Grant Lake Project
(FERC No. 13211 and 13212)

Water Resources

Draft Study Plan

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List of Acronyms

ADF&G	Alaska Department of Fish and Game
AEIDC	Arctic Environmental Information and Data Center (University of Alaska)
AHRS	Alaska Heritage Resources Survey
APA	Alaska Power Authority
AWC	Anadromous Waters Catalog
BLM	Bureau of Land Management
°C	Degrees Celsius
cfs	cubic feet per second
cm	centimeter
CPUE	catch per unit effort
°F	Degrees Fahrenheit
DNR	Alaska Department of Natural Resources
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FL	Fork Length
fps	feet per second
ft	feet
G&A	general and administrative
GPS	global positioning system
GWh	gigawatt hours
HEP	Hydroelectric Evaluation Program
IFIM	instream flow incremental methodology
in	inch
KHI	Kenai Hydro Inc.
KHL	Kenai Hydro, LLC
KPB	Kenai Peninsula Borough
kWh	kilowatt hours
LLC	Limited liability company
mg/L	milligrams per liter
mi	mile
MIF	minimum instream flow

mm	millimeter
MSL	Mean sea level
MW	Megawatt
MWh	Megawatt hours
NWI	National Wetlands Inventory
O&M	Operations & maintenance
RM	river miles
RVDs	Recreation visitor days
TL	total length
TWG	technical working group
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
YOY	Young of the year

Water Resources Draft Study Plan
Grant Lake Hydroelectric Project
(FERC No. 13211/13212)

1 Introduction

Kenai Hydro, LLC (KHL) received preliminary permits from the Federal Energy Regulatory Commission (FERC) for the study of proposed hydroelectric projects at Grant Lake/Grant Creek (FERC No. 13212) and Falls Creek (FERC No. 13211) in October 2008. The preliminary permits expire on September 30, 2011. On August 6, 2009, KHL filed a Pre-Application Document (PAD), along with a Notice of Intent to file an application for an original license for a combined Grant Lake/Falls Creek Project (FERC No. 13211/13212 ["Project" or "Grant Lake Project"]) under Part I of the Federal Power Act. On September 15, 2009, FERC approved the use of the Traditional Licensing Process for development of the license application and supporting materials. KHL is planning to file a License Application for the Project in September 2011.

The Project will be located near the community of Moose Pass, Alaska in the Kenai Peninsula Borough, approximately 25 miles north of Seward, Alaska, and just east of the Seward Highway (State Route 9) (Figure 1).

This Water Resources study plan is designed to address information needs identified in the PAD, during the Traditional Licensing Process public comment process, and through early scoping conducted by FERC. A study report will be produced in early 2011. The study report will present existing information relative to the scope and context of potential effects of the Project. This information will be used to analyze Project impacts and propose protection, mitigation, and enhancement measures in the draft and final License Application for the Project.

Proposed Project Description

The PAD identified a preliminary Project facilities proposal, which includes a diversion dam at the outlet to Grant Lake, and a powerhouse along Grant Creek. The PAD Project proposal also included diverting water from Falls Creek into Grant Lake to provide additional flows and power generation at the Grant Creek powerhouse. The Falls Creek diversion has been removed from the Project proposal and associated impacts will not be studied.

The proposed Project will use approximately 48,000 acre-feet of storage in Grant Lake during operations between pool elevations of 675 and 709 feet mean sea level (MSL). Storage will be obtained by raising the natural level of Grant Lake using a low diversion at the outlet and drawing down Grant Lake below its natural water level. The proposed lake level will range from approximately 9 feet above up to 25 feet below the natural lake elevation. A multi-level intake will be constructed near the diversion structure. An approximate 2800-foot-long, 10-foot diameter horseshoe tunnel will convey water from the intake to directly above the powerhouse at about elevation 650 MSL. At the outlet of the tunnel a 650-foot-long section of penstock will convey water to the powerhouse located at about elevation 518 MSL. The tailrace will be located in order to minimize impacts to fish habitat by returning flows to Grant Creek upstream of the most productive fish habitat. An existing mining road along Falls Creek will be extended in the area between Falls Creek and Grant Creek in order to access the Project. Two potential

transmission line options will be investigated; an overhead line and an underground option which would follow the access road grade. Portions of the Falls Creek preliminary permit area will continue to be studied for access and transmission routes associated with the Grant Lake Project. The transmission line corridor for each option would generally follow the access road grade.

2 Goals and Objectives

Together with existing information, the goal of the study effort described in this plan is to provide baseline information, and where applicable, information on alternative flow regimes, which will inform an assessment of potential Project impacts on water resources. The impact assessments and potential protection, mitigation, and enhancement measures will be presented in the draft and final License Applications.

The objectives of this study are to provide supporting information on the potential resource impacts of the proposed Project that were identified during development of the PAD, public comment, and FERC scoping for the License Application, as follows:

- Impact of Project construction and operation (lake level fluctuations, changes in flow) on Grant Lake, and Grant Creek water quality, hydrology, and water temperature.
- Impact of Project construction and operation on water quality, hydrology, and ice conditions of Lower Trail Lake and Trail Creek.
- Impact of Project construction and operation on possible erosion and sedimentation in the fluctuation zone in Grant Lake (including the Inlet Creek delta).

3 Existing Information and Need for Information

3.1 Existing Information

3.1.1 Pre-2009 Studies

The hydroelectric potential at Grant Lake (Figure 1) has been evaluated several times as a potential power source for the Seward/Kenai Peninsula area. In 1954, R.W. Beck and Associates (cited by APA 1984) conducted a preliminary investigation and concluded that a project was feasible. The U.S. Geological Survey (USGS) conducted geologic investigations of proposed power sites at Cooper, Grant, Ptarmigan, and Crescent Lakes in the 1950s (Plafker 1955). In 1980 CH_2M Hill (cited by APA, 1984) prepared a pre-feasibility study for a Grant Lake project and concluded that a project developed at the site would be feasible. The Grant Lake Project was referenced in the 1981 U.S. Army Corps of Engineers (USACE) National Hydroelectric Power Study (USACE 1981). The most extensive study was performed by Ebasco Services, Inc. in 1984 for the Alaska Power Authority (now Alaska Energy Authority; APA 1984). Two of the alternatives evaluated by Ebasco included the diversion of adjacent Falls Creek into Grant Lake to provide additional water for power generation. These investigations have provided hydrological records as follows:

- Historical Grant Creek stream gage data (USGS 15246000) – 11 years of continuous stream gage data from 1947-1958.

- Grant Lake Hydroelectric Project Detailed Feasibility Analysis, by EBASCO, (APA 1984), that includes modeled Falls Creek data.
- Historical Falls Creek discharge data limited to several instantaneous discharge measurements made over various years including 1963-70, 1976, and 2007- 2008.

3.1.2 HDR 2009 Water Resources Studies

The 2009 aquatic resources study program began the process of acquiring resource information needed for FERC licensing and other regulatory requirements. Emphasis was on updating existing information, acquiring more complete information required for specific issue analysis, and providing background information needed to develop more focused studies during the formal FERC licensing process.

Water quality measurements and water samples were collected in Grant Lake near the proposed project intake and near the natural outlet of Grant Lake during June and August, 2009. In-situ parameters were measured at 1-meter depth increments including temperature, pH, dissolved oxygen, conductivity, and oxygen reduction potential. Water quality samples were collected at several depths for laboratory analysis. A string of logging thermistors was installed in the water column near the proposed intake to a depth of 20 meters. Loggers began collecting temperature data at various depths in June, 2009 and continued logging throughout the winter.

Water samples were collected at three sampling sites in Grant Creek and one site in Falls Creek in June and August, 2009 for laboratory analysis. Temperature data and other in-situ parameters including; pH, dissolved oxygen, conductivity, and oxygen reduction potential were also collected. Temperature data loggers were installed at the three water quality sampling sites.

The 2009 hydrology studies included establishing one stage recorder each on Grant Creek (at the original USGS site), and on Falls Creek, establishing temporary benchmark monuments at the gage sites and relating the elevations of the monuments to project datum, installing continuously recording stage and temperature loggers, and collecting instantaneous discharge measurements when stream flows allowed to begin development of rating curves at each site. Water temperature data loggers were also installed in Grant Creek in four locations in run and pool habitat types.

3.2 Need for Additional Information

Early study programs and the 2009 baseline study program conducted by KHL have provided a significant amount of background information regarding water resources in the Project area. Following analysis of the 2009 study results, needs for additional study were identified to support the FERC licensing process and accompanying permit requirements.

Additional water quality field studies will:

- Collect water chemistry data in Grant Creek and Grant Lake to confirm 2009 measurements and better define baseline water quality conditions. Water chemistry fluctuates naturally and additional baseline studies are needed to determine the natural variability from year to year.

- Continue to collect water temperature data in Grant Creek and Grant Lake to extend the period of record. Water temperature is not always the same during a given month from year to year. An extended period of record will determine the natural range of water temperatures.

Additional hydrology field studies will:

- Continue continuous stream flow data collection in Grant Creek at the historical gage station to support fisheries studies and to begin developing a rating curve for lower flows on Grant Creek. Data collected will also aid in correlating the historic USGS rating curve.
- Compile and summarize anecdotal information on possible accretion flow in the Grant Creek Canyon, including photographs and GPS points, into a map and section in the 2010 baseline report in order to determine if there are measureable sources of flow to Grant Creek through that reach (anecdotal information on possible accretion flow in the Grant Creek canyon reach will be collected by fisheries teams while working in that reach).
- Characterize the fluvial geomorphology of Grant Creek to address issues of sediment transport in Grant Creek, especially as it may be related to maintenance of salmon spawning habitat.
- Characterize the erosion potential along the shores of Grant Lake and its tributaries resulting from potential lake impoundment and drawdown scenarios.

4 Methods

The following sections describe the project study area and proposed 2010 methods for the water quality and temperature, hydrology, and Grant Lake and Grant Creek fluvial geomorphology studies.

4.1 Study Area

The Project area (Figure 1) is located near the town of Moose Pass, Alaska (pop. 206), approximately 25 miles north of Seward, Alaska (pop. 3,016), just east of the Seward Highway (State Route 9); this highway connects Anchorage (pop. 279,671) to Seward. The Alaska Railroad parallels the route of the Seward Highway, and is also adjacent to the project area. The town of Cooper Landing is located 24 miles to the northwest and is accessible via the Sterling Highway (State Route 1) which connects to the Seward Highway approximately 10 miles northwest of Moose Pass.

Grant Creek is approximately 5,180 feet long (approximately one mile) and flows west from the outlet of Grant Lake to the narrows between Upper and Lower Trail lakes (see Figure 1). The Grant Creek watershed is approximately 44 square miles and the watershed contains Grant Lake, as well as a portion of the Kenai Mountain Range with peaks as high as 5,500 feet. Grant Creek has a mean annual flow of 193 cfs, is 5,180 feet long, and has an average slope of 0.039 with a steep canyon reach that has an average slope of 0.06 and a less steep lower reach that has an average slope of 0.013; its substrate includes cobble and boulder alluvial deposits and platy gravel shoals (APA 1984). The stream is 25 feet wide on average. In its upper half, the stream passes through a rocky gorge with three substantial waterfalls; in its lower half, the stream becomes less turbulent as it passes over platy gravel shoals and diminishing boulder substrate (APA 1984). Grant Creek's mobile substrate is comprised of tightly pack unsorted broken

angular rock and there is minimal rounded material. Some fines may be found in small eddies and a few backwaters.

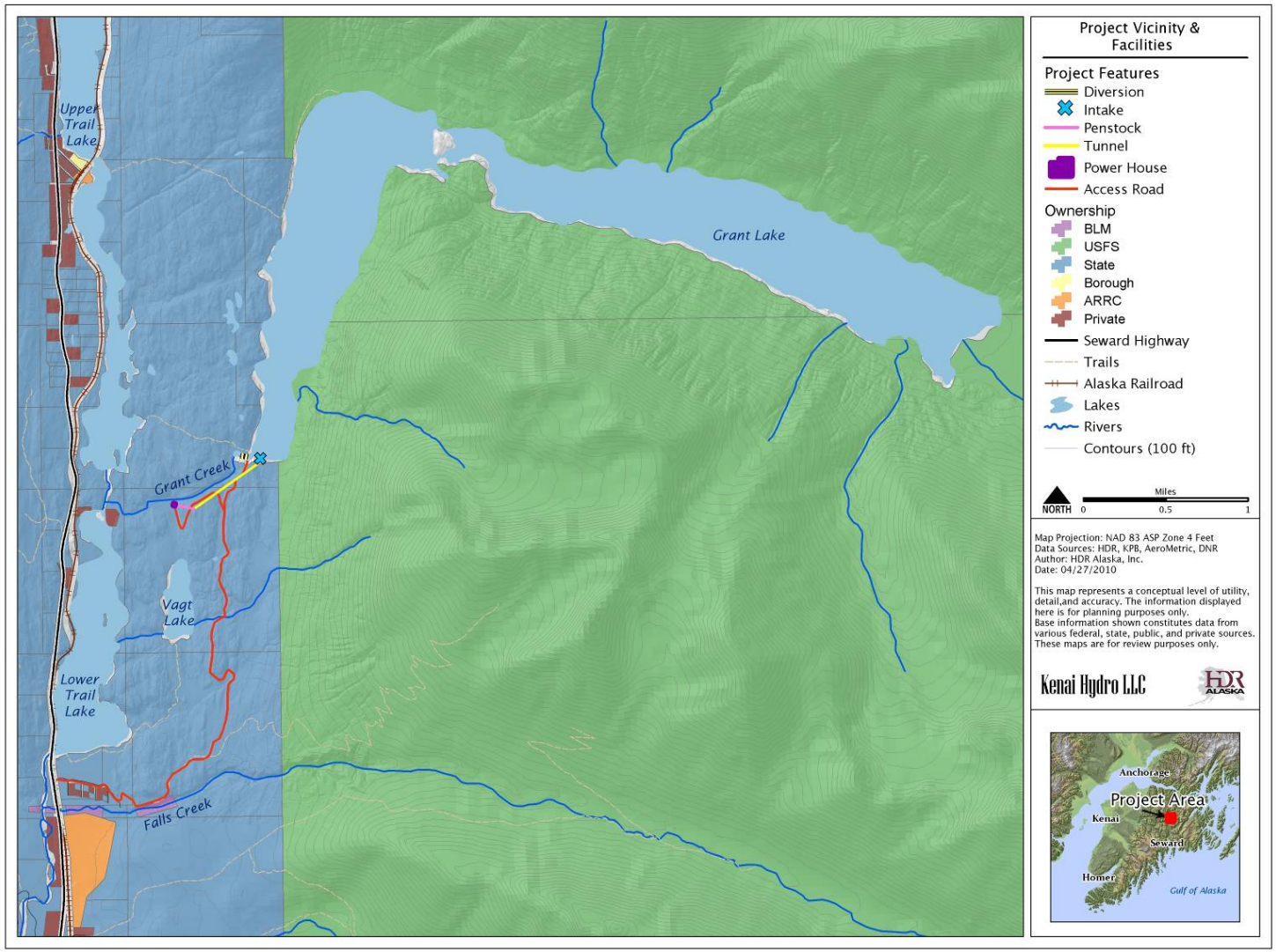

Figure 1. Project vicinity and proposed facilities.

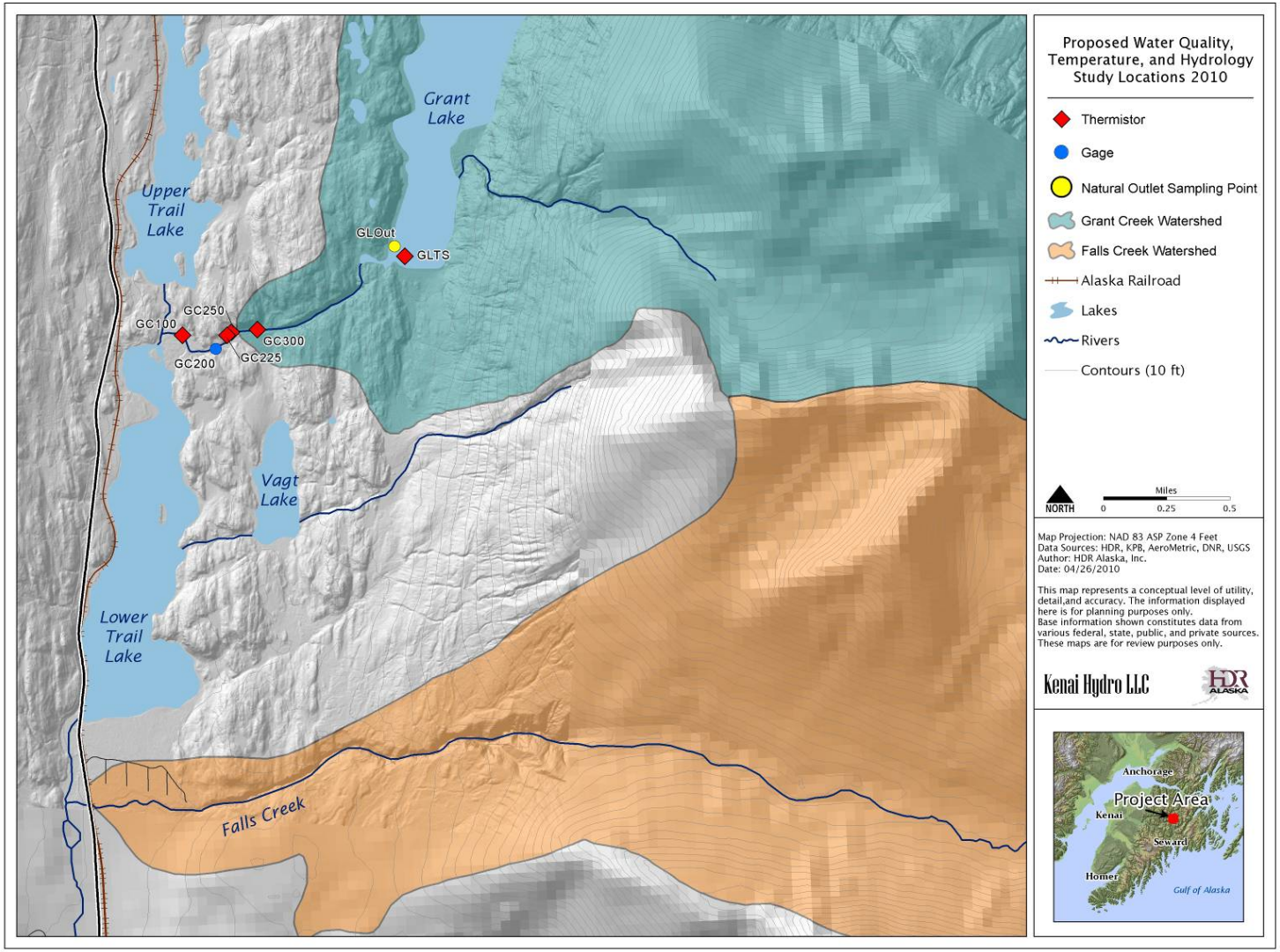

Figure 2. Proposed water quality, temperature, and hydrology study locations.

4.2 Field Study Design

4.2.1 Water Quality and Temperature

Water quality studies will be conducted in order to further document baseline conditions in Grant Lake and Grant Creek throughout the year. Describing the baseline conditions in each of these systems is necessary for understanding how Project operations may affect water quality. Water quality parameters were chosen for analysis based on several factors: those parameters sampled in previous studies; those parameters that may be affected by land use practices in the Project area; those parameters either necessary for aquatic life or which act as nutrients; and the drinking water and aquatic life criteria that have been developed for fresh water in Alaska. Water quality criteria have been established in order to set limits on how much certain water quality parameters may change due to human activity.

The 2010 water quality and temperature study contains the following subcomponents: baseline water quality studies in Grant Creek and baseline water quality studies in Grant Lake.

Baseline water quality studies in Grant Creek

- Water quality samples will be collected at three sites on Grant Creek (GC100, GC200, and GC300; Figure 2)
- In situ parameters will be collected using a YSI 556 multi-parameter meter at each creek location.
- Water samples will be collected for laboratory analysis of the analytes listed in Table 1.
- Temperature data loggers will be established at the four sites on Grant Creek (GC100, GC200, GC250, and GC300), and will be downloaded during water quality or hydrology sampling events. These loggers will remain in the stream throughout 2010.

Baseline water quality studies in Grant Lake

- Water quality samples will be collected at two sites in Grant Lake three times during the open water season. Samples will be collected at two depths at the natural outlet site (GLOut) and at three depths at the proposed intake location (GLTS).
- In situ parameters will be collected using a YSI 556 multi-parameter meter at each site in a vertical transect at one meter increments.
- Water samples will be collected for laboratory analysis of the analytes listed in Table 1.
- The thermistor string located near the proposed intake (GLTS) will continue to log temperature at ten depths in a vertical transect throughout 2010. The thermistor string may be pulled during an early 2011 winter sampling event.

Table 1. Water quality analytes.

Parameter	Units
Alkalinity ($CaCO_3$)	mg/L
Total dissolved solids (TDS)	mg/L
Total suspended sediment (TSS)	mg/L
Kjeldahl Nitrogen	mg/L
Nitrate/Nitrite	mg/L
Orthophosphate	mg/L
Total phosphorous	mg/L
Lead	µg/L
Hardness	mg/L
Calcium	mg/L
Magnesium	mg/L
Sodium	mg/L
Potassium	mg/L
Low level mercury	ng/L
Fluoride	mg/L
Chloride	mg/L
Sulfate	mg/L
pH	STD
Temperature	^{0}C
Dissolved oxygen (DO)	mg/L, %
Specific and Relative Conductivity	mS/cm, µS/cm
Oxygen Reduction Potential (ORP)	mV
Turbidity	NTU

The technique used for collecting water quality samples from Grant Creek (sampling sites GC100, GC200, and GC300; Figure 2) will depend on flow rate and water depth. Depth and width integrated sampling with a DH-81 sampler will be conducted when it is necessary to collect water from multiple locations within the cross section of Grant Creek. A DH-81 sample bottle will be used to collect one liter sub-samples, and the sub-samples will be combined in one sampling bucket to integrate water collected across the width of the cross section. Depth integration will be accomplished by gradually lowering and raising the sample bottle within the water column allowing it to fill from different depths. Integrated grab samples will be collected when the width of the stream is wide enough to require multiple subsamples across the section, yet it is not deep enough to require depth integration. Laboratory sample bottles will be filled from the bucket when integrated sampling techniques are used. In situations where the creek is too narrow and too shallow to warrant integrated sampling, or when the creek is very well mixed, a single grab sample will be collected. In these cases, grab samples will be collected from the most well mixed portion of the stream and transferred directly into the laboratory sample bottles.

Grant Lake water samples will be collected from two sampling sites, GLOut and GLTS (Figure 2), using a Niskin bottle sampler. At GLTS, which is approximately 20 meters deep, samples will be collected at three depths: surface, mid-depth or just below the thermocline when present, and from one meter above the substrate. GLOut is shallower, approximately 10 meters, and samples will be collected from the surface and mid-depth of the water column. Depths will vary seasonally at the lake sampling sites as the lake level elevation changes.

In situ parameters will be measured in both Grant Creek and Grant Lake using a YSI 556 multi-parameter meter. Bottles and preservatives for all water quality samples for laboratory analysis will be supplied by SGS Environmental Services in Anchorage, AK. All in situ water quality measurements will be recorded on a standard water quality study field data form. Water quality samples will be sent to SGS Environmental Services in Anchorage, Alaska for analysis.

Temperature sensors and data loggers were installed at GC100, GC200, GC250, GC300, and GLTS (Figure 2) in 2009. These instruments will remain in place throughout 2010. Temperature measurements will be collected using HOBO Pro V2 continually recording temperature loggers and HOBO U20 Water Level Loggers manufactured by Onset Computer Corporation. Loggers in the lake and in Grant Creek pools at GC100, GC250 and near GC200 will continue to collect temperature data throughout the year. Water temperature data loggers will be downloaded periodically throughout the ice-free season as conditions permit and in conjunction with other field efforts for the sake of safety and efficiency**.** Similar to 2009 studies, 2010 stream temperature data loggers will be placed within the stream channel in areas expected to remain submerged during all flows. Temperature data loggers will be kept submerged by anchoring them to boulders using stainless steel wire cable. Each temperature data logger will also be anchored (i.e., tree, log, or boulder) along the shoreline.

Temperature measurements in Grant Lake are intended to provide a temperature profile of the water column near the proposed intake. Water temperatures in Grant Lake will be measured both instantaneously and using continuously recording data loggers. At both GLOut and GLTS, temperatures will be measured in a vertical transect during water quality sampling events with a YSI 556 multi-parameter meter using a 20 meter cable calibrated at one meter intervals. The instantaneous water temperature measurements will be used to supplement the continually recorded temperature data. HOBO Pro V2 temperature data loggers are also used at the proposed intake site on Grant Lake. A thermistor string was installed in 2009 along a vertical transect in

this location to a depth of 20 meters. Data loggers were attached to the string at depths of 0.2, 0.5, 1.5, 3, 6, 9, 12, 15, 18 and 19.5 meters. The data loggers record temperature in four hour intervals. The thermistor string will remain in place through the winter of 2009-2010 and throughout 2010. The thermistor string may be removed during an early 2011 winter sampling event depending on project needs.

4.2.2 Hydrology

Hydrology studies will be conducted in order to further document baseline conditions in Grant Lake and Grant Creek throughout the year. Describing the baseline conditions in each of these systems is necessary for understanding how alterations to seasonal flow regimes might affect aquatic resources. Results will be used in conjunction with data collected in 2009, as well as historical data, to support the Instream Flow Study (HDR 2010), the engineering effort, and other related studies. To meet the 2010 goal, the study will have two components as follows:

Collection of continuously recording stage data

- Seasonal installation and removal of staff gage at GC200
- Seasonal installation and removal of continuously recording water surface data loggers at GC200
- Download data loggers at the end of the openwater season
- Process data, QA/QC

Development of rating curve

- Make discharge measurements using the wading method for low flows during spring installation, and up to three additional discharge measurements as flow depth and velocities allow
- Attempt to correlate data to the historic USGS rating curve for medium and high flows
- Data entry, QA/QC
- Analyze data and correlate stage and discharge
- Annual reporting

4.2.2.1 Stream Gage Installation (Continuously Recording Data Logger) and Instantaneous Discharge Measurements

Following guidelines from previously permitted installation activities in 2009, a stream gage will consist of a staff gage and a continuous stage (CQ) data logger. The data loggers used for this project will be HOBO U20 Water Level Loggers manufactured by Onset Computer Corporation. Each data logger records water temperature and pressure, which is correlated to water surface elevation with post-processing and has an accuracy of 0.015 feet. The data loggers are set to record water depth and temperature at 15-minute intervals.

The staff gage will be four inches wide by four feet long, mounted vertically on a post anchored in the stream bed (Figure 2). The data loggers will be housed in a polyvinyl chloride (PVC) sleeve that will be attached to post anchored in the streambed. A perforated one foot long PVC housing will be connected to a post at the channel bottom with steel clamps. One data logger will be suspended approximately one inch from the top of the PVC housing to record barometric

pressure. The second data logger will sit on a bolt passed through the bottom of the one foot PVC housing to record water pressure.

Figure 3. Example staff gage and data logger installation.

A differential survey will be performed for the data loggers and associated staff gage following installation in the spring and prior to removal in the fall. Cross sections at these locations are typically surveyed once per year during low flow conditions. The Grant Creek stream gage is tied into the elevation of the historical USGS gage and this elevation will be confirmed at installation.

Data loggers will be operated during ice free months (i.e. April-October). The schedule for these installations is dependent on site conditions (e.g., ice cover and water level). Installation of stream gauging equipment is expected to begin as soon as practicable in the spring 2010. All installed equipment will be removed by late October 2010 or prior to freeze-up.

An instantaneous discharge measurement will be made using the wading method during stream gage installation in the spring. Three additional discharge measurements will be made for a variety of flows throughout the year as conditions permit. All discharge measurements will follow standard USGS procedures as described in Rantz et al. (1982).

4.2.3 Grant Lake and Grant Creek Fluvial Geomorphology

The Grant Lake and Grant Creek Fluvial Geomorphology study consists of two study components; a Grant Lake erosion inventory and comparison, and a Grant Creek spawning substrate assessment. The results of these studies will be documented in a technical memorandum.

4.2.3.1 Grant Lake shore erosion study

- Summarize existing topographic, soils, and geology data of potential erosion features

- Compile and analyze local wind intensity and direction data
- Map high wave areas on Grant Lake
- Conduct a boat-based GIS-enabled lake shore inventory
- Conduct data analysis, and QA/QC
- Produce a technical memorandum

The purpose of the 2010 Grant Lake shore erosion inventory is to characterize the erosion potential along the shores of Grant Lake and its tributaries resulting from potential lake impoundment and drawdown scenarios. HDR proposes a boat-based inventory of areas of current erosion and potential erosion along the shores of Grant Lake. Location data, site characteristics and photos will be collected using GIS mapping techniques. The Grant Lake data will be compared to the Cooper Lake shore erosion data (HDR 2004) to allow for the general prediction and identification of possible erosion issues under an impoundment and drawdown scenario. A qualitative assessment of current and potential future processes will be summarized in a technical memo.

4.2.3.2 Grant Creek spawning substrate recruitment study

- Summarize and compile existing topographic, soils, and geology data, and data from previous studies.
- Visit Grant Creek and the shores of Grant Lake near the outlet to qualitatively assess Grant Creek substrate recruitment processes.
- Determine likely post impoundment substrate recruitment and/or sedimentation scenarios
- Organize observations and photos into a technical memorandum

The purpose of the 2010 Grant Creek spawning gravel recruitment study is to assess the existing processes that control the supply of substrate suitable for spawning in Grant Creek and to assess potential changes to substrate composition under the potential scenario of a dewatered canyon reach. HDR proposes a two day site visit exploring as much of Grant Creek as is safely possible, as well as allowing for a visit to the area near the Grant Lake outlet. A qualitative assessment of current and potential future processes will be summarized in a technical memo.

5 Agency Resource Management Goals

Stated resource agency management goals resulting from coordination include:

- Alaska Department of Fish and Game published “Our Wealth Maintained: A Strategy for Conserving Alaska’s Diverse Wildlife and Fish Resources” in 2006. The Strategy is intended to integrate new conservation methods with existing wildlife management and research programs. Maintaining diversity of wildlife (including fish) is the main goal of the Strategy.
- The Kenai River Special Management Area (KRSMA) is managed under Alaska Department of Natural Resources. The area includes public lands and waters that contribute to sustaining Kenai River’s fish resources.

- The Revised Land and Resource Management Plan for the Chugach National Forest developed by the United States Forest Service lists multiple goals based around maintaining and/or improving fish habitat within the National Forest.
- The Kenai River Comprehensive Management Plan is managed by the Alaska Department of Natural Resources is the basis for management of state lands within KRSMA.
- The Alaska Department of Fish and Game published "Aquatic Resources Implementation Plan for Alaska's Comprehensive Wildlife Conservation Strategy" (CWCS) in 2007. The goal of the CWCS is to conserve the diversity of Alaska's fish and wildlife resources focusing on species and habitats of greatest concern.

6 Project Nexus

The proposed Project may have potential impacts on water resources within Grant Creek and Grant Lake. The studies described above are intended to provide sufficient information regarding the nature of the existing water resources such that these potential impacts can be adequately assessed. A discussion of the data will be presented in the study report, and will be used to inform the development of protection, mitigation, and enhancement measures to be proposed in the draft and final License Applications.

7 Consistency with Generally Accepted Practices

7.1 Water Quality and Temperature

Water quality samples will be collected using standard methods approved by the EPA. Sampling equipment will be cleaned and decontaminated between each sampling site. Sample frequency during open water months can vary depending on the needs of the project. The HOBO Pro V2 logging thermistor has an operating range of -40 to 50ºC, and is accurate to 0.2ºC over 50ºC. The HOBO U20 water level logger has a pressure operating range of 0-207 kPA, with a typical error of 0.05%, and a temperature operating range of -20 to 50ºC and is accurate to 0.37ºC at 20ºC. Both HOBO units have 64K bytes of memory.

7.2 Hydrology

Hydrology studies, including the installation and operation of surface water elevation data loggers, and instantaneous discharge measurement methods will be conducted using standard methods such as those described by Rantz et al (1982). These methods have been developed, standardized, and are in use by the US Geological Survey specifically for measuring stream discharges throughout the nation.

7.3 Grant Creek Fluvial Geomorphology

Both components of the Grant Creek fluvial geomorphology study are designed to be reconnaissance-level efforts that rely on existing geologic and soils data, hydrologic and meteorological data as well as professional experience and judgment to produce technical memoranda of the processes and resulting issues involved in both studies. Both studies will

incorporate methods used in previous studies (e.g. HDR 2004) including site visits and mapping of areas of potential erosion.

8 Schedule for Conducting the Study

8.1 Water Quality and Temperature

- May 2010 –One day field event to download and reinstall thermistors
- June 2010 – Water resources study plan review meeting
- June 2010 – Three day field event to collect water quality samples at Grant Lake, Grant Creek, one day of preparation
- August 2010 – Three day field event to collect water quality samples at Grant Lake, Grant Creek, one day of preparation, download and reinstall thermistors
- October 2010 – Three day field event to collect water quality samples at Grant Lake, Grant Creek, one day of preparation, download and reinstall thermistors
- November 2010 - Complete QA/QC on all 2010 data, complete data processing and analysis
- November 2010 – Submit internal draft study report
- December 2010 - Submit final draft study report
- January 2010 – Submit final report
- February 2011 – Two day field event to collect field parameters at Grant Creek and Grant Lake
- March 2011 – Submit draft supplemental report for winter work
- April 2011 – Submit final supplemental report

8.2 Hydrology

- April 2010 – Prepare equipment and materials; install staff gage and datalogger at GC200; conduct topographic survey of cross-section at GC200; obtain one IQ measurement at GC200
- April-May 2010 –Make up to three IQ measurements on Grant Creek. These measurements could also be made during autumn low flow conditions.
- June 2010 – Water resources working group meeting (in conjunction with FERC scoping)
- October 2010 – Download data loggers at GC200; resurvey GC200 uninstall gage and dataloggers
- November 2010 - Complete QA/QC on all 2010 data, complete data processing and analysis
- November 2010 – Submit internal draft study report
- December 2010 - Submit final draft study report
- January 2010 – Submit final report

8.3 Grant Lake and Grant Creek Fluvial Geomorphology

- May 2010 –Prepare and conduct spawning gravel reconnaissance field visit during spring low flow conditions
- June 2010 – Water resources working group meeting

- June 2010 –Prepare draft spawning substrate technical memo
- July 2010 – Prepare for lake shore erosion inventory field event
- August 2010 – Conduct Cooper Lake calibration site visit and Grant Lake shore erosion inventory
- September 2010 – Process and analyze lake shore erosion data
- October 2010 – Submit internal draft technical memo for both lake shore and spawning substrate components
- November 2010- Prepare final draft technical memos
- December 2010 – Submit final technical memos

9 Provisions for Technical Review

KHL will provide updates and study products for review by agencies and stakeholders during the licensing process.

- May 2010: distribute draft study plan for review
- June 2010: Issue revised study plan
- May through June 2010: Start of Study Season
- Mid-Summer 2010: Update on field activities and update to study plan (if necessary per FERC scoping process)
- October 2010: End of Study Season [varies by study area]
- Fall 2010 – Update on field activities
- December 2010: Distribute draft study report
- January 2011: Meeting/conference call to discuss comments on draft study report
- May 2011: Issue Draft License Application
- September 2011: File Final License Application

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