook salmon spawning and to provide data to support the F-S3 study.

The spatial extent of the Upper River Chinook salmon spawning surveys planned for 2012 is driven primarily by the known upstream extent of Chinook salmon above Devils Canyon (i.e. Oshetna River). Results of the 2012 data collection efforts will be used to provide refinements to the extent if the study area for the 2013-2014 seasons.

It is expected that the turbidity in the main stem Susitna River will severely restrict or preclude the ability to visually identify adult salmon. Thus, main channel surveys will focus on clear water areas including plumes at the mouths of tributaries and shallow margins and side channels where spawning fish may be observed.

Experienced surveyors from ADF&G will be consulted to assist in refining the field survey methods for aerial spawning ground surveys to be consistent with previous efforts in the area. ADF&G may, at a minimum consult, on survey flight paths and data forms and may provide a trained surveyor to accompany the AEA survey team during the initial survey flights.
Aerial surveys for spawning Chinook salmon will be conducted over portions of 17 Susitna River tributary streams above Devils Canyon upstream to and including the Oshetna River as well as Indian Creek and Portage Creek (Figure FS4- 1). Aerial surveys will be conducted within target tributaries from their confluence with the Susitna River upstream to a 3,000-ft elevation[3] or to adult salmon passage barriers[4]. If adult salmon are observed in the vicinity of 3,000-ft elevation then surveys will continue upstream until no adult salmon are observed for at least 1 mile or up to a determined migration barrier whichever comes first.

Aerial spawning surveys will be conducted by a two-person crew from a helicopter. Personnel conducting the counts will be consistent throughout the study to ensure familiarity with the streams being surveyed and overall observation consistency. Counts will be made from low altitudes (200 to 400 feet) at an air speed of up to 25 mph. Polarized sunglasses will be used to reduce glare. An experienced survey pilot will be requested to optimize aircraft positioning and minimize the effects of glare off the water. The entire survey route will be tracked with GPS and the survey results mapped in GIS.

Live salmon and carcasses will be counted separately. Counts will be recorded directly on a field data form. If aggregations of adult salmon are encountered an estimated size of the group will be recorded. All fish locations will be marked by GPS. Locations of individual fish and redds will be recorded. In the event of spawning aggregation, the lower and upper extent will be marked. Photographs of fish locations will be taken form the air and fish behavior will be described if possible (i.e. actively spawning, holding, or migrating). Due to the small numbers of fish expected in the Upper River it is anticipated that the survey will pause when fish are identified and an accurate count will be obtained.

If actively spawning salmon locations are identified, habitat suitability criteria data will be collected at a subset of the redds (the selection criteria are yet to be developed). Field surveys will locate redds based on the GPS location and descriptive information collected during aerial surveys. For each selected redd, the following measurements will be made: 1) redd dimensions (length and width [to nearest 0.5 ft] to allow computation of area); 2) water depth to the nearest 0.1 feet at the upstream end of each redd measured using a top setting wading rod; 3) mean water column velocity (fps) at the upstream end of each redd measured to the nearest 0.01 fps using a Marsh McBirney Flow Mate 2000 current meter or equivalent method; and 4) substrate size (dominant, sub-dominant, and percent dominant). In addition, representative digital photographs of selected redds will be taken if possible. Methods to collect habitat utilization parameters are consistent with those identified below, and in the Instream Flow Study (F-S5).

[3] Most Chinook salmon have been observed downstream of a 3,000-ft elevation; however, a juvenile Chinook salmon was captured above an elevation of 3,000-ft in Fog Creek in July 2011 (ADF&G 2011).
[4] Chinook salmon passage barriers will be identified prior to the spawning survey period.

The 2012 surveys are planned to correspond with the Chinook migration timing documented during the 1980s[5]. In 1983, peak Chinook salmon counts for Indian Creek (RM 138.6) and Portage Creek (RM 148.9) were obtained on July 25. Based on this information, the 2012 Chinook spawning surveys will begin in early to mid-July and continue through late August. Surveyors will work closely with the F-S3 study team to verify run-timing (to initiate surveys and/or end surveys) and coordinate efforts and data between these related tasks.

It is likely that rain events will increase turbidity in some clear water streams, or within particular stream reaches. Surveys will be scheduled every five days with the expectation that weather delays may result in surveys averaging out to every seven days and take into account weather, water clarity, and aircraft availability. If weather delays occur the survey schedule will resume with a five day interval at the next scheduled survey.
Visual surveys account for only a portion of the spawning population. At the time of any one survey, some of the salmon may not have reached their spawning destination, some may have already spawned and left the area, and some are present but simply not seen. This study is challenged by the vast extent of the survey area, large areas of turbid water, the relatively small number of fish that are expected to return above Devils Canyon, and a lack of documented spawning habitat locations.

The intent of this study is not to estimate total escapement but only to determine an approximate count and the distribution of Chinook salmon migrating, holding and spawning in the upper Susitna River. Visual counts of salmon obtained by this study will be used by F-S3 investigators to estimate the proportion of fish in each tributary that are radio-tagged (see F-S3 study plan).

The actual number of salmon sighted will be considered an indicator of relative abundance comparable to previous ground and aerial surveys and a minimum estimate of the number of fish present. Expansion factors to account for less than ideal survey conditions or less than total survey area coverage will not be developed for 2012 and may not be appropriate to apply to a system with so few fish.

Aerial surveys will be conducted to provide observer training and estimate observer efficiency. Observer efficiency is an estimate of the proportion of the true number of fish actually present that are observed and counted by the surveyor. This proportion can vary both spatially and temporally, as well as among observers, depending on factors that affect an observer's ability to view an individual fish. Such factors include stream width, depth, substrate, turbidity, precipitation, glare off the water surface, aircraft speed and altitude, and observer experience. The observer efficiency can also be greater than 1, which occurs when observers overestimate the number of fish.

Observer efficiency will be calculated at calibration sites (stream reaches) in Portage Creek and Indian River. The calibration locations will be representative of stream conditions expected in the mainstem Susitna River including area with very low densities of fish. A minimum of six calibrations will be conducted. At each location, observer efficiency will be evaluated by

[5] Chinook salmon enter the Susitna River in late May and early June soon after the river becomes ice free, and begin to disperse into various tributaries to spawn. In general, 90 percent or more of the Chinook escapement moves past Susitna Station (RM 26) prior to July 1 each year. Movement of Chinook past Sunshine Station (RM 80) begins in early June, peaks in mid to late June and is essentially complete (>90 percent) by early July. Adult Chinook that reach Sunshine Station enter one of the three major subbasins of the Susitna River drainage: The Chulitna River, the Middle Susitna River, or the Talkeetna River. Adult Chinook continue into the Middle River through June to mid-July with 90 percent of the migration past Curry Station (RM 120) completed by late July (ADF&G 1983a, 1985c).

enumerating fish in the calibration reach using independent aerial survey counts from two observers; 2)a review of low level still photography immediately following the aerial count. Counts of salmon from photos will be conducted by an independent and experienced surveyor and will be assumed to represent actual values. Thus, mean aerial counts will be compared to actual counts to determine error associated with visual estimates during aerial surveys. An observer efficiency estimate will be generated as a proportion of the actual count; it is important to note that the efficiency can be greater than 1, which occurs when observers overestimate the number of fish.

Immediately after each aerial survey, or during the survey if survey conditions change rapidly (e.g. weather effects visibility), observers will complete a standardized worksheet that rates an established set of aerial observation criteria including weather conditions, sun angle, overall visibility, overhanging vegetation, and relative fish density. A numerical rating for each survey will be calculated and used to provide an index of the observer's confidence in the estimate. These data will be review to determine any correlation between observer efficiency and conditions.

## DISTRIBUTION OF JUVENILE CHINOOK SALMON AND OTHER FISH SPECIES

### *Approach*

The AEA team will conduct surveys to document fish species composition, distribution, and relative abundance with an emphasis on juvenile Chinook salmon rearing habitat in the mainstem Susitna River and selected tributary and lake habitats above Devils Canyon upstream to the Oshetna River (Figure FS4-1). The study design for 2012 varies across the broad study area and with respect to proximity to the proposed inundation zone. The 2012 efforts will focus on conducting comprehensive sampling for juvenile Chinook salmon and other fish species in habitats located within the inundation zone downstream of Chinook salmon passage barriers . The team will also sample to document species presence/absence in select tributaries and lakes that do not fall within the bounds of the expected reservoir inundation zone (Figure FS4-1).

The AEA team will conduct as much of the in-water fish sampling efforts during July and August at which time fish should be well distributed throughout feeding or rearing habitats. It is possible that some sampling efforts may start in late June and extend beyond the month of August, such as those in lake habitats or those associated with migration periods.

Sampling reaches within tributaries will be identified in coordination with the habitat mapping team prior to conducting in-water sampling efforts. The habitat mapping team will identify all accessible and safe river and stream habitats and from this subset of habitat sample reaches for fish distribution and relative abundance will be selected.

Sample site selection within accessible target stream reaches will by systematic in nature and based on methods used during previous baseline fish distribution studies conducted by ADF&G (Buckwalter et al 2010, 2011). Sample sites will be located within the stream starting near the confluence and continuing upstream at approximately 150 meter (approximately 500 feet) intervals until the location of the 3,000 ft elevation contour is reached. The length of each site will be determined in the field and will be equal to or greater than 40 wetted channel widths based on the mean wetted width at the site (Buckwalter et al. 2010). Mean wetted width will be calculated for each site. A calculation of average wetted width will begin with an initial measurement near the beginning of the survey segment followed by two additional width measurements (upstream and downstream respectively from the initial one), at distances of 5 times the width of the initial measurement. The initial measurement will be taken far enough upstream such that the downstream measurement fits within the survey segment.

The 2012 sampling effort will target lakes that fall within the reservoir inundation zone as well as those identified in Figure FS4-1. The team will use a combination of gear types to sample for various fish species and size ranges at varying depths, as identified below. A minimum of two transects running in a north/south and east/west pattern will be recorded. If possible, transects will be established so that they intersect at what is believed to be the deepest part of each lake sampled. All sample sites will be flagged in the field and the location recorded on a handheld commercial grade GPS unit.

In stream habitats, the primary methods to document fish species distribution will be electro-fishing and snorkeling depending upon stream size, water velocity, water clarity, accessibility and safety. The bulleted items below provide a generalized basis for selection of sampling method.

- **Boat Electro-fishing** will occur in large streams (> 15 meters wide) that are accessible by boat and contain either clear or turbid water conditions.
- **Backpack Electro-fishing** will occur in shallow (generally smaller than 3 meters wide) low flow streams that are too small/shallow to snorkel and are characterized as containing clear or turbid water conditions.
- **Snorkeling** will occur in small to moderately-sized streams (between 3 and 15 meters wide) that are wadeable have low turbidity with mid to low water velocity rates.

Sampling method selection will be variable based on site- specific habitat conditions such as water depth, flow and wetted width. For example, stream channels containing very high water velocity and/or high turbidity may not be suitable for any of the above sampling methods. For these streams, alternative sampling methods such as fyke nets, seines, angling, gill nets, and minnow traps may also be used. In lake habitats, the team will use a combination of gear types to sample for various fish species and size ranges at varying depths. We expect to use fyke nets, seines, angling, gill nets, and minnow traps in lake habitats to determine fish species composition.

Information collected at each sample site will include site identification, crew member initials, date and time, weather conditions, surface water temperature, a general description of flow conditions and water clarity, conductivity, and beginning and ending sample locations. Information specific to each gear type will also be recorded, such as the number of snorkelers at each site, snorkel or other gear start/stop time, individual electro-fishers ‘time on and time off’, etc., so that catch per unit effort can be calculated for each gear type. The team will also record habitat parameters specific to each site or sample reach. Parameters will include: habitat type (using USFS habitat classifications designated for this Project), estimated thalweg depth, estimated average wetted width and bank full width, dominate in-water cover type, and estimated dominate and sub-dominate substrate. The team will base substrate types using the classification system chosen for the Susitna-Watana Project. To the extent possible, habitat data will be collected using habitat classification parameters consistent with related studies.

*Snorkeling*

Snorkeling will be used to enumerate fish by species and size class to identify cover availability and describe substrate where fish are observed. The team will measure the distance snorkeled and record three wetted-widths for each sample site. In small streams with suitable visibility, one snorkeler may be able to effectively sample the entire stream. In most streams, multiple snorkel divers will be needed. In these cases, the stream will be divided into "lanes" of travel, with the width of each "lane" dependant upon visibility. Where possible, enough divers will be used to complete the survey in a single pass (Thurrow 1994). Divers will typically begin at the downstream end of the sample site and move upstream, enumerating fish within each lane of travel (along one bank, or extending into the stream's mid-channel if fish can be positively identified). When multiple divers are used, they will attempt to stay adjacent to one another and move at the same speed.

In streams with high velocities, downstream to upstream movement may only be possible along stream margins. Thus mid-channel observations will require the diver(s) to float with the current. In some cases (e.g. exceptionally wide channels; high velocity in mid channel and deep undercut bank along stream margins), conditions may require that multiple passes (one pass per lane) be conducted. If multiple passes are used, the first pass will generally occur on the same bank as the person recording the data in an effort to avoid disturbance to fish and water clarity. The second pass will likely involve an upstream to downstream float to count fish occupying the mid-channel; the third pass will be similar to the first but will occur on the opposite stream bank. Depending largely on visibility or stream size, a fourth pass – or additional downstream float – may be necessary. Where multiple snorkelers are used the method assumes that juvenile fish observed along the banks, usually within or near undercut areas, will not leave the habitat in which they were observed (e.g., fish are assumed not swim across the mid channel to the opposite stream bank).

In cases where fish identification may be in doubt, reference samples will be retained using a hand net, electro-fisher, or other suitable method, for species identification using a taxonomic key at the end of the field effort. It should be noted that sculpin have not been considered a key evaluation species in the project area, and, thus, will not be uniformly enumerated during the study. However, sculpin presence will be recorded when observed. Whitefish will be determined to species.

Fish length will be estimated using size classes in 20 millimeter increments, as follows: 000-020, 020-040, 040-060, 060-080, and so on. Estimating underwater fish lengths can be challenging, especially considering that objects generally appear up to 1.3 times larger underwater (Thurow, 1994). To improve the accuracy of fish length estimates, the neoprene gloves used by each diver will be marked in 20 and 40 increments. Marks will be sewn with two thread colors into one side of the glove with the finger tip as the "0" mark; the first color will be sewn 20 mm from the fingertip, the second at 40 mm, and so on. Additionally, flagging marked in a similar manner will be tied to the other glove to aid in estimating fish longer than 200 mm. Floating cut-outs of fish, a training method described below, will be used periodically throughout the season to maintain consistent estimates. Fish estimated to be longer than approximately 300 mm will be recorded as "300+"since accuracy of estimation in 20 mm increments likely declines with increased length.

Relative underwater visibility estimates will be recorded for each study site. The first step will be measuring the visibility of an object, such as a floating fishing lure or other salmonids silhouette painted with parr marks, similar to that described by Thurow (1994). At the onset of each survey, the diver will place the lure into the water, move away from the lure, and measure the distance at which the parr marks are no longer distinguishable. Similarly, the diver will measure the distance at which the parr marks become visible while moving toward the object. These two distances will be averaged and provide the minimum distance of visibility. This will help determine the number of passes necessary to complete the survey at each site. Through other studies, researchers have recommended minimum visibilities ranging from 1.5 meters to 4 meters (Thurow, 1994).

The second step will be to rank the underwater visibility on a scale from 0 to 3, following an underwater visibility ranking system developed by the Colville Confederated Tribes in 2005. A score of "0" will indicate less than 25% visibility (very poor water clarity or dense cover); a "1' will indicate approximately 25% to 50% visibility (less cover, slightly better clarity); a "2" will indicate approximately 50 to 75% visibility (moderate water clarity), a score considered by the CCT not to impede accurate fish counts; and a "3"will indicate a more than 75% visibility (water clarity is good, very little cover or hiding places).

*Electro-Fishing*

Single pass electro-fishing will be used in streams where snorkeling is not feasible to stream depth or visibility. Back-pack electro-fishing will be used in wadeable stream and, for non-wadeable streams, electro-fishing will be conducted from a boat or raft. If adult salmonids or aggregations of large (>300 mm) salmonids are encountered, electrofishing activities in the immediate vicinity will cease, except to capture a fish if necessary in order to confirm it specific identity (Buckwalter et al. 2010).

Backpack electro-fishing will be conducted with a Smith-Root LR-24 (or similar) electro-fisher. Electro-fish settings will be determined in the field based upon water quality conditions, professional judgment, and the overall goal of minimizing fish health effects. Backpack electrofishing will be conducted by trained staff, using a protocol consistent with Buckwalter (2010) and the following guidelines: Guidelines for Electro-fishing Waters Containing Salmonids Listed Under the Endangered Species Act (NMFS, 2000); Fish Exclusion Protocols and Standards (2006); and Backpack and Drift Boat Design Considerations and Sampling Protocols (Temple and Pearsons, 2007).

Boat based electro-fishing will be conducted from an 18 foot long aluminum hulled jet-boat or a 13 to 15 foot long raft depending on site and flow conditions. Boats will be outfitted with a Smith-Root electro-fisher (kVA size to be determined) that will include a cathode arrangement across the stern of the boat and two anode arrays positioned off the bow. The size of the sampling crew will generally consist of two to three people depending on boat size, river conditions, safety considerations and maneuverability. One or two netters will be positioned on the bow of the boat. During fish collection, the driver of the boat will maneuver the boat laterally across the current while moving downstream, while a second operator controls the electro-fishing system and collects fish with a dip net standing at the bow.

Fish that are captured using electro-fishing methods will be held in buckets and/or live cars until the sampling of each reach is complete. All fish will be identified to species and counted. Up to 100 fish will be measured to the nearest millimeter based on fork length or total length. Fish will be released within the sampling reach once electro-fishing has ceased. Mortalities and fish condition will be noted and recorded prior to release. All reasonable effort will be made to ensure that sampling activities in the field will minimize potential injury or mortality to fish captured. All data will be recorded on a standardized datasheet.

*Lake Sampling Gear*

The team will use a combination of gear types to sample for various fish species and size ranges at varying depths and to target a variety of habitats. Sampling may include the use of fyke-nets, baited minnow traps, and multi-mesh gill nets, seine nets and angling gear. The gear used at individual sample sites will be a function of habitat conditions encountered. The field team will record GPS locations for each sample site, and document general aquatic habitat characteristics. If fish are present, catch per unit effort will be calculated for each gear type and a relative abundance index will be determined for each lake.

Gill nets will be situated perpendicular to shore and fished at varying depths. The team will deploy nets for several hours at a minimum and will check nets periodically to minimize potential fish mortality. To the extent possible, the team will sample multiple locations throughout each lake, including around the inlet and outlet areas. If no fish are captured within several hours, gear will be set overnight. The team will use an inflatable boat and/or drysuits to sample off-shore habitats.

The team will use standard galvanized minnow traps (basket traps) (436 millimeters long by 229 millimeters in diameter) with 6.4 millimeters (¼ inch) and/or 3.2 millimeters (⅛ inch) mesh size. Traps will be baited with commercially processed roe and secured to vegetation or rock anchors to soak overnight (roughly 24 hours).

Fyke nets will be used to document fish species presence in both stream and lake habitats. The team will rely primarily on relatively small fyke nets in 2012. The fyke nets are constructed of ¼ inch (44-pound) green treated netting (H. Christiansen Co. of Duluth, MN), with two metal rectangular entrance frames (27 by 39 inches), a vertical net throat and 4 metal hoops with a single 6-inch diameter throat. The maximum depth fished is approximately 33 inches. The cod end (fish containment) is 8 feet in length. Each net will be fished with attached wings and detachable center leads with floats and weighted line. Alternative fyke net sizes and designs may also be used in 2012.

Beach seines may be used to target fish too small to be captured by traps or species that typically do not recruit well to traps. The team will use a variety of sizes, including a 1.2-meter (4-foot) by 6.1-meter (20-foot) black mesh beach seine with 6.4 millimeters (¼ inch) mesh. The seine should be adequate to sample slow water habitats, such as small pocketwater and backwater sloughs, but will likely not be suitable in areas with swift current. Beach seine sets will be timed and involve a single pass through the sample area.

In addition to biological information, connectivity to other surface-water bodies will be documented. Bathymetry data are available for Lake Sally and Clarence Lake; collection of bathymetry data may be necessary for other lakes identified as providing habitat for fish species. The team will identify lakes where bathymetry data may need to be collected in future study years. To the extent possible, the team will collect depth data at a reconnaissance level using a tag line or electronic depth finder to record depths these lakes. In 2012, the team will record depths along a minimum of two transects running in a north/south and east/west pattern. If possible, transects will be established so that they intersect what is perceived to be the deepest part of each lake sampled.

*Inundation Zone Fish Sampling*

In 2012, sampling efforts in the main stem Susitna River will primarily target habitats where conditions appear to be suitable for juvenile Chinook salmon (and other species), such as sloughs, in the vicinity of tributary mouths, and throughout side channels. In the 1980s, researchers identified and sampled four major spring-fed sloughs above Devils Canyon and identified (from color aerial photos) six other sloughs (ADF&G 1983a). The team will review available imagery and existing data prior to initiating field sampling, as discussed above. The team will also try to relocate main channel sites that were identified and/or sampled in the 1980s.

The method used to determining the length of the survey in side channels or sloughs will be similar to that described for tributaries, as described above (i.e. 40 wetted channel widths; Buckwalter 2010 based on average wetted width). If the side channel or slough is relatively homogeneous in nature, wetted with will be determined using five wetted width measurements collected randomly in proximity to the selected sample site, otherwise the same method for determining channel width described for tributary streams will be used.

The field crew leader will select sample sites in the main stem based on the criteria listed below using similar methods developed by ADF&G (Buckwalter et.al 2010). It is assumed that boat based electro fishing will be use as the primary fish collection method in the mainstem Susitna River. However, other sampling methods are gear (e.g., snorkeling or backpack electro-fishing, nets) may also be used in select areas.

1. The sample site must be able to be safely floated or accessed with a jet-boat.
2. Where the crew leader anticipates that anadromous or resident fish could be present, based on observable characteristics including: fish observed in the air, substrate, velocity, aquatic habitat types, known seasonal variation in stream flow and accumulated experience in evaluating the presence of fish in adjacent and similar water bodies.
3. Main stem areas located immediately downstream of a major tributary.
4. Where up-welling or down-welling areas have been identified.
5. If applicable, having a safe helicopter landing zone located close enough to the target stream at both the upstream and anticipated downstream ends of the general area to be sampled.
6. If applicable, where the landing zones at the put-in and take-out point and the sample site are on lands where previous access approval has been obtained.

Fish sampling planned for the 2012 season includes multiple gear types that will target various fish species and size ranges. The team will use results of sampling efforts, as described above, to determine fish species composition and relative abundance of fish species within the reservoir inundation zone. Locations of salmon observations will be documented with GPS. Active salmon spawning locations, if present, will be identified by field staff during helicopter surveys of each stream. This information will be used to identify areas with of spawning activity for anadromous fish species located within in the inundation zone, likely only for Chinook salmon. Fish habitat utilization will be collected as described above under spawning ground surveys.

*Fish Tissue Sampling*

Tissue samples will be obtained from juvenile Chinook salmon collected upstream of Devil's Canyon for the purpose of genetic analysis to support the development of DNA baseline representing Chinook stocks of the Upper Susitna River. Given the spawning site fidelity of salmon and the tendency of juvenile salmonids to stay in family groups, in order to obtain samples representative of the genetic diversity across the Upper River population the goal during 2012 is to collect 60 tissues samples from juvenile Chinook within each of the major tributaries and to spread the samples out across six individual habitats within each tributary. Due to the anticipated low densities of juvenile Chinook in the Upper Susitna River, this spread of genetics samples may not be possible. In the least, samples will be collected on an opportunistic basis during the 2012 fish characterization task.

Tissue samples for DNA analysis will be taken from live or recently dead fish. Fin tissue will be the preferred method because sampling is relatively fast, logistically simple, and is non-lethal however; handling and taking fin tissue samples of juvenile salmon for genetic analyses may compromise the individual specimen's survival. One lobe of the caudal fin will be clipped with scissors to obtain the minimum 2mm$^2$ of tissue required for DNA analysis. Juvenile Chinook will not be anesthetized during the handling procedure. Fin clips from the juvenile Chinook population will be placed in separate vials (one sample per vial) and preserved in 100% ethanol. Each sample will be coded to link the sample to its collection location and submitted to the laboratory as soon as practical. Note: at the time of this study plan a laboratory has not been contracted to analyze the samples however; ADF&G Gene Conservation Laboratory would be the first choice to complete the analysis.

Otoliths will be extracted from Dolly Varden and humpback white fish to document life histories exhibited by these fish populations in the upper river. Strontium (Sr) distribution within otoliths has been used to describe fish migrations between marine and freshwater environments (Brown et al. 2007). Due to the expected low probability of anadromy above Devils Canyon a large sample size likely will be necessary. A sample size of 10 fish has a 97% probability of selecting one anadromous fish when the actual proportion of anadromous fish in the population is 30% or greater (Brown et al. 2007). The goal during 2012 will be to collect 30 adult Dolly Varden and 30 adult humpback whitefish.

This analysis determines strontium Sr concentrations across a cross section of the otolith. The laboratory analysis will include otolith Sr or strontium-to-calcium ratios which can be used as a tool to reconstruct the chronology of migration among salinity environments for diadromous salmonids (Zimmerman 2005). Predetermined thresholds from known anadromous and non-anadromous fish standards in published literature will be used as the reference. In whitefish, a Sr concentration above the threshold of 1,700 mk/kg indicates exposure to marine conditions during the fish's life history (Brown et al. 2007).

Angling and gill nets will be the primary collection method for this task however; adult Dolly Varden and humpback whitefish captured during sampling as part of other F-S4 tasks may also be retained for otolith microchemistry analysis. Large fish, which are more likely anadromous, may be most readily caught when they congregate for spawning in the fall however; whitefish spawning typically occurs late in the fall and even after freeze up therefore; in order to obtain the target sample size of 30 adult fish from each species, fish will be collected throughout the open water period in whichever location and riverine habitat they are readily captured. If greater than 30 fish are collected, otoliths from the largest specimens will be analyzed.

Immediately following capture, the collection site will be located with a GPS, the fish will be measured, weighed, photographed, bagged whole in plastic bags, and transported in coolers. Otoliths will be extracted either at a field camp or back at the office. Otoliths will be individually labeled to assure analysis results can be linked back to each specimen's length and weight measurements and shipped to the laboratory for microchemistry analysis. At the time of this study plan a laboratory to perform the analysis has not been contracted.

Tissue samples also will be collected from Dolly Varden, Arctic grayling and whitefish species to evaluate baseline metal contaminant levels. Longnose sucker and/or sculpin also may be evaluated. Fish tissue metals content analysis will be conducted on tissues from fish collected within the reservoir inundation zone during 2012. . Seven samples will be collected for each species. Analysis will be coordinated with the water quality study.

Angling and gill nets will be the primary collection method for this task however; adult resident fish captured during electrofishing sampling as part of other F-S4 tasks may also be retained for tissue metals content analysis. In order to obtain the sample size of 7 fish from each species, fish will be collected throughout the open water period in whichever location and riverine habitat they are readily captured. Lakes will not be sampled in 2012.

Immediately following capture, the collection site will be located with a GPS, the fish will be measured, weighed, photographed, rinsed in stream water to remove any obvious debris, bagged whole in plastic bags, and transported in coolers as soon as possible to be frozen. Chain of custody (COC) seals provided by the laboratory will be placed on each sample bag in the field. Frozen whole body samples will be shipped with dry ice to the laboratory for dissection and metals analysis. COC forms will be enclosed with the samples during shipment to the lab. Upon receipt, the laboratory sample custodian will remove the samples from the cooler, inspected the contents, and log the samples into an information management system. The custodian will verify the samples were received in good condition (i.e. still frozen) and COC documents were in order. The fish will be dissected by laboratory personnel following standard protocols to isolate the volume of muscle, liver, kidney, and reproductive tissue required for analysis of inorganic parameters. The laboratory will also include sample standards in the QA/QC program; the sample standard material provided by the laboratory for this purpose will be oyster tissue with known concentrations of metal analytes. At the time of this study plan a laboratory has not been identified and samples may be transported outside of Alaska for analysis.

### *Field Protocols and Data Consistency*

Prior to field sampling events, all field staff will meet to review study objectives, sampling protocols, and documentation requirements. Multiple fish identification reviews will also be conducted prior to entering the field. During the first day of the field event, field crews will conduct surveys (snorkel or electro-fishing) together to ensure consistency of sampling methods and data documentation, accuracy of species identification and fish length estimates.

For snorkel surveys, to calibrate fish length estimates among the team, the use of floating cut-outs of fish of various sizes will be employed as a training tool. In addition, a backpack electro-fisher may be used to capture fish on the first day and periodically throughout the season to confirm that consistency of species identification and size class estimation exists among field staff.

Each field team will carry fish identification reference material that will include if possible a small compilation of fish photographs from the project area.  This will help to minimize the number of fish relegated to the unknown species classification. However, if a fish cannot be positively identified, the fish will be recorded as “unknown”. If a juvenile salmon cannot be identified to species (sometimes juvenile coho and Chinook can be difficult to distinguish from one another-namely at lengths less than 40 mm or greater than 100 mm), the fish will be recorded as “salmon, coho salmon, or Chinook salmon”. The team will retain specimens in question and perform more rigorous methods to identify to species (e.g., count gill rakers).

### *Data Entry and QA/QC Protocols*

Data collected during 2012 will be recorded on data sheets and entered into an electronic database (Excel or Access) shortly after returning to the office. The database design will be coordinated with the Susitna Fish Program and may include the use of look-up tables to maintain consistency during data entry. Fish Program QAQC protocols will be followed and will include completion check of all field data forms while field surveys are being conducted, data entry check against hard copy data, senior data quality assurance and Database Manager quality checks.

### *Data Analysis*

Catch per unit effort (CPUE) will be determined by dividing the catch (number of fish captured or observed) by the effort (electro fishing time or distance snorkeled). Conductivity and area sampled will also be factored into CPUE calculations. Data collected using different methods will be normalized so results can be appropriately compared. CPUE will be determined for each species in each stream reach and gear type. CPUE will be compared between reaches to determine the greatest relative abundance for each species.

Due to small sample sizes and the likelihood that the data will not be normally distributed, a nonparametric ANOVA will be used to determine if there are statistically significant differences in CPUE between reaches. If a significant result arises, statistical tests will then be used to determine which reaches are significantly different from each other. It is anticipated that the 2012 results will be more qualitative in nature, and they will be used to develop quantitative objectives for the 2013 2014 study seasons.

Relative abundance will be determined by species for each stream reach sampled. Relative abundance values between reaches will also be compared statistically using similar methods as described above. Length frequency distribution graphs will be produced for each species and life stage to determine age classes present in catch.

## PROJECT NEXUS

The proposed Project will inundate approximately 39 miles of the Susitna River (~RM 184 – ~RM 223) and operations will modify the flow, thermal, and sediment regimes downstream to and beyond Devils Canyon (~RM 150-154). Tributaries to the Susitna River within the proposed reservoir will be inundated up to an elevation of approximately 2,100 ft msl at normal maximum full pool and will be subject to seasonal water level fluctuations between approximate elevations of 2,000 ft and 1,850 ft msl.

In addition, the Project will block fish migration between the upper and lower river at RM 184 and will alter stream flow through Devils Canyon, potentially impacting fish passage conditions through the canyon. Understanding the distribution and relative abundance of Chinook salmon populations above Devils Canyon and the proposed Dam site is essential to assess potential impacts to Chinook salmon, refine Project design, and develop Protection, Mitigation and Enhancement measures (PM&Es).

Existing fish and aquatic resource information appears insufficient to address the following issues that were identified in the PAD (AEA 2011):

<u>Upper River Fish and Aquatic Issues (Upstream of the Watana Dam Site [RM 184])</u>

- F1: Effect of change from riverine to reservoir lacustrine habitats resulting from Project development on aquatic habitats, fish distribution, composition, and abundance, including primary and secondary production.
- F2: Potential effect of fluctuating reservoir surface elevations on fish access and movement between the reservoir and its tributaries and habitats.
- F3: Potential effect of Watana Dam on fish movement.

Information from this study will also be used to identify study areas or potential survey locations for other studies such as Instream Flow and the 2012 F-S3 Adult Salmon Distribution and Habitat Utilization Study.

## DATA MANAGEMENT AND GIS

The AEA field teams will record site coordinates using a handheld GPS. Where appropriate, the team will use more advanced mobile data applications to collect aquatic habitat and fish capture data, to increase accuracy and reduce processing involved with migrating data from field to office servers.. Data will be directly integrated into the Susitna-Watana Project database and distributed to resource specialists quickly and efficiently. The AEA team follow the QAQC protocol establish for the Sustina Fish Program and will submit original data collected in 2012 to the Fish Program Data Resource Manager for post-QC processing and conversion into the geospatially-referenced,relational database.

## PRODUCTS

### *Data*

Data will be entered into the relational database described below. All original data collected in the field in 2012 will be QC'd and delivered to the Fish Program Data Resource Manager prior to submittal to AEA.

### *Geospatially-Referenced Relational Database*

All data generated during this study will be incorporated into the Susitna Fish Program geospatially-referenced relational database.  This database will form the basis for additional data collection in 2013-2014.  All new field data will be associated with location information collected using a Global Positioning System (GPS) receiver in unprojected geographic coordinates (latitude/longitude) and the WGS84 datum.  Naming conventions of files and data fields, spatial resolution, and metadata descriptions will meet the ADNR standards established for the Susitna-Watana Hydroelectric Project.

### *Spatial Products in ArcGIS Software*

The geospatial products will include geo-spatially referenced relational databases, maps presenting areas sampled, adult Chinook salmon locations by survey, habitat data, and locations of significant features such as barriers and springs.  Naming conventions of files, data fields and metadata descriptions will meet the ADNR standards established for the Susitna-Watana Hydroelectric Project.  All map and spatial data products will be delivered in the two-dimensional Alaska Albers Conical Equal Area projection, and North American Datum of 1983 (NAD 83) horizontal datum consistent with ADNR standards.

### *Summary of Interim Results*

The AEA team will prepare a brief interim report to summarize the study's progress, identify Chinook salmon presence, and identify any issues that have occurred, and provide a basis and allow for further refinement of 2013-2014 Study Plans. The interim report will be delivered to the Fish Program Manager for senior review prior to submittal to AEA.

### *Technical Memorandum*

AEA will complete a technical memorandum that will present data collection and analysis methods and results of field and office-based efforts (including graphic outputs) relevant to this task. This memorandum, which will include spatial data products, will be delivered to the Fish Program Manager for senior review prior to submittal to AEA.

### *Annual Project Report*

An annual report will be prepared to document the methods, field effort, results, conclusions, and recommendations from the 2012 study.

## SCHEDULE

This is a multi-year study. The following tentative schedule is for the significant 2012 scope of work deliverables. The schedule for the 2013-2014 components will be developed with AEA, the AEA-selected environmental consultant, during the final 2013-2014 study planning process.

- Final 2012 Study Plan – March 20, 2012
- Summary of Interim Results – September 10, 2012
- Original QC'd 2012 Data – To be determined
- Final Technical Memorandum on 2012 Activity – To be determined

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