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Susitna-Watana Hydroelectric Project
(FERC No. 14241)

River Productivity Study
Study Plan Section 9.8

Initial Study Report
Part C: Executive Summary and Section 7

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants, Inc.
Alaska Cooperative Fish and Wildlife Research Unit,
University of Alaska Fairbanks

June 2014

TABLE OF CONTENTS

EXECUTIVE SUMMARY

River Productivity Study 9.8	
Purpose	The overarching goal of this study is to collect baseline data to assist in evaluating the effects of Project-induced changes in flow and the interrelated environmental factors (temperature, substrate, water quality) on the benthic macroinvertebrate and algal communities in the Middle and Lower Susitna River.
Status	The 2013 sampling season was successfully conducted from June 19 through October 3, 2013. Sample results for most study components are pending completion of processing by the contracted taxonomic laboratory, and analyses will be conducted in 2014 and 2015. The literature review on the impacts of hydropower development and operations on benthic macroinvertebrate and algal communities is completed, and is included as Appendix A to this report.
Study Components	Synthesize existing literature on the impacts of hydropower development and operations (including temperature and turbidity) on benthic macroinvertebrate and algal communities. Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River. Estimate drift of benthic macroinvertebrates in selected habitats within the Middle and Lower Susitna River to assess food availability to juvenile and resident fishes. Conduct a feasibility study in 2013 to evaluate the suitability of using reference sites on the Talkeetna River to monitor long-term Project-related change in benthic productivity. Conduct a trophic analysis to describe the food web relationships within the current riverine community within the Middle and Lower Susitna River. Develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats to predict potential change in these habitats downstream of the proposed dam. Characterize the invertebrate composition in the diets of representative fish species in relationship to their source (benthic or drift component). Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including coarse particulate organic matter, fine particulate organic matter, and suspended organic matter in the Middle and Lower Susitna River. Estimate benthic macroinvertebrate colonization rates in the Middle Susitna Segment under pre-Project baseline conditions to assist in evaluating future post-Project changes to productivity in the Middle Susitna River.

River Productivity Study 9.8	
2013 Variances	AEA implemented the methods as described in the Study Plan with the exception of the following variances. The significance of these variances is discussed within the ISR. Lower River site was moved from Trapper Creek to Montana Creek (IP Section 2.1.3). See ISR Section 4.2.4.1. Sampling at the FA-173 (Stephan Lake Complex) upland slough replaced by small unnamed tributary mouth (FERC SPD, B-181). See ISR Section 4.2.4.2. Storm event sampling at side slough at FA-173 (Stephan Lake Complex) instead of FA-144 (Slough 21); upper and lower end sites not established (RSP Section 9.8.4.3; IP Section 2.1.2). See ISR Sections 4.2.4.3 and 4.4.3.2. Frequent and rapid river stage changes limited sampling sites available with 30-day periods of continuous inundation (RSP Section 9.8.4.3; IP Section 2.2.1). See ISR Section 4.4.3.1. Number of depth and velocity measures intended to evaluate shoreline bathymetry reduced for each Hess sample (RSP Section 9.8.4.3; IP Section 2.2.1). See ISR Section 4.4.3.1. Algae samples were taken from stones and woody debris as opposed to fine sediment in grab samples (FERC SPD, B-187). See ISR Section 4.4.3.3. Plankton tows were conducted at 5 still water sites instead the potential total of 11 recommended by FERC (FERC SPD, B-188). See ISR Section 4.5.1.1. Dry weights for macroinvertebrate taxa will be estimated using length-weight relationship data from UAF (RSP Section 9.8.4.3; IP Section 2.2.2.). See ISR Section 4.4.3.4. The Talkeetna reference station features a side channel, side slough, and upland slough, and does not include a main channel macrohabitat type (IP Section 2.1.4). See ISR Section 4.6.1. Stable isotope site selection was increased from the original two stations (3 sites each) to four stations, sampling 16 sites total (IP Section 2.11.1; FERC SPD, B-201). See ISR Section 4.7.3.1. Macrohabitat-specific subcutaneous dye marking was not used to track movements of juvenile chinook, coho or rainbow trout less than 60 mm long (FERC SPD, B-199). See ISR Section 4.7.3.2. Fish stomach content samples were not assessed in the field as to whether the stomach was empty or not (IP Section 2.8.1.). See ISR Section 4.9.1.1. Dry weights for prey items in stomach contents will be estimated using length-

River Productivity Study 9.8	
	weight relationship data from UAF (IP Section 2.8.2.). See ISR Section 4.9.1.2. Hester-Dendy Samplers were not pre-conditioned before deployment (IP Section 2.9.1). See ISR Section 4.11.1.
Steps to Complete the Study	To complete the River Productivity Study (Study 9.8), AEA will continue to implement the methods in the Study Plan in 2014 and 2015 except as described in Sections 7.1.1 and 7.1.2. AEA expects to continue to implement the 2013 study season variances to the Study Plan methods described in Section 4 of this report as study modifications, in addition to specific modifications to several of the study components. In 2014, AEA plans to complete the following activities: • Estimate drift of invertebrates (RSP Section 9.8.4.5) with Study Plan modifications incorporating variances described in Section 4.5.1. See ISR Section 7.1.2.2. • Conduct trophic modeling and stable isotope analysis (RSP Section 9.8.4.7) with Study Plan modifications incorporating variances described in Section 4.7.3., as well the modification to add Arctic grayling juveniles and adults as target species/lifestages. See ISR Section 7.1.2.4. • Analyze fish diet (RSP Section 9.8.4.11) with Study Plan modifications incorporating variances described in Section 4.9.1, as well the modification to add Arctic grayling juveniles and adults as target species/lifestages. See ISR Section 7.1.2.5. • Measure productivity in selected Susitna River tributaries and lakes above Devils Canyon. An additional study effort will be added to the River Productivity Study, with the stated objective to "Characterize the pre-Project benthic macroinvertebrate communities, with regard to species composition and abundance, and algal production in selected Susitna River tributaries and lake systems located above Devils Canyon." AEA will collect benthic macroinvertebrate and algal samples in riffle habitats within nine tributaries located above Devils Canyon in the Middle and Upper Susitna River basin, and benthic macroinvertebrates and plankton within three lakes in the Upper Susitna basin. See ISR Section 7.1.2.7. In 2015, AEA plans to complete all remaining data collection and analysis for this study, which include the following activities: • Characterize pre-Project benthic macroinvertebrate and algal communities (RSP Sections 9.8.4.2., 9.8.4.3., and 9.8.4.4.) with Study Plan modifications incorporating variances described in Section 4.4.3., as well as the modification to redesign adult emergence traps for more successful deployments, as detailed in ISR Section 7.1.2.1. • Evaluate the feasibility of Talkeetna River reference sites (RSP Section 9.8.4.6) with continued sampling efforts pursuant to a decision point based

River Productivity Study 9.8	
	on 2013 results, as described in ISR Section 7.1.1. Should the decision be made to continue with an additional season of collections from the Talkeetna Station sites, the methods for sampling will be employed as described in the Study Plan, with modifications incorporating variances described in Section 4.6.1. See ISR Section 7.1.2.3. • Develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats (RSP Section 9.8.4.10.) with no modifications. • Characterize organic matter resources (RSP Section 9.8.4.12.) with no modifications. Estimate benthic macroinvertebrate colonization rates (RSP Section 9.8.4.13.); with Study Plan modifications incorporating variances described in Section 4.11.1., as well as the modification to revise the deployment of Hester-Dendy sampler sets to macrohabitat-type sites within a River Productivity station, and to deploy additional Hester-Dendy sampler sets to record the effects of stage changes and exposures along the main channel's fluctuating shoreline. See ISR Section 7.2.1.6.

River Productivity Study 9.8	
Highlighted Results and Achievements	Key achievements of the River Productivity Study are as follows. 1. Benthic samples collected during the three index events in 2013 were comprised of 301 Hess samples, 155 LWD (snag) samples, 85 petite Ponar grab samples, 45 adult emergence traps, and 105 Hester-Dendy samples. These samples were successfully transported to the contracted taxonomic laboratory in 2013, and results are pending upon completion of processing. 2. Benthic algae samples collected during the three index events in 2013 were comprised of 309 composite algae samples. Results were summarized, and generally indicated that algae were lower in mainstem macrohabitats than off-channel habitats (side sloughs, upland sloughs). 3. Drift samples collected during the three index events in 2013 were comprised of 104 drift samples and 95 plankton tows. These samples were successfully transported to the contracted taxonomic laboratory in 2013, and are being processed. 4. The Talkeetna River was sampled for 30 Hess samples, 45 composite algae samples, 15 petite Ponar grabs, 12 drift samples, and 10 plankton tows during the three index events in 2013, to assess the feasibility of the Talkeetna as a reference site for the Middle Susitna River. These samples were successfully transported to the contracted taxonomic laboratory in 2013, and are being processed. 5. A total of 1,242 sample components were collected in 2013 for Stable Isotope Analyses, which included collection of stomach contents from 261 Chinook salmon, coho salmon, and rainbow trout. These samples were successfully transported to UAF laboratory in 2013 for ongoing analyses. 6. A total of 105 Hester-Dendy multiplate samplers were collected at 4 sites reflecting different temperature/turbidity combinations over an 8-week colonization period. These samples were successfully transported to the contracted taxonomic laboratory in 2013, and are being processed.

7. COMPLETING THE STUDY

7.1. Proposed Methodologies and Modifications

To complete the River Productivity Study, AEA will continue to implement the methods in the Study Plan except as described in Section 7.1.2, which includes the 2013 variances to the Study Plan methods described in Section 4 of this report. Continued activities will:

- Characterize the pre-Project benthic macroinvertebrate and algal communities with regard to species composition and abundance in the Middle and Lower Susitna River (RSP Sections 9.8.4.2, 9.8.4.3, and 9.8.4.4). Sampling sites will be as described in the Study Plan (IP Section 2.1; April 2013 SPD) except as noted in Section 4.2.4. Sampling methods used will be as described in the Study Plan (IP Sections 2.2, 2.3, and 2.6; April 1, 2013 SPD), except as noted in Section 4.4.3. An additional modification will be the redesign of adult insect emergence traps (Section 7.1.2).
- Estimate drift of invertebrates in selected habitats within the Middle and Lower Susitna River to assess food availability for juvenile and resident fishes (RSP Section 9.8.4.5). Sampling sites will be as described in the Study Plan (IP Section 2.1; April 2013 SPD) except as noted in Section 4.2.4. Sampling methods used will be as described in the Study Plan (IP Section 2.5; April 2013 SPD), except as noted in Section 4.5.1.
- Evaluate the suitability of using reference sites on the Talkeetna River to monitor long-term Project-related changes in benthic productivity (RSP 9.8.4.6). Continued sampling is pursuant to a decision point based on 2013 results, as described in Section 7.1.1.
- Conduct a trophic analysis to describe the food web relationships within the current riverine community within the Middle and Lower Susitna River (RSP Section 9.8.4.7). AEA will develop a trophic model to estimate how environmental factors and food availability affect the growth rate potential of focal fish species under current and future conditions (RSP Section 9.8.4.8) and conduct stable isotope analysis of food web components to help determine energy sources and pathways in the riverine communities (RSP Section 9.8.4.9). Sampling sites will be as described in the Study Plan (IP Section 2.1; April 2013 SPD) except as noted in ISR Sections 4.2.4 and 4.7.3.1. Sampling methods used will be as described in the Study Plan (IP Section 2.11.1; April 2013 SPD), except as noted in Section 4.7.3.2. An additional modification will add adult and juvenile Arctic grayling as target species (Section 7.1.2.4).
- Develop habitat suitability criteria for Susitna benthic macroinvertebrate and algal habitats to predict potential change in these habitats downstream of the proposed dam site (RSP Section 9.8.4.10). No variances from the methods described in the Study Plan (RSP Section 9.8.4.10) occurred during the 2013 study season, and no modifications are planned for continued activity to complete this objective.
- Characterize the invertebrate compositions in the diets of representative fish species in relationship to their source (benthic or drift component) (RSP Section 9.8.4.11). Sampling sites will be as described in the Study Plan (IP Section 2.1.; April 12013 SPD) except as described inSections 4.2.4. Sampling methods used will be as described in the

Study Plan (IP Sections 2.7 and 2.8; April 2013 SPD), except as noted in ISR Section 4.9.1. An additional modification will add collections from adult and juvenile Arctic grayling, which will be added as target species (Section 7.1.2.5).

- Characterize organic matter resources (e.g., available for macroinvertebrate consumers) including coarse particulate organic matter, fine particulate organic matter, and suspended organic matter in the Middle and Lower Susitna River (RSP Section 9.8.4.12). No variances from the methods described in the Study Plan (RSP Section 9.8.4.12) occurred during the 2013 study season, and no modifications are planned for continued activity to complete this objective.
- Estimate benthic macroinvertebrate colonization rates in the Middle Susitna River Segment under pre-Project baseline conditions to assist in evaluating future post-Project changes to productivity in the Middle Susitna River (RSP Section 9.8.4.13). Sampling methods used will be as described in the Study Plan (IP Section 2.9), except as noted in ISR Section 4.11.1. Additional modifications include the deployment of Hester-Dendy sampler sets to each of the macrohabitat-type sites within a River Productivity station, and an additional set in a main channel site to investigate effects of stage changes and exposures (Section 7.1.2.6).

7.1.1. Decision Points from Study Plan

RSP Section 9.8.4.6 provided that AEA would make a decision regarding the suitability of the Talkeetna River as a reference site to the Middle Susitna River Segment based on the 2013 sampling results from three Talkeetna sites. However, the laboratory processing of 2013 samples was only recently completed, and subsequent data analysis of these samples is ongoing. In 2014, based upon the results of the 2013 data collection, AEA will make a decision on the suitability of the Talkeetna River sites as reference sites after seeking input from the TWG.

RSP Section 9.8.4.6 states:

> "In the first quarter of 2014, sampling results from Talkeetna sites will be compared to results from similar sites in the Middle Susitna River Segment to determine whether the Talkeetna River would serve as a suitable reference site. Statistical analyses will test for similarities and significant differences between Talkeetna sites and Middle Susitna Segment sites by comparing community compositions and a collection of calculated metrics. Results indicating close similarities, or no significant differences, between sites on the two rivers would indicate suitability as a reference."

The suitability of the Talkeetna River as a reference for the Middle Susitna River cannot be fully assessed until results from the samples are received in 2014, and data analyses are complete. The results of the analyses used in determining the feasibility of Talkeetna sites as reference sites will be presented and discussed with the TWG prior to a decision being made regarding continued sample collection in the Talkeetna River.

7.1.2. Modifications to Study Plan

AEA will implement the methods as described in the Study Plan with the exception of the following modifications.

7.1.2.1. Modifications to Characterizing Pre-Project Benthic Macroinvertebrate and Algal Communities (RSP Sections 9.8.4.2, 9.8.4.3, and 9.8.4.4.)

The methods for characterizing pre-Project benthic macroinvertebrate and algal communities in the Middle and Lower Susitna River (RSP Sections 9.8.4.2, 9.8.4.3, and 9.8.4.4) will be conducted as in 2013, at sites as described in the Study Plan (River Productivity IP Section 2.1; April 2013 SPD) except for those changes detailed as variances in Section 4.2.4. The variances being carried forward as modifications to the Study Plan include: 1) moving the Lower River site from Trapper Creek to Montana Creek, which has no effect on any of the study objectives, as it establishes one study station within the Lower River Segment (ISR Section 4.2.4.1); 2) replacing the upland slough sites at FA-173 (Stephan Lake Complex) with a small unnamed tributary mouth (ISR Section 4.2.4.2), which has no effect on accomplishing the study objectives; and 3) conducting storm event sampling at side slough at FA-173 (Stephan Lake Complex) instead of FA-144 (Slough 21), which made it possible to accomplish the required sampling for the purpose of evaluating the effects of the storm event in 2013, and benefits the study by providing a second post-flood event sampling during the Fall Index period, which may give further information on recovery times (Section 4.2.4.3).

Sampling methods will be the same as those used in 2013, as described in the Study Plan (River Productivity IP Sections 2.2, 2.3, and 2.6; April 2013 SPD), with the exception of those changes detailed as variances in Section 4.4.3, and additional modifications. Variances from 2013 being carried forward as modifications to the Study Plan include: 1) sampling at sites that could have potentially been inundated for less than the 30-day periods of continuous inundation, due to frequent and rapid river stage changes, which allows for sample collection during all seasonal events as opposed to postponements or cancellations (ISR Section 4.4.3.1); 2) the reduction in the number of depth and velocity measures intended to evaluate shoreline bathymetry, which enables the completion of each seasonal event within a 14-day period, allowing for better comparability among sites sampled within each seasonal event, and sample-specific depth and velocity measurements were able to be made to satisfy the requirements for both the trophic modeling effort (ISR Section 4.7), and the HSC/HSI development effort (ISR Section 4.8). (ISR Section 4.4.3.1); 3) taking algae samples from stones and woody debris as opposed to fine sediment in grab samples, which allows for algae samples to be consistently collected in slow-water habitats, as required for the study objective (ISR Section 4.4.3.3); and 4) estimating dry weights for macroinvertebrate taxa using length-weight relationship data from UAF as opposed to direct oven-dried biomass weights. Repeating theses variances as modifications will increase accuracy, reduce sampling bias, and provide a standard methodology for estimating biomass and energy density while achieving the study objective (ISR Section 4.4.3.4).

Modifications to the Study Plan for this objective include a redesign of the adult insect emergence traps. The Study Plan states that *"Adult aquatic insect emergence mass is a product of aquatic insect production from the stream, and is therefore a good surrogate for actual production. To measure insect emergence, floating emergence trap samplers will be deployed,*

with one trap per site" (IP Section 2.6). Collection efforts in 2013 found that the traps were prone to damage from wildlife and were often stranded on shorelines due to rapid changes in flow levels or from disturbances by boating activities (ISR Section 4.4.1). Due to prolonged set times of approximately two weeks, the exact timing of disturbances was unknown, making any sample data that could be retrieved from the trap bottle qualitative, because the total sampling time was uncertain. To resolve this concern, emergence trap methods have been reviewed and refined for future efforts. Emergence trap modifications include: 1) increased floatation to prevent sinking and/or capsizing and 2) improved anchoring and deployment. These changes will facilitate installations at a greater distance from the shoreline and in swifter currents, thus minimizing losses and improving AEA's ability to evaluate insect emergence.

7.1.2.2. Modifications to Estimating Drift of Invertebrates (RSP Section 9.8.4.5.)

The methods for estimating drift of invertebrates (RSP Section 9.8.4.5) will be employed as described in the Study Plan (River Productivity IP Section 2.1; April 2013 SPD) with the exception of the variances implemented in 2013, as described in ISR Section 4.5.1. The variances being carried forward as modifications to the Study Plan include: 1) collecting plankton tows at 5 still water sites instead the potential total of 11 recommended by FERC, which provides a standardized approach for sampling the water column for invertebrates, depending upon the velocity, allowing the study team to achieve the study objective (ISR Section 4.5.1.1); and 2) estimating dry weights for macroinvertebrate taxa using length-weight relationship data from UAF as opposed to direct oven-dried biomass weights, which increases accuracy, reduces sampling bias, and provides a standard methodology for estimating biomass and energy density while achieving the study objective (ISR Section 4.5.1.2).

7.1.2.3. Modifications to the Feasibility of Talkeetna River Reference Sites (RSP Section 9.8.4.6.)

As discussed previously (Section 7.1.1), the suitability of the Talkeetna River as a reference for the Middle Susitna River cannot be fully assessed until results from the samples are received, and data analyses are completed. The results of the analyses used in determining the feasibility of Talkeetna sites as reference sites will be presented and discussed with the TWG, prior to a decision being made regarding the continued sample collections on the Talkeetna River.

Should the decision be made to continue with an additional season of collections from the Talkeetna Station sites, the methods for sampling (RSP Section 9.8.4.6) will be employed as described in the Study Plan (River Productivity IP Section 2.1.4; April 2013 SPD) with the exception of the variance implemented in 2013 that will be carried forward as a modification to the Study Plan. The main channel macrohabitat type would be replaced with an upland slough site within the Talkeetna reference station, which would add a second off-channel habitat type to compare to the Middle River Segment sites, allowing for better evaluation of the Talkeetna River as a future reference site for evaluating Project effects within a monitoring program (ISR Section 4.6.1).

7.1.2.4. Modifications to Trophic Modeling and Stable Isotope Analysis (RSP Section 9.8.4.7.)

The methods for conducting the trophic analysis, using trophic modeling and stable isotope analysis (RSP Section 9.8.4.7), will be conducted as in 2013, in accordance with the Study Plan (River Productivity IP Sections 2.10.1 and 2.11.1; April 2013 SPD), with the exception of those changes detailed as variances in Section 4.7.3 and additional modifications. Variances from 2013 that will be carried forward as modifications to the Study Plan include: 1) increasing stable isotope site selection from the original two stations (3 sites each) to four stations, sampling 16 sites total, which will better address the study objective of quantifying the relative importance of riverine, terrestrial, and marine energy sources to juvenile salmon and the broader river food web (ISR Section 4.7.3.1); and 2) not utilizing macrohabitat-specific subcutaneous dye marking to track movements of juvenile chinook salmon, coho salmon or rainbow trout less than 60 mm long, which would be much less useful for GRP model validation than the PIT tag data, and therefore allow study resources to be focused on using a robust PIT tag study to most effectively document the movements and growth of individual fish, test the GRP models, and accomplish the objectives of the study (ISR Section 4.7.3.2).

The Study Plan states, "*To determine how water temperature, food availability, and food quality influence the growth of juvenile Chinook salmon, juvenile coho salmon, and juvenile and adult rainbow trout, field data from the Fish and Aquatics Instream Flow Study (Study 8.5), Study of Fish Distribution and Abundance in the Middle and Lower Susitna River (Study 9.6), and this River Productivity Study will be analyzed using a bioenergetics approach* (IP Section 2.10.1)*."* Modifications to the Study Plan for trophic analyses include the addition of Arctic grayling as a target species.

Numbers of fish collected in 2013 were lower than expected; FDA (Study 9.5 and Study 9.6) efforts at several of the River Productivity sites did not capture juvenile salmonids. Sampling at FA-173 (Stephan Lake Complex) and FA-184 (Watana Dam) did not capture any of the targeted species/lifestages and sampling efforts in the main channel macrohabitat sites produced limited catches as well. In addition, no coho salmon or rainbow trout were observed for fish sampling efforts above Devils Canyon in 2012 (HDR 2013) or 2013 (ISR Study 9.6, Sections 5.1.1.3 and 5.1.1.12). In contrast, Arctic grayling are present at sites both above and below Devils Canyon, and bioenergetic models are available for the species. The addition of Arctic grayling juveniles and adults as target species/lifestages to the Study Plan will aid in the development of bioenergetics models by providing new fish growth and foraging information for the models and stable isotope analysis efforts that lacked adequate samples in 2013.

7.1.2.5. Modification to Fish Diet Analysis (RSP Section 9.8.4.11)

The methods for collecting fish diet information (RSP Section 9.8.4.11) will be conducted as in 2013, as described in the Study Plan (River Productivity IP Sections 2.7 and 2.8; April 2013 SPD), with the exception of those changes detailed as variances in Section 4.9.1 and additional modifications described below. Variances from 2013 that will be carried forward as modifications to the Study Plan included: 1) elimination of field determinations of fish stomach emptiness to reduce uncertainties in sample collection by standardizing the sampling effort and decision process, thus allowing the study crew to achieve the study objective (ISR Section

4.9.1.1); and 2) estimating dry weights for prey items in stomach contents using length-weight relationship data from UAF, as opposed to direct oven-dried biomass weights, which increased accuracy, reduces sampling bias, and provides a standard methodology for estimating biomass while achieving the study objective (ISR Section 4.9.1.2).

The modification to the Study Plan for fish diet analysis efforts includes adding Arctic grayling juveniles and adults as target species/lifestages. The Study Plan states, *"In support of the bioenergetics modeling (Objective 5, Section 9.8.4.5.1), fish species targeted for dietary analysis will include juvenile coho salmon, juvenile Chinook salmon, and juvenile and adult rainbow trout, as identified in consultation with the TWG* (RSP Section 9.8.4.11)*."*

As previously stated, the numbers of fish collected in 2013 were lower than expected; FDA (Study 9.5 and Study 9.6) efforts at several of the River Productivity sites did not capture juvenile salmonids. Sampling at FA-173 (Stephan Lake Complex) and FA-184 (Watana Dam) did not capture any of the targeted species/lifestages, and sampling efforts in the main channel macrohabitat sites produced limited catches as well. The addition of Arctic grayling as a target species would address the lack of fish diet samples collected from target fish species at FA-173 (Stephan Lake Complex) and FA-184 (Watana Dam). Due to the presence of Arctic grayling at sites both above and below Devils Canyon, the addition of this species will help provide better comparisons and help define differences in diet and food availability among all sites.

7.1.2.6. Modifications to Benthic Macroinvertebrate Colonization Rates (RSP Section 9.8.4.13)

Methods described in RSP Section 9.8.4.13 and River Productivity IP Section 2.9.1 will be conducted in the same manner, with the exception of the variances implemented in 2013 regarding Hester-Dendy samplers not being pre-conditioned before deployment, which would provide for an assessment of the influences of turbidity and temperature on the benthic community colonization rates (ISR Section 4.11.1), and additional modifications described below.

The deployment of Hester-Dendy sampler sets from sites with different turbidity/temperature conditions, to deployment in each of the macrohabitat-type sites within a River Productivity station. The Study Plan states, "*In order to assess the influences of turbidity and temperature on the benthic community colonization rates, a field study will be conducted for both study years. The field study was to estimate potential benthic macroinvertebrate colonization rates for four different habitat types that reflect these conditions in the Susitna River* (RSP Section 9.8.4.9)"

Four sites were established for this objective to capture the different conditions of turbidity and temperature (turbid/cool, turbid/warm, clear/cool, and clear/warm), at two depths (1- and 2- ft depth). In practice, however, controlling for all three of these factors affected the occurrence of other confounding factors, primarily velocity and substrate, that are equally, if not more, important to colonization. For example, the clear/cool site was located in a pool habitat with upwelling colder water, resulting in low current velocities at depths greater than 2 ft, and an accumulation of finer sediments as substrate. This is markedly different from the clear/warm site, with higher current velocities, and depths of l ft or less. Therefore, due to the number of confounding factors involved, it was difficult to isolate differences in colonization rates solely

due to different temperature and turbidity conditions; colonization rates were largely reflective of the macrohabitat in which the samplers were located.

Colonization sampling sites established in 2013 were placed at three of the five sampling sites established by the River Productivity Study for benthic and drift sampling in FA-104 (Whiskers Slough), sampling main channel, side channel, side slough above tributary mouth influence, and side slough below tributary mouth influence habitats. Therefore, a modification to the Study Plan will investigate the overall differences in colonization rates and compositions among the five macrohabitat types within River Productivity sites. This will include a main channel site, a side channel site, a side slough site, an upland slough site, and a tributary mouth/clearwater plume site. This modification adds one upland slough site to the sampling efforts.

As a modification to the Study Plan, AEA plans to add an extra collection of six Hester-Dendy sampler sets at a main channel site at increasing depth increments. This modification will allow AEA to record the effects of stage changes and exposures along the main channel's fluctuating shoreline. Sampling along a depth gradient will address the challenges of sampling along a fluctuating shoreline as detailed in ISR Section 4.4.3.1 and provide insight into inundation and exposure limits for benthic macroinvertebrates for HSC/HSI models (RSP Section 9.8.4.10). This collection of samplers will be deployed for 4-6 week periods, resulting in a potential of two or three collections over the open water period.

7.1.2.7. River Productivity in Susitna River Tributaries and Lakes above Devils Canyon

As a modification to the Study Plan, additional effort will be added to the River Productivity Study, with the stated objective to characterize the pre-Project benthic macroinvertebrate communities, with regard to species composition and abundance, and algal production in selected Susitna River tributaries and lake systems located above Devils Canyon. AEA will collect benthic macroinvertebrate and algal samples once during the summer period in riffle habitats within nine selected tributaries located above Devils Canyon in the Middle and Upper Susitna River basin, based on Barrick et al. (1983; APA Doc. 522), in order to characterize the productivity of these habitats within these tributaries under their current, baseline condition. Invertebrate drift sampling will be conducted concurrently with benthic macroinvertebrate sampling to allow for comparisons between the drift component and the benthic macroinvertebrate assemblage, as well as revealing the availability of terrestrial invertebrates for fish predation. Sampling in tributaries will include the collection of Hess, drift, and algal samples, and water quality measurements within riffle habitats at one representative station. For tributaries within the proposed reservoir inundation zone, sampling will be conducted between the maximum pool elevation (2,050 ft. MSE) and slightly above the upper extent of known Chinook presence (approximately 3,000 ft MSE), at 3,500 ft. (MSE). For tributaries outside the proposed reservoir inundation zone, sampling will be conducted between the mouth of the tributary and either 3,500 ft MSE or the downstream-most fish barrier. In addition, three lakes (Tyone Lake, Susitna Lake, and Lake Louise) will be sampled once during the summer period to characterize the productivity of these habitats under the current, baseline condition. Due the large size of these lakes, three stations will be established in each lake, with the collection of Ponar grabs, D-net sweeps (in the littoral shoreline areas), vertical plankton tows, and water quality measurements at each station.

This collection of benthic macroinvertebrates and algae data, along with associated water quality data, will provide a snapshot of the pre-Project condition of habitats in selected tributary and lake systems and the levels of productivity available to support fish populations. A majority of these systems will not be directly affected by the Project; however, passage barriers on some tributaries will be inundated by the reservoir pool, providing new fish access to the upper portions of those basins. The information gathered in this one-time summer sampling event will provide a basis for understanding the habitats in the middle and upper basins that will be available to support fish after the Project is in operation.

7.2. Schedule

In general, the schedule for completing the FERC-approved Study Plan is dependent upon several factors, including Project funding levels authorized by the Alaska State Legislature, availability of required data inputs from one individual study to another, unexpected weather delays, the short duration of the summer field season in Alaska, and other events outside the reasonable control of AEA. For these reasons, the Study Plan implementation schedule is subject to change, although at this time AEA expects to complete the FERC-approved Study Plan through the filing of the Updated Study Report (USR) by February 1, 2016, in accordance with the ILP schedule issued by FERC on January 28, 2014.

With regard to this specific study, AEA expects to complete data collection in both the 2014 and 2015 study seasons, which will be reported in the USR.

In 2014, AEA plans to complete the following activities:

- Estimating Drift of Invertebrates (RSP Section 9.8.4.5) as modified in ISR Section 7.1.2.2.
- Trophic Modeling and Stable Isotope Analysis (RSP Section 9.8.4.7) as modified in ISR Section 7.1.2.4.
- Fish Diet Analysis (RSP Section 9.8.4.11) as modified in ISR Section 7.1.2.5.
- River Productivity in Susitna River tributaries and lakes above Devils Canyon Study, as described in ISR Section 7.1.2.7.

In 2015, AEA plans to complete all remaining data collection and analysis for this study.

7.3. Conclusions

During 2014 and 2015, AEA will continue to implement the River Productivity Study (Study 9.8). In doing so, AEA will follow the methods described within the Study Plan, as modified in Sections 7.1.1 and 7.1.2.

AEA plans to continue to integrate the Fish Distribution and Abundance in the Middle and Lower Susitna River Study (ISR Study 9.6; fish stomach content collection and fish movement data via the PIT-tagging efforts) into this study. As envisioned by the Study Plan, AEA plans to continue to integrate the output from this study into the Instream Flow Study (ISR Study 8.5), Baseline Water Quality Study (ISR Study 5.5), and Water Quality Modeling Study (ISR Study 5.6) in HSC/HSI development. Based upon this, AEA expects that the data collection effort, and

the subsequent analyses of the resulting data as it is received, will fully achieve the approved Study Plan objectives (Section 2).

7.4 Literature Cited

Barrick, L., Kepshire, B., G Cunningham. 1983. Upper Susitna River Salmon Enhancement Study. Alaska Department of Fish and Game FRED Report Number 4. 156 pp.

HDR Alaska, Inc. 2013. 2012 Upper Susitna River Fish Distribution and Habitat Study: Fish Distribution Report. Susitna-Watana Hydroelectric Project. Prepared for the Alaska Energy Authority, Anchorage, Alaska. April 2013.