Pre-Application Document

Grant Lake/Grant Creek and Falls Creek Project
(FERC No. 13211 and 13212)

Photo Credit: HDR, Alaska, Inc.

Kenai Hydro, LLC

August 2009

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1 EXECUTIVE SUMMARY

Kenai Hydro, LLC (KHL) was issued two preliminary permits effective October 1, 2008 to investigate hydropower projects at Grant Lake/Grant Creek (FERC Project No. 13212) and Falls Creek (FERC Project No. 13211). This Pre-Application Document describes a combined Grant Lake/Falls Creek Hydroelectric Project that includes a proposed Grant Lake/Grant Creek development, and a Falls Creek development to divert water from Falls Creek to Grant Lake in order to supplement generation capacity at the powerhouse located on Grant Creek.

The proposed Project generating facilities will be located on Grant Creek, near the outlet of Grant Lake, with a diversion tunnel constructed from Falls Creek. The proposed Project would be located near the community of Moose Pass, Alaska, approximately 25 miles north of Seward, Alaska, and just east of the Seward Highway (State Route 9). The proposed Project location is in the Kenai Peninsula Borough.

This PAD summarizes existing information on geology and soils, water resources, fish and aquatic resources, wildlife and botanical resources, recreation and land use, aesthetic and visual resources, cultural resources, socioeconomic resources, and Tribal resources in the proposed Project vicinity. The PAD presents preliminary engineering descriptions of proposed Project facilities and describes a proposed environmental study program to determine potential Project impacts. Finally, the PAD summarizes early consultation efforts to gather existing information and begin development of environmental studies for the Project area.

KHL is requesting Commission approval to use the Traditional Licensing Process (TLP). The proposed Grant Lake/Falls Creek Project is a new, relatively small (4.5 MW) conventional hydropower project. As proposed the Project would affect flows in less than one mile of Grant Creek and less than two miles of Falls Creek and would change water levels in existing Grant Lake. The overall footprint of the proposed Project covers a relatively small geographic area. The licensing process should be scaled appropriately to the potential impacts of the proposed Project and size of the proposed Project area. KHL believes that a TLP, with an additional communications protocol is the preferred process for the pre-filing consultation and study efforts for the Project.

2 PROCESS PLAN, SCHEDULE, AND COMMUNICATION PROTOCOL

2.1. Overview of Licensing Approach and Early Consultation

In conjunction with its Notice of Intent (NOI) to file for a new license, Kenai Hydro, LLC is seeking FERC approval to use the Traditional Licensing Process (TLP) for the licensing of the Grant Lake/Falls Creek Hydroelectric Project (Project) in order to complete pre-filing consultation and file a license application within the timeframes of the preliminary permits issued by FERC. KHL initiated informal consultation with potentially interested parties with an outreach effort that

began in 2008. KHL is initiating formal pre-filing consultation with issuance of the NOI and this Pre- Application Document (PAD). The TLP, if approved, will require a Joint Meeting and site visit with the agencies, Tribes and public. The TLP also provides opportunities for the agencies and other interested parties to provide comments on the PAD and to make study requests.

2.2. Process Plan and Schedule

Table 2.2-1 summarizes milestones in the TLP along with dates pursuant to timelines identified in 18 CFR § 4.38. In the interest of offering a site visit during the field season, prior to study design, KHL has scheduled a site visit with the Instream Flow Technical Workgroup established to inform study plan development. In addition agencies and active Participants were apprised of field schedules between June and September 2009, and were offered the opportunity to join field crews in the proposed Project area. Finally, KHL will offer a site visit to agencies, Tribes, and the public on November 5, in conjunction with the proposed Joint Meeting date.

Table 2.2-1. Milestones, responsible parties, and proposed dates for pre-licensing activities, assuming approval of the TLP.

Pre-Filing Milestone	Responsible Party	Date [Required Timeframe]
Initiate informal consultation with agencies, non-governmental organizations, and public	KHL	Fall 2008
Informational Meetings	KHL	January 20, 21, & 28, 2009
Fish, Instream Flow, Hydrology, and Water Quality Workgroup meeting	KHL	March 24, 2009
Instream Flow Technical Workgroup meeting	KHL	April 21, 2009
Instream Flow Technical Workgroup conference call	KHL	May 19, 2009
Instream Flow Technical Workgroup conference call	KHL	July 16, 2009
File NOI and PAD with FERC and distribute (via email notice) to appropriate Federal, state, and interstate resource agencies, Indian tribes, local governments and members of the public likely to be interested in the proceeding	KHL	August 6, 2009
Conduct Tribal meeting(s)	FERC	September 6, 2009 [within 30-days of the NOI]
Comments on use of the TLP	Interested Parties, Agencies, and Tribes	September 6, 2009 [within 30-days of the NOI and request to use TLP]
Instream Flow Technical Workgroup Meeting and Agency Site Visit	KHL	September 22-24, 2009 [Voluntary]
Commission issues decision on use of TLP	FERC	October 5, 2009 [within 60-days of NOI and request to use TLP]
Consultation with agencies and Tribes to schedule a Joint Meeting	KHL	October 5 – October 14, 2009 [within 30-days of TLP decision]

Pre-Filing Milestone	Responsible Party	Date [Required Timeframe]
Advance notice to FERC of Joint Meeting and proposed site visit	KHL	October 15, 2009 [at least 15-days prior to Joint Meeting]
Hold Joint Meeting and site visit with agencies and Tribes, and members of the public	KHL	November 5, 2009 [between 30 and 60 days of TLP decision]
Parties provide study determinations and information requests	Interested Parties, Agencies, and Tribes	November 5, 2009 – January 6, 2010 [Within 60-days of Joint Meeting, unless extension is granted upon request of agencies]
Dispute resolution steps (if necessary)	KHL, interested parties, FERC	January – April 2010
Additional study plan development and review meetings proposed by Kenai Hydro to gain feedback during the study implementation phase. Timeframes and meeting dates will be agreed to by Participants and KHL according to the consultation protocol outlined below.		
Provide technical memorandum outlining 2009 reconnaissance study results and draft study plans	KHL	January 2010
Proposed meeting to discuss 2010 draft study plans	KHL	April 14 – April 16, 2010
Issue 2010 final study plans for agency approval	KHL	May 8-12, 2010
Conduct studies per study plans and provide periodic agency updates as agreed	KHL	May 2010 – January 2011 (or later as agreed in study plans)
Issue Draft License Application	KHL	May 3, 2011
Submit Final License Application	KHL	September 29, 2011
Expiration of Preliminary Permit	KHL	September 30, 2011

2.3. Communications and Document Distribution

This Communication Protocol (Protocol) is intended to facilitate communication and cooperation among KHL, federal and state agencies, Indian tribes, native corporations other interested organizations and members of the public (collectively, Participants) during the preparation of KHL's

Application for Original License for the Project. This Protocol is structured based on the assumption that FERC will approve the use of the Traditional Licensing Process (TLP) for the pre-filing consultation period for the Project. Given KHL's understanding based on its outreach efforts that agencies and others are concerned with the rigid timeframes and deadlines of the Integrated Licensing Process (ILP) it believes that the TLP, supplemented by the provisions outlined below, would be the most effective process for completing the necessary pre-filing work while providing for meaningful participation by agencies and other interested organizations.

KHL conducted a successful pre-formal consultation with agencies and other interested stakeholders regarding informal study efforts in 2009. These efforts included face to face meetings, conference calls and field visits, where scheduling of interactions and review periods were worked out in a collaborative fashion. As a result of this collective effort, draft study plans were developed, reviewed, comments provided and revised plans issued in an efficient and effective fashion. KHL hopes to emulate this success utilizing the modified TLP for the formal licensing consultation.

Should the TLP not be approved for use, KHL will continue with consultation utilizing the default ILP and follow the applicable regulations.

This Protocol will govern communications among all Participants and provide public access to information regarding the consultation activities related to the licensing of the Project. The Protocol also applies to communications made by contractors or consultants on behalf of KHL or any of the Participants. This Protocol does not apply to communications solely between Participants, or to any Participant's internal communications.

2.3.1. Participation in the Licensing Process

The licensing process for the Project is open to the general public and interested parties are encouraged to participate. A contact list, compiled by KHL, will be maintained to identify those agencies, organizations, individuals or groups that have been identified as interested parties or who have requested to be included as Participants. The contact list will be used to provide notice of any public meetings, as well as notice of the availability of information for public review. The contact list will be updated periodically by KHL and inactive Participants will be asked annually to re-affirm their interest in participating in the process.

In response to concerns with the TLP identified by agencies and other interested parties, KHL proposes to supplement the TLP process with additional consultation steps to provide an enhanced level of engagement and transparency. These enhancements include:

- Working with agencies and other stakeholders on the scheduling of meetings and conference calls,

- Providing opportunities for the review of draft study plans and study reports and addressing those comments in final plans/reports,

- Allowing for more than the minimum 30 days for review of significant documents when possible without jeopardizing the overall project schedule.

To the extent possible, KHL is committed to working with agencies and other Participants to identify opportunities to make adjustments to timeframes throughout the pre-filing period. Given that this licensing effort will occur within a TLP, these decisions regarding adjustments to timeframes can be made by KHL in coordination with Participants.

2.3.2. Maintenance of the Public Reference File

KHL has developed and will maintain a public reference file at KHL's offices. The public reference file will include copies of all written correspondence (including e-mails), documentation of phone conversations, meeting notices, agendas and summaries, study plans, study reports, status reports, and other documents developed during consultation or submitted for inclusion in the public reference file. All documents in the public reference file will be submitted to FERC as part of the formal licensing record.

KHL will also maintain a website (www.kenaihydro.com) for access to key documents developed during the course of the licensing consultation, such as the PAD and NOI, meeting notices, meeting summaries, study plans, and study reports. The licensing website will also have an information library that allows Participants to access relevant information that KHL has gathered through its due diligence process.

For the duration of the licensing proceeding KHL will also make available to the public for inspection in a form that is readily accessible, reviewable and reproducible during regular business hours, the PAD, materials referenced in the PAD and other information that will make up the complete application for license, including all exhibits, appendices, and any amendments, pleadings, supplementary or additional information, or correspondence filed by KHL with the Commission n connection with the application.

2.3.3. Meetings

KHL shall be responsible for scheduling all consultation meetings involving KHL and Participants. For the meeting specified in 18 CFR Section 4.38(b)(3), KHL will provide the required notice in appropriate local and other forums. KHL will solicit input from Participants on meeting agendas and objectives and will seek to locate meetings to facilitate Participant attendance to most effectively accomplish those objectives.

KHL will notify all Participants of meetings scheduled by KHL at least 30 days prior to the meeting date. This notification may be made in writing, via fax, via email, or by telephone conversation. Under special circumstances, KHL may hold a meeting with less than 30 days notice.

KHL shall propose the meeting agenda and will strive to provide a written meeting agenda to all Participants at least two weeks prior to a scheduled meeting. Participants may submit comments on the agenda to KHL up to one week before the scheduled meeting. KHL will address any proposed changes to the agenda and will distribute a final agenda at the meeting. In addition, the agenda may be modified at the beginning of the meeting.

KHL and all Participants will endeavor to make available all documents and other information necessary to prepare for a consultation meeting at least two weeks prior to the scheduled meeting. In the alternative, materials can be provided at the meeting.

2.3.4. Documentation

All of the documentation requirements described below apply to substantive communications regarding the licensing of the Project; communications related to procedural matters (e.g., responding to inquiries regarding meeting scheduling) are not subject to the same documentation requirements.

Meeting Summaries

KHL will be primarily responsible for providing a written summary of the matters addressed at all meetings involving KHL and Participants. A draft meeting summary will be distributed to all meeting attendees within 15 days of the meeting. Any corrections to the draft meeting summary should be submitted to KHL within 15 days. KHL will finalize the meeting summary within 30 days after receiving corrections. If no corrections are submitted, the meeting summary will become final 30 days after the date of the meeting. Final meeting summaries will be posted on the licensing website.

Oral Communications

Any oral communication (i.e., telephone conversations) between KHL and any Participant regarding any substantive aspect of the Project licensing shall be documented in writing by KHL and included in the public reference file, with a copy provided to those participating in the oral communication.

Technical Documents

A variety of technical documents will be produced during the course of licensing consultation, including the PAD, study plans, study reports, and draft and final license applications. Whenever comments are solicited on documents, review periods will be established and communicated to Participants. Review periods will typically be 30 days, unless longer periods are required by FERC regulations (e.g., 90 day comment period on the draft application). Participants will strive to provide comments to KHL within the timeframes specified for comment periods. KHL will consider adjusting comment periods, making them either longer or shorter, to better utilize

available time within the course of pre-filing consultation, without jeopardizing the overall project schedule. Any such adjustments will be made with the concurrence of the Participants.

Written Correspondence

Any written correspondence (including e-mails) regarding the licensing of the Project between KHL and Participants will become part of the public reference file.

All written correspondence should be sent to KHL at the following address:

Kenai Hydro, LLC
Attn: Steve Gilbert
6921 Howard Ave.
Anchorage, AK 99504

With a copy sent to:
Jenna Borovansky
Long View Associates, Inc.
P.O. Box 3844
Coeur d'Alene, ID 83816

Or by email: SteveG@enxco.com and jborovansky@longviewassociates.com.

2.3.5. Distribution of Licensing Documentation

Distribution of licensing documents will be accomplished primarily by email notice and availability on the KHL web-site (www.kenaihydro.com). If a Participant has indicated a preference to receive hard-copy mailings, KHL will send paper documents through regular mail. A Participant may also request to receive a paper copy of any specific licensing document by contacting Jenna Borovansky at jborovansky@longviewassociates.com. Fees in accordance with regulations may apply.

In addition to distribution to all Participants, all licensing documents will be posted on the licensing website (www.kenaihydro.com). Distribution of licensing documents (aside from brief letters, notices, etc.) will include a copy of the distribution list.

2.4. Revisions to the Communications Protocol

This protocol may be revised at any time upon general agreement of KHL and the Participants.

2.5. Duration of the Communication Protocol

This Communications Protocol will remain in effect until FERC notices that the License Application is accepted for filing.

3 PROJECT LOCATIONS, FACILITIES, AND OPERATIONS

3.1. Authorized Agents for the Applicant

The name, business address, and telephone number of each person authorized to act as agent for the Applicant are as follows:

Steve Gilbert
Manager
Kenai Hydro, LLC
6921 Howard Ave.
Anchorage, Alaska 99504
907-333-0810

Brad Zubeck
Project Engineer
Kenai Hydro, LLC
280 Airport Way
Kenai, Alaska 99611
907-335-6204

3.2. Project Location

The proposed Grant Lake/Falls Creek Hydroelectric Project would be located near the community 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 community of Cooper Landing (pop. 369) 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. The proposed Project location is in the mountainous terrain of the Kenai Mountain Range.

Land ownership and the proposed locations for Project facilities are shown in Figure 3.2-1. (Appendix 1 includes larger scale versions of the figure.)

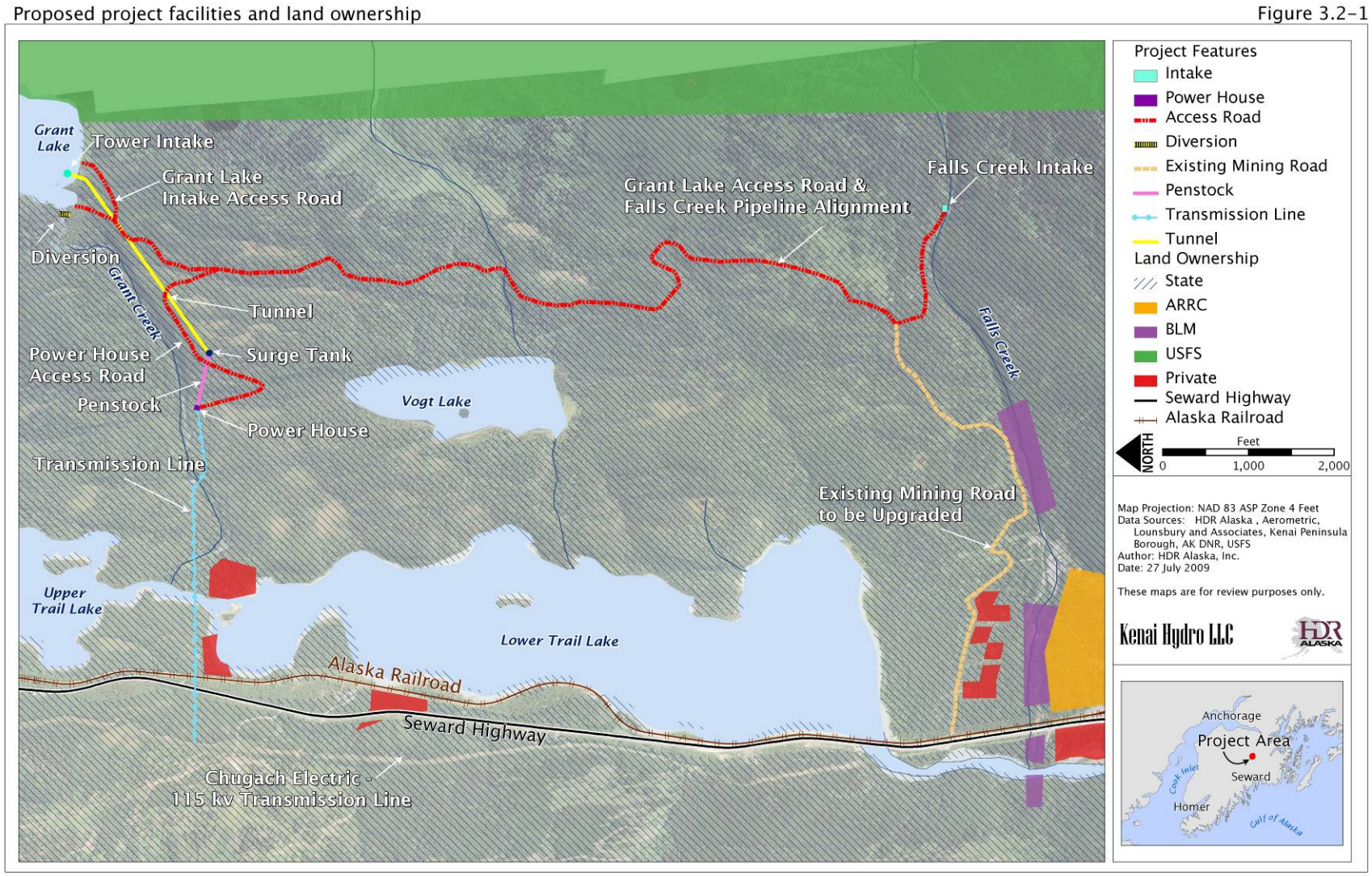

Figure 3.2-1. Proposed Project facilities and land ownership.

3.2.1. Grant Lake and Grant Creek Development

KHL was issued a preliminary permit to investigate a proposed hydropower development on Grant Creek near the outlet of Grant Lake. Several potential alternatives were reviewed for this project; the most promising alternative would use approximately 48,000 acre-feet of storage during operations between pool elevations of 675 and 706 feet. Storage would 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 would range from approximately 9 feet above up to 25 feet below the natural lake elevation. A multi-level intake would 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 from mean sea level (MSL). At the outlet to the tunnel a 650-foot-long section of penstock will convey water to the powerhouse located at about elevation 518-foot MSL. The tailrace would be located in order to minimize impacts to fish habitat by returning flows to Grant Creek upstream of the most productive fish habitat.

3.2.2. Falls Creek Development

KHL was issued a preliminary permit to investigate a proposed hydropower project on Falls Creek. Upon investigation, the most feasible alternative is to combine the Falls Creek development with the Grant Lake/Grant Creek development, and divert water from Falls Creek via an approximately 13,000-foot-long pipe into Grant Lake to create increased generation capability at the proposed generation facility located on Grant Creek.

3.3. Proposed Project Facilities

The Project will consist of two developments – a Grant Lake/Grant Creek development and a Falls Creek development. The Grant Lake/Grant Creek development is comprised of a diversion dam at the outlet to Grant Lake, an intake structure in Grant Lake, a tunnel, a potential surge tank, a penstock, a powerhouse, access roads, a step-up transformer, a breaker, an overhead transmission line, and a switchyard. The powerhouse will contain two Francis turbine generating units with a combined rated capacity of 4.5 MW with a total design flow of 350 cfs.

Additionally, a Falls Creek development will be constructed in order to divert water from Falls Creek to Grant Lake. Falls Creek will be diverted into Grant Lake during the spring, summer and fall months to provide additional flows into Grant Lake for subsequent power generation. The Falls Creek development is comprised of a diversion dam, a pipeline between Falls Creek and Grant Lake, and an access road.

Conceptual drawings of proposed Project facilities are included in Appendix 2.

3.3.1. Summary of Project Features

The proposed Project features have been developed based upon existing physical and environmental information and are conceptual in nature. As part of the pre-filing consultation process additional information will be obtained through technical and environmental studies, research and consultation with equipment manufacturers and resource agencies. As new information becomes available, the design features presented below can be expected to be refined and/or modified to accommodate any changed conditions, including maintenance of instream flow requirements.

Project features as currently envisioned are summarized in Table 3.3-1 and described in this section.

SUMMARY OF PROJECT FEATURES	
Number of Generating Units	2
Turbine Type	Francis
Rated Generator Output	
Unit 1	1.2 MW
Unit 2	3.3 MW
Maximum Rated Turbine Discharge	
Unit 1	100 cfs
Unit 2	250 cfs
Turbine Centerline Elevation	521.0
Normal Tailwater Elevation	
Minimum	512.0
Maximum	515.0
Average Annual Energy	23,430 MWh
Normal Maximum Reservoir Elevation	706.0
Normal Minimum Reservoir Elevation	675.0
Gross Head	191.0 feet
Net Head at Maximum Rated Discharge	170.4 feet
Grant Lake	
Drainage Area	44.0 sq. mi.
Surface Area at Elevation 706.0	1,790 acres
Active Storage Volume	48,000 acre feet (Elevation 706.0 to 675.0)
Average Annual Natural Outflow	139,650 acre feet
Average Annual Natural Outflow	192.9 cfs
Grant Creek Diversion	
Type	Concrete Gravity Dam
Maximum Height	10 feet
Overall Width	120 feet
Spillway Crest Length	60 feet
Crest Elevation	706
Water Conveyance	
Intake	Tower

Invert Elevation	660
Lower Pressure Pipeline	
Type	Welded Steel
Length	200 feet
Diameter	96 inches
Pressure Tunnel	
Type	10-foot Horseshoe
Length	2,800 feet
Velocity at Maximum Turbine Discharge	3.9 fps
Surge Tank	
Diameter	96 inches
Base Elevation (Preliminary)	650
Top Elevation (Preliminary)	760
Penstock	
Type	Welded Steel
Length	650 feet
Diameter	66 inches
Falls Creek Diversion	
Type	Concrete Gravity Dam
Maximum Height	10 feet
Crest Length	50 feet
Crest Elevation	800
Falls Creek Pipeline	
Type	Welded Steel
Length	13,000 feet
Diameter	42 inches
Powerhouse	
Approximate Dimensions	45 feet x 60 feet x 30 feet high
Finished Floor Elevation	518
Tailrace	
Type	Open Channel
Length	200 feet
Transmission Line	
Type	Overhead
Length	4,100 feet
Voltage	115 kV
Access Roads	
Type	Single lane gravel surfacing with turnouts
Length	3.4 miles

Table 3.3-1. Summary of proposed Project features.

3.3.1.1. Grant Creek Diversion

A concrete gravity diversion structure will be constructed near the outlet of Grant Lake. The dam will have a maximum height of approximately 10 feet and will have an overall width of approximately 120 feet. The center 60 feet of the dam will have an uncontrolled spillway section

with a crest elevation at 706 MSL. The abutments will have a top elevation of 716 MSL. The spillway will have a flood capacity of 4,200 cfs with 3 feet of freeboard.

A low level outlet will be constructed on the north abutment of the diversion dam. The outlet works will be contained in a valve house constructed integral with the diversion structure. This outlet will be used during the construction of the intake on Grant Lake. The valve house will contain a regulating valve, controls, and associated monitoring equipment. The outlet will discharge into Grant Creek immediately below the diversion. This low level outlet will aid in construction of the intake by lowering the lake level. The outlet will also be available to provide instream flow to the reach of Grant Creek between the intake and the powerhouse tailrace. The potential need for instream flow in this reach of Grant Creek will be examined during licensing studies.

3.3.1.2. Grant Lake Intake

The water intake will be a free-standing concrete tower structure located approximately 500 feet east of the natural outlet of Grant Lake and approximately 120 feet off-shore. The intake structure will have base dimensions of approximately 20 feet by 20 feet. At the top of the intake will be a small gate house to contain the gate hoist mechanism and controls. The intake will be connected to the shore by a narrow access bridge at elevation 720 MSL.

The intake will allow for drawdown of Grant Lake to elevation 675 MSL thereby creating 48,000 acre-feet of active storage for the project between elevations 706 MSL and 675 MSL. The invert of the intake will be at elevation 660 to provide for adequate submergence. The intake will consist of multiple levels to allow the Project to draw water near the surface during all seasons of operation. The front of the intake will be protected by a steel trashrack. Downstream of the trashracks will be a shut-off gate. A 200-foot-long, 8-foot diameter steel pipeline section will connect the intake to the power tunnel.

3.3.1.3. Tunnel

An approximately 2,800-foot-long, 10-foot diameter horseshoe tunnel will convey water from the intake to directly above the powerhouse at about elevation 650 MSL. It is expected that the tunnel will be supported with rock bolts and shotcrete. It may be partially lined depending upon the geotechnical conditions encountered during excavation.

3.3.1.4. Penstock and Surge Tank

At the outlet to the tunnel a short section of penstock will convey water to the powerhouse. The penstock will be constructed of welded steel and will be approximately 650-feet-long and will have an outside diameter of 66 inches. Additional engineering work will be done to determine the feasibility of utilizing a surge tank located at the beginning of the penstock. Preliminary

designs propose an 8-ft diameter by 110-ft high structure, however the height could be reduced depending on alternative generator design, constructing this tank into the slope or integral to the tunnel, or using a synchronous bypass valve. The surge tank will have a base elevation of 650 MSL with a top elevation of 760 MSL if built to maximum height proposed. The penstock will bifurcate to the two turbines immediately upstream of the powerhouse.

3.3.1.5. Tailrace

The tailrace will be an open channel approximately 200-feet-long and will convey water back to Grant Creek at approximately elevation 508 MSL. The tailrace will be excavated from in-situ material and armored with riprap to prevent erosion.

3.3.1.6. Falls Creek Diversion/Intake

Diversion of Falls Creek will be made via a concrete diversion structure. The diversion dam will have a crest elevation of 800 MSL and a crest width of approximately 50 feet. The intake structure will consist of a small concrete box type of structure located on the right bank of Falls Creek, approximately 1.4 miles from the mouth of Falls Creek. The front of the intake will be protected by a trashrack. Stoplog slots will be located downstream of the trashrack to provide a means to dewater the intake during periods of maintenance. A small valve house will be located immediately downstream of the intake. The valve house will house the pipeline shut-off valve and operator and level control and flow sensors. If studies support the need for maintaining instream flows downstream of the diversion, water can be allowed to spill over the spillway by reducing flows through the pipeline.

3.3.1.7. Falls Creek Pipeline

An approximate 13,000 foot-long welded steel penstock will convey water from the Falls Creek intake to Grant Lake. The pipeline will have a diameter of 42 inches corresponding to a maximum flow rate of 150 cfs. The pipeline will be of above-ground construction on simple saddle supports approximately 40 feet on center. The pipeline will have an epoxy lining and coating to prevent corrosion. The pipeline will enter Grant Lake through an energy dissipating channel which will start at the new high lake elevation and continue to the proposed low lake elevation.

3.3.1.8. Powerhouse

The powerhouse will be located on the south bank of Grant Creek near the end of the canyon section of the creek. The powerhouse will be approximately 45 feet by 60 feet by 30 feet high and will have a finished floor elevation of 518 MSL. The powerhouse will be a pre-engineered metal building on a concrete foundation.

The powerhouse will contain two horizontal Francis type turbine/ generator units with a rated total capacity of 4,500 kW, guard valves, and associated switchgear and controls. Unit 1 will have a design flow of 100 cfs and a rated capacity of 1,200 kW. Unit 2 will have a design flow of 250 cfs and a rated capacity of 3,300 kW. Centerline of the turbine and generator units will be approximately 521 MSL. Tailwater elevation at the powerhouse will range from approximate elevations 512 MSL to 515 MSL depending upon output level. The turbines could operate over a range of flows from the maximum of 350 cfs to a minimum of around 30 cfs depending on conditions. The powerhouse will also contain a bypass valve to release flows during power generation outages.

3.3.1.9. Transmission Line/Switchyard

The switchyard at the powerhouse will consist of a pad-mounted disconnect switch (i.e., breaker) and a pad-mounted step-up transformer. An overhead 115 kV transmission line would run from the powerhouse approximately 4,100 feet to a point of interconnection directly west where it would intersect the existing 115 kV transmission line. At the intersection a switchyard would be constructed in consultation with the existing transmission line owner. The route would attempt to incorporate setbacks to the creek and alignment changes to minimize visual impacts as viewed from the Seward Highway.

The poles would be designed as tangent line structures on about 300 foot centers. Design of the line will also incorporate the latest raptor protection guidelines. Collision avoidance devices will be installed on the line at appropriate locations to protect migratory birds.

3.3.2. Proposed Project Boundary

The Project Boundary will encompass each of the Project features described above in the Grant Creek and Falls Creek drainages, and the area of Grant Lake up to approximately contour elevation 720. The corridors for the access roads, penstock and transmission line will be approximately 50-75 feet from each side of the centerline. The specific delineation of the proposed Project Boundary, in terms of survey coordinates, will be made after study work has been completed and will be included as part of the License Application.

3.3.3. Proposed Construction and Development Schedule

The Project will be constructed over a 30-36 month timeframe after the issuance of the License. Construction will begin in the April timeframe with the construction of access roads immediately followed by the start of tunnel construction. Construction of the Grant Lake diversion dam and intake will be performed by first drawing down the lake elevation using a pair of diversion trenches cut through the outlet of the lake. This method will allow the lake to be drawn down to approximately elevation 680 MSL over the winter. Next the intake will be constructed behind an in-situ rock cofferdam. Once the intake and tunnel are complete the in-situ cofferdam will be

removed by blasting. The Grant Lake diversion dam will be constructed at the same time in parallel.

Construction of the Falls Creek diversion structure will be performed in two phases. In the first phase, the creek will be diverted to the left side to allow construction of the intake box and sluiceway. In phase two, water will be diverted to the right bank and through the sluiceway to allow construction of the main body of the diversion.

3.4. Project Operations

3.4.1. Proposed Project Operations

Two modes of operation are likely for the Project: block loading or level control (run-of-river). The primary operational mode will be block loading at a specific output level. Level control, or balancing of outflow to inflow, will likely only occur during periods of low natural inflow to Grant Lake when the reservoir is at or near minimum pool elevation. Due to the small size of the Project in relation to the size of the interconnected system, the Project is not likely to be used to load follow.

With Grant Lake operating as a regulating reservoir, the typical mode of operation will be to capture high spring and summer runoff and to enter the late fall and winter season with the reservoir full at elevation 706 MSL. During the winter months when the energy is needed most on the system, the reservoir will be systematically drafted to produce energy throughout the winter. The rate at which water is drawn from storage will decrease gradually until reaching a base rate of approximately 100 cfs. Occasionally, the Project may run at higher capacities to meet system needs at intermittent times. However, the amount of time the Project could operate at higher outputs would be limited by available storage. This process will continue until the reservoir begins to refill with snowmelt (typically around May). During the summer months when inflow exceeds powerhouse capacity, the Project will most often run continuously at peak capacity. During the months of May through October, up to 150 cfs will be diverted from Falls Creek into Grant Lake to supplement reservoir refilling and energy generation.

Expected average annual reservoir fluctuations are shown in Figure 3.4-1. Due to the amount of storage, there will be negligible carryover storage from one year to the next. The maximum lake level drawdown will be to 675 MSL, but actual drawdown will be dependent on water inflow and operational scenarios.

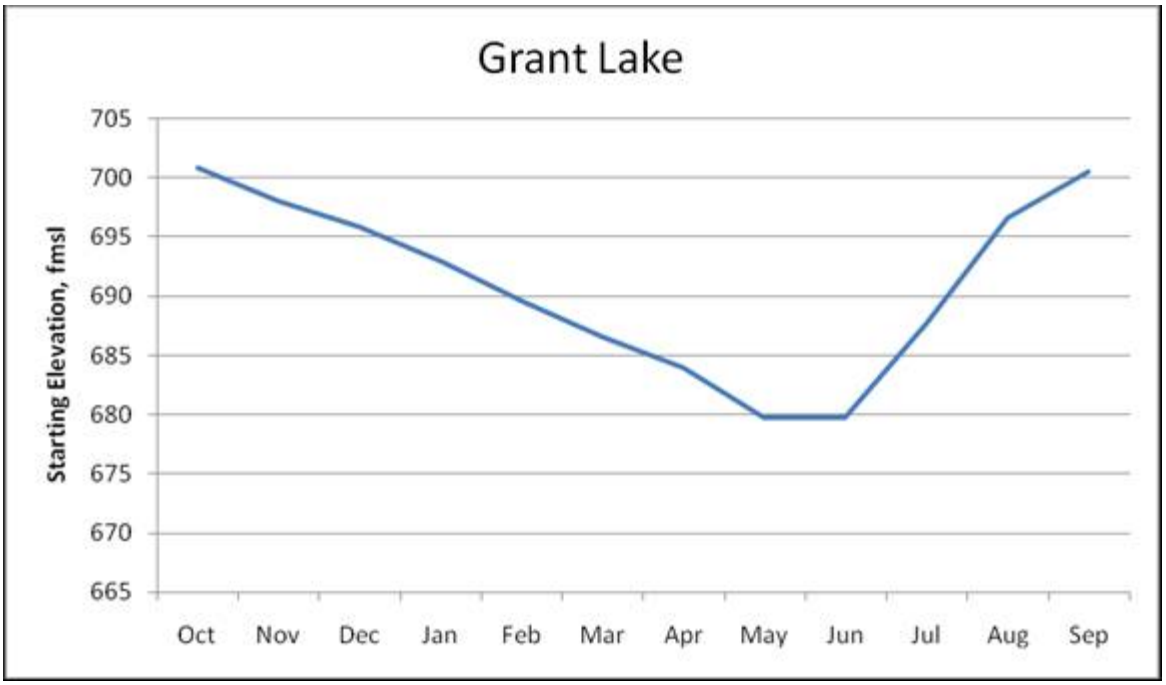

Figure 3.4-1. Estimated Grant Lake elevations with proposed Project operations.

Flows in Grant Creek are naturally high during the summer when snowmelt is occurring and low in the winter when temperatures are below freezing. With the proposed Project in operation, the high flows in the summer will be stored and released later in the season. Figure 3.4-2 shows the effect of this operation.

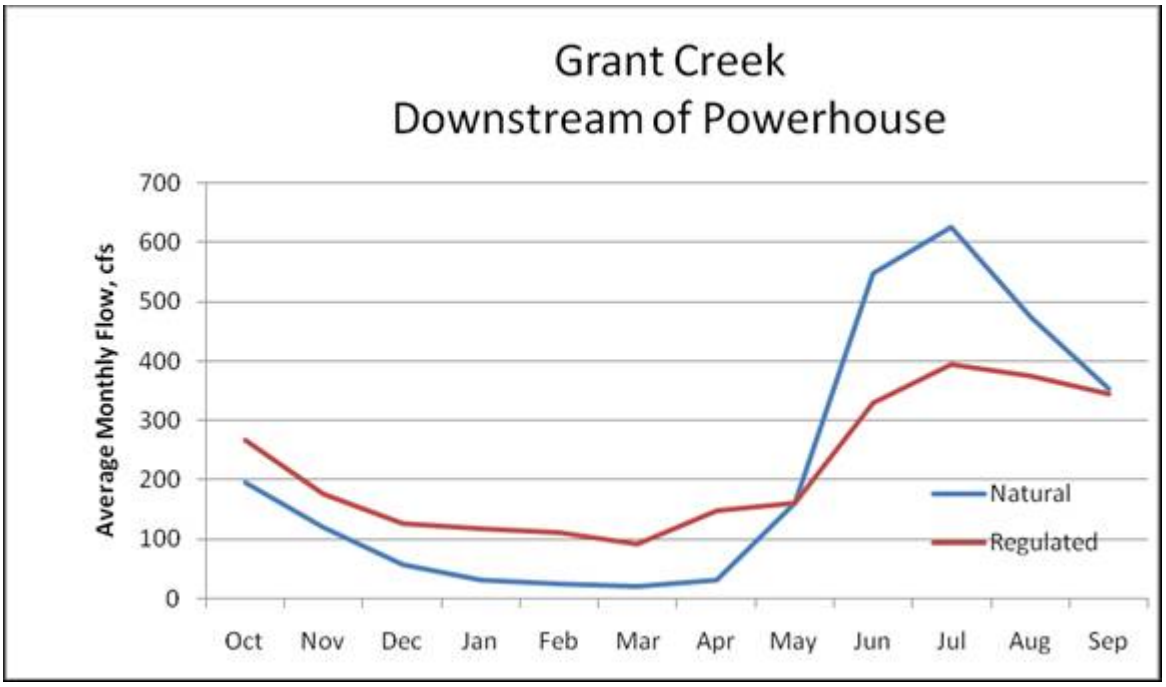

Figure 3.4-2. Estimated average monthly flows in Grant Creek downstream of the proposed powerhouse location.

Flows in Grant Creek downstream of the tailrace are expected to vary from the minimum flow requirement determined to be needed in the creek to a flow rate that will be a combination of turbine discharges, natural inflow, and bypassed flows.

3.4.2. Project Capacity and Production

The Project will have an installed capacity of 4,500 kW. Estimated energy production was simulated using a computer model utilizing daily flows, reservoir characteristics, assumed equipment data, and no required flows in the reaches below the Grant Lake diversion to the powerhouse or below the Falls Creek diversion. The predicted average annual energy from the Project is 23,400 MWh representing a plant factor of 59%. Monthly generation is assumed to vary as shown in Figure 3.4-3. Estimates will be revised once instream flow studies are completed, and any flow requirements below the Grant Lake and Falls Creek diversions are determined.

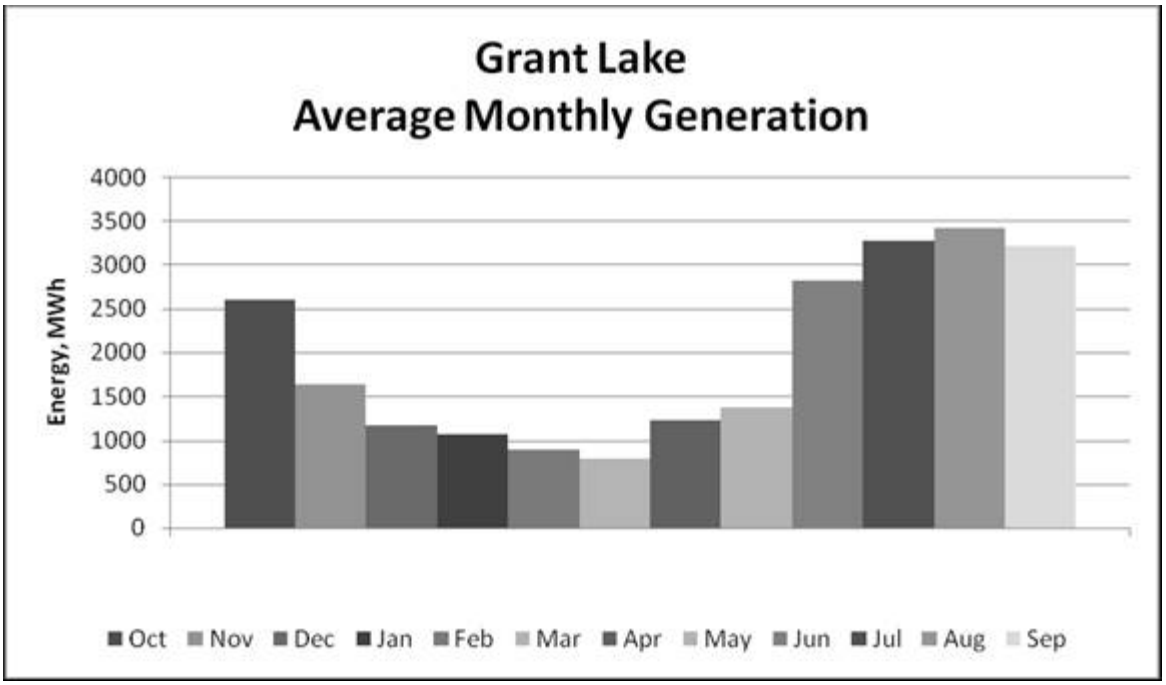

Figure 3.4-3. Grant Lake estimated average monthly generation.

3.4.3. Summary of Project Generation

The proposed Project is a new facility. As such there is not a record of generation.

4 DESCRIPTION OF EXISTING ENVIRONMENT AND RESOURCE IMPACTS

4.1. Summary

The hydroelectric potential at Grant Lake 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) prepared 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 also 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 Resources 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 flows from the adjacent Falls Creek into Grant Lake to provide additional water for power generation. Kenai Hydro, Incorporated further

refined the APA (1984) proposals in a license application to FERC (Kenai Hydro, Incorporated 1987). Kenai Hydro, LLC is not affiliated with Kenai Hydro, Incorporated.

During the licensing process, KHL will be investigating the feasibility of diverting a portion of Falls Creek flows to the proposed powerhouse on Grant Creek. Background literature and field research conducted to support the APA's impact study is reported in AEIDC (1983). The project proposal in the 1980s contemplated a different project configuration, including dewatering of Falls and Grant Creek, therefore while baseline information from these earlier studies is presented below, the potential impacts of the proposed Project described by this PAD may be different than those impacts described in the 1980s impact analyses. Nonetheless, this PAD relies heavily on the research conducted previously for the majority of the resource evaluation presented in the following section.

HDR Alaska, Inc. is under contract to Kenai Hydro, LLC to conduct field studies and supplemental literature reviews to supplement the existing information presented in this PAD as the FERC licensing process proceeds.

4.2. Basin Overview

4.2.1. Description of the Grant Lake, Grant Creek, and Falls Creek Basin

4.2.1.1. Basin Description and Drainage Area

Grant Lake is located approximately 1.5 miles southeast of Moose Pass, Alaska. It is located at an elevation of approximately 696 feet from mean sea level (MSL), with a maximum depth of nearly 300 feet and surface area of 2.6 square miles (APA 1984). The Grant Lake and Grant Creek watershed has a total drainage area of approximately 44 square miles. Grant Lake consists of an upper and lower portion separated by a natural constriction and island near the lake's midpoint. The lake is ringed by mountains of the Kenai Mountain Range to the east, north, and south, with elevations ranging from 4,500 to 5,500 feet.

Grant Lake's only outlet, Grant Creek, runs west approximately 1 mile from the south end of Grant Lake to drain into the narrows between Upper and Lower Trail Lake. Trail River drains Lower Trail Lake, and then flows into Kenai Lake. Kenai Lake drains into the Kenai River at its west end near Cooper Landing (APA 1984). Grant Creek has a mean annual flow of 193 cubic feet per second (cfs), is 5,180 ft long, with an average gradient of 207 feet per mile; its substrate includes cobble and boulder alluvial deposits and 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 gravel shoals and diminishing boulder substrate (APA 1984).

The Falls Creek watershed is about 12 square miles and has an estimated average annual flow of 38 cfs, with a stream length of 8 miles, and an average stream gradient of 418 feet per mile (APA

1984). The creek runs through a very confined, steep walled valley with numerous waterfalls. The substrate consists of cobble and boulder deposits with a few gravel bars and fine silt near the mouth (APA 1984). Falls Creek occupies the valley immediately south of the Grant Lake Valley, and drains into the Trail River approximately 1.8 miles downstream of the mouth of Grant Creek and 0.5 miles north of the town of Crown Point.

4.2.1.2. Tributaries Potentially Affected by Project Operations

Grant Lake Tributaries

Tributaries to Grant Lake include Inlet Creek at the headwaters and other small glacial-and snowmelt fed streams in the watershed.

Grant Creek Tributaries

The majority of Grant Creek flow is from Grant Lake. There is one unnamed tributary to Grant Creek, located downstream of the lake outlet and proposed powerhouse location. It is thought to be intermittent. Instantaneous flow measurements will be taken during the 2009 field season to characterize the unnamed tributary's hydrologic input into Grant Creek (HDR 2009a). No other significant tributaries are known to exist.

Falls Creek Tributaries

Falls Creek has no major tributaries, with water originating primarily from snowmelt.

Trail River/Trail Lake

Grant Creek and Falls Creek are both tributaries to the Trail Lake/Trail River system. Upper and Lower Trail Lakes flow into the Trail River, which is a tributary to Kenai Lake.

4.2.1.3. Dams and Diversion Structures in the Basin

There are no existing dams or diversion structures in the Grant Lake, Grant Creek, or Falls Creek drainages.

4.2.2. Land and Water Uses

4.2.2.1. Grant Lake and Grant Creek

Alaska Department of Natural Resources records were reviewed to gather information on land status, mining claims, and water rights within the proposed Grant Lake Development (HDR 2008a). Land status in the proposed Grant Lake/Falls Creek Project area is shown in Figure 4.2-1. (Appendix 1 includes a large scale version of Figure 4.2-1.) Lands surrounding Grant Lake are primarily federally owned and are managed by the Chugach National Forest, with state

ownership west of Grant Lake to the Seward highway and along Grant Creek. State lands are managed by the Alaska Department of Natural Resources (ADNR). There is a limited amount of private ownership (mainly rural residential) in the lower portions of the Grant Creek drainage. The proposed Project's facilities would be located on state land managed by ADNR.

Four mining claims were identified on federal lands on the north side of Grant Lake's lower basin, and their locations are shown on Figure 4.2-1. There is active mining occurring at this location. No documented water rights were found within the Grant Lake drainage area. (HDR 2008a).

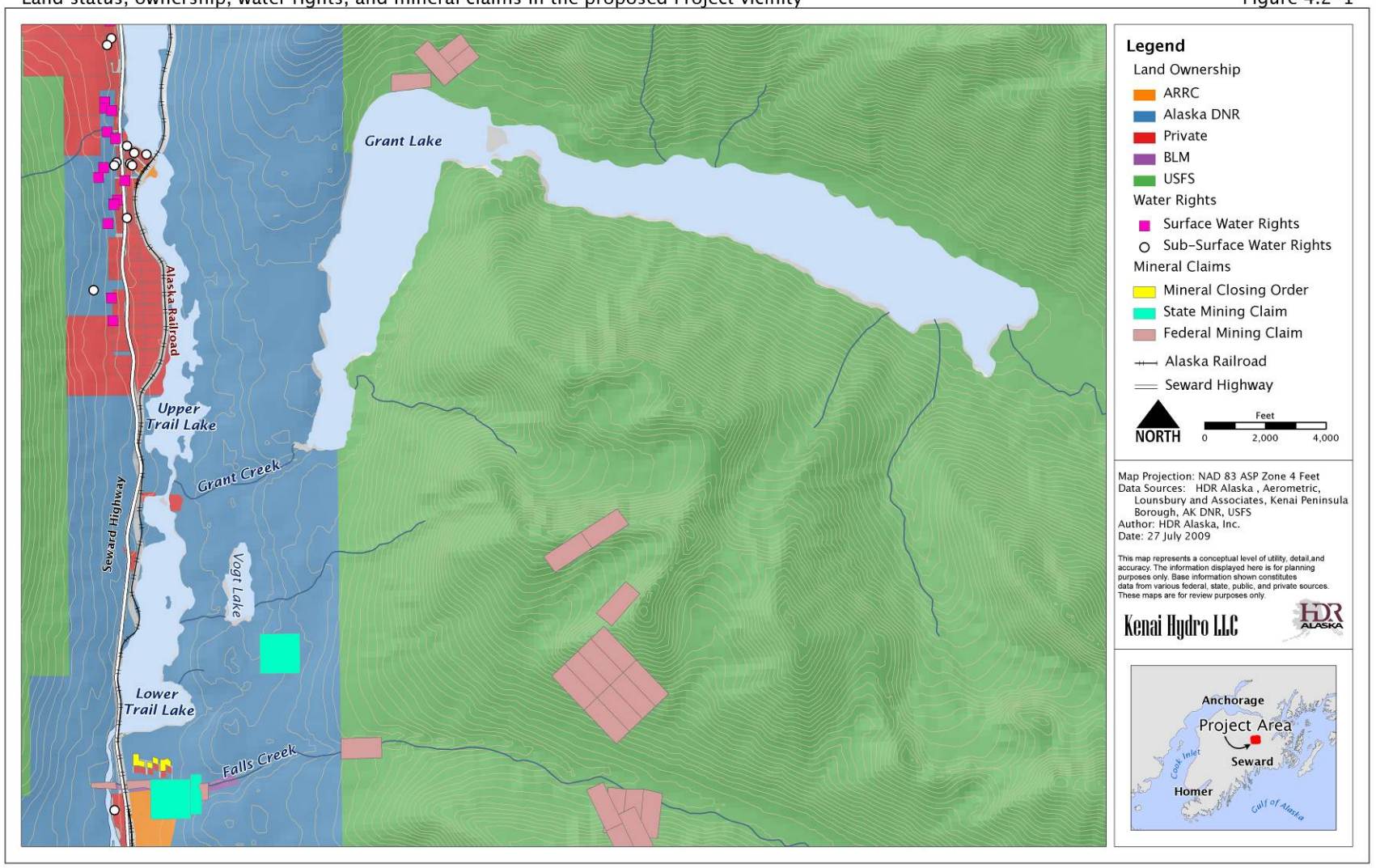

Figure 4.2-1. Land status, ownership, water rights, and mineral claims in the Project vicinity.

4.2.2.2. Falls Creek

Research was conducted on land status, mining claims, and water rights within the vicinity of the proposed Falls Creek Development (HDR 2008b). Land ownership surrounding Falls Creek is shown in Figure 4.2-1. The proposed Falls Creek Development will be located on state lands. There is a parcel of BLM managed land, and there are numerous private landowners along the Seward Highway and the mining access road below the Development (Figure 4.2-1).

Sixteen federal mining claims and four state mining claims exist within the proposed Falls Creek Development (Figure 4.2-1). Several of these lie within the location of the preferred intake site. It is unknown whether these are active mining claims, or the extent to which they may be impacted by Project development. This will be investigated further during pre-licensing activities.

One subsurface water right was identified at the far west end of the proposed Project area near the Trail River, but it is unlikely to be affected by the Falls Creek Development.

4.3. Geology and Soils

4.3.1. Introduction

Grant Lake is a glacier-formed lake surrounded by the Kenai Mountain Range in south-central Alaska. Its right-angle bend is indicative of the diversion of a side glacier at its intersection with the major southward moving glaciers, a morphology characteristic of the east-west trending Grant Lake and Kenai Lake valleys that have nearly right-angle bends where they intersect the major north-south trending lowlands. The surrounding mountains rise to over 5,000 feet elevation and contain many small glaciers at the heads of most of the major valleys. The geology of the proposed Project site and vicinity is associated with the upper Cretaceous age of the Mesozoic era and is between 64 and 100 million years old. Most of Grant Lake and is underlain by low-grade metamorphosed sedimentary rock, predominantly greywacke and slate. This area of Alaska is also one of the most seismically active regions in the world, being located above the Alaska-Aleutian megathrust fault that extends eastward along the Aleutian arc into south-central Alaska.

4.3.2. Geology

4.3.2.1. Regional Geology and Tectonics

The proposed Grant Lake Development will be located on Grant Lake within the Cook Inlet Basin in the Pre-Ridge Subduction Upper Cretaceous Valdez Geologic Group (Figure 4.3-1) (Bradley et al. 2003). The Cook Inlet Basin is located in the fore-arc region of the convergent plate margin in southern Alaska. The basin lies directly above the Aleutian subduction zone, and the northeastern part of the basin overlies the transition from the subduction of Pacific oceanic

lithosphere to the subduction of the Yakutat terrane, an allochthonous fragment of the North American continental margin. The transition from Pacific to Yakutat lithosphere is marked by widening of the low-angle subduction interface from about 200 kilometers to more than 400 kilometers proceeding from southwest to northeast, and a change in trend of the Benioff zone from northeast beneath Cook Inlet Basin to north-northeast beneath the Susitna River Basin as illustrated in Figure 4.3-2. The Susitna River and Cook Inlet basins form part of the structurally diffuse western boundary of the intra-continental Southern Alaska tectonic block, which is driven counter-clockwise in response to accretion and subduction of the Yakutat terrane (Bruhn 2006).

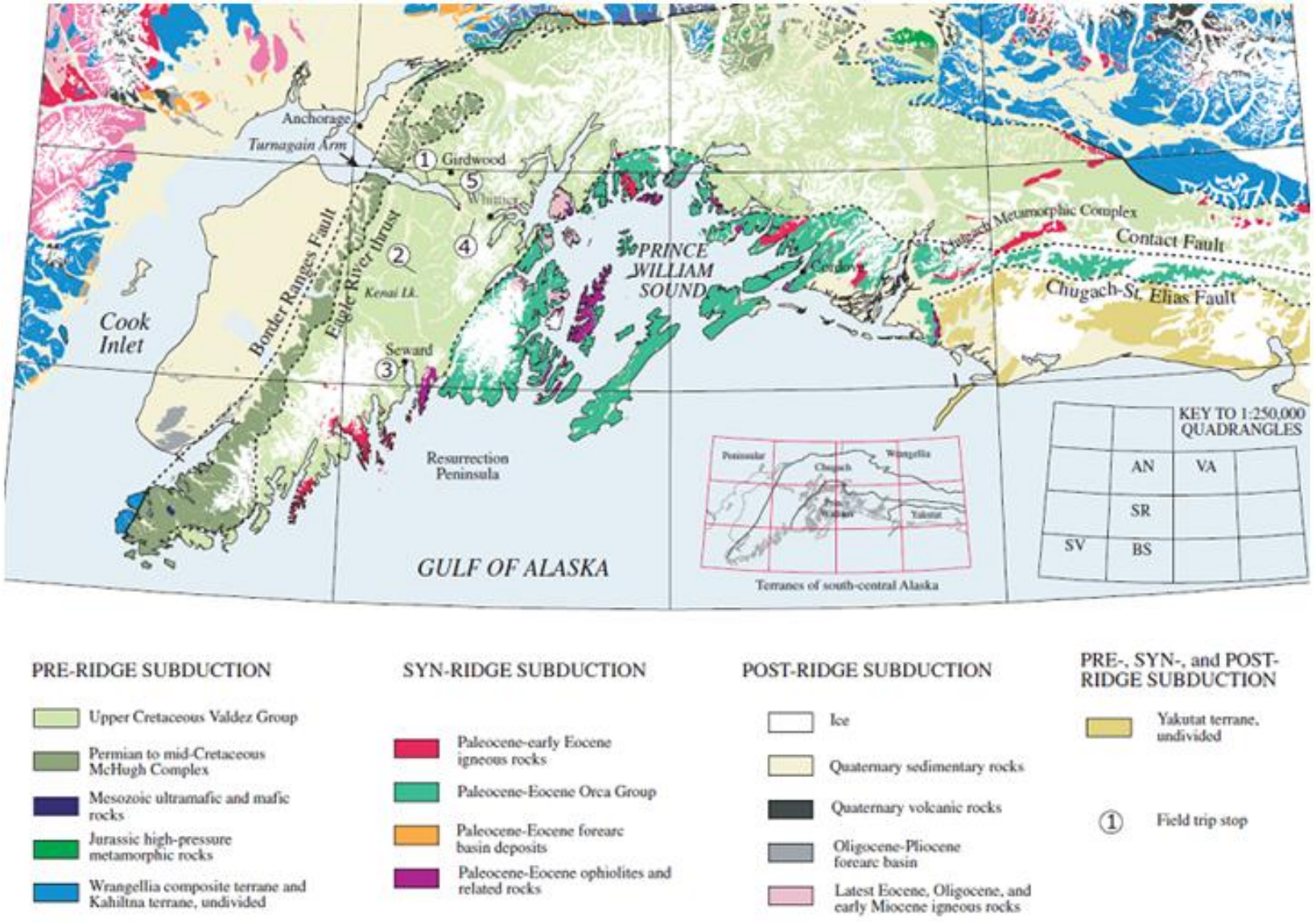

Figure 4.3-1. Generalized geologic map of south-central Alaska, from Bradley et al. (2003).

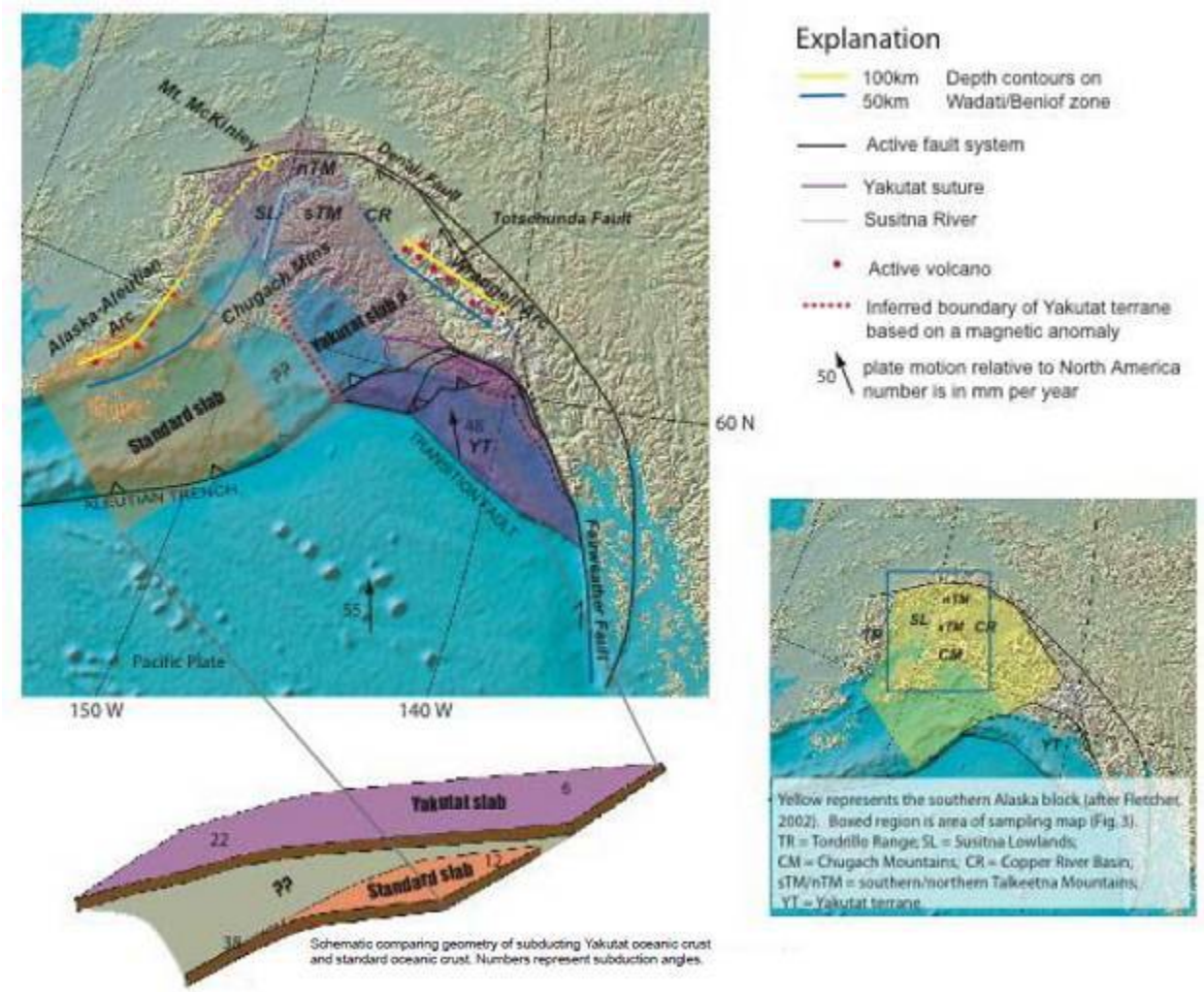

Figure 4.3-2. Tectonic setting of southern Alaska and Cook Inlet Basin showing subduction of Pacific plate and Yakutat microplate. Insert on lower right shows Southern Block outlined in yellow. Figure prepared by J. Willis, University of Utah (cited in Bruhn 2006).

The basin is filled by uppermost Cretaceous through Quaternary strata that were deposited in a northeast-trending trough and bordered by uplift accretionary complex rocks of the Chugach and Kenai Mountains and the plutonic and volcanic belt of the Alaska-Aleutian Range (Bruhn 2006). The structural contact between the crystalline rocks and accretionay complex is the Border Ranges Fault shown in Figure 4.3-3 (Pavlis 2006). Mesozoic-age rocks are present at depth, are greater than 36,000 feet thick, and represent deposition in marine environments. Commercial quantities of oil and gas have not been discovered in these rocks, although all oil found to date has its source in this section. The Tertiary succession is up to 25,000 feet thick in upper Cook Inlet and was deposited as alluvial fans along the basin margins and as river and floodplain

deposits along the basin axis. All commercial oil and gas fields in the basin are produced from reservoirs in Tertiary strata in fields associated with northeast-trending faulted anticlines (DGGS Staff 2008).

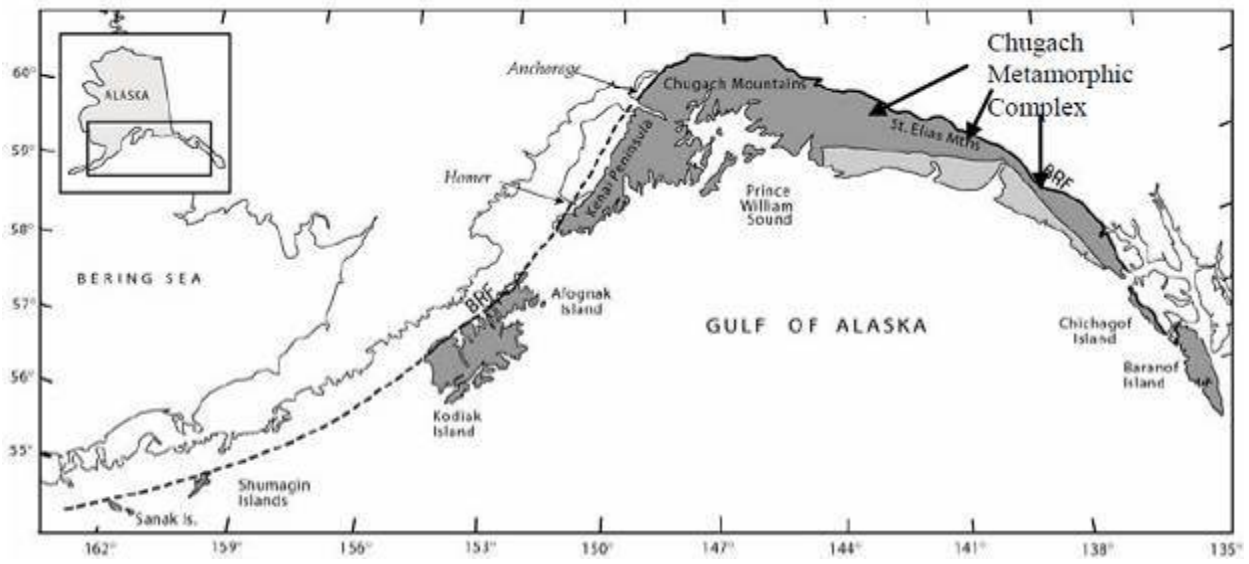

Figure 4.3-3. Map of southern Alaska showing the distribution of the Chugach terrane accretionary complex (dark grey) relative to its crystalline backstop (Border Ranges Fault – BRF) and to the east, the Yahutat block(light grey), which collided with North American in late Neogene (Pavlis and Roeske [in press] cited in Pavlis 2006).

4.3.2.2. Project Area Geology and Tectonics

The bedrock in the proposed Project area is a complex assortment of metamorphosed sandstone, siltstones, and mudstones with some fine-grained volcanic units (Tysdal and Case 1979, cited in APA 1984). The area bedrock includes a large number of structural features, and joints are common. Joint orientations vary, although there are minor maxima orientated north-south to Northeast-Southwest, dipping between 50 and 90 degrees to the south or southeast (APA 1984).

The Trail Lakes valley is a long, north-trending valley that extends from the town of Seward northward to Upper Trail Lake. It has been called the "Kenai Lineament" since it is obvious on satellite imagery as a long, linear feature (Plafker et al. 1993). The valley runs parallel to the N-NW fault, and the Kenai Lineament may represent one of these fault zones that was extensively eroded during the glacial period. It is unlikely that the Kenai Lineament represents a major active fault. More likely it is a glacial valley whose orientation and location followed the N-NW trend of the minor fault set observed in other areas. (APA 1984)

Minor faults and fracture zones were discovered during the geologic study of the area and these are shown on Figures 4.3-4 and 4.3-5 (APA 1984). Two fracture directions are dominant. One set trends NE and the other N-NW. Grant Creek follows the most obvious NE feature, which is identified as the Grant Creek Fault.

4.3.3. Glacial Features

Small glaciers occur at the head of most of the major valleys on the upper most heights of Solars Mountain. See Figure 4.3-4 for the location of these glacial features in the proposed Project area.

4.3.3.1. Unconsolidated Surficial Deposits

Unconsolidated surficial deposits are relatively rare in the proposed Project area. Figures 4.3-4 and 4.3-5 show the location of unconsolidated surficial deposits for the proposed Project area and Project site, respectively.

Alluvium is found at the head of Grant Lake, in the area between Lower Trail Lake and Kenai Lake, within a few of the coves around the Trail Lakes, and within the small bogs found in the low, bedrock ridges flanking the Trail Lakes valley. These deposits are typically mixtures of silt, sand, and gravel. Minor sand and gravel deposits are also found at the mouth of Grant Creek and Falls Creek.

Avalanche debris, the result of transport by snow avalanches during the winter and spring, consists of poorly sorted mixtures of cobbles, gravel, sand, and silt at the base of the major avalanche chutes. Avalanche debris is found on the north shore of Grant Lake where the lake bends to the east.

Tallus deposits are rare in the proposed Project area, despite the steep slopes. The one exception is in the area between Falls Creek and Solars Mountain. In this area, large talus slopes of angular sandstone boulders and cobbles extend from the small cirque at the top of the mountain down the steep slopes into Falls Creek. The lobate morphology of the deposits suggests that they constitute a rock glacier.

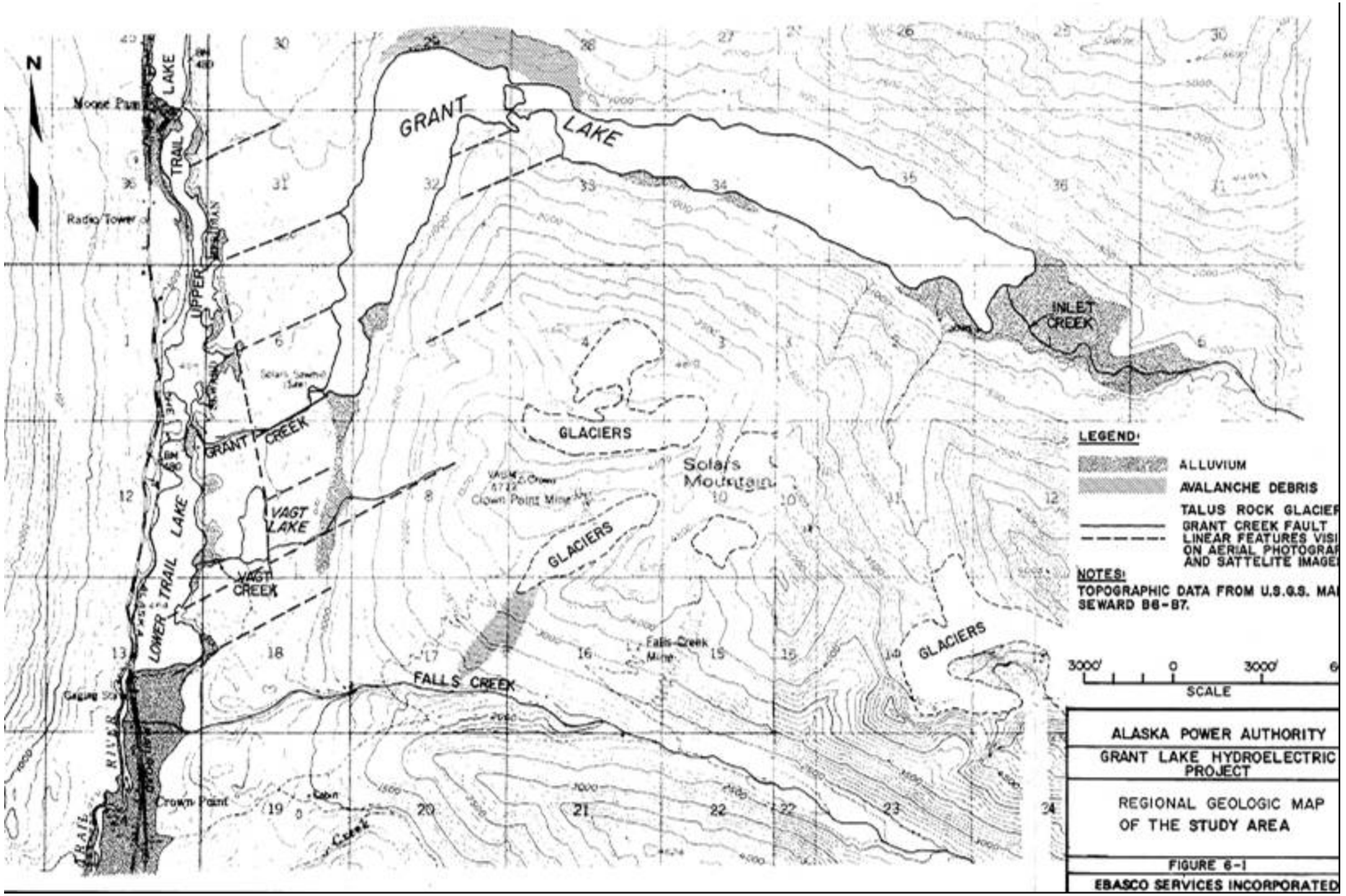

Figure 4.3-4. Major geologic features and unconsolidated surficial deposits in the Project vicinity (APA 1984).

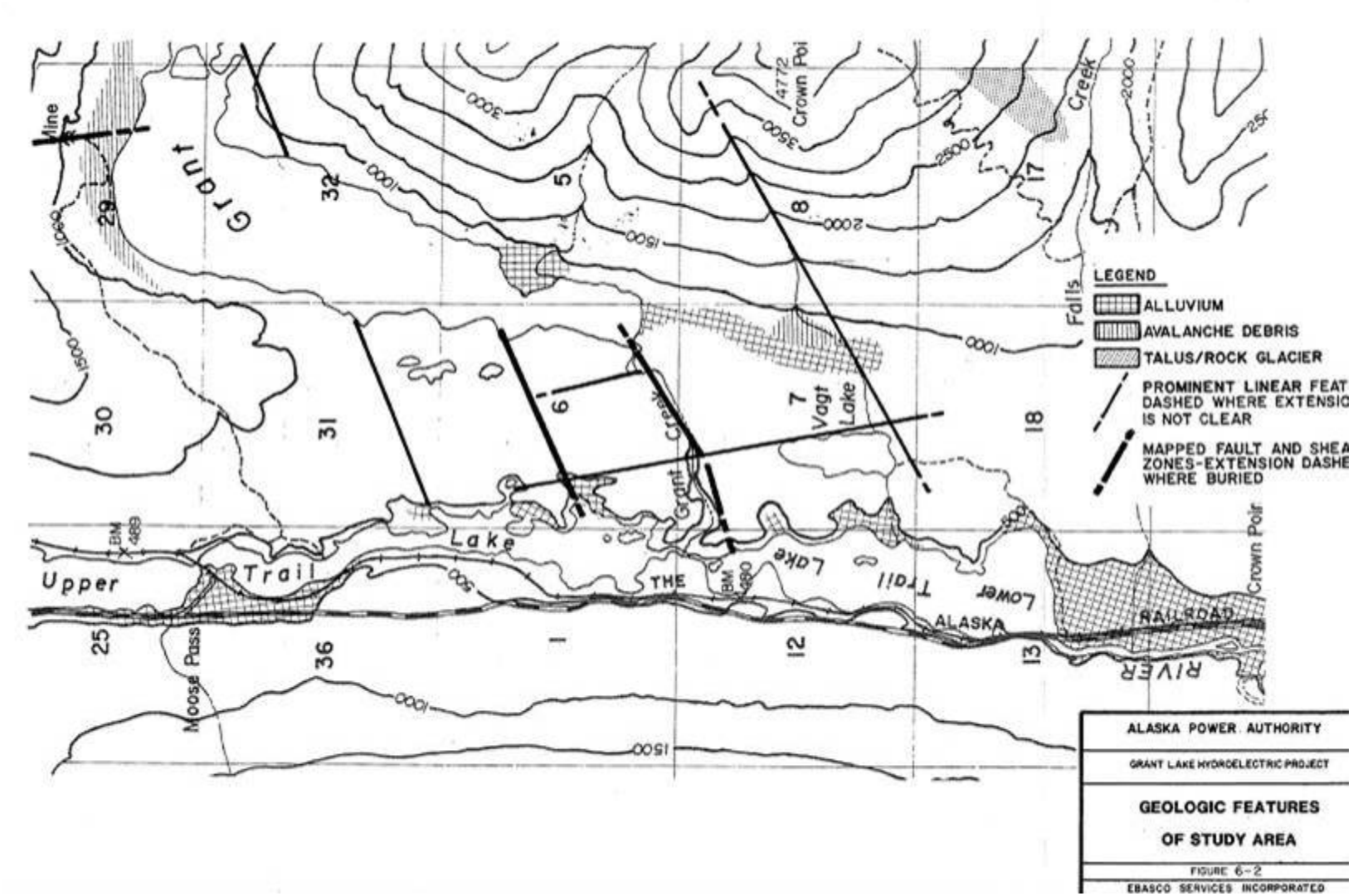

Figure 4.3-5. Geologic features and unconsolidated surficial deposits near the proposed Project site (APA 1984).

4.3.4. Mining and Mineral Resources

Historically, there are portions of the Project area have been mined for gold. A search of ADNR records (December 2008) identified four mining claims on federal lands on the north side of Grant Lake's lower basin (HDR 2008a). In addition, several mining claims exist along Falls Creek, with a history of extensive placer mining at the outlet of Falls Creek.

4.3.5. Project Site Geology

The bedrock that forms the ridge between Grant and Upper Trail lakes contains rocks typical of the bedrock throughout the area and is composed of metamorphosed sedimentary rocks of the Valdez Group. The predominant rock types are greywacke, slate, and a mixture of the two. Previous field investigations and exploratory borings (APA 1984) conducted on this ridge between the west shore of Grant Lake and Upper Trail Lake, north of the lake's outlet, indicated that the greywacke is an extremely hard and dense metamorphosed sandstone of varying composition.

Additional geologic investigations will be required for the proposed Project site at the lake's outlet and along Grant Creek for the siting, design and construction of project structures. No previous subsurface exploratory borings have been conducted at these locations. As previously described and illustrated in Figure 4.3-5, Grant Creek follows a NE trending fault identified as Grant Creek Fault that appears to be an inactive fault but may require further study for placement and design of Project structures.

4.3.6. Seismic and Volcanic Activity

4.3.6.1. Southern Alaska

Alaska is the most seismically active state in the United States. Southern Alaska is one of the most seismicially active regions in the world. Most of the seismicity in the region is associated with the Alaska-Aleutian megathrust fault extending eastward along the Aleutian arc into south-central Alaska and is described further in Wesson (2007). The northwestward-moving Pacific plate is subducted along this megthrust beneath the North American plate, giving rise to the Aleutian trench, islands, and related volcanic activity. Additional significant seismicity occurs along the Denali fault in south-central Alaska and along a northwestward-striking system of right-lateral strike-slip faults extending southeastward through and offshore from the panhandle of southeast Alaska. The southeastern portion of this system forms the northeast boundary of the Pacific plate. Additional seismicity also occurs elsewhere in central Alaska (Wesson 2007).

During this century, virtually the entire plate boundary from the westernmost Aleutian Islands to the Queen Charlotte Islands off British Columbia has ruptured in large (Richter surface wave magnitude Ms 7 to Ms 8) to great (Ms 8 or greater) earthquakes. The exceptions are areas near the Komandorski Islands (subzone Komandorski), near the Shuagin Islands (subzone Shumagin),

and near Cape Yakataga (subzone Yakataga). In the vicinity, of Sumagin Island no great earthquake has occurred in this century. Similarly, the vicinity of Cape Yakataga has experienced no great earthquakes since 1899 or before. These two regions have been identified as "seismic gaps", that is, the potential sites of future large earthquakes (Sykes 1971, cited in Wesson 2007).

Folds in Cook Inlet Basin are cored by moderately to steep dipping faults that have the potential to generate large earthquakes. These folds within the basin and major faults along the basin borders are shown in Figure 4.3-6 (Bruhn 2006). The Border Ranges Fault (see Figures 4.3-1 and 4.3-6), located approximately 45 kilometers (28 miles) west of the proposed Project on Kenai Peninsula, occupies the westerly edge of the Eagle River thrust. The other faults shown on Figure 4.3-6, the Bruin Bay Fault, Lake Clark Fault, and the Castle Mountain Fault are located on the west side of Cook Inlet in the Western Alaska Range, north and west of Anchorage, over 125 kilometers (78 miles) from the Project site (Bruhn 2006).

Occasionally, severe volcanic activity such as phreatic explosions or explosive caldera collapses may be accompanied by significant earthquake events. Because such large volcanic events are rare, there is little data from which to estimate earthquake magnitudes that may be associated volcano to those of the Aleutian chain, it is reasonable to assume that earthquakes associated with them. However, because of the similarities in characteristics of the Mount St. Helens with the recent Mount St. Helens eruption of May 1980 may also occur during future volcanic activity in the Aleutian chain. During the Mount St. Helens pre-cataclysmic eruption period before May 18, 1980, over 600 earthquakes greater than magnitude 3 and 12 around magnitude 5 were detected (PNSN 1980). The earthquake associated with Mount St. Helens explosive eruption that occurred on 18 May had a magnitude of 5.1 (U.S. Geological Survey 2000). Figure 4.3-7 shows the location of historically active Alaskan volcanoes (McGimsey et al. 1995). The volcanoes closest to the Project site, located over 180 kilometers (112 miles) away, include:

- Mt. Spurr and Crater Peak at location 2 on the west side of Cook Inlet, last active in 1953 (Spurr) and in 1992 (Crater Peak).
- Mt. Redoubt at location 3 on the west side of Cook Inlet, last active in 1989-90 and again in March 2009 (still currently venting).
- Mt. Iliamna at location 4 on the west side of Cook Inlet, no historic activity.
- Mt. Augustine at location 5 on Augustine Island in lower Cook Inlet, last active in 1986.

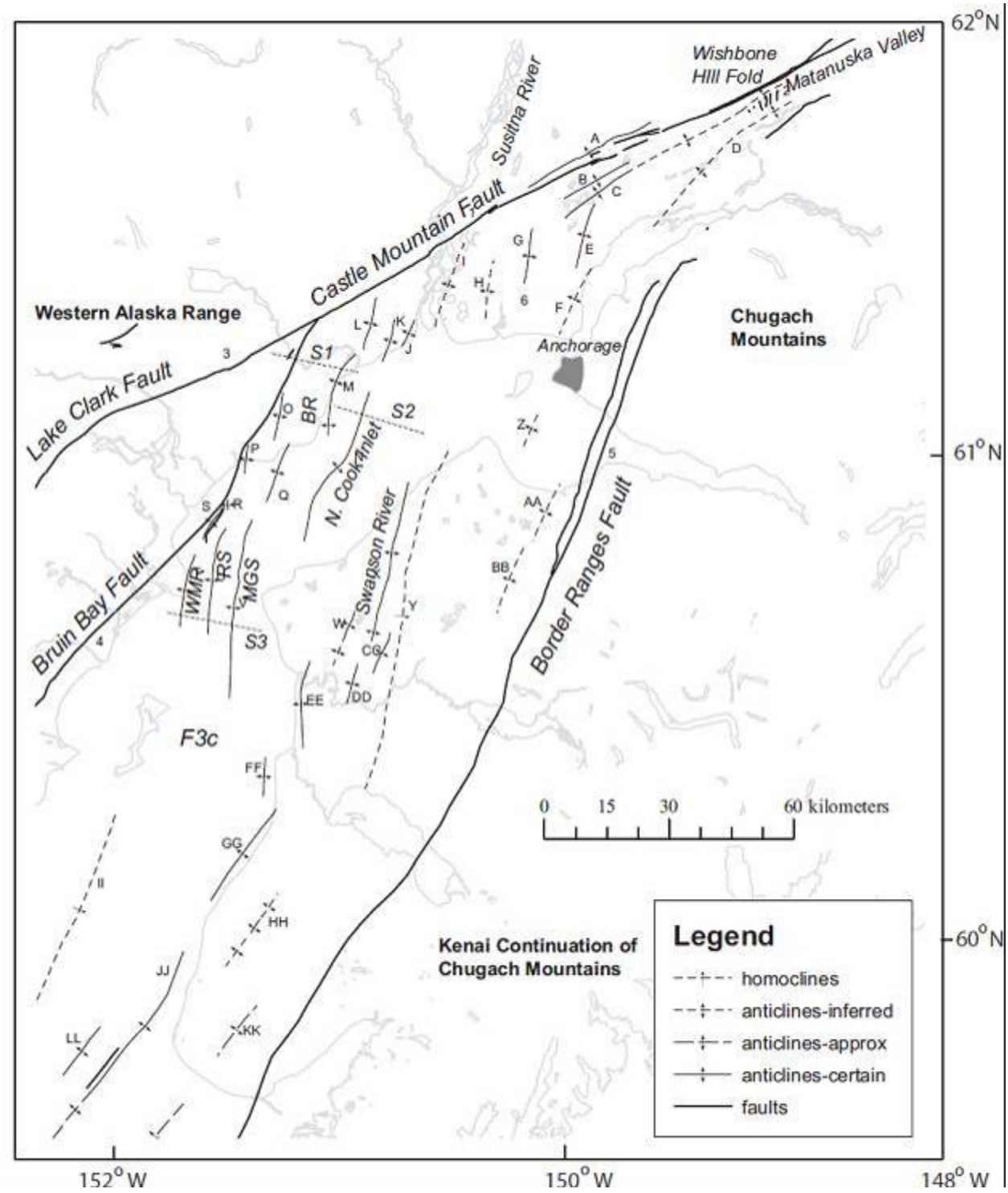

Figure 4.3-6. Generalized structure map of Cook Inlet Basin showing folds within the basin and the regional faults along the basin borders (Bruhn 2006). P.J. Haeussler compilation.

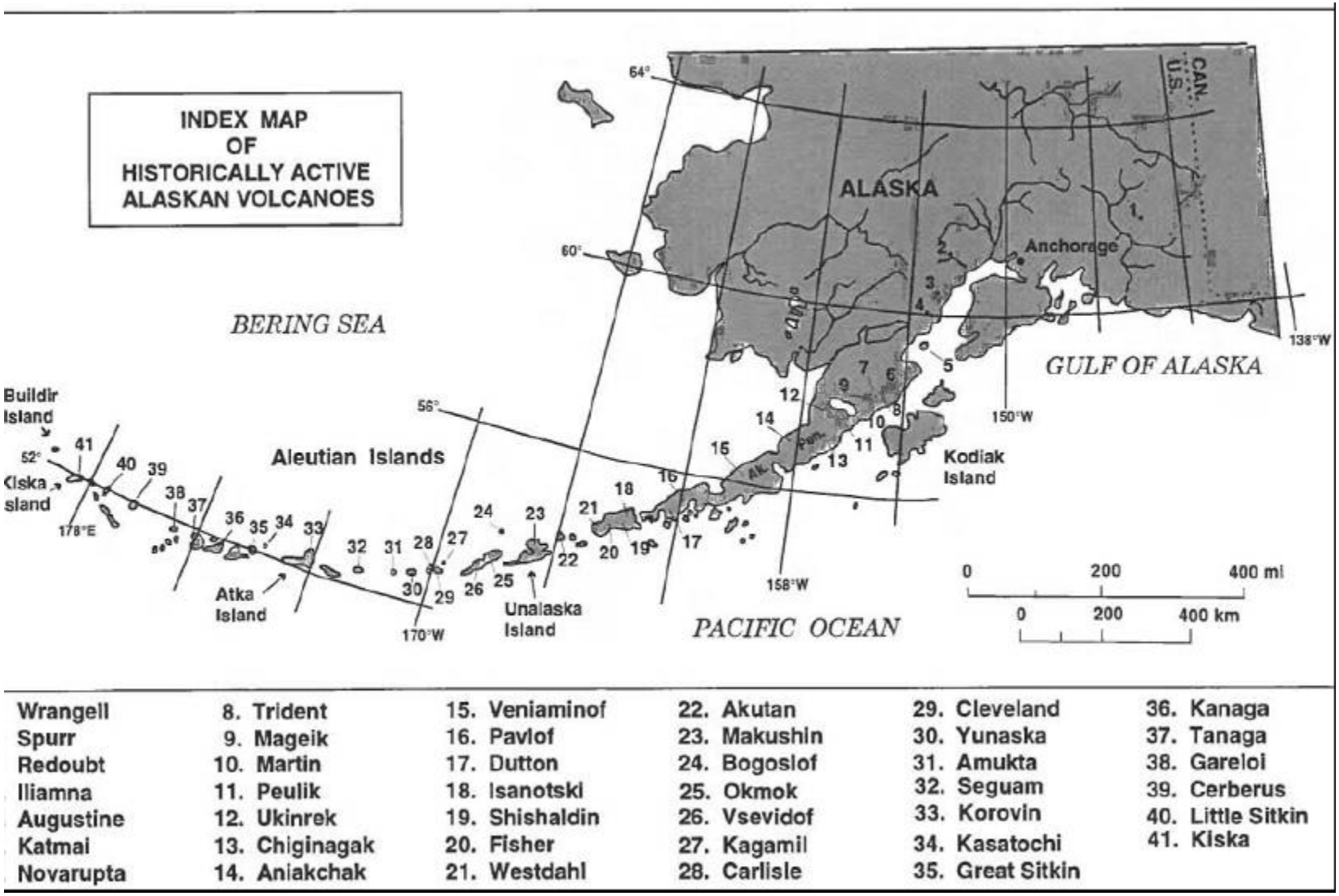

Figure 4.3-7. Historically active Alaskan volcanoes, locations 2, 3, 4, and 5 are nearest to the Project site (McGimsey et al. 1994).

4.3.6.2. Prince William Sound and Kenai Peninsula

The 1964 Prince William Sound earthquake remains the second largest earthquake ever recorded. It ruptured 750 - 800 kilometers (466 - 497 miles) of the Alaska-Aleutian megathrust (Figure 4.3-8).

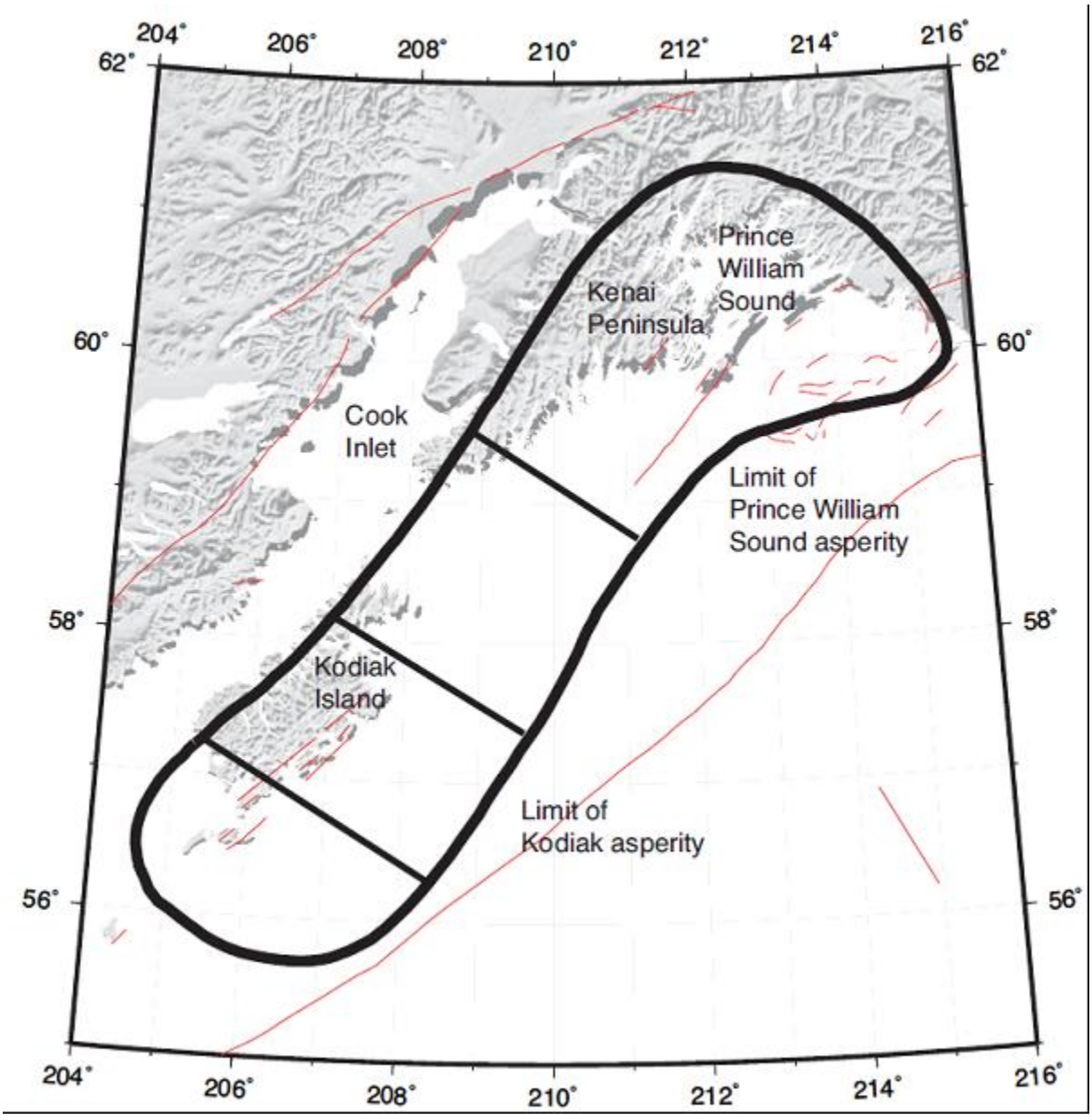

Figure 4.3-8. The region of the 1964 Prince William Sound earthquake (Freymueller 2006). The rupture area of the 1964 earthquake zone is shown in the bold line. The thinner lines indicate the approximate limits of the two asperities that released most of the moment in the earthquake.

The rupture extended roughly from the eastern end of the trench around Kayak Island to the southwest end of Kodiak Island. This segment of the megathrust is an exception for having an extraordinary shallow dip angle. A trench-normal profile passing through Seward on the Kenai Peninsula has an average dip angle of about 3 degrees, including a nearly flat section at roughly 20 kilometers depth. The dip angle gradually increases to the southwest, but remains only 6-7 degrees at Kodak Island. One consequence of the shallow dip angle is that the main thrust zone on the interface is extremely wide, extending as far as 250-300 kilometers in from the trench. The earthquake caused large displacement over a wide area as illustrated in Figure 4.3-9. The most prominent displacements were vertical displacements along the coast, because of the resulting changes in relative sea level. Subsidence along Turnagain Arm and along the coast of the Kenai Peninsula created a number of drowned forests, and submerged the town of Portage. However, the horizontal displacements were much larger. In the outer part of Prince William Sound, repeated triangulation measurements showed measured horizontal displacements as large as 20 meters. The displacements were calculated relative to a specific benchmark, FISHHOOK 1944, and this mark probably moved about 4 meters (13 feet) during the earthquake (Suito et al. in prep and Cohen and Freymueller 2004 cited in Freymueller 2006).

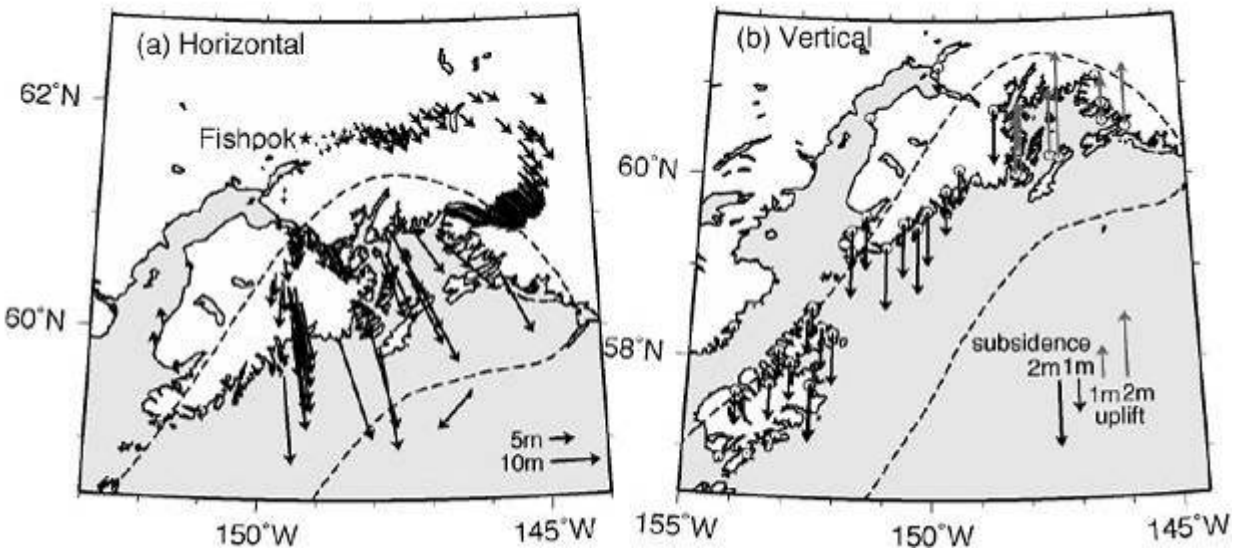

Figure 4.3-9. Coseismic displacements during the 1964 M9.2 earthquake (Suito et al. [in prep] cited in Freymueller 2006).

Slip in the earthquake was concentrated in two main regions or asperities, one beneath Prince William Sound and one off shore of Kodiak Island (Figure 4.3-8). Seismic source modeling of the earthquake has always been difficult because seismometers around the world went off-scale from the direct body waves, and in some cases remained off-scale for several hours. The long duration of the earthquake (≈5 minutes) poses an additional challenge.

Sites in the eastern Kenai Peninsula are moving toward the north-northwest, while sites in the western Kenai Peninsula are moving toward the south or southeast. The motions of sites in the eastern Kenai Peninsula are generally consistent with a simple model of subduction-related locked strain accumulation at the North America-Pacific plate interface. The site velocities are oriented in the direction of relative plate convergence, are largest close to the trench, and decrease with distance from the trench. The velocity vectors rotate somewhat across Prince William Sound, taking on a more westerly orientation, which reflects the impact of the Yakutat block collision. It is likely that both the Yakutat block and the Pacific plate subduct beneath Prince William Sound, with different directions of relative motion (Freymueller 2006).

4.3.6.3. Project Site Seismicity

The detailed feasibility analysis contained in APA (1984) considered the following potential occurrence of seismic hazards at the proposed Project area: vibratory ground motion, ground rupture, seismically-induced slope failure, and seiche. Information from APA (1984) on each of these hazards is excerpted below.

Vibratory Ground Motion

Deterministic analysis of the sources of earthquakes, their distance from the proposed Project site, and the potential accelerations at the site indicate that the megathrust zone beneath southern Alaska and the random crustal event are the primary sources of seismic hazard. Random crustal events are then considered "floating" and potentially could occur anywhere. For calculation purposes, the random crustal event is considered to be directly beneath the Project site.

All known sources of earthquakes that were close enough to the proposed Project area to have significant impact were compiled in Table 6.1 the APA (1984) analysis. The maximum credible earthquake (MCE) for a random crustal event was chosen as magnitude 6.0, a conservative upgrade from the maximum recorded magnitude of 5.5. As indicated in APA (1984), the maximum calculated acceleration at the proposed Project site is 0.40 gravity from the random crustal event and 0.37 gravity from the 1964-type Aleutian Arc megathrust.

Return periods for these maximum earthquake events were established using historical and instrumental earthquake data. Based on the estimated return periods and the time since the last major event, the likelihood of such events was estimated by APA for the life of the project as proposed at the time. The likelihood of another 1964-type event on the megathrust was considered low for the life of that project. Because the return period exceeds 160 years; it is presumed that the calculations are still relevant and would apply to the currently proposed Project. The likelihood of a large random crustal event is moderate to high, with a recurrence interval of 50 to 100 years, and a low probability of such an event occurring in the proposed Project area.

Ground Rupture

There are no known active faults crossing the proposed Project site. No seismic events have been associated with known structures around the site, and no geologic data have been found to suggest the presence of active faulting. Ground rupture is not considered a hazard for the Project.

Seismically Induced Slope Failure

One of the most common features associated with moderate to large magnitude earthquakes is slope failure. Triggered by ground motion, naturally unstable slopes can fail. Slope failure can be broadly classified into landslides, rockfalls, avalanches, and slab or tumbling failures of rock faces.

There is little material in the Project area that would be susceptible to landslides during seismic events. No evidence was found for the occurrence of major landslides or of their deposits (APA 1984).

Rockfalls from the steep cliffs could occur during seismic shaking. Some evidence of minor rockfalls has been found in the area, but the triggering mechanism is unknown. The rock cliffs along the Upper Trail Lake valley on the west slope below Grant Lake are a potential source of rockfalls.

Seismically induced avalanches could occur in the mountains above the Project. However, the topography around the proposed Project facilities does not appear to be subject to a hazard from avalanche.

Slab or tumbling failure of rock faces during seismic events is common in areas of unstable rock slopes. The western shore of Grant Lake is particularly susceptible to such failures, as the slopes are steeply dipping slopes of bedrock. Data from exploratory boring in this area in the early 1980s suggest that bedding-plane slides have already occurred here.

Seiche

Seiches are waves in lakes that are formed by water sloshing back and forth as the result of ground shaking during seismic events or the catastrophic inflow of material by slope failures around the lake's rim. There are several areas surrounding Grant Lake that could be sources of earth or avalanche material for mass movements into Grant Lake, which could generate seiche waves. Fieldwork associated with the APA (1984) analysis did not reveal any areas along the shoreline of Grant Lake where wave damage above normal high water levels was noted. This observation suggests that significant wave run-up did not occur during the 1964 earthquake. Further, the volumes of material that could enter Grant Lake are probably not sufficient to generate very large seiche waves.

Investigations around Lower and Upper Trail lakes indicate that the surrounding topography coupled with the shallowness of the lakes present significantly less hazard from seiche. There are no areas of material that could generate large waves by mass movement into these lakes. The proposed Project's facilities would be designed so that they are not susceptible to damage by seiches that could occur in Grant Lake.

4.3.7. Soils

4.3.7.1. Regional Soils

The soils on Kenai Peninsula, including the proposed Project area, are derived from glacial and other deposits associated with heavily glaciated alpine mountains as depicted on Figure 4.3-10.

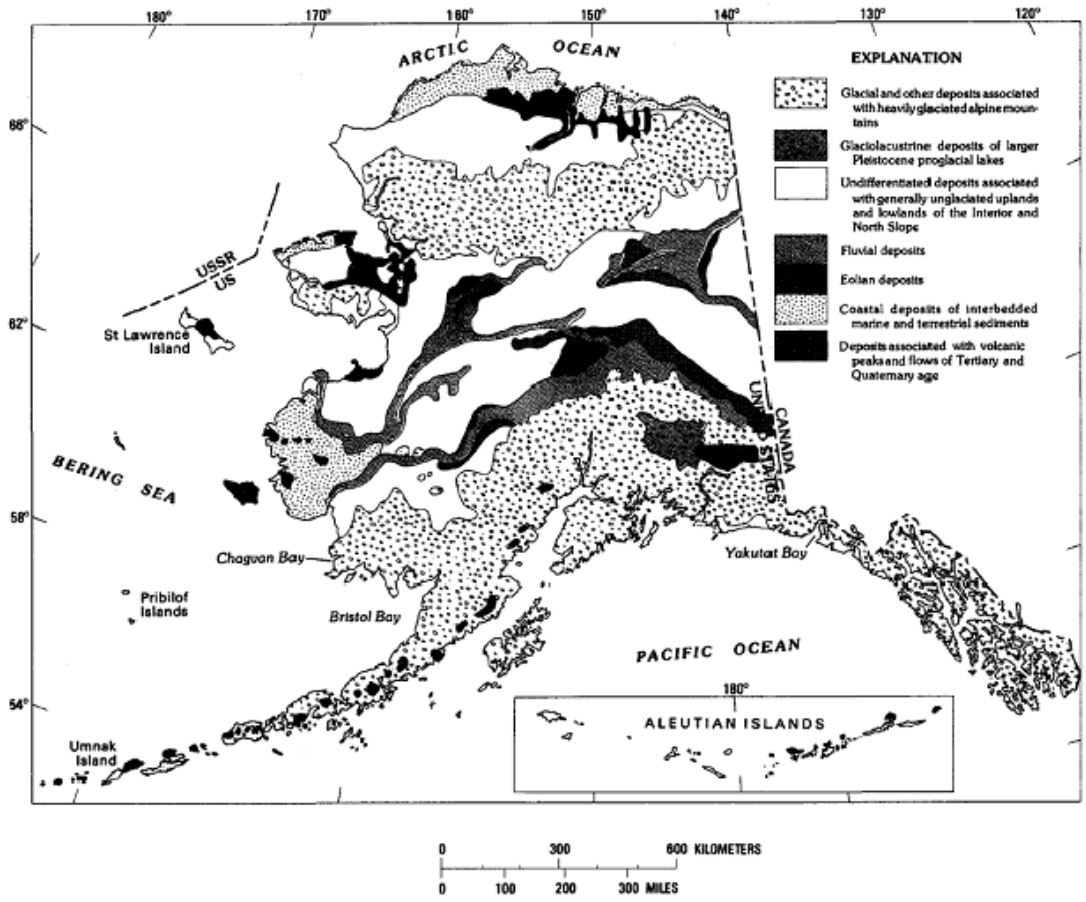

Figure 4.3-10. Major regional groups of surficial deposits in Alaska (cited in Gough et al. 1988).

Project Area Soils

The investigations reported in APA (1984) indicate extensive glacial till deposits are absent in the Project area. Minor glacial till deposits may exist at the base of some of the bogs and lakes and within some of the coves along Upper and Lower Trail lakes.

Two exploratory borings, conducted in an area of alluvial deposits in the valley on the east side of Upper Trail Lake, penetrated 28 feet and 18 feet of soils ranging from sand and silt near the surface to poorly sorted mixtures of cobbles, gravel, sand, and silt at depth. The lower material may represent glacial till or outwash, while the upper material is likely younger stream or lake bed sediment. None of the material is consolidated (APA 1984).

Project Site Soils

As discussed above for the proposed Project area, Figure 4.3-5 shows in greater detail the location of alluvium, avalanche debris, and talus deposits/rock glaciers in the immediate area of

the proposed Project site. No unconsolidated surficial deposits are known to exist at the site of the proposed Project developments.

The lack of significant soil cover or alluvial deposits indicates that erosion would be minimal during construction and operation of the Project.

Mass movements or slope failures, including landslides, rockfalls, avalanches, and slab failure, are discussed above as possible results of seismic activity. The rock cliffs along Upper Trail Lake from the east could be a source of small rockfalls, triggered either by seismic activity or seasonal freeze-thaw. Examination of the many cliffs in the area, however, suggests a high degree of stability (APA 1984).

4.3.8. Glacial Activity

Glacial activity in the immediate vicinity of the Project is limited to the Solars Mountain to the east and south of Grant Lake as illustrated in Figure 4.3-4.

4.3.9. Lake Shoreline and Streambanks

4.3.9.1. Grant Lake

Grant Lake is composed of two basins, an upper and lower basin, joined at right angles by a relatively narrow and shallow channel and island near its midpoint. The shoreline is forested to the edge of the water. The shoreline vegetation consists of lowbush cranberry, ferns, alders, spruce, hemlock, and a few cottonwoods near the inlet stream deltas. Conifer stands occur in some avalanche-free sites around the lake. The shoreline is littered with floating and sunken organic debris and patches of thick macrophyte growth (e.g., *Ranunculus* spp.) in the limited littoral areas (Figures 4.3-11 and 4.3-12).

Figure 4.3- 11. Grant Lake, lower basin looking south toward the outlet for Grant Creek (HDR 2008a).

Figure 4.3-12. Grant Lake, upper basin looking east toward the inlet for Inlet Creek (HDR 2008a). Channel and island between the upper portion and lower portion of the lake is in the foreground.

4.3.9.2. Tributary Streams to Grant Lake

Tributaries to Grant Lake include Inlet Creek at the headwaters and numerous short streams, including three glacial-fed streams, which originate in the nearly vertical mountains surrounding the Lake. The Inlet Creek stream valley supports a mature balsam poplar stand on the deltas and conifer stands farther up the valley. Inlet Creek has a poorly defined channel and appears to shift its course across the delta frequently. Additional vegetation along the creek and on the delta includes willows, river beauty, fireweed, horsetail, and on the drier sites, bluejoint.

4.3.9.3. Grant Creek

Grant Creek, Grant Lake's only outlet, flows from its origin at the south end of Grant Lake approximately one mile in a westerly direction, draining into the narrows between Upper and Lower Trail lakes. In the upper section, the creek flows over three substantial waterfalls, through a rocky canyon, and over large rubble and boulders. The lower section is somewhat less

turbulent with fewer boulders and more cobble and frequent gravel shoals, although the gradient of the lower 0.5-mile segment is still fairly steep. The average width of the stream is approximately 25 feet.

4.3.9.4. Upper and Lower Trail Lakes

Both the Upper and Lower Trail lake shorelines are forested with a mixed forest type consisting of paper birch, white spruce, and western hemlock on relatively warm, dry sites, and black spruce on the cool wet sites. Investigations around Lower and Upper Trail lakes indicate that the surrounding topography coupled with the shallowness of the lakes present significantly less hazard from seiche. There are no areas of material that could generate large waves by mass movement into the lakes.

4.3.10. Potential Adverse Impacts

Potential adverse environmental impacts of the proposed Project will be assessed by the licensing studies. Table 4.3-1 summarizes potential resource issues related to geology and soils.

Table 4.3-1. Potential Project impacts to geology and soil resources.

Potential Impact	Resource Issue
Increased Grant Lake Water Level Fluctuation	Possible erosion and sedimentation in the zone above normal full pond due to the increase in lake level fluctuation.
	Possible down-cutting of the Inlet Creek delta as a result of lowered water levels in Grant Lake.
Construction of dam and diversions, including blasting of cofferdam	Impact of sediment releases into Grant Lake, Grant Creek, and Falls Creek, Trail Lake and Trail Creek
Roads and Transmission Lines	Potential contribution of road and transmission line construction to erosion in the proposed Project area.
	Potential contribution of road and transmission line operation to erosion in the Project area.

4.3.11. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro has not to date identified proposed geology and soils related protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license.

Identification of PM&Es will occur following completion of effects analyses based on licensing studies.

4.4. Water Resources

4.4.1. Introduction

The drainage basin area is described in section 4.2.1, and existing water rights are discussed in Section 4.2.2, Land and Water Uses. This section includes a discussion of historic drainage basin hydrology, a summary of available streamflow data, applicable Alaska Water Quality Standards, and available water quality data. Additional water quality data collected in 2009 and 2010 to support the licensing effort will supplement available historic data and establish a pre-project baseline (HDR 2009a).

4.4.2. Drainage Basin Hydrology

4.4.2.1. Grant Lake and Grant Creek

In 1947, the USGS installed a stream gage (#15246000) approximately 0.3 miles upstream of the mouth of Grant Creek. This gage recorded continuously for 11 years between 1947 and 1958 (average annual flow was 193 cfs; drainage area at gage site is 44.2 square miles; Figure 4.4-1). Flow was generally lower in the winter months (December through April, <50 cfs). During the ice-free seasons (June through September), mean monthly flows exceeded 300 cfs. Peak flow occurred during the month of July, with a mean of 518 cfs. Grant Creek's flows rarely exceeded 600 cfs or dropped below 50 cfs (Figure 4.4-2).

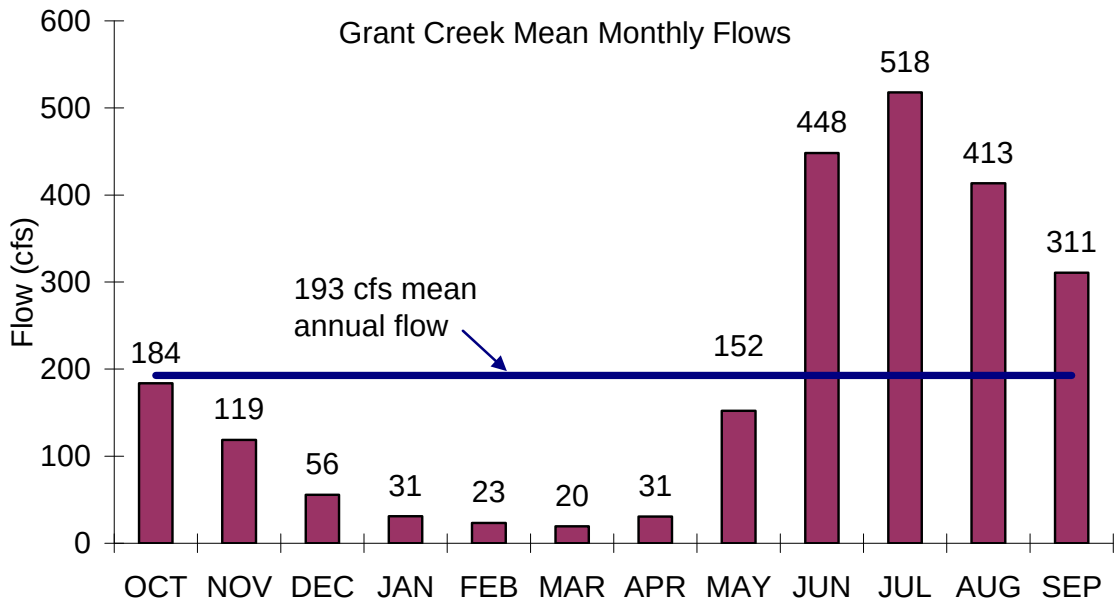

Figure 4.4-1. Mean monthly discharge at Grant Creek. Average annual flow (for period of record 1947-1958, from USGS gage #5246000) is shown as a solid horizontal line (193 cfs).

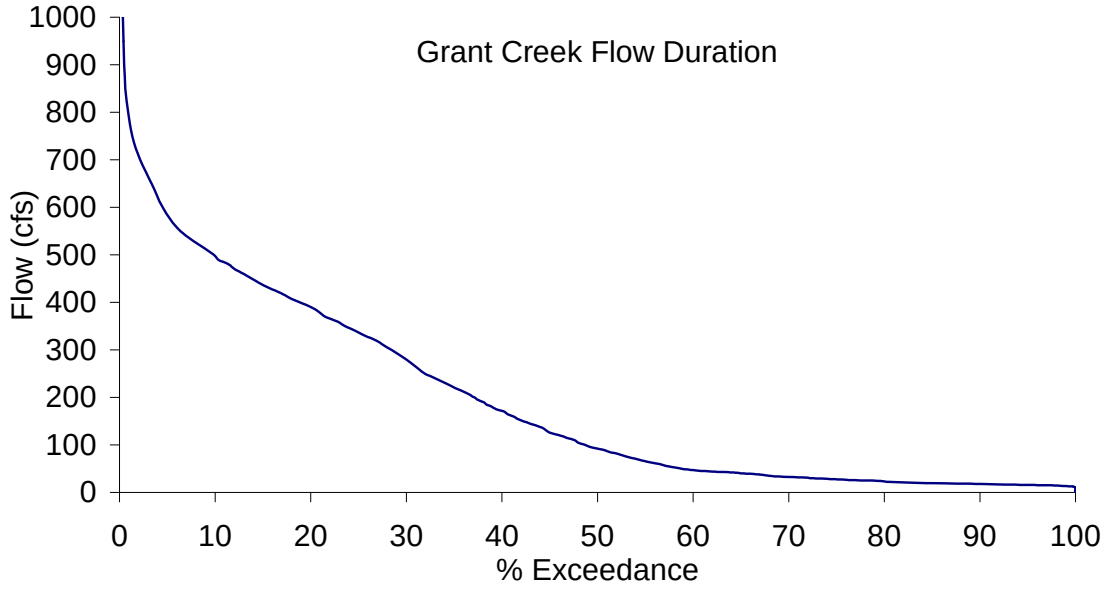

Figure 4.4-2. Flow duration curve for Grant Creek. Percent exceedance, the value of the x-axis, is the percent of the time flow surpasses the value on the y-axis. This curve was generated using data from the period 1947-1958, from USGS gage #5246000.

HDR Alaska gathered instantaneous discharge data at Grant Creek on October 4, October 23, and December 3 of 2008. Stream discharge measurements were taken just downstream of the original site of the USGS stream gauge, at a site that allowed safe fording of the stream, using standard USGS gauging protocols (Buchanan and Somers 1969). Measurements from 2008 were compiled with historical discharge data from USGS Gage 15246000 (1947-1958; Figure 4.4-3). Wetted stream width ranged from 35.0 (October 4, 2008) to 38.9 ft (December 3, 2008; Table 4.4-1).

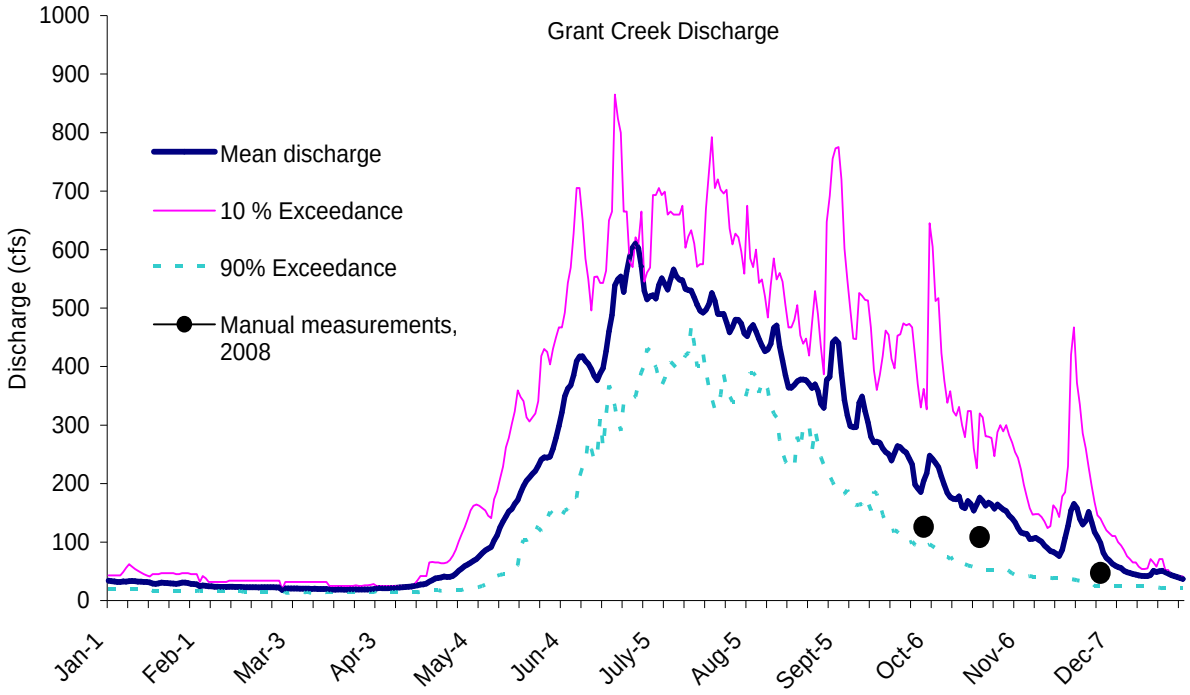

Figure 4.4-3. Grant Creek discharge data. Historic data are from USGS gage 15246000 (1947-1958) and manual instantaneous flow measurements made in 2008 by HDR Alaska. Mean discharge (heavy blue line), 10% flow exceedance (dashed aqua line), and 90% flow exceedance (solid pink line), in cubic feet per second are shown for historical data. Manually collected instantaneous stream flow measurements collected in 2008 by HDR Alaska are shown as black dots.

Table 4.4-1. 2008 instantaneous flow measurements collected by HDR October to December 2008.

Site	Date	Instantaneous Discharge (cfs)	Stream Width (ft)
Grant Creek	10/4/2008	126.0	35.0
	10/23/2008	108.3	38.9
	12/3/2008	47.3	36.8
Falls Creek	10/5/2008	22.1	19.1
	10/24/2008	13.9	16.7

4.4.2.2. Falls Creek

Continuous streamflow data were collected from May to October 1982 as part of the Ebasco studies (APA 1984). This stream gage was located near the mouth of Falls Creek. The average flow during this period was 38 cfs.

Because of the short period of record at Falls Creek, long term estimates of the flow in Falls Creek were estimated by comparison to adjacent Grant Creek (USGS #15246000) which was gaged continuously by the USGS for 11 years between 1947 and 1958. To estimate the hydrology of Falls Creek, the mean daily flows from the Grant Creek gage for May through September were scaled by factors determined by Ebasco (APA 1984; Table 4.4-2) to create a simulated daily flow file. In estimating the hydrology for hydropower generation, Ebasco assumed that flows in Falls Creek would be minimal during the months of November through April. Ebasco estimated the average monthly flow for May through October to be 56 cfs (Figure 4.4-4).

Table 4.4-2. Falls Creek scale factors (determined by APA 1984) used to simulate flow of Falls Creek from stream flow data collected at Grant Creek.

Month	Scale factor
October	6.2%
November	0
December	0
January	0
February	0
March	0
April	0
May	5.2%
June	24.2%
July	21.2%
August	14.6%
September	13.4%

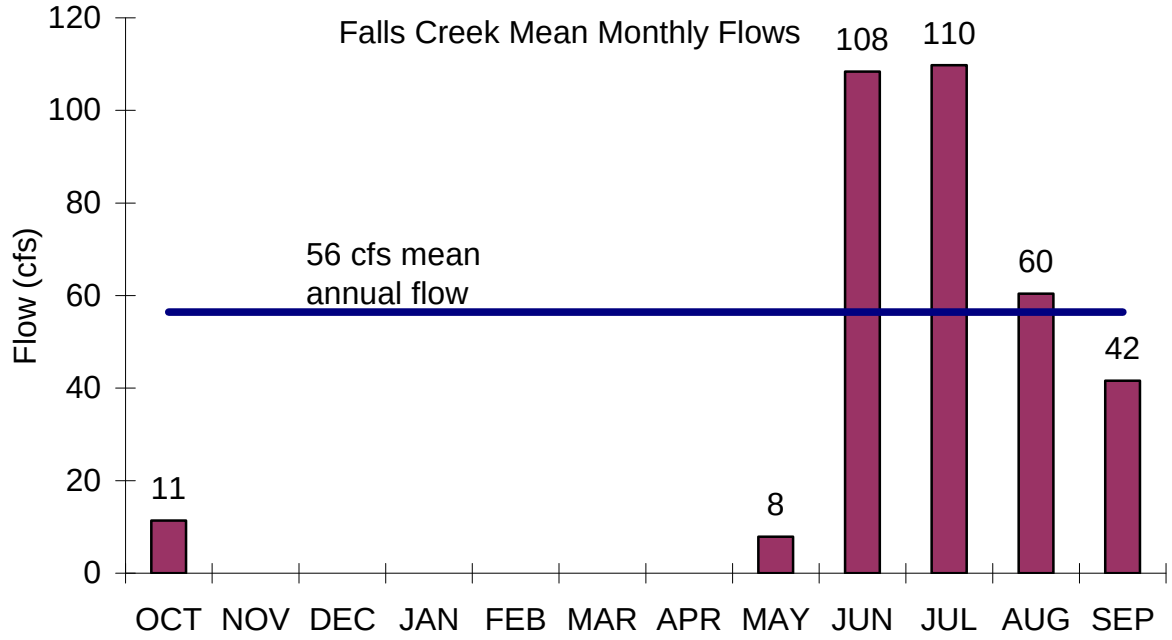

Figure 4.4-4. Mean monthly discharge of Falls Creek, modeled using data from USGS gage 15246000 (1947-1958) at Grant Creek, adjusted by monthly ratios developed by Ebasco (APA 1984; using one open water season of flow data at Falls Creek).

During these ice-free months, Falls Creek's mean monthly flow was lowest in May (8 cfs) and October (11 cfs), and highest in mid-summer (approximately 110 cfs). Estimated flows rarely

exceeded 200 cfs or dropped below 70 cfs (Figure 4.4-5). This curve was generated using modeled data from USGS gage 15246000 (1947-1958) at Grant Creek, adjusted by monthly ratios developed by Ebasco (APA 1984; using one open water season of flow data. at Falls Creek).

Stream flow and stream widths were measured at Falls Creek on October 5 and October 24, 2008 (Table 4.4-1). Measurements were taken at a site approximately 100 feet downstream of the Seward Highway Bridge. Falls Creek modeled discharge data were compiled with field measurements from 2008; data were generated from USGS gage 15246000 (1947-1958) at Grant Creek and adjusted by monthly ratios developed by Ebasco (APA 1984) using one open water season of current flow data from Falls Creek (Figure 4.4-6).

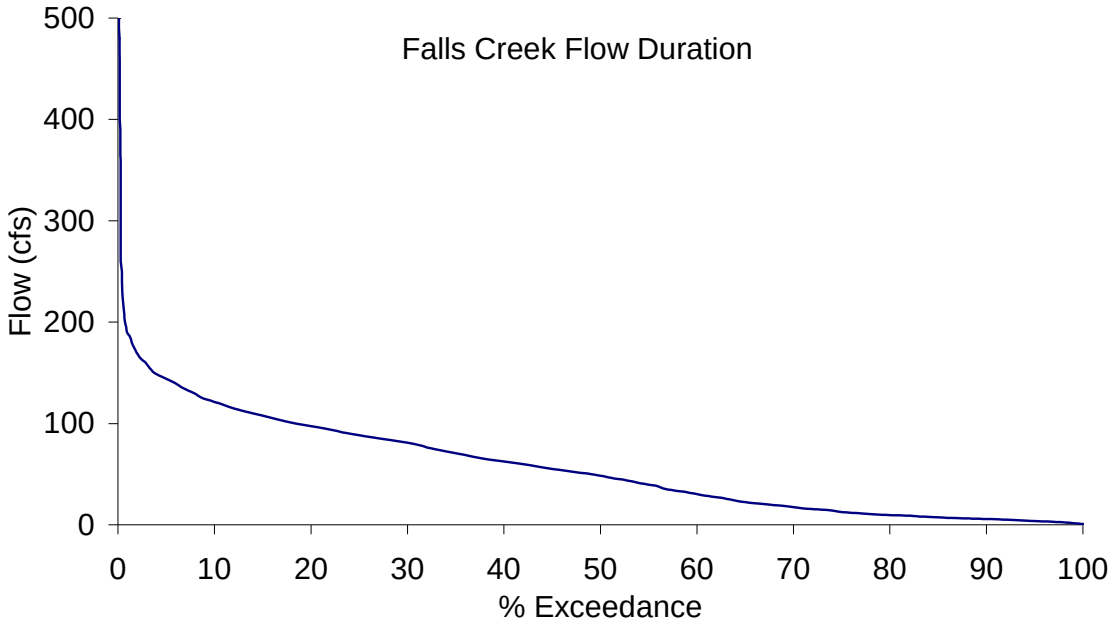

Figure 4.4-5. Flow duration curve for Grant Creek. Percent exceedance, the value of the x-axis, is the percent of the time flow surpasses the value on the y-axis.

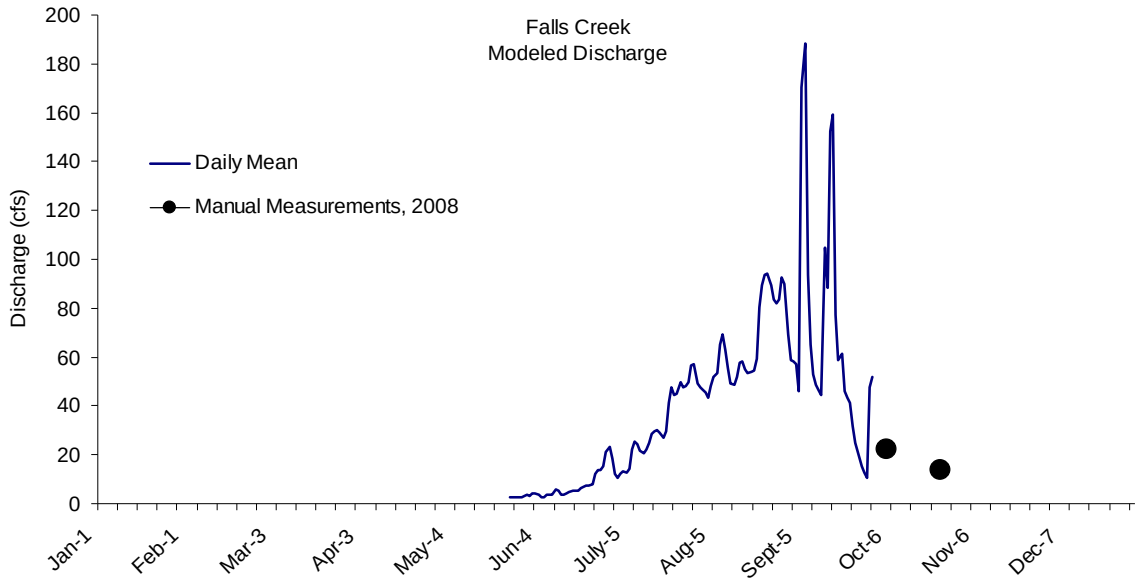

Figure 4.4-6. Falls Creek modeled discharge based on data from USGS gage 15246000 (1947-1958) at Grant Creek, adjusted by monthly ratios developed by Ebasco (APA 1984).

4.4.3. Project Streamflow Data

The monthly minimum, mean, and maximum recorded flows in cubic feet per second of Grant Creek at the powerplant intake, and at the potential Falls Creek diversion will be determined by instream flow studies to be conducted following filing of this PAD.

4.4.4. Water Quality

4.4.4.1. Applicable Water Quality Standards

Alaska Water Quality Standards require that, unless otherwise designated, all fresh water bodies be protected for all designated uses listed below:

- Water supply (drinking water, agriculture, aquaculture, industrial)
- Water recreation (contact and non-contact)
- Growth and propagation of fish, shellfish, other aquatic life, and wildlife

Alaska Water Quality Standards identify acceptable levels for designated use for categories of pollutants, including: color; fecal coliform bacteria; dissolved oxygen (DO); dissolved inorganic substances; petroleum hydrocarbons, oil and grease; pH; radioactivity; residues (floating solids, foam, debris, deposits); sediment; temperature; toxic substances; and turbidity (18 Alaska

Administrative Code [AAC] 70). Data collected in 2009 and 2010 to support the licensing effort will be evaluated for consistency with relevant water quality standards.

Grant Lake and Grant Creek are not specifically identified in Alaska's Final 2008 Integrated Water Quality and Assessment Report to EPA (ADEC 2008), and Falls Creek is listed as a water body for which not enough information exists to determine its compliance with water quality standards.

4.4.4.2. Water Clarity, Turbidity, and Dissolved Solids

Turbidity and suspended solids were consistently low in Grant Lake during the 1981-1982 monitoring period (October 1981, and March, June and August 1982) (APA 1984). Turbidity measured 0.24 to 3.8 NTU at the surface of the lake and 0.28 to 0.46 NTU at 50 m depth. Secchi disc readings ranged from 1.6 to 16.4 feet (APA 1984).

Grant Creek turbidity values ranged from 0.40 to 0.80 NTU, and Falls Creek turbidity values ranged from 0.35 to 6.0 NTU (APA 1984).

4.4.4.3. Nutrients

Nutrient levels in Grant Lake, Grant Creek, and Falls Creek are low. Nitrate (NO_3) concentrations were reported between 0.1 and 0.38 mg/l for Grant Lake in 1981-1982, and orthophosphate concentrations were less than 0.01 mg/l, except in March 1982 when 0.13 mg/l was recorded (APA 1984).

Grant Creek nutrient levels closely follow Grant Lake levels. In 1981-1982, Grant Creek nitrate levels were between 0.1 and 0.36 mg/l and orthophosphate was less than 0.01 mg/l, except in March 1982 when 0.04 mg/l was recorded (APA 1984). Periodic USGS data between 1950 and 1958 reported nitrate levels between 0.3 and 2.6 mg/l and nitrogen levels between 0.05 and 0.59 mg/l in Grant Creek (AIEDC 1983).

In 1981-1982, Falls Creek nitrate concentrations ranged from less than 0.1 to 0.12 mg/l, and orthophosphate was less than 0.01 mg/l.

4.4.4.4. Coliform Bacteria

Coliform bacteria were not detected in 1981-1982 monitoring in Grant Lake, Grant Creek, and Falls Creek (APA 1984).

4.4.4.5. Dissolved Oxygen

Grant Lake DO concentrations reported in APA (1984) from 1981 and 1982 studies conducted by ADF&G and AEIDC were at saturation for all depths measured (surface to 60 m). Lower and upper basin DO levels ranged from 9.75 to 13.5 mg/l.

4.4.4.6. Temperature

Temperature data show that Grant Lake is stratified during summer months, with surface temperatures reaching 14 ˚C and bottom (depth of 100 feet) temperatures of 5 ˚C. Fall overturn occurred in mid-September in 1981 and October in 1982. Seasonal temperature profiles for data collected in 1981-1982 in the upper and lower basins of Grant Lake are shown in Figures 4.4-7 and 4.4-8.

In 1981-1982, Grant Creek temperatures were between 0 ˚C and 13 ˚C and found to be closely related to Grant Lake surface temperatures (APA 1984). Temperatures in Falls Creek, which freezes solid in the winter, ranged from 0.3 ˚C to 6.7 ˚C during 1981-1982. Table 4.4-3 includes historic Grant Lake surface, Grant Creek, and Falls Creek temperature data reported in APA (1984).

Table 4.4-3. Temperature comparisons of Grant Lake, Grant Creek, and Falls Creek (Source: APA 1984).

Date	Source	Grant Lake Surface (°C)	Grant Creek (°C)	Falls Creek (°C)	Temperature Difference Between Grant Lake and Grant Creek (°C)	Temperature Difference Between Grant Creek and Falls Creek (°C)
11/3/59	USFW (1961)		4.4	0.3		4.1
6/8/60	USFW (1961)		7.8	5.0		2.8
6/17/60	USFW (1961)	11.7	11.7		0	
7/20/60	USFW (1961)	12.8	11.1	5.0	1.7	6.1
8/8/60	USFW (1961)	11.1	11.1		0	
8/13/60	USFW (1961)		10.6	6.7		3.9
9/1/60	USFW (1961)		10.0	5.6		4.4
9/14/60	USFW (1961)		9.4	5.0		4.4
10/16/60	USFW (1961)	6.7	5.6	2.2	1.1	3.4
10/13/81	AEDIC (1982)	7.2	6.0	3.5	1.2	2.5
3/2/82	AEDIC (1982)	2.0	1.0		1.0	
6/9/82	AEDIC (1982)	6.6	6.5	4.0	0.1	2.5
8/3/82	AEDIC (1982)	14.0	12.5	5.5	1.5	7.0
Average Temperature Difference, (°C)		…	…	…	0.8	4.1

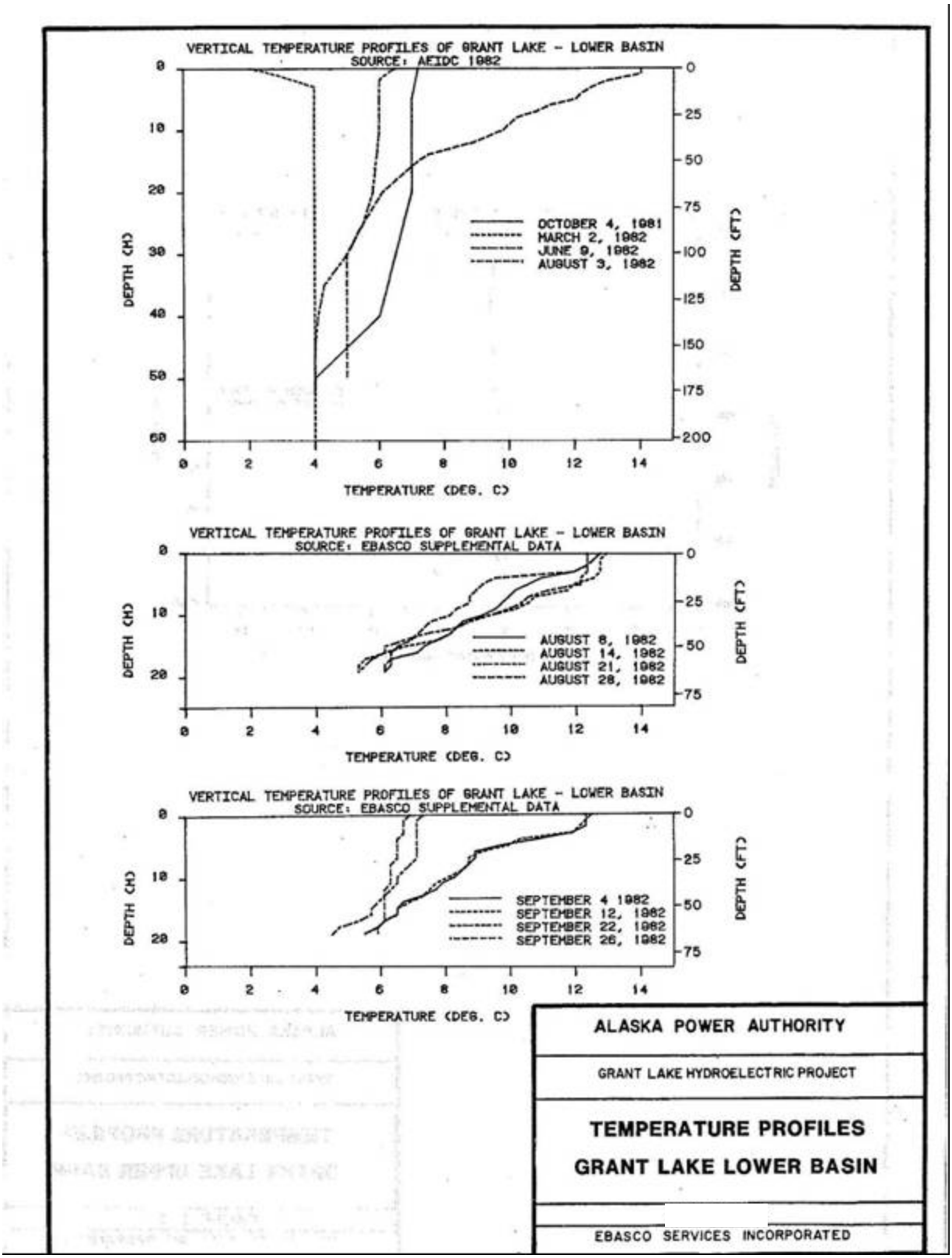

Figure 4.4-7. Temperature profiles in Grant Lake (APA 1984).

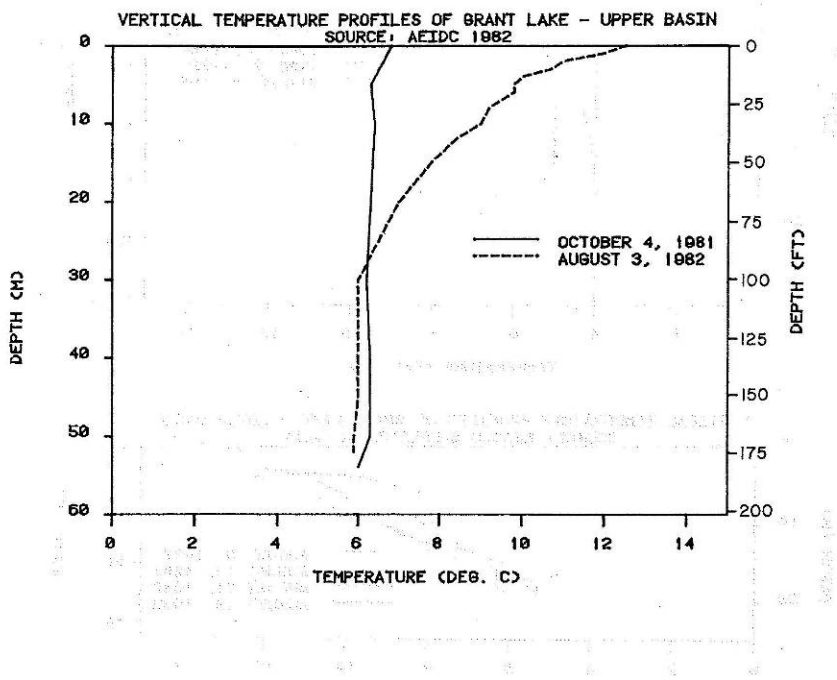

Figure 4.4-8. Temperature profile for the upper basin of Grant Lake (APA 1984).

4.4.4.7. pH

Grant Lake pH values were measured between 6.2 and 7.6 standard units (APA 1984) in 1981 and 1982, with the lowest levels recorded in October. Grant Creek pH was measured between 6.2 and 7.2, and Falls Creek pH was between 6.3 and 7.3.

4.4.4.8. Trace Metals and Hardness Levels

Limited trace metals data are available from 1981-1982 water quality studies. Cadmium, chromium (trivalent), copper, lead, mercury, silver, and zinc levels are reported in Table 4.4-4. In addition to the metals listed above, barium, cobalt, and manganese were measured in Grant Lake, Grant Creek, and Falls Creek in October 1981 and were found to be below the detection limit. Arsenic, gold, boron, bismuth, molybdenum, nickel, platinum, antimony, selenium, tin, strontium, titanium, tungsten, vanadium, and zirconium were measured in Grant and Falls Creek below detection limits, except strontium (0.06 mg/l in Grant Creek and 0.07 mg/l in Falls Creek) (APA 1984). Total hardness data from October 1981 and March, June, and August 1982 are reported in AEIDC (1983) as $CaCO_3$: Grant Lake – 27-33 mg/l; Grant Creek – 28-31 mg/l; and Falls Creek – 25-39 mg/l.

Table 4.4-4. Trace metals data collected in 1982.

	Grant Lake (µg/l)			Grant Creek (µg/l)			Falls Creek (µg/l)			
Metal	**March**	**June**	**August**	**March**	**June**	**August**	**June**	**August**	**Method[1]**	**Detection Limit (mg/l)**
Cadmium	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	Graphite Furnace AA[2]	0.0001
Chromium (trivalent)	0.6	0.8	1.4	0.5	<0.5	0.6	3.7	<0.5	Graphite Furnace AA	0.0005
Copper	3	2	18	2	<1	2	4	1	Graphite Furnace AA	0.001
Lead	9	2	5	4	<1	<1	2	<1	Graphite Furnace AA	0.001
Mercury	<0.2	Not Measured	Not Measured	<0.2	Not Measured	Not Measured	Not Measured	Not Measured	Cold Vapor Technique	0.0002
Silver	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.3	Graphite Furnace AA	0.0003
Zinc	<5	6	15	125	6	<5	8	8	Flame AA	0.005

Notes:
1 Samples taken in October 1981 were below detection limits, processed using the Inductively Coupled Argon Plasma Scan (ICAP) method, with detection limits as reported in APA (1984).
2 AA – Atomic Absorption
Source: APA 1984, Tables 2-1 and 2-3

4.4.5. Existing and Proposed Water Uses

4.4.5.1. Existing Water Use

Existing water uses for Grant Lake and Creek and Falls Creek are summarized in section 4.2.2 – Land and Water Uses.

4.4.5.2. Grant Lake Proposed Water Use

Kenai Hydro, LLC submitted a water rights application for the proposed Grant Lake Development to the Alaska Department of Natural Resources, Water Resources Section, in April 2009 (KHL 2009a). The application requested water rights for the proposed Project, to include:

- 48,000 acre feet of storage in Grant Lake
- 910 acre feet per day (for use January – December)
- 297 million gallons per day (maximum daily use)

4.4.5.3. Falls Creek Proposed Water Use

Kenai Hydro, LLC submitted a water rights application for the proposed Falls Creek Development to the Alaska Department of Natural Resources, Water Resources Section, in April 2009 (KHL 2009b). The application requested water rights for the proposed Project, to include:

- 210 acre feet per day (for use January – December)
- 70 million gallons per day (maximum daily use)

4.4.6. Potential Adverse Impacts

Potential adverse environmental impacts of the proposed Project will be assessed by the licensing studies. Table 4.4-5 summarizes potential Project impacts to water resources. Seasonal temperature changes in Grant Creek could occur. Minimum instream flow needs for fish and aquatic habitat will be determined through future studies. Potential water quality impacts due to seasonal changes in hydrology through diversion of flow from Falls Creek, and changed flows in Grant Creek will be investigated and baseline data collected will be evaluated by Alaska Water Quality Standards.

Table 4.4-5. Potential Project impacts on water resources.

Potential Impact	Resource Issue
Changes in seasonal flows from Grant Lake into Grant Creek	Water quality, including temperature, impacts on Grant Creek.
Reduction in flow in Falls Creek	Water quality impacts on Falls Creek
Changes in seasonal flows in Grant Creek and Falls Creek	Water quality and hydrology impacts on Trail Lake and Trail Creek

4.4.7. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro, LLC has not to date identified proposed water resources related protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es will occur following completion of effects analyses based on licensing studies. The proposed Project facilities include a multi-level intake structure in order to address potential temperature impact of changes in stream hydrology due to the Project.

4.5. Fish and Aquatic Resources

4.5.1. Introduction

The following subsections include a description of existing fish and aquatic resources in the vicinity of the proposed Grant Lake/Falls Creek Project. Topics addressed, to the extent possible based on existing information, include anadromous and resident fish, invertebrate, and aquatic plant communities

4.5.2. Existing Fish and Aquatic Communities

4.5.2.1. Kenai River Basin

The Kenai River system, one of the most productive salmon rivers in the world, supports 34 species of anadromous and resident fish, including five species of Pacific salmon: Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), pink (*O. gorbuscha*), and chum (*O. keta*) salmon, although chum salmon are uncommon in the Kenai River. Other salmonid species in the Kenai River and its tributaries include resident rainbow trout (*O. mykiss*), Dolly Varden (*Salvelinus malma*), lake trout (*S. namaycush*), Arctic grayling (*Thymallus arcticus*), Bering cisco (*Coregonus laurettae*), and round whitefish (*Prosopium cylindraceum*). Anadromous rainbow trout (steelhead) do not occur in the Kenai River basin (ADNR 1997).

Chinook Salmon

There are two distinct Chinook salmon spawning runs in the Kenai River basin: an early run that enters the river from May through late June and spawns primarily in tributaries from late July to mid August and a late run that enters the river from late June through August and spawns primarily in the mainstem Kenai River. In recent years, the early run population has fluctuated between 8,100 fish and 16,000 individuals, whereas the late run is typically larger, with a total run size averaging 56,000 fish (ADF&G 2006a).

A number of upper river tributaries are used by early run Chinook salmon for spawning. In the mainstem Kenai River the greatest amount of Chinook salmon spawning occurs between river miles 10 - 21 and 40 - 50. Rearing Chinook salmon are seasonally distributed throughout the entire mainstem Kenai River, in the lower reaches of a number of tributaries, and in Skilak and Kenai lakes (ADNR 1998). Juvenile Chinook typically rear in fresh water for just over one year and are usually associated with low gradient, meandering, unconstrained river reaches. The majority of Chinook juveniles in the mainstem Kenai River rear within about six feet of undisturbed riverbanks where natural bank indentations provide cover (ADNR 1997).

Coho Salmon

Coho salmon also have two distinct spawning runs in the Kenai River basin. The early run enters the river in late July and the late run in November and December. Early-run coho spawn primarily in tributaries from September through early October, and late-run coho spawn in the mainstem Kenai River from October through February. After emergence, juvenile coho spend from one to three winters in streams and may spend up to five winters in lakes before migrating to the ocean as smolts (ADF&G 2006a).

Sockeye Salmon

There are also two distinct sockeye salmon runs in the Kenai River. The early run enters the river in mid May, and the late run begins entering the river by mid July. Spawning usually occurs in rivers, streams, and upwelling areas along lake beaches. In systems with lakes, juveniles usually spend one to three years in fresh water before migrating to the ocean in the spring as smolts (ADF&G 2006a). The majority of mainstem and tributary juvenile sockeye salmon rear in Kenai and Skilak lakes.

Rainbow Trout

Resident rainbow trout occur throughout the Kenai River system, and the upper Kenai River supports a large portion of the overall rainbow trout population. The majority of these fish over-winter in Skilak and Kenai lakes and migrate to spawning and feeding locations in the upper Kenai River and tributaries during May and June. Adult rainbow trout move from upper river locations to over-wintering areas in September and November.

Dolly Varden

Resident and anadromous Dolly Varden inhabit the entire Kenai River system, including both Skilak and Kenai lakes (ADF&G 2004). Several staging areas containing spawning fish have been identified in tributaries and in the mainstem Kenai River. Dolly Varden occupy most of the tributaries to Kenai Lake and the Kenai River during summer and fall and overwinter in lakes.

4.5.2.2. Grant Lake and Grant Creek

Grant Lake

Because of the impassable falls below Grant Lake's outlet, no anadromous fish species occur in Grant Lake and its tributaries (USFWS 1961, AEIDC 1983, APA 1984), and Grant Lake is not included in the Anadromous Waters Catalog (AWC) published by ADF&G (Johnson and Daigneault 2008). Grant Lake appears to support only resident populations of sculpin–including slimy sculpin (*Cottus cognatus*) and coast range sculpin (*Cottus aleuticus*)–and threespine stickleback (*Gasterosteus aculeatus*) (AEIDC 1983, USFWS 1961, Johnson and Daigneault 2008). Although Sisson (1984) reported that Dolly Varden and a few rainbow trout occupied Grant Lake, subsequent investigations (USFWS 1961, AEIDC 1983, Marcuson 1989) have documented only sculpin and stickleback. From 1983-1986, coho salmon fry were stocked in Grant Lake by ADF&G, with limited success, through some enhanced returns to Grant Creek were recorded (Marcuson 1989). To augment existing information, KHL is conducting surveys in 2009 to characterize fish use within Grant Lake (HDR 2009a).

Patches of aquatic macrophytes occur in Grant Lake in the few littoral areas shallow enough to allow their growth. Based on surveys conducted in the early 1980s, white water crowfoot (*Ranunculus trichophyllus*) occurred in Grant Lake but was abundant only near the lake's outlet (APA 1984). Sedges (*Carex rhynchophysa*) were documented in the narrows between upper and lower Grant Lake basins. Both species were uncommon, which was attributed to the lake's lack of shallows and level of turbidity (APA 1984).

Results of 1982 phytoplankton collection in Grant Lake show that the dominant taxa during all seasons were diatoms, mainly *Cyclotella* and *Synedra*, and that phytoplankton abundance was greatest in August (APA 1984). Phytoplankton density was low compared to measurements from other northern oligotrophic lakes.

Surveys conducted in 1982 showed that the zooplankton community in Grant Lake was dominated by rotifers, mainly *Kellicottia* and *Asplanchna*, and cyclopoid copepods (APA 1984). Non-rotifer zooplankton abundance was highest in August, likely following peak abundance of the phytoplankton upon which they feed.

Sampling conducted in Grant Lake in 1981 and 1982 revealed that benthic macroinvertebrate diversity was low, as is typical of cold, glacial fed lakes with limited littoral habitat (APA 1984).

The three most abundant taxa were midges (Chironomidae), segmented worms (Oligochaeta), and clams. Densities of all insect taxa, other than chironomids, were low. Macroinvertebrates were typically most abundant in summer, and the lower Grant Lake basin had more abundant caddisflies (Trichoptera) and clams and fewer worms that the upper basin.

Grant Creek

Both anadromous and resident fish are present in Grant Creek, which is included in the Anadromous Waters Catalog (AWC) due to the presence of spawning and rearing salmon (Johnson and Daigneault 2008). The section of Grant Creek containing anadromous fish is shown in Figure 4.5-1. A series of impassable falls near Grant Lake's outlet (approximately 0.75 miles upstream of the creek's mouth) prevents colonization of the lake by salmonids from Grant Creek (APA 1984).

Spawning Chinook, sockeye, and coho salmon, rainbow trout (*O. mykiss*), and Dolly Varden occur in the lower reaches of Grant Creek (APA 1984, Johnson and Daigneault 2008). Round whitefish and Arctic grayling have been captured in Grant Creek but are not known to spawn there (APA 1984). Chinook salmon may be present in Grant Creek from early July to early September with the peak of spawning occurring in late July-early August. Sockeye salmon may be present from mid-July through late September with the spawning peak in late August. Coho salmon enter the creek in late August and may be present through early November with the spawning peak occurring in early October (Marcuson 1986). Rainbow trout may be present most of the year with spawning likely occurring just after ice breakup in late spring. Dolly Varden spawning occurs in the late fall.

Counts of salmon in lower Grant Creek based on foot surveys by a number of investigators are presented in Table 4.5-1. Additionally, a counting weir was operated on lower Grant Creek in late summer and fall during the years 1986-1989 in order to evaluate the experimental stocking of coho salmon in Grant Lake. Foot survey counts are likely substantially lower than actual escapement numbers. The weir data can be expected to be more reflective of actual fish numbers. However, the weir was placed after the peak of the chinook run so numbers of chinook probably underestimate total escapement. Very small numbers of pink and chum salmon (less than 10) were also caught in the weir.

Table 4.5-1. Number of adult salmon observed in lower Grant Creek during intermittent foot surveys (1952-1982) and weir counts (1985-1988).

YEAR	NUMBER OF ADULT SALMON		
	Chinook Salmon	Sockeye Salmon	Coho Salmon
1952	0	250	
1953	12	13	
1954	6	45	
1957	8	0	
1959	28	0	
1961	86 Total		
1962	2	234	
1963	33	41	
1976	29	0	
1977	0	4	
1978	5	0	
1979	42	29	
1980	5	0	
1981	45	19	
1982	46	135	
1985	53	400	301*
1986	46	675	178*
1987	34	2181	312*
1988	33	551	55*

*Estimated wild fish - additional cohos were present but were returns from Grant Lake fry stocking and do not represent current conditions.

Source – APA 1984 and Marcuson 1989

Minnow trapping and electrofishing conducted in lower Grant Creek during 1981 and 1982 yielded higher catches of salmon, trout, and Dolly Varden in the fall and summer than in winter and spring (AEIDC 1983). Length-frequency distribution of fish caught via electrofishing in Grant Creek during 1982 show that most fish captured were small, particularly Chinook and coho salmon (Figure 4.5-2) (AEIDC 1983).

As noted above, upper Grant Creek is impassable to fish because of barrier falls (APA 1984, Johnson and Daigneault 2008), restricting usable anadromous fish habitat to the lower portion of the stream. Juvenile fish habitat exists mainly in the stream's margins, eddies, deep pools with cover, and side channels (APA 1984). Substrate throughout Grant Creek is large as a result of high water velocity, although isolated areas of spawning gravel occur in the lower half of the stream (APA 1984).

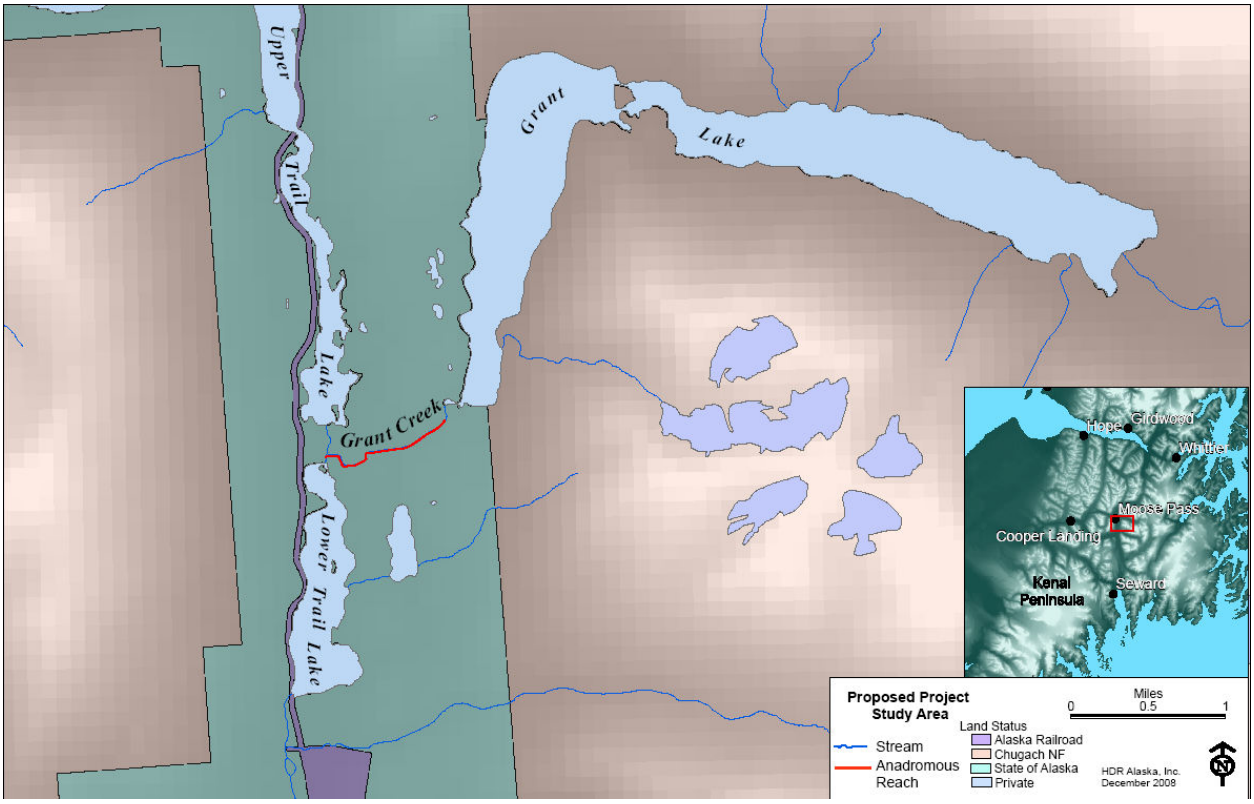

Figure 4.5-1. The range of anadromous fish in Grant Creek, as documented by the AWC (Johnson and Daigneault 2008).

To augment existing fisheries information, KHL is conducting surveys of fish populations and habitat in Grant Creek during 2009 (HDR 2009a). The purpose of the study is to characterize resident and anadromous fish use, fish spawning abundance, spawning run timing, and habitat quality. As part of the study, potential locations will be evaluated for the installation and operation of a fish weir on Grant Creek, which may be used to estimate salmon escapement. In addition to fish and habitat surveys, KHL is conducting an instream flow study to determine the potential effects of a range of flow regimes on physical habitat and water temperature in Grant Creek.

Surveys conducted in 1982 showed that the periphyton community in Grant Creek was dominated by diatoms, mainly *Achnanthes* and *Synedra* (APA 1984). Diatoms were most abundant in spring, as is typical of streams. Galcial runoff may at times reduce light penetration in Grant Creek, which in turn would reduce potential periphyton production. APA (1984) concluded that allochthonous input of leaves and other organic matter, along with input of phytoplankton and zooplankton from Grant Lake, was likely more important than periphyton as the basis of productivity in Grant Creek.

Surber sampling conducted in Grant Creek in 1981 and 1982 revealed that benthic macroinvertebrate diversity was low, as is typical of cold, glacial fed streams (APA 1984). The most abundant taxa were midge species (Chironomidae), followed by mayflies (Ephemeroptera), stoneflies (Plecoptera), and clams. No seasonal variation in macroinvertebrate abundance was observed.

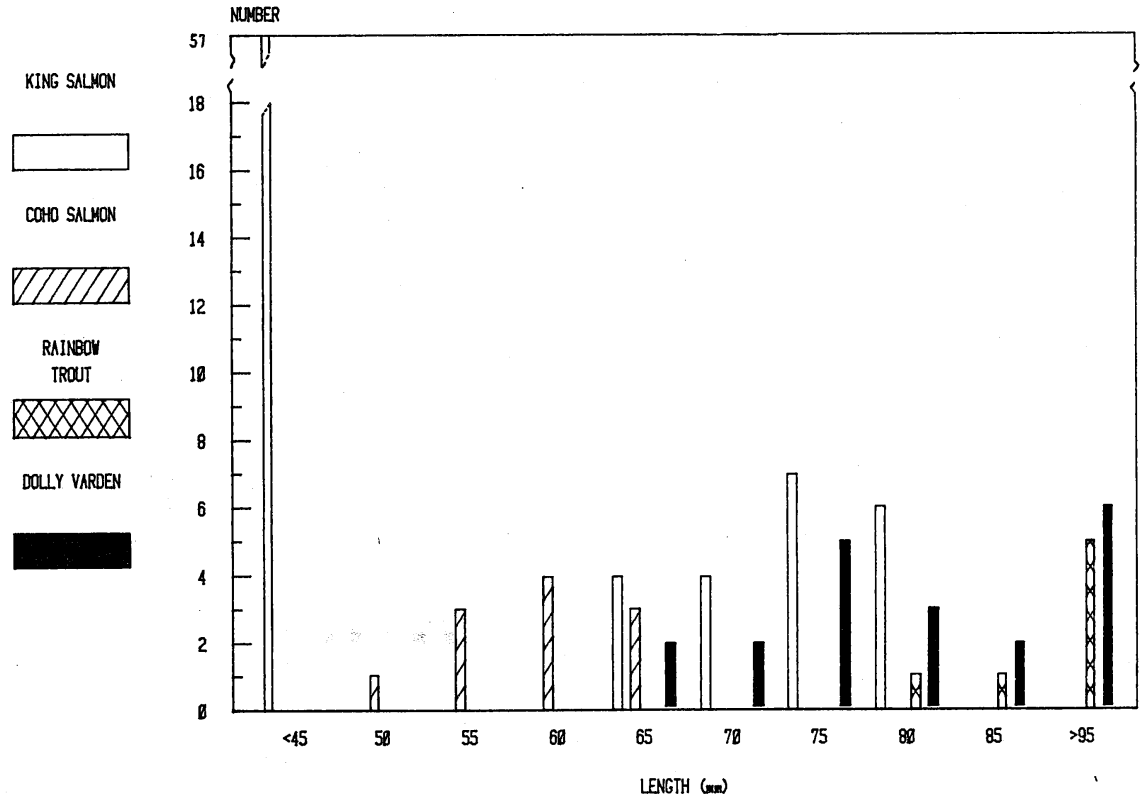

Figure 4.5-2. Length-frequency distribution of Chinook (king) salmon, coho salmon, rainbow trout, and Dolly Varden captured via electrofishing in Grant Creek during 1982 (from AEIDC 1983).

4.5.2.3. Falls Creek

Both anadromous and resident fish are present in the lowest 0.25 miles of Falls Creek, which is included in the Anadromous Waters Catalog (AWC) due to the presence of spawning and rearing salmon (Johnson and Daigneault 2008). There is a fish barrier at the lower end of Falls Creek preventing further upstream passage. Sampling conducted in 1959 by the USFWS in Falls Creek documented the presence of juvenile Chinook salmon, Dolly Varden, and sculpin species; the

rearing Chinook juveniles were all observed in the lowest 0.1 miles of the stream (based on minnow trapping results). During surveys in the early 1980s there was no evidence that Dolly Varden spawned in Falls Creek (AIEDC 1983).

Sampling conducted in Falls Creek in 1981 and 1982 revealed that benthic macroinvertebrate diversity was low (AIEDC 1983), as is typical of cold, glacial streams. The dominant taxa were midges and mayflies, although stoneflies, caddisflies, and other species of true flies (Diptera) were present. Densities of all insect taxa, other than mayflies, were low. Macroinvertebrates were typically most abundant in late summer.

To augment existing information, KHL is conducting surveys in 2009 of fish populations and habitat in Falls Creek (HDR 2009a). The purpose of the studies is to evaluate resident and anadromous fish species composition, distribution, and abundance and to survey fish habitat resources and assess quality and quantity of key habitat parameters.

4.5.2.4. Trail Lake/Trail River

Anadromous and resident fish species in the Trail Lake/Trail River system include Chinook, coho, sockeye, and pink salmon. Other salmonid species include resident rainbow trout, Dolly Varden, lake trout, Arctic grayling, and round whitefish (ADNR 1998, AIEDC 1983). Both late-run sockeye salmon and lake trout spawn in Upper Trail Lake (ADF&G 2006a).

4.5.3. Threatened and Endangered Species

There are no federally or state listed Threatened or Endangered fish species in the vicinity of Grant Lake, Grant Creek or Falls Creek.

4.5.4. Federally Designated Habitat

The Magnuson-Stevens Fishery Conservation and Management Act of 1996 defines Essential Fish Habitat (EFH) as "those waters and substrates necessary for fish spawning, breeding, feeding, or growth to maturity." Freshwater EFH includes streams, rivers, lakes, ponds, wetlands and other bodies of water currently and historically accessible to Pacific salmon. EFH for Pacific salmon recognizes six critical life history stages: (1) spawning and incubation of eggs; (2) juvenile rearing; (3) winter and summer rearing during freshwater residency; (4) juvenile migration between freshwater and estuarine rearing habitats; (5) marine residency of immature and maturing adults; and (6) adult spawning migration. Habitat requirements within these periods can differ significantly, and modification of habitat within these periods can adversely affect EFH. By agreement between NOAA Fisheries and ADF&G, EFH for anadromous species in Alaskan fresh waters is defined by the ADF&G Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (ADF&G 2008).

4.5.4.1. Grant Lake and Grant Creek

In Grant Creek, EFH is limited to those areas occupied by Chinook, coho, and sockeye salmon identified in ADF&G's Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (ADF&G 2008). The reach (about 0.75 miles) of Grant Creek below the impassable barrier falls is identified as EFH by ADF&G.

4.5.4.2. Falls Creek

In the Falls Creek, EFH is limited to those areas occupied by Chinook, coho, and sockeye salmon identified in ADF&G's Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (ADF&G 2008). The lowest reach (about 0.25 miles) of Falls Creek is identified as EFH by ADF&G.

4.5.4.3. Trail Creek

In Trail Creek, EFH is limited to those areas occupied by Chinook, coho, and sockeye salmon identified in ADF&G's Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (ADF&G 2008). Trail Creek between Trail Lake and Kenai Lake (about 1.5 miles) is identified as EFH by ADF&G.

4.5.5. Potential Adverse Impacts

4.5.5.1. Grant Lake and Grant Creek

Potential adverse environmental impacts of the proposed Project will be assessed by the licensing studies being undertaken in 2009 to develop the information needed to understand the potential effects of the Grant Lake and Falls Creek developments on fish and aquatic resources in the vicinity of the project.

Alteration of streamflow and temperature regime (depending on the depth of water withdrawal in Grant Lake) in Grant Creek as the result of potential Project operation could affect spawning and rearing habitat for anadromous fish species and habitat for all lifestages of resident fish species, depending on the timing and magnitude of flow alteration.

Changes in water surface elevations in Grant Lake would likely affect aquatic biota in littoral areas, including fish, macroinvertebrates, and macrophytes; the timing and magnitude of lake level changes would dictate the level of effects (the proposed lake level changes would range from 9 feet above to 25 feet below the natural lake elevation of approximately 696 feet). Areas of shoreline wetlands could also be affected. Any dredging of Grant Lake in the vicinity of the proposed intake structure could result in short-term impacts on benthic macroinvertebrate populations in the area. Water temperatures in Grant Lake could be influenced by operation of the proposed Project, depending on the depth of water withdrawal.

Increased fine sediment runoff from access roads and contruction activities could affect habitat conditions in Grant Creek over the short-term, but implementation of Best Management Practices (BMPs) at the site would minimize, and possibly preclude, such impacts. The stream, however, is already turbid as the result of glacial runoff, so it is uncertain how significant effects of any sediment input would be.

4.5.5.2. Falls Creek

Alteration of streamflow in Falls Creek due to the diversion of flow from Falls Creek to Grant Lake, could affect spawning and rearing habitat for anadromous fish species and habitat for all lifestages of resident fish species, depending on the timing and magnitude of flow alteration. It is unknown whether alteration of streamflow in Falls Creek as the result of potential Project operations, i.e., water diversion to Grant Lake, could affect conditions in Falls Creek. Because Grant Creek flows into Trail Lake upstream of the mouth of Falls Creek, no net change in flow would be experienced in Trail Creek due to Falls Creek diversion.

4.5.6. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro, LLC has not to date identified proposed fish and aquatic resource related protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es will occur following completion of effects analyses based on licensing studies. An instream flow study will be conducted on Grant Creek to determine the effects of altered flow on fish habitats and to provide a basis for establishing minimum flow releases to protect anadromous fish habitat within the lower Grant Creek fish use area.

4.6. Wildlife and Botanical Resources

4.6.1. Introduction

The ecological setting of the Project vicinity reflects the area's low average temperatures, prolonged freezing in the winter, and the relative geographic isolation of the Kenai Peninsula from the principal land mass of Alaska. Low overall temperatures limit primary and secondary productivity, and the area's geographic isolation lead to low plant and animal diversity. The proposed Project would be located between elevation 500 feet and 700 feet MSL within a transition zone between boreal and coastal coniferous forests dominated by Sitka spruce and hemlock. Timberline lies between 1,000 and 1,500 feet elevation, and plant species adapted to avalanches, desiccation, and freezing occur at higher elevations. Willow and alder occupy areas between forest and alpine species.

There are no known occurrences of federally listed endangered or threatened plant or wildlife species in the vicinity of the proposed Project.

4.6.2. Wildlife

A series of reconnaissance-level foot and aerial field surveys were conducted between October 1981 and September 1982 by AEIDC to ascertain the presence, distribution, relative abundance, and use patterns of wildlife species and to identify the distribution and relative value of seasonally-limited habitats in the Grant Lake/Falls Creek Project vicinity. Limited additional information on wildlife populations is available in more recent ADF&G reports for some species; wildlife surveys will be conducted as a part of licensing studies in order to update the information included in this section.

4.6.2.1. Description of Wildlife Populations and Habitat Use

Tables with a list of all mammal and bird species found in the proposed Project vicinity along with their occurrence in the area, relative abundance, breeding habitats (bird species), and population estimates (mammals) are included in APA (1984).

Mammals

The mammalian fauna of the proposed Project vicinity is composed of a nearly equal mix of herbivore and carnivore species. In general, habitat is marginal for mammals and supports few individuals of most species. Notable exceptions are some south-facing alpine and subalpine communities, which are important to mountain goat and Dall's sheep.

Most mammal species in the area are migratory. Movements are influenced by the terrain, snowfall, and snow melt. Several movement corridors of large mammals were identified in the 1980s field study (APA 1984), and this historical species information is summarized below.

Small mammals – Twelve species of shrew and mice are possible residents of the proposed project vicinity. Shrews were ubiquitous in all forest and scrub associations based on observed sign, particularly in older forest communities, but less so above timberline. Vole tracks were observed throughout the Project vicinity to 2,000 feet elevation, the altitudinal limit of foot surveys. The tundra and singing voles are the most common species in the area. Only the northern red-backed mouse *(Clethrionomys rutilus)* was seen in the Project vicinity. This species is common throughout the Kenai Peninsula. The little brown myotis *(Vespertilionidae Myotis lucifugus)*, a common summer resident of southcentral Alaska is likely present.

Hoary marmots *(Marmota caligata)* are common residents of alpine tundra communities throughout the project vicinity. In general they were observed at between 1,500 and 3,000 feet elevation. Highest marmot concentrations were observed in the Upper Falls Creek drainage and in local areas north and northeast of Grant Lake. Red squirrels *(Tamiascirus hudsonicus)* are conspicuous throughout the coniferous forests of the Project vicinity, being most abundant in areas of larger spruce timber. No northern flying squirrels *(Glaucomys sabrinus)* were observed but they probably occur in forest in the area.

Although beavers *(Castor canadensis)* are one of the most abundant furbearing mammals in Alaska, little beaver habitat exists in the Project area. Evidence of beaver was scarce and, with few exceptions, was confined to Grant Lake and its tributaries. Four lodges were observed in this area although only one appeared active. Limited trapping of beavers occurs in the area, but trapping intensity varies considerably between and within years.

Porcupines *(Erethizon dorsatum)* are common throughout the coniferous forests of the Kenai Peninsula, particularly in mountainous regions near timberline. Population sizes are highly variable and fluctuate over long intervals. Occasional scattered porcupine sign was noted in the project area, generally at altitudes of 500 to 1,000 feet. The species was not abundant in the area at the time of the surveys in 1981 and 1982.

Wolf *(Canis lupus)* –Wolves recologinzed the Kenai Peninsula during the 1960s, and ADF&G estimates the wolf population on the Kenai Peninsula in Game Management Units 7 and 15 (10,637 square miles) to be about 200 (Selinger 2006). The wolf is a frequent transient in the Grant Lake, Falls Creek, and Trail Lakes region (APA 1984). The wolves in the Grant Lake area are probably the group known as the Mystery Creek pack, ranging in the mountain area from Mystery Creek as far east as Grant Lake or perhaps, on occasion, as far as Nellie Juan Lake (APA 1984). The wolf preys upon a variety of animals, including moose, Dall's sheep, mountain goat, snowshoe hare, beaver, coyote, and fox.

Coyote *(Canis latrans)* – Coyote abundance has increased rapidly since colonizing the Kenai Peninsula around 1930. Coyote sign was noted over much of the Project vicinity during the 1981-82 field studies. Like the wolf, the coyote is wide-ranging and will travel and hunt throughout all the habitat types of the Project vicinity. A frequently used coyote travel route was noted on the bench between Falls Creek and Grant Lake in the timberline region at the base of the mountain slope (APA 1984).

Red fox *(Vulpes vulpes)* – The red fox is an indigenous species on the Kenai Peninsula, although population sizes have remained small since about 1930. Low red fox densities are likely due to competition from coyotes and wolves (McDonough 2007a).

Black bear *(Ursus americansus)* – Black bears are one of the most widely distributed and abundant large mammals on the Kenai Peninsula. Black bear within the Project vicinity are generally associated with valley floors, small alluvial plains, lakeshores, and intervening streams. Sign was evenly distributed between 500 and 1,000 foot elevations between and around the lakes. There was no evidence of black bear activity in the upper Grant Lake valley during early 1980s surveys. Black bear distribution is regulated by the temporal and spatial distribution of food, which in the Grant Lake area appear to be limited. Important black bear habitat in the Project vicinity includes the lower alpine zone near the shrubline, which is used in July and August for rearing. During August and September black bears feed on salmon in Grant Creek, but because salmon densities are low, bears intermittently forage in the subalpine zone and on

lowland berries at this time. Likely denning habitat in the Grant Lake area includes spruce-covered slopes and hillsides. Primary denning habitat for black bears probably occurs in the Trail Lakes and Moose Creek valleys; the forested habitat along Trail Lakes appears less suitable because of human disturbance. Studies reported in APA (1984) identified the bench between Grant and Trail lakes south to and including the Ptarmigan Creek drainage as potential denning habitat.

Brown bear *(Ursus arctos)* – Brown bears are sparsely distributed throughout much of the region surrounding the Project vicinity. During the 1981-1982 field studies, only 16 widely scattered sets of tracks and three individuals, a female with one yearly and a mature individual, were observed. Alaska Department of Fish and Game reported insufficient forage as the factor responsible for the low density of brown bears in the region. Forage resources and denning habitat in 1982 are shown in Figure 4.6-1 for the Project vicinity. (APA 1984). Three units of potential denning habitat are delineated based on sightings of individual bears and their sign at the time of den emergence and on the basis of geomorphic and vegetation characteristics. No more than one or two families and possibly two or three solitary animals would den within the proposed Project area in any given year. The slopes west of Solars and Lark mountains and the bench partitioning Grant and Trail lakes constitute the principal travel routes to and from the Grant Lake valley, although some travel occurs in the pass intersecting the headwater areas of Moose Creek and Snow River. The period of greatest activity during the 1981-1982 studies was the last half of May, coinciding with den emergence and breeding. Few, if any, brown bears reside year-round within the Project vicinity due to lack of food, limited denning habitat, and residential development along the Seward Highway.

The State of Alaska developed a Kenai Peninsula Brown Bear Conservation Strategy (ADF&G 2000) to address impacts of human activities on brown bear habitat. Kenai Peninsula brown bears are listed as a Species of Special Concern by the State of Alaska. ADF&G believes that the population has been increasing over the last decade, but no recent population estimates have been established (Selinger 2005).

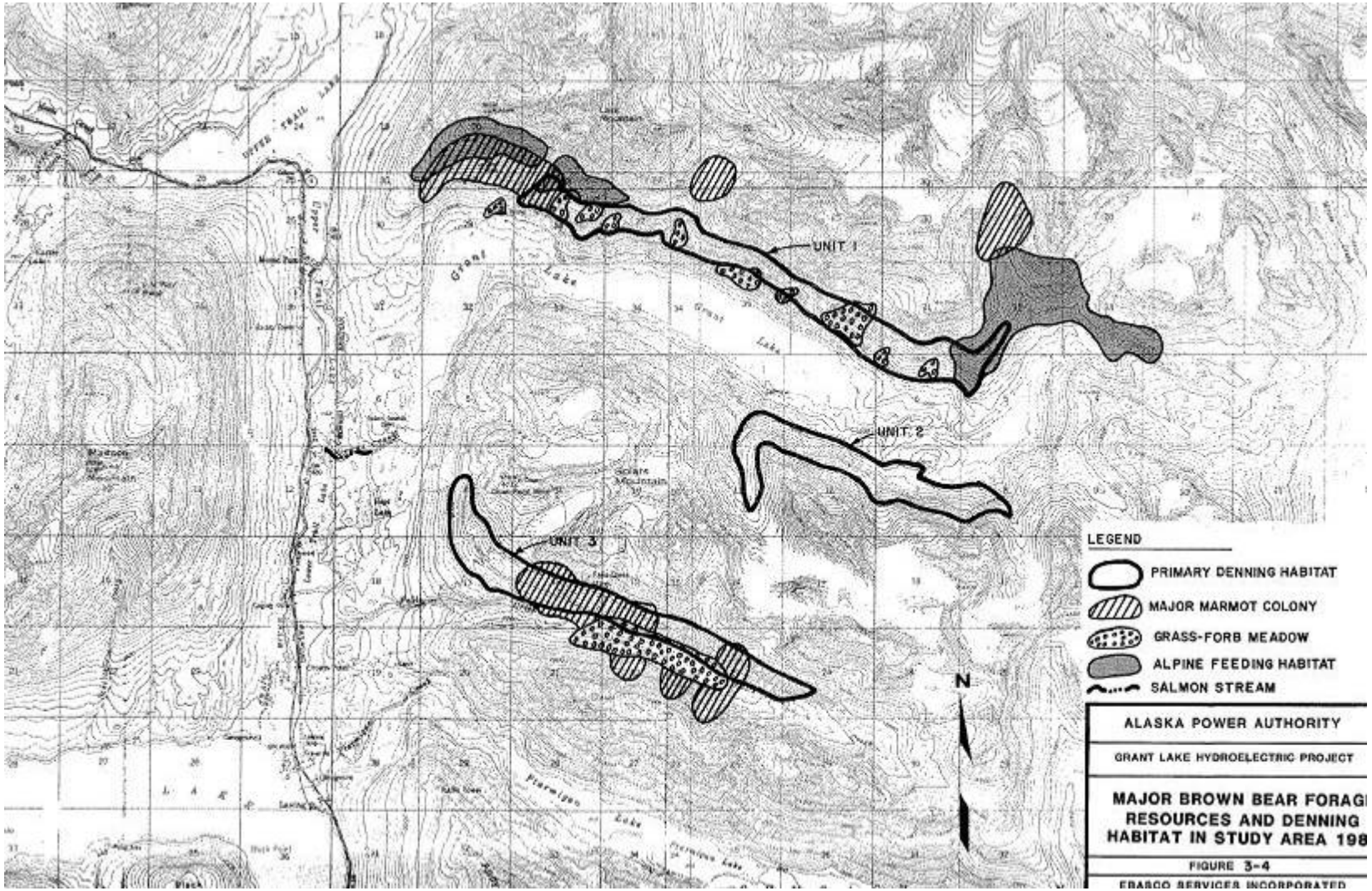

Figure 4.6-1. Major brown bear forage resources and denning habitat in the Project vicinity in 1982 (APA 1984).

Mustelids - Although martens *(Martes americana)* are indigenous to the Kenai Peninsula and present over much of its mountain and foothill areas, little marten sign was found in the Grant Lake area in during the 1981-1982 studies.

The least weasel *(Mustela nivalis)* is widely distributed throughout the Kenai Peninsula, and sign was found throughout all habitat types in the Grant Lake area, particularly in grassy areas near timberline and around lake margins.

Mink *(Mustela vison)* were not sighted during the 1981-1982 field surveys and very little sign was observed. Mink habitat is limited to the lower reaches of Grant and Falls creeks and to the shoreline of Trail Lake. Habitats along Trail Lake are probably important only following salmon runs when salmon carcasses provide food.

Wolverines (*Gulo gulo*) are relatively abundant predators on the Kenai Peninsula. Wide-ranging by nature, they can be found in all habitat types, most commonly in mountain areas. During the 1981-1982 field surveys, the Project vicinity was within the travel and hunting range of one or more wolverines. The Grant Lake-Inlet Creek delta was the site of considerable wolverine foraging activity in March 1982.

River otters *(Lutra canadensis)* are relatively abundant and widespread on the Kenai Peninsula, but no sign of their presence was found in the Project vicinity. Suitable habitat for otter is limited to the lower reaches of Grant Creek. Lack of habitat probably precludes the establishment of a resident population, but otters are probably present as transients in the area.

Canada Lynx *(Lynx canadensis)* – Lynx are widespread over the Kenai Peninsula. Lynx distribution and population levels vary in response to snowshoe hare abundance. Forest and shrubland habitats with an abundance of hardwood browse plants available for hares is prime lynx habitat. In 1981-1982, the Project area had a relatively low hare population, so lynx were also uncommon.

Moose *(Alces alces)* – Moose inhabit the Project vicinity, but were not particularly abundant during 1981-1982 field studies. Snow depth and a corresponding lack of winter forage limit moose numbers in the Project area (APA 1984). Figure 4.6-2 shows summer and winter ranges and travel routes, with one travel route identified that crosses the bench between Grant and Trail lakes. While little moose monitoring has been conducted, ADF&G estimates moose populations at between 700 and 1,000 based on harvest information in the Eastern Kenai Peninsula Game Management Unit 7 (McDonough 2007c).

Mountain goats *(Oreamnos americanus)* – The Kenai Peninsula goat population is subject to considerable short-term annual fluctuations and shifts in ranges occur due to primarily to winter weather conditions and recently to hunting pressures. In the summers of 1979 and 1981, ADF&G conducted a population study, and estimated a population of 246 goats. Of this group,

about one-quarter (an average of 50) commonly use the Grant Lake basin through much of the year.

Although the entire drainage is used by mountain goats, the principal area of use is the north side of Grant Lake on the south-facing slopes – generally small vegetated benches and ridges between 1,000 to 3,200 feet. These locations, where mountain goats were observed during April, May, and June in 1982, are depicted on Figure 4.6-3. The primary areas of interchange between Grant Lake and other subpopulations are the Moose Creek drainage and across the glacier to the Kings River-Kings Bay area.

Dall sheep *(Ovis dalli)* – Dall sheep are more abundant in the interior sections of the Kenai Mountain range than elsewhere on the Kenai Peninsula. The Grant Lake area constitutes the southern limit of Dall sheep range in Alaska. Dall's sheep reportedly range over the entire Grant lake and Falls Creek drainages in several small bands. During the 1981-1982 field studies, however, they were only noted on the northern half of the Grant Lake drainage. The locations, where Dall's sheep were observed during May and June in 1982, are depicted in Figure 4.6-4. Frequent interchange apparently occurs with the Moose Creek herd, particularly during summer. As with goats, mid-elevations of the slopes constitute favored range, especially vegetated benches, and the upper edges of timbered areas and exposed ridges where some forage plants are available. Sheep were observed during various seasons from the Lark Mountain ridge line above Moose Pass to slopes in the upper basin of the drainage.

Winter range is the principal limiting factor for sheep. Good winter range in the Grant Lake basin consists of snow-free sites near escape terrain at the mid-altitude. In early spring, sheep sometimes move to lower altitudes into subalpine tree cover, where emergent vegetation appears soon after the snow recedes. Sheep scats were found in open bluejoint meadows as low as 1,000 feet.

The most recent survey of the Kenai Peninsula Dall sheep population was conducted in 1992, when 1600 sheep were counted by ADF&G (McDonough 2008).

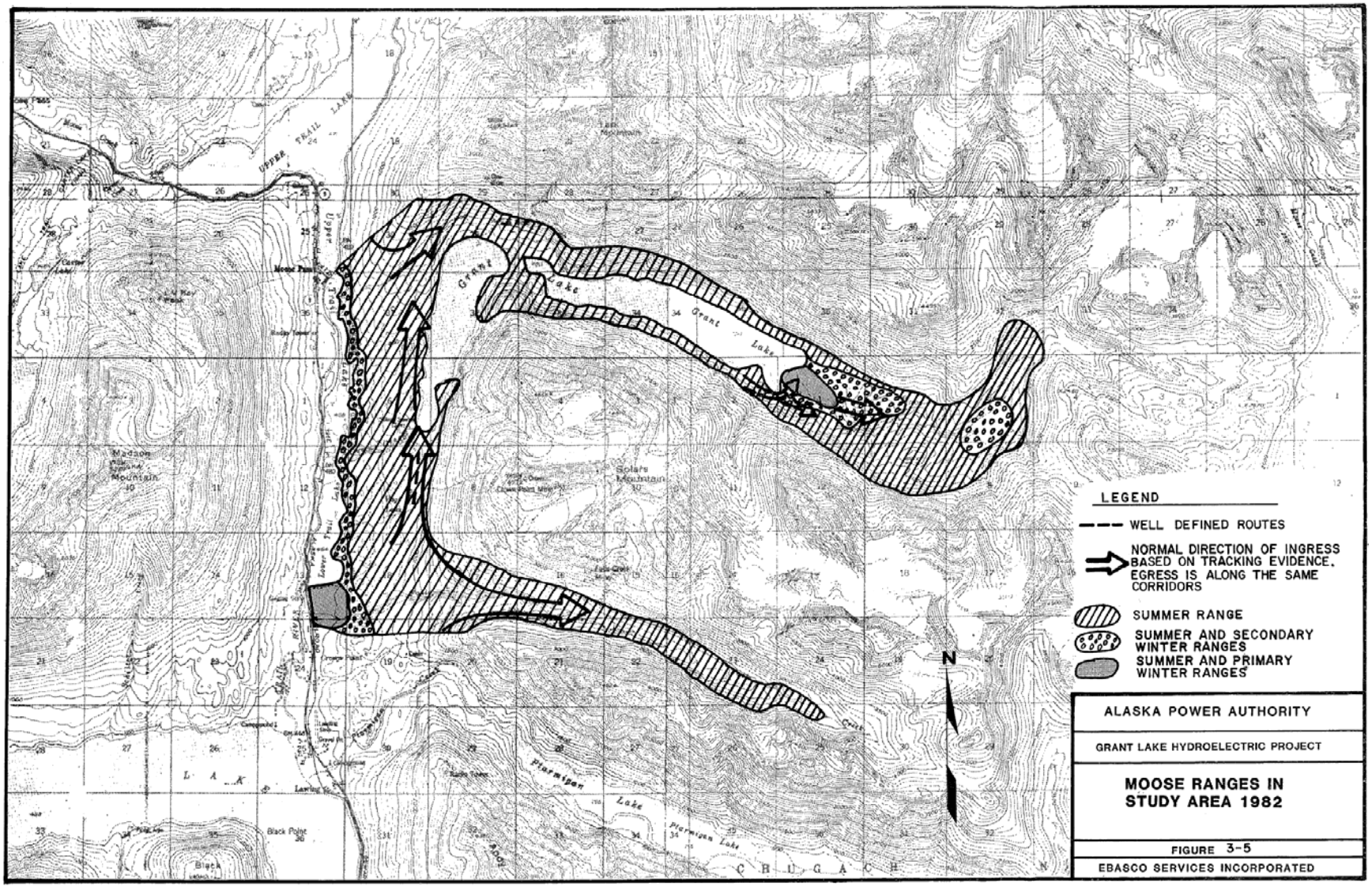

Figure 4.6-2. Moose ranges in the Project vicinity in 1982 (APA 1984).

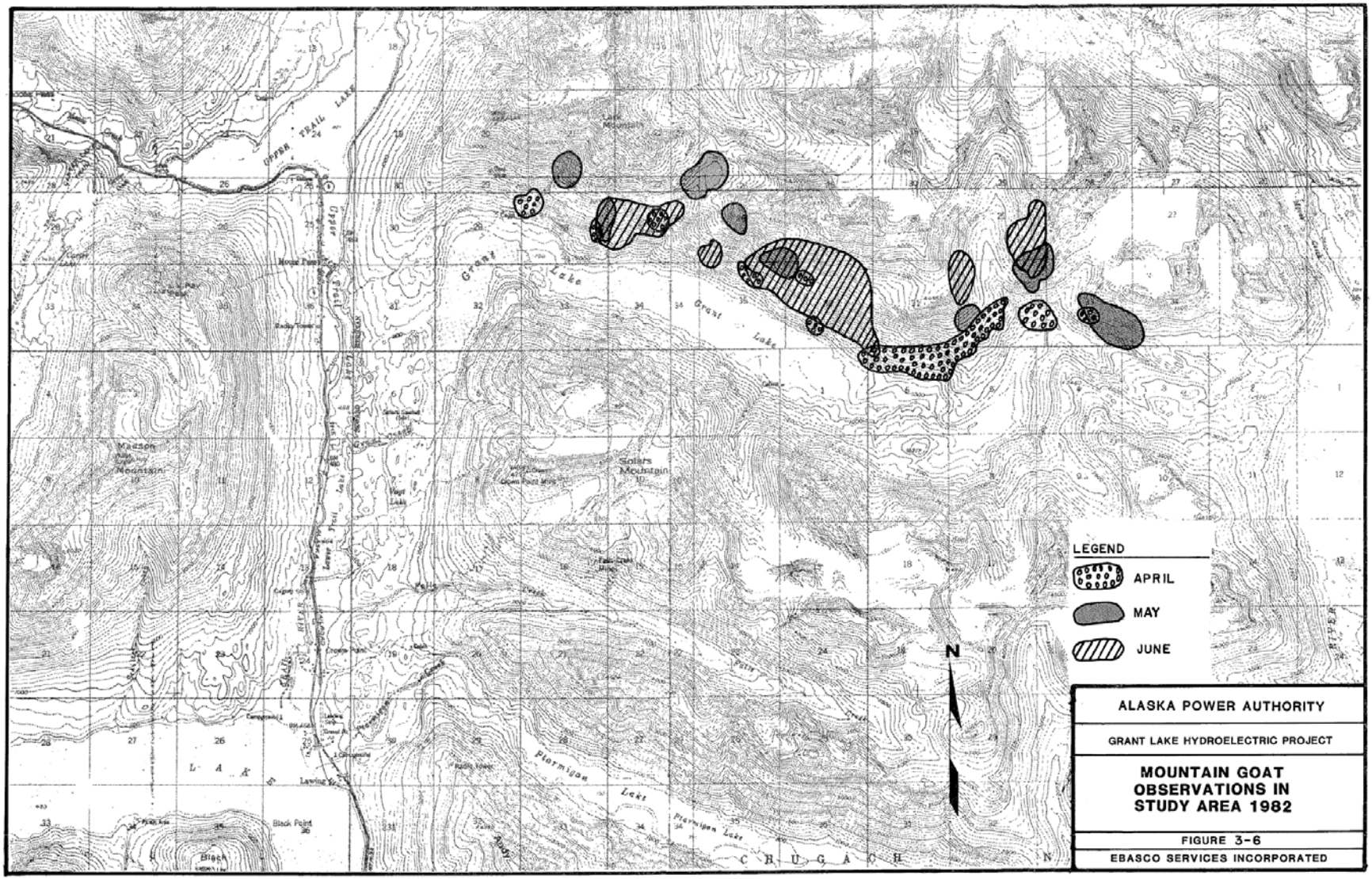

Figure 4.6-3. Principal area of mountain goat use in the Project vicinity in 1982 (APA 1984).

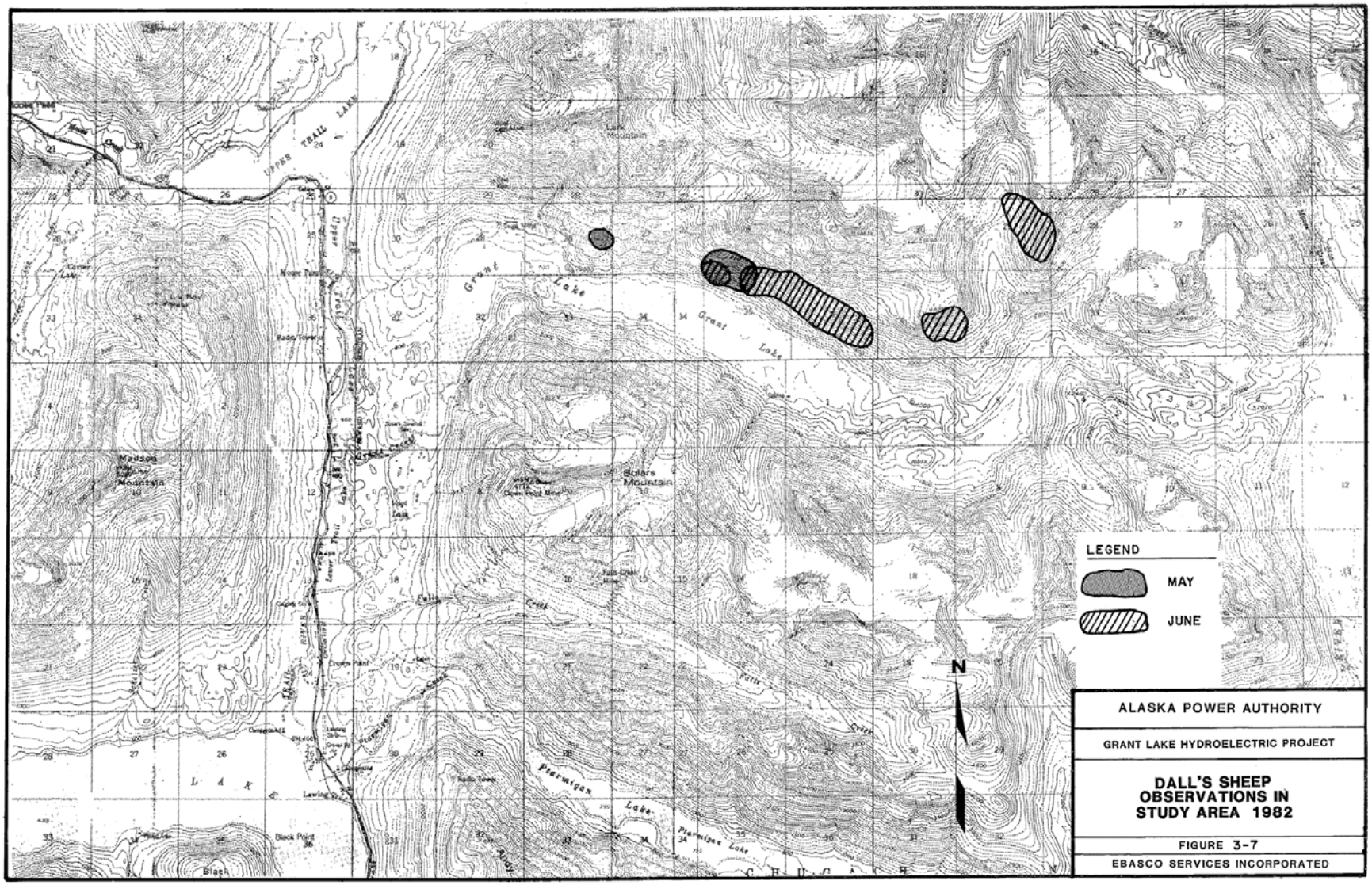

Figure 4.6-4. Favored range of Dall's sheep in the Project vicinity in 1982 (APA 1984).

Birds

AEIDC (1983) studies identified approximately 108 bird species that could either inhabit or migrate through the proposed Project vicinity. A comprehensive list of the species that may occur in the Project vicinity and their breeding status, relative abundance, and breeding habitats is presented in Table 3-16 of the APA analysis (1984).

During field studies, 63 bird species were observed in the Project area in 1981-1982 (AEIDC 1983). Of the 63 species observed, 43 were known or probable breeders within the Project area. The status of the major species groups in the Project vicinity is discussed in APA (1984), and summarized below.

Waterfowl, Loons, and Grebes – A variety of swans, geese, and ducks use the Kenai Peninsula, mostly on broad low level plains, with numerous lakes and ponds.

Nine duck species were observed during field studies. An American wigeon *(Anas Americana)* nest was found along the shores of Upper Trail Lake and a common goldeneye *(Bucephala clangula)* with a single down young was observed in Grant Lake. Harlequin ducks *(Histrionicus histrionicus)* and green-winged teal *(Anas crecca)* were observed and suspected to be nesting in the Grant Lake Inlet Creek area.

When Grant Lake is iced-over, an area at the outlet of the lake remains ice-free. This area was a winter feeding area for a flock of mallards *(Anas platyrhynchos)*. As many as 30 individuals were observed in this opening during winter 1981-1982 field studies. White-water crowfoot in this area supports benthic macroinvertebrates, which serve as a food source for the ducks. With the exception of the two pools in Grant Creek, this was the only area within the study area boundaries remaining ice-free and possessing an abundant, available food supply during the 1981-1982 winter.

Four loon and two grebe species inhabit the Kenai Peninsula. Nesting habitat in the Project vicinity is limited; but Vagt Lake, Grant Lake, and, to a lesser extent, the ponds along the bench between Grant and Upper Trail lakes provide some nesting habitat. Several common loons *(Gavia immer)* were observed during field studies and a pair was assumed to be nesting at Vagt Lake. While it is more typical for arctic loon nesting to occur further north, a pair of arctic loons *(Gavia arctica)* nested near the east end of Grant Lake during 1982.

Shorebirds, Gulls, and Terns – Gulls, terns, and shorebirds are more common along the outer Kenai Peninsula than in the project vicinity, although a number of shorebird species potentially occur in the project vicinity. Five species were observed during the 1981-1982 field studies and four were assumed to be breeding. The four probable breeders were greater yellowlegs *(Tringra melanoleuca)* and lesser yellowlegs *(Tringra flavipes)* (in bogs on the bench between Grant and Upper Trail Lakes), the spotted sandpiper *(Actitis macularia)* (along the Grant Lake inlet creek),

and the common snipe *(Cupella gallinago)* (along Upper Trail Lake). The mew gull *(Larus canus)* and arctic tern *(Sterna paradisaea)* were observed but did not appear to be nesting.

Raptors – There are five hawk species, two eagle species, two falcon species, and five owl species that breed on or migrate through the Kenai Peninsula. Of the hawk species only one, the sharp-shinned hawk *(Accipiter striatus)*, was observed in the Project area, in a small forested drainage along the south shore of Grant Lake's upper basin. Nesting habitat for this species, as well as the goshawk *(Acipiter gentilis)* and red-tailed hawk *(Buteo jamaicensis)*, occurs within the forested portions of the project vicinity. Several cliffs in the project vicinity appear to have suitable nesting habitat for rough-legged hawks *(Buteo lagopus)*, and nesting habitat for marsh hawks *(Circus cyaneus)* is present in bog areas. A single American kestrel *(Falco sparverius)* was observed on the north slopes of Grant Lake's upper basin, but there was no evidence of breeding.

A single bald eagle *(Haliaeetus leucocephalus)* was observed along Grant Lake in October 1981. No nest sites were found. The small Grant Creek salmon run is not believed to be of sufficient magnitude to sustain fish-eating birds in large numbers. Juvenile and adult golden eagles *(Aquila chrysaetos)* were regularly observed in the alpine zone of the project vicinity. Nesting is assumed to occur in this habitat but was not documented.

No owl species were observed during field studies; however, suitable habitat exists throughout the Grant Lake area.

Grouse and Ptarmigan – One species of grouse, the spruce grouse *(Canachites canadensis)*, occurs on the Kenai Peninsula. Two of the three species of ptarmigan, the rock *(Lagopus mutus)* and willow ptarmigan (*Lagopus lagopus)*, that inhabit the Kenai Peninsula were observed in the project vicinity. The best habitat for spruce grouse in the project vicinity was located in mixed forest along Trail Lake and the Vagt Lake Trail. The remainder of the area provides marginal habitat. Eight adults and one chick were observed in the project vicinity during 1981-1982 field studies. Neither species appeared to be abundant.

Other Birds –Belted kingfishers *(Megceryle alcyon)* were commonly observed during field studies around Trail Lake and Grant Creek. Several dippers (*Cinclus mexicanus*) were observed in the Project area and young were seen along Grant Creek and the Grant Lake Inlet Creek, indicating breeding in these areas. A large flock of Bohemian waxwings *(Bombycilla garrulous)* containing many young birds was observed feeding on insects at the mouth of Grant Creek. Five warbler species, all suspected to be breeding, were commonly seen throughout upland scrub and riparian scrub communities as well as the small patches of scrub vegetation that occurred on the bench between Grant Lake and Trail Lake.

Amphibians

The wood frog *(Rana sylvatica)* is the only amphibian known to occur in the proposed project area based on the 1981-1982 field surveys. Habitat for this species is present in the area between Grant and Trail lakes. No reptiles were found in the region.

4.6.2.2. Wildlife Species with Commercial, Recreational, or Cultural Importance

Several species of wildlife are of commercial, recreational, or cultural importance. The Project area lies within ADF&G Unit 7 (Seward), with black bear, brown bear, goat, moose, sheep, wolf, and wolverine regulations in place (ADFG 2009) for recreational hunting. Furbearer trapping on the Kenai Peninsula is primarily a recreational activity, with a louse infestation currently impacting wolves and some coyotes, further decreasing fur quality and also reducing trapping effort (McDonough 2007a).

4.6.2.3. Rare, Threatened, and Endangered Species and Other Species with Special Status

Thirteen wildlife species and one plant species are federally listed in Alaska. Of these, only the Canada lynx may occur in the Project vicinity, and the Alaska population is not included in threatened listing (USFWS 2009; L. Kahn, USFWS, personal communication, July 2009). The FEIS for the Revised Land and Resource Management Plan for the CNF (USFS 2005) also indicates that there are no known federally threatened and endangered species on the Kenai Peninsula area of the CNF. The U.S. Forest Service (USFS) has identified three management indicator species (MIS) and eight species of special interest (SSI) in the Kenai Peninsula area section of the CNF (Table 4.6-1).

Several species on the State of Alaska list of Species of Special Concern (ADF&G 1998) likely occur in the proposed Project area, including the olive-sided flycatcher, gray-cheeked warbler, Townsend's warbler, Blackpoll warbler, and the Kenai population of the brown bear.

Table 4.6-1. Management indicator species, species of special interest, and general habitat types located on the Kenai Peninsula area of the Chugach National Forest (USFS 2005).

Species		Species Status		General Habitat Type				
Common Name	**Scientific Name**	**MIS**	**SSI**	**Early Forest Succession**	**Late Forest Succession**	**Alpine**	**Freshwater**	**Riparian**
Brown bear	*Ursus arctos*	X		X			X	X
Moose	*Alces alces*	X						X
Mountain goat	*Oreamnos americanus*	X				X		
Lynx	*Lynx canadensis*		X	X				
Wolverine	*Gulo gulo*		X				X	X
River otter	*Lutra canadensis*		X					X
Marbled murrelet	*Brachyramphus marmoratus*		X		X			
Townsend's warbler	*Dendroica townsendi*		X		X			X
Northern goshawk	*Accipiter gentilis*		X		X			
Bald eagle	*Haliaeetus leucocephalus*		X					X
Osprey	*Pandion halioetus carolinensis*		X					X

4.6.3. Botanical

The proposed project areas includes a variety of vegetation associations, from conifers and mixed conifer/broadleaf stands, which include small ponds and bogs between Trail Lake and Grant Lake (500 to 700 feet), to alpine tundra vegetation above 2,000 feet, to barren mountain

tops and snow fields above 4,000 feet on Solars Mountain to the south and Lark Mountain to the north. The 1981-1982 field studies by AEIDC (1983) identified 109 plant species occupying nine vegetation association cover types (APA 1984).

4.6.3.1. Vegetation Cover Types

The Project vicinity examined for botanical resources was defined as the watersheds of Grant Lake, Grant Creek, and Falls Creek. Nine vegetation cover types (mapping units) were identified in this area using 1978 NASA high-altitude, color-enhanced, infrared photography (ADA 1984). The mapping units represent combinations of plant community types that could be delineated from the aerial photographs. Nine vegetation cover types were field checked and classified according to an unpublished 1982 version of the classification system published by Viereck et al. (1992). The cover types identified in the Project vicinity include:

- Coniferous Forest
- Broadleaf Forest
- Mixed Broadleaf/Coniferous Forest
- Riparian Scrub
- Upland Scrub
- Grass/Forb Meadow
- Bog (Wet Meadow)
- Alpine Tundra
- Barren

These vegetation cover types are described in detail below. Site specific local vegetation classification information for the Project vicinity is available from the Chugach National Forest GIS data library layers and in DeVelice et al. (1999) and will be used to map vegetation in the proposed Project area during licensing studies.

Coniferous Forest – This vegetation cover type is represented in the Project area primarily by pure or mixed stands of white spruce *(Picea glauca)* and western hemlock *(Tsuga heterophylla)*. Mountain hemlock *(T. mertensiana)* occurs at higher elevations. Coniferous forest occurs primarily between Grant Lake and Upper Trail Lake, in patches along Grant Lake's shoreline, in the valley of the Grant Lake Inlet Creek, and between the mouth of the Falls Creek valley and Trail River. Understory shrubs are primarily rusty menziesta *(Menziesia ferruginea)*, early blueberry *(Vaccinium ovalifolium)*, and Alaska spirea *(Spiraea beauverdiana)*. Devil's club *(Echinopanax horridum)* occurs in moist areas and along drainages. Forest openings may support Sitka alder (*Alnu crisp subsp. sinuata*), serviceberry *(Amelanchier alnifolia)*, Pacific red elder *(Sambucus racemosa)*, and Sitka mountain ash *(Sorbus sitchensis)*. Other common shrubs in this cover type are trailing black currant *(Ribes laxiflorum)* and American red currant *(R. triste)*. The ground cover consists primarily of Sphagnum spp. and other mosses. Areas of poor

drainage may support open stands of black spruce *(Picea mariana)*, with an understory of Labrador tea *(Ledum palustre subsp. decumbens)*, linonberry *(Vaccinium vitis-idaea)*, and dwarf blueberry *(V. caespitosum)* growing over a layer of sphagnum moss and lichens (primarily *Cladonia spp.*). These black spruce stands occur along Trail Lake and are scattered throughout the lower elevations around ponds and adjacent to open meadows.

Broadleaf Forest – This vegetation cover type is dominated by balsam poplar *(Populus balsamifera)*, with an understory of feltleaf willow *(Salix alaxensis)*, Sitka willow *(S. sitchensis)*, Sitka alder, and occasional white spruce. The ground cover is extremely sparse and consists of scattered patches of horsetail *(Equisetum arvense)* and river beauty *(Epilobium latifolium*). Frequent flooding is an important factor influence vegetation in this cover type. This cover type occurs in the Project area only along the main Grant Lake Inlet Creek and on the small delta of another inlet creek to the west of the main creek. Inlet Creek has a poorly defined channel and appears to shift its course across the delta frequently. During July 1982, the main body of the stream flowed directly through a mature poplar *(Populus spp.)* stand.

Mixed Broadleaf/Coniferous Forest – This vegetation cover type is dominated by paper birch *(Betula papyrifera)*, white spruce, and western hemlock on relatively warm, dry sites, whereas cool wet sites are often dominated by black spruce. Common understory plants are rusty menziesia, highbush cranberry *(Viburnum edule)*, early blueberry, American red currant, and prickly rose *(Rosa acicularis)*. Devil's club is found in wet places and along streams. Open sites often support Sitka alder thickets. Ground cover is primarily mosses, bunchberry *(Cornus canadensis)*, five-leaf bramble *(Rubus spp.)*, and lingonberry. The mixed forest type occurs in the Project vicinity in a band along Trail Lake and Vagt Lake.

Riparian Scrub – This vegetation cover type, which consists almost entirely of willows *(Salix spp.)*, river beauty, fireweed *(Epilobium angustifolium)*, horsetail, and on drier sites, bluejoint *(Calamagrostis canadensis)*, is uncommon in the Project vicinity, occurring only along the Grant Lake Inlet Creek, on the Grant Lake delta, and interspersed within the broadleaf forest.

Upland Scrub – This vegetation cover type comprises most of the subalpine vegetation in the Project vicinity, and is composed primarily of Sitka alder thickets in a complex mosaic with the grass/forb meadow type. This cover type has an understory composed primarily of lady fern *(Athyrium filix-femina)*. In some avalanche chutes the alder is mixed with willows. Rusty menziesia commonly occurs in this cover type along the conifer/scrub interface. This mapping unit generally occurs from 700 to 2,500 feet, along mountain slopes throughout the Project vicinity.

Grass/Forb Meadow – This vegetation cover type forms a mosaic with the upland scrub type described above and is mostly included in the upland scrub unit on the map (Figure 4.6-5) because of the small size of these meadows. However, larger meadows are mapped separately. The primary constituent of this type is bluejoint grass . Salmonberry *(Rubus spectabilis)*, red

raspberry *(R. ideaeus)*, fireweed, cow parsnip *(Heracleum lanatum)*, false hellebore *(Veratrum viride)* and goatsbeard *(Arnuncus sylvester)* are found throughout these meadows but generally are sparsely distributed. Dry, rocky slopes often support prickly rose, yarrow *(Achillea millefolium)*, arctic sagewort *(Artemisia tilesii subsp. elator)*, cranesbill *(Geranium erianthum)*, and harebells *(Campanula rotundifolia)*. Monkeyflower *(Mimulus guttatus)* is conspicuous along drainages. These meadows are located primarily along the slopes of both Grant Lake and Falls Creek valleys, but small meadows also can be found in the mixed forest and coniferous forest types.

Bog (Wet Meadow) – Sphagnum mosses form the basis of this vegetation cover type. The bogs vary from extremely wet, floating mats to firm, treed bogs with a high proportion of shrubs. Often there is a small pond or wet spot near the center of the bog. The wettest of these communities support sphagnum, sundews *(Drosera angelica)*, buckbean *(Menyanthes trifoliate)* and scattered beakrush *(Rhynchospora alba)* and sedges *(Carex spp.)*. The ponds themselves often support buckbean and yellow pond lily *(Nuphar polysepalum)*. The drier bogs may support scattered black spruce, dwarf birch *(Betula nana)*, Labrador tea, lingonberry, dwarf blueberry, crowberry *(Empetrum nigrum)*, and cloudberry *(Rubus chamaemorus)*. These bogs are most common in the Project vicinity in areas of low relief in the mixed and conifer forest types, often surrounding ponds or lakes. Most of them occur between Grant Lake and the Trail Lake. Some of the smaller or more forested bogs are included in the forest classes.

Alpine Tundra – Tundra vegetation can vary considerably depending on the microclimate of a site. In many areas, upland scrub and grass/forb meadows intergrade with tundra types, making the map delineations somewhat arbitrary. Therefore, this description is a generalization of many types that occur in patches throughout the alpine zone. Lichens are conspicuous in many alpine areas, the most prevalent being *Cladonia spp.* and *Stereocaulon spp.* Prostrate willows, such as ovalleaf willow *(Salix stolonifera)* and arctic willow *(S. arctica)*, form a mat over the lichens in many alpine areas, as does bearberry *(Arctostaphylos alpine)*. Graminoids, such as woodrush *(Luzula walenbergii subsp. piperi)*, finely-awned sedge *(Carex microchaeta)*, and fescue *(Festuca altaica)*, are interspersed throughout tundra areas, especially on moist sites. Alaska moss heath *(Cassiope stelleriana)*, Aleutian mountain heather *(Phyllodoce aleutica)*, and crowberry can cover large areas on the alpine slopes. Leutkea *(Luetkea pectinata)* and sweet coltsfoot *(Petasites hyperboreus)* grow in moist places such as snowbeds and along drainages. Bog blueberry *(Vaccinium uliginosum)* grows in patches on sunny slopes. Shrubby willows such as barclay willow *(Salix barclayi)*, feltleaf willow, and diamondleaf willow *(S. pulchra)* grow along some of the alpine drainages. Alpine tundra in the Project vicinity is limited to the steep barren mountain tops, talus slopes, and permanent snowfields. It is most extensive on south-facing slopes above 2,000 feet and is very restricted on north-facing slopes.

Barren – These areas are mountain tops, talus slopes, cliffs, and snowfields having less than 10 percent plant cover.

4.6.3.2. Plant Species in the Project Vicinity

Species characteristic of the vegetation cover types in the Project vicinity are noted in the above Section 4.6.3.1. Subalpine vegetation species, including alder interspersed with dense grass/forb meadows are common in the Grant Lake/Falls Creek Project area. A full species list of plants identified during 1981-1982 field investigations is included as Table 3-14 in APA (1984).

4.6.3.3. Rare, Threatened, and Endangered Species

Based on information contained in the FEIS and Revised Land And Resource Management Plan for the CNF (USFS 2005), there are no known threatened and endangered plant species in the CNF and, therefore, in the Project vicinity. The U.S. Forest Service has identified 13 sensitive plant species as known or suspected to occur on the Chugach National Forest. Based on the Forest Service's review of the Grant Lake and Grant Creek project area and the bioenvironmental database used in the Forest Plan, there are three Alaska Region sensitive plant species potentially occurring in the project area are Norberg arnica (*Arnica lessingii* ssp. *norbergii*), goose-grass sedge (*Carex lenticularis* var. *dolia*), and pale poppy (*Papaver alboroseum*). The U.S. Forest Service's review of the Falls Creek project area indicated that the five Alaska Region sensitive plan species potentially occurring in the project area are Eschscholtz's little nightmare (*Aphragmus eschscholtzianus*), Norberg arnica (*Arnica lessingii* ssp. *norbergii*), goose-grass sedge (*Carex lenticularis* var. *dolia*), tundra whitlow-grass (*Draba kananaskis*), and pale poppy (*Papaver alboroseum*). The U.S. Forest Service indicated that only pale poppy and Eschscholtz's little nightmare will remain on a revision of the Alaska Region sensitive species list since the other two are included in more broadly distributed or abundant taxa (Mary Stensvold, personal communication, cited in Simmons 2008a and 2008b).

Both of these species are identified as rare or uncommon in the state (Forest Service Rank S3). Eschscholtz's little nightmare occurs in mountainous areas in moist, mossy habitats or near rivulets in alpine habitat areas. The pale poppy occurs in open, recently deglaciated areas, rock outcrops, and on sand and gravel or other well-drained soils. (USFS 2004).

4.6.3.4. Plant Species with Important Commercial, Recreational, or Cultural Value

Plant species with important commercial, recreational, or cultural value have not been identified in existing studies and available information.

4.6.3.5. Non-native Plant Species

Non-native species known to occur in the Kenai Peninsula are listed in DelVelice (2004) and Duffy (2003). Twenty-four non-native plant species were found during a survey along trails in the Kenai Peninsula portion of the Chugach National Forest (DelVelice 2004). The DelVelice study did not include trails specifically located within the proposed Project area, though similar

species may occur in the Project area. Duffy (2003) surveyed 78 sites in the Kenai Mountains Ecosection of the Chugach National Forest and found 57 non-natives species, and two prohibited noxious weeds (quack grass and hemp nettle). The Duffy surveys included sites along the Seward Highway and Trail Lakes in the Project vicinity. Licensing studies will investigate non-native species observed in the proposed Project area.

4.6.4. Potential Adverse Impacts

Proposed Project operations will change the Grant Lake level. Project operation will alter flows in Grant and Falls Creeks, depending on the operational parameters determined. Habitats around the shores of Grant Lake could be affected by increased fluctuation in the water surface elevation of the lake, including the Inlet Creek area and associated delta into Grant Lake.

The extent of these potential impacts, and possible needs for mitigation, will be examined during the licensing process. To assist in this effort, studies are planned to inventory potentially affected terrestrial wildlife, bird species, and sensitive plants.

Potential impacts from the proposed Project include minor disturbances resulting from study activity as well as impacts due to construction and hydrologic changes after Project operation begins. A discussion of potential impacts to Wildlife and Botanical Resources, by impact category, is shown in Table 4.6-2.

Table 4.6-2. Potential Project impacts to wildlife and botanical resources

Potential Impacts to Wildlife and Botanical Resources	
Potential Impact	**Resource Issue**
General project activity, including air and ground disturbance, which may be associated with pre-project studies, construction and operation.	General disturbance (e.g. from helicopter overflights) of wildlife species during critical life stages.
Increased Grant Lake Water Level Fluctuation	Changes in shoreline vegetation due to lake level fluctuation.
	Loss of, or increase in, shoreline habitats used by wildlife species due to lake level fluctuations; resulting effects on wildlife populations.
	Potential Changes in distribution and/or number of fish used by wildlife species.
	Changes in breeding and rearing habitat and nesting success of waterbirds in Grant Lake and Inlet Creek.
Seasonal Flow Changes in Grant Creek and Falls Creek	Potential changes in riparian vegetation due to hydrologic changes.
	Potential reductions in the abundance of fish used by wildlife species.
	Loss or increase in riparian habitats used by wildlife species due to hydrologic changes; resulting effects on wildlife populations.
Construction of Intake, Sluiceway, Penstock, and Powerhouse	Loss of existing habitat.
	Potential disruption of wildlife movement across the bench between Grant Lake and Trail lakes, and between Grant Creek and Falls Creek.
Roads and Transmission Lines	Construction and maintenance impacts on vegetation.

Potential Impacts to Wildlife and Botanical Resources	
Potential Impact	**Resource Issue**
	Disturbance to wildlife populations due to initial habitat disturbance and subsequent corridor maintenance.
	Potential for bird deaths because of collisions with the transmission lines.

4.6.5. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro, LLC has not to date identified proposed protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es will occur following completion of effects analyses based on licensing studies. Transmission line design will incorporate the latest raptor protection guidelines and collision avoidance devices will be installed on the line in appropriate locations to protect migratory birds.

4.7. Wetlands, Riparian, and Littoral Habitat

The major water-bodies located in the proposed Project vicinity include: Upper and Lower Trail Lakes, Grant Creek, Grant Lake, and Inlet Creek. The lower reach of Grant Creek supports an anadromous fish run (see Section 4.5) and has been identified as a salmon stream for brown bear forage in Section 4.6.2 Wildlife Resources on Figure 4.6-1. The wetland, riparian, and littoral habitats that could be affected by the proposed Project would most likely be associated with these waterbodies. Wetlands mapping and an inventory of potentially affected wetlands is planned for this licensing effort.

4.7.1. Introduction

The vegetation cover type mapping from the APA (1984) studies identified nine vegetation associations or habitat types. Of the nine habitat types described in the APA studies, three would fall under categories of wetlands and riparian habitats, although wetlands were not specifically identified. These habitats, described in detail under Section 4.6.3, Botanical, Vegetation Cover Types, are:

- Riparian Scrub
- Bog (Wet Meadow)
- Alpine Tundra (includes riparian vegetation along alpine drainages)

Since the studies performed in 1982, the USFWS has mapped wetlands in the Project area as part of the National Wetlands Inventory (NWI). Available digital mapping covers the entire Project area and is provided here for two levels of detail i.e., two general location maps (Figures 4.7-1, Sheet 1, and Figure 4.7-2, Sheet 1) and corresponding detail maps of the wetland locations. The descriptions of the wetlands are provided below.

Figure 4.7-1 Sheet 1 and Sheet 2, Upper Trail and Lower Trail Lakes, Grant Creek, and the south leg of Grant Lake:

- Grant Lake and Upper and Lower Trail lakes are lacustrine limnetic, unconsolidated bottom, permanently flooded wetlands.
- Grant Creek, at the outlet of Grant Lake, is a riverine upper perennial, unconsolidated bottom, permanently flooded wetland.
- Numerous small freshwater forested/shrub wetlands are scattered throughout the area between Grant Lake and Upper and Lower Trail lakes. A few of these individual areas are classified on the NWI map as palustrine scrub-shrub, broad-leaved deciduous, and either temporarily flooded, saturated, or seasonally flooded wetlands.

Just west of Grant Lake on the bench between Grant Lake and the Trail lakes there are several more wetland types, in addition to the scattered forested/shrub wetlands described above:

- Several small freshwater ponds in one area are classified palustrine unconsolidated bottom, permanently flooded wetlands.
- Two separate areas of freshwater palustrine emergent, persistent wetland exist; one is seasonally flooded, and the other is semi-permanently flooded.
- One wetland area is palustrine scrub-shrub, broad-leaved deciduous and emergent, persistent, seasonally flooded.

Figure 4.7-1 Sheet 1 and Sheet 3 narrows at the juncture of the south and east legs of Grant Lake:

- One freshwater forested/shrub wetland is located in the narrows on the south shore of Grant Lake. It is a small palustrine scrub-shrub, broad-leaved deciduous, saturated wetland.

Figure 4.7-2 Sheet 1 and Sheet 2, east leg of Grant Lake at Inlet Creek:

- Inlet Creek is a riverine upper perennial, unconsolidated shore, and unconsolidated bottom wetland.
- Other wetlands located at the creek's inlet with Grant Lake and extending along and from the shore of Grant Lake include: a lacustrine littoral, unconsolidated, seasonally flooded wetland; a palustrine forested, broad-leaved deciduous, and dead, seasonally flooded

wetland; and two palustrine scrub-shrub, broad-leaved deciduous wetlands, one temporarily flooded and one seasonally flooded.

- Several more wetlands are located a short distance up Inlet Creek as shown on Figure 4.7-2 and Sheet 2. These include: a palustrine forested, broad-leaved deciduous and scrub-shrub broad-leaved deciduous, temporarily flooded wetland located adjacent to Inlet Creek; and located a short distance away from the creek is a palustrine scrub-shrub, broad-leaved deciduous and emergent, persistent, saturated wetland; and a palustrine scrub-shrub, broad-leaved deciduous, saturated wetland.

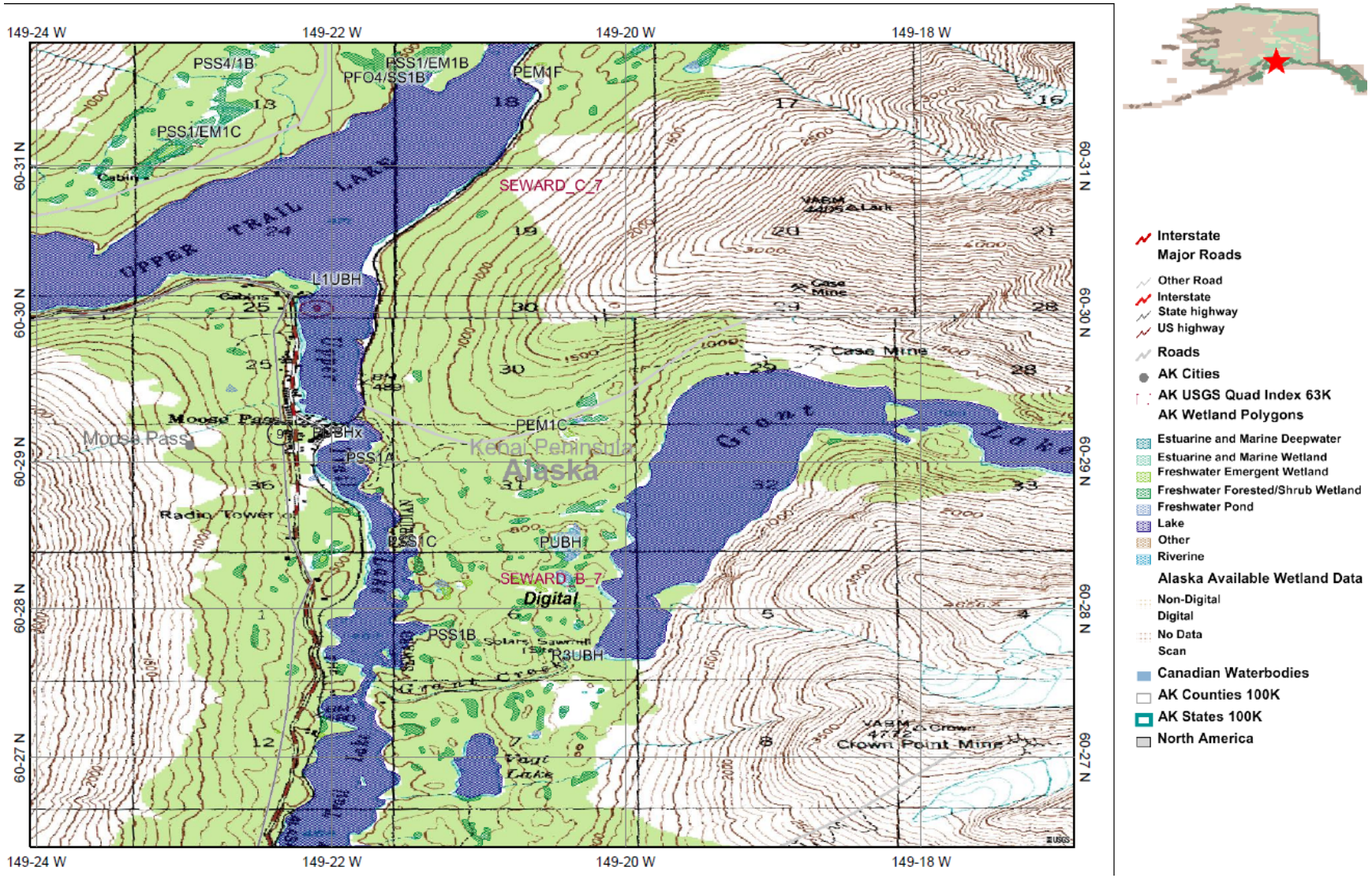

Figure 4.7-1. Sheet 1. Upper and Lower Trail Lakes, Grant Creek, and south leg of Grant Lake showing general location of wetlands (NWI mapping, USFWS 2007).

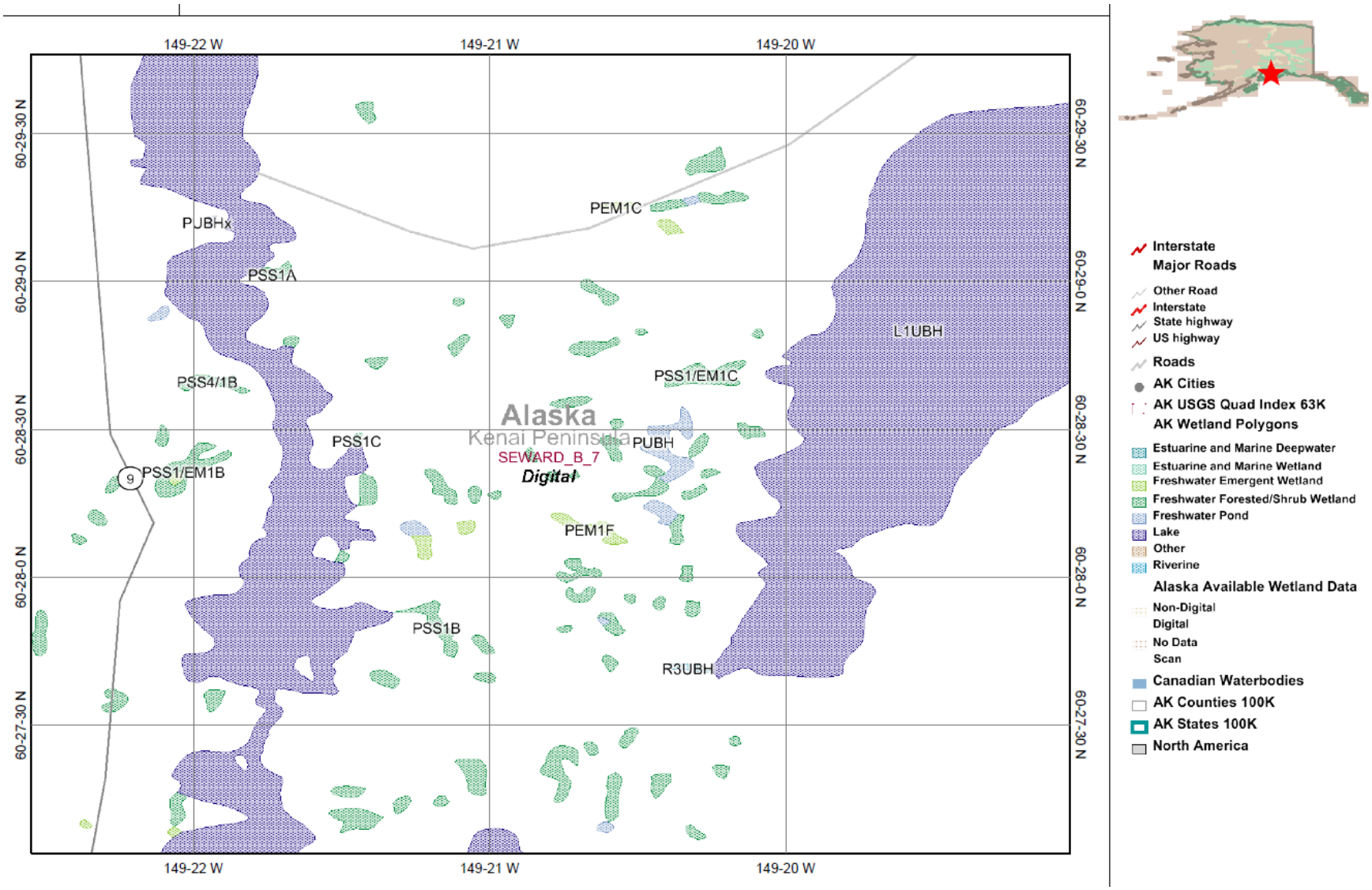

Figure 4.7-1, Sheet 2. Upper and Lower Trail Lakes, Grant Creek, and south leg of Grant Lake showing detail location of wetlands (NWI mapping, USFWS 2007).

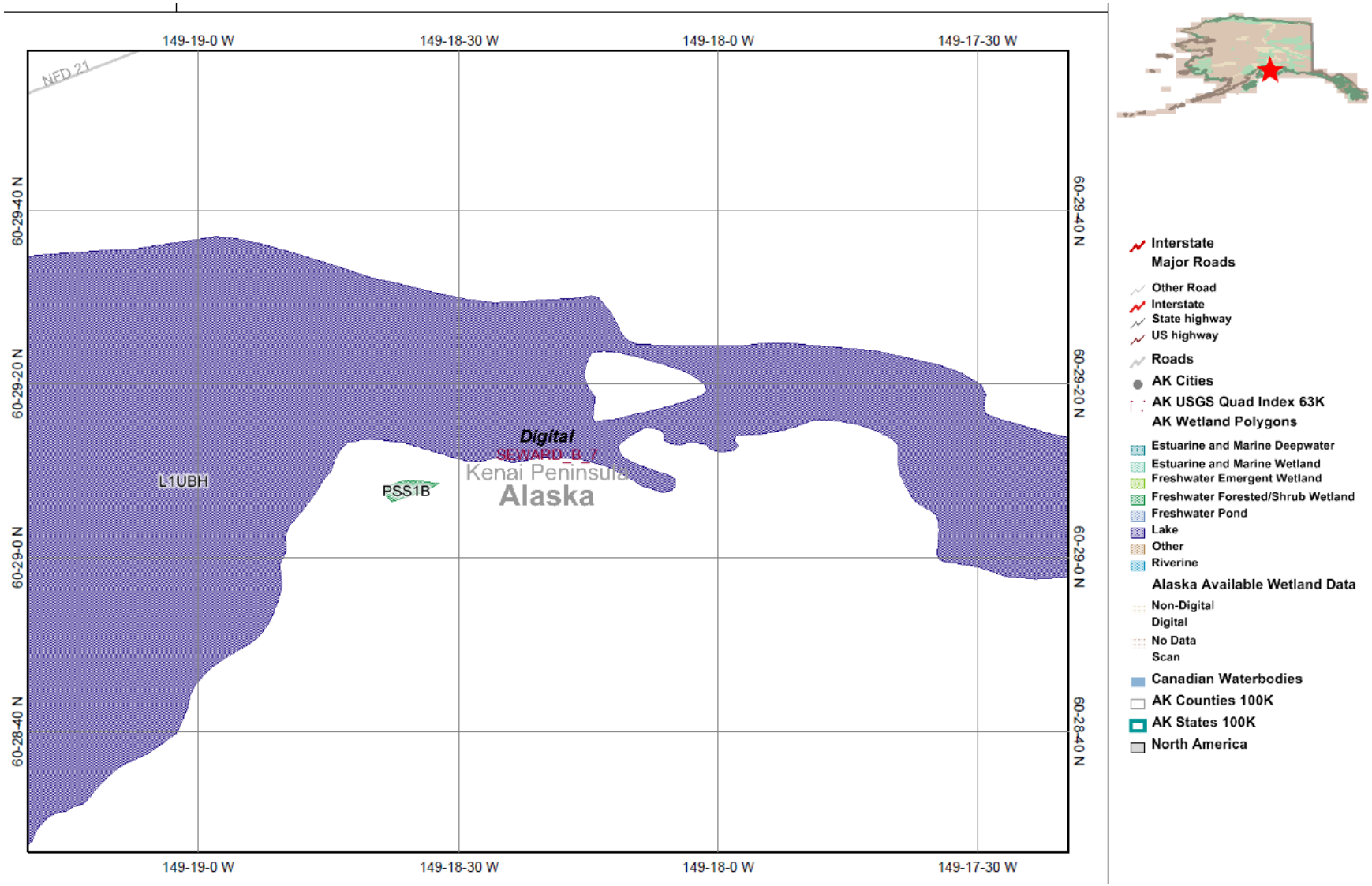

Figure 4.7-1. Sheet 3. Narrows at the juncture of the south and east legs of Grant Lake showing detail location of one wetland (NWI mapping, USFWS 2007).

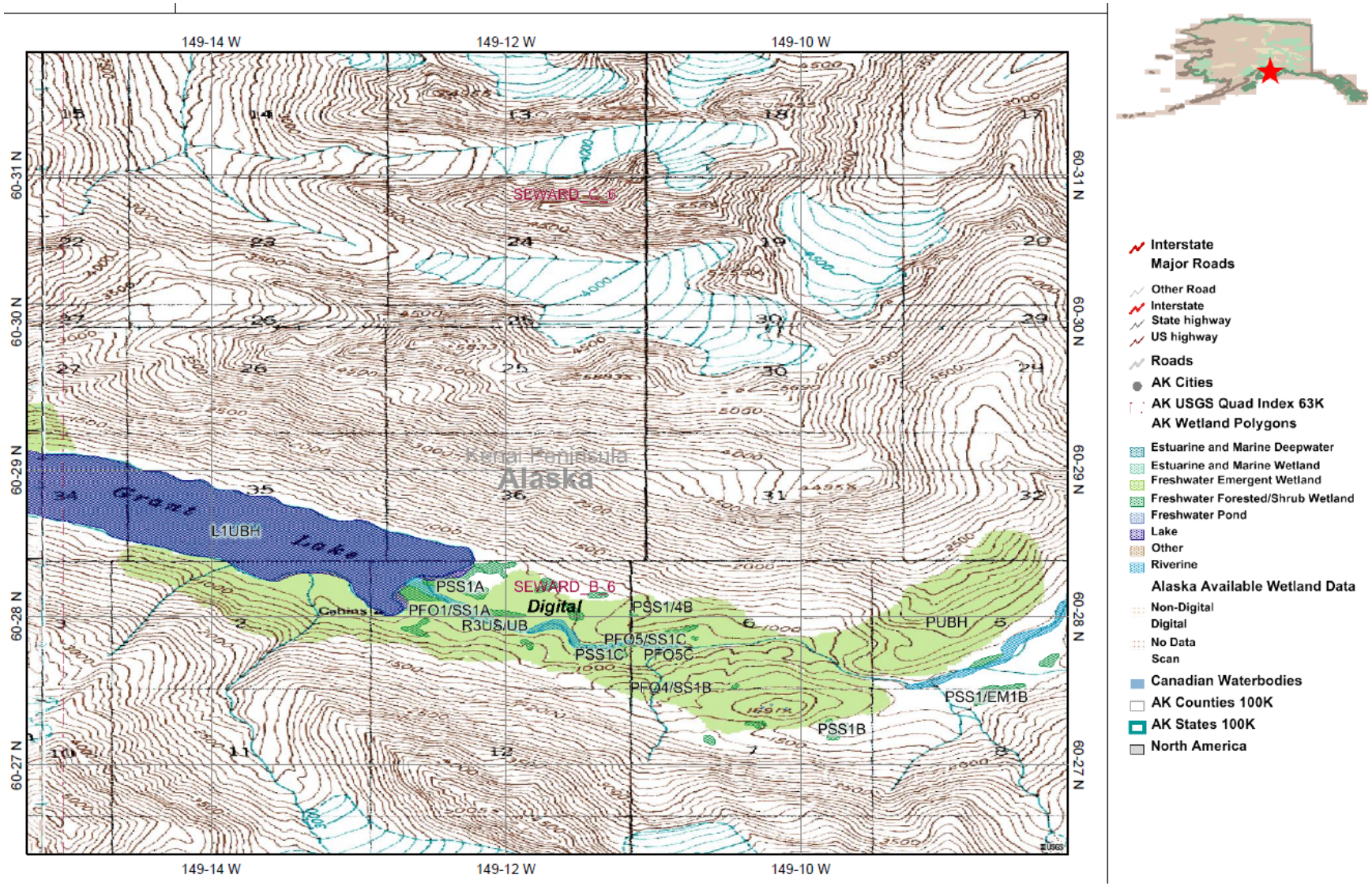

Figure 4.7-2. Sheet 1. East leg of Grant Lake at Inlet Creek showing general location of wetlands (NWI mapping, USFWS 2007).

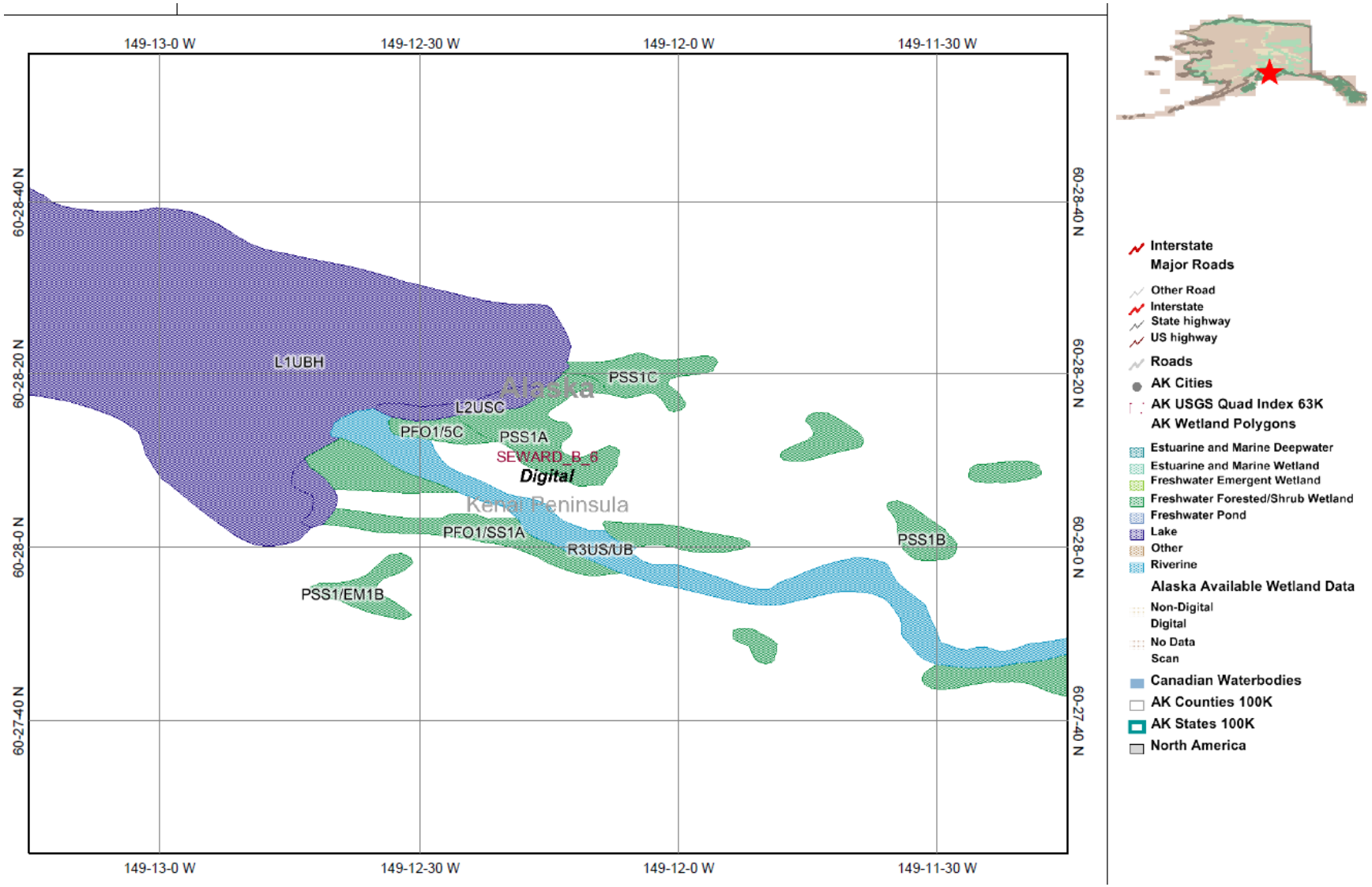

Figure 4.7-2, Sheet 2. East leg of Grant Lake at Inlet Creek showing detail location of wetlands (NWI mapping, USFWS 2007).

4.7.2. Potential Adverse Impacts

Potential impacts from the proposed Project could result from disturbances due to construction activities and to hydrologic changes after Project operation begins. A discussion of impacts to Wetland Resources related to potential impacts is shown in Table 4.7-1.

Proposed Project operations will change the Grant Lake level. Project operation will also changes flows in Grant Creek and Falls Creek. Decreased flow in Grant Creek or Falls Creek may reduce the amount of water available to support existing riparian and littoral habitat at the Grant Lake outlet and in the section of Grant Creek with reduced flows in some seasons. Increased flow in Grant Creek below the powerhouse may also impact riparian habitats in this section of the Creek as well as the littoral habitat at the mouth of Grant Creek at the narrows between Upper and Lower Trail Lakes.

Wetland, riparian, and littoral habitats around the shores of Grant Lake could be affected by increased fluctuations in the water surface elevation of the lake, including Inlet Creek, its delta and associated wetland areas.

Table 4.7-1. Potential Project impacts related to wetland resources.

Potential Wetland Resource Impacts	
Potential Impact	**Resource Issue**
Increased Grant Lake Water Level Fluctuation	Changes in wetland, riparian, and littoral habitats along Grant Lake, at Inlet Creek and at Grant Creek outlet due to lake level fluctuation.
	Loss of, or increase in, littoral habitats due to lake level fluctuations.
Flow Changes in Grant Creek and Falls Creek (due to Project operations and potential diversion from Falls Creek)	Changes (reduction) in riparian and littoral wetland habitats due to hydrologic changes in Grant Creek and Falls Creek.
	Potential Changes in riparian habitat in Grant Creek and adjacent littoral habitat at the mouth of Grant Creek at the narrows between Upper and Lower Trail Lakes due to hydrologic changes. Changes in riparian habitat in Falls Creek may occur due to reduced flows.

Potential Wetland Resource Impacts	
Potential Impact	**Resource Issue**
Construction of Intake, Sluiceway, Penstock, and Powerhouse	Potential loss of existing riparian, and littoral wetland habitat on the shore of Grant Lake and at the outlet to Grant Creek.
	Potential construction and maintenance impacts on riparian habitat of Grant Creek.
Construction, maintenance, and use of Roads and Transmission Lines	Potential construction and maintenance impacts on forested/scrub wetlands.

4.7.3. Proposed Protection, Mitigation, and Enhancement Measures

The extent of the potential impacts identified above, and possible needs for mitigation, will be examined during the licensing process. To assist in this effort, studies are planned to identify critical wetland resources in the Project area and any potential impacts.

4.8. Recreation and Land Use

4.8.1. Introduction

Lands in the Kenai Peninsula and the Project vicinity are predominantly undeveloped public lands with significant recreation and aesthetic value. Fishing opportunities are the driving factor for most visitors (Kenai Peninsula Borough Coastal Management Program 2008). Hunting for wild game and wildlife viewing are also popular activities in the Project vicinity. The primary recreational fishing locations in the region are located on the mainstem Kenai River, though there is some use of the streams in the Project area for recreational fisheries.

Land ownership in the Project vicinity is a mix of federal, state, and borough agencies, Native corporations, and private parties. Land use in the Project area is generally rural residential or undeveloped, and the portion of the project area located on National Forest System land is part of an inventoried roadless area. There is some historic mining use in the area. Falls Creek has a history of placer mining, and there are a few mining claims near the Grant Lake development. Mining claim locations are shown in Figure 4.2-1.

This section provides a summary of the information readily available on recreation and land use in the Project area.

4.8.2. Current Recreational Use of the Project Vicinity and Region

While there are few developed recreation facilities in the vicinity, the Forest Service reported some lake and trail use (Simmons 2008a and 2008b). The BLM manages the Iditarod Trail in the vicinity, which is primarily used in the winter. The National Park Service is assisting the Kenai Peninsula Borough and Iditarod Trailblazers (Seward Chapter) to plan an extension of the Iditarod National Historic Trail south to Seward, where the serum run originated. The proposed trail segments run close to the proposed Project location on the eastern side of the Seward Highway. If established, the trail would have both recreational and cultural significance (C. Thomas, NPS, personal communication, July 2009).

There is some commercial recreation use in the Project vicinity. ADNR (2009) provides annual use information from permitted commercial recreation operators through a registration system used to make informed land management decisions for state land. ADNR collects information about where such uses are occurring, how many clients are recreating on state land (i.e., state uplands, shorelands, tidelands, and fresh water bodies), and the type of activity that is occurring. Table 4.8-1 summarizes the registration information for 2006 through 2008 for game management unit 7 that includes the Project area, and the surrounding area.

Table 4.8-1. Recreation activity and access information for Game Management Subunit 7 (ADNR 2009b).

Year	Number of Registered Operators	Visitor Days	Activity Types	Types of Access
2008	13	3592	Skiing, snowshoe, snowboard, Dogsledding, Bicycling, Hunting, Off-road Vehicle Use, Motorized Boating, General Tour (sightseeing, wildlife, nature), Hiking Rock/Mountain Climbing, Drop-off Comm. Recreation Uses, Rafting, Kayaking, Canoeing, Fishing	Float Plane, Wheel Plane, Ski Plane, Helicopter, Off-road Vehicle, Road Vehicle, Foot, Motorized Boat, Non-motorized Boat
2007	14	7118	Skiing, snowshoe, snowboard, Hunting, Off-road Vehicle Use, Motorized Boating, Scuba Diving, General Tour (sightseeing, wildlife, nature), Hiking Rock/Mountain Climbing, Drop-off Comm. Recreation Uses, Rafting, Kayaking, Canoeing, Horseback Riding, Fishing	Float Plane, Wheel Plane, Ski Plane, Helicopter, Off-road Vehicle, Road Vehicle, Foot, Horse/Beast of Burden, Motorized Boat, Non-motorized Boat

2006	12	5803	Skiing, snowshoe, snowboard, Hunting, Motorized Boating, General Tour (sightseeing, wildlife, nature), Hiking Rock/Mountain Climbing, Drop-off Comm. Recreation Uses, Rafting, Kayaking, Canoeing, Horseback Riding, Fishing	Float Plane, Wheel Plane, Ski Plane, Helicopter, Road Vehicle, Foot, Horse/Beast of Burden, Motorized Boat, Non-motorized Boat

4.8.3. Shoreline Buffer Zones and Adjoining Land Use

The shoreline of Grant Lake is managed by the Forest Service and the state of Alaska and is currently undeveloped except for one small cabin site near the south end of Grant Lake.

4.8.4. Recreation-Related Goals and Needs Identified in Agency Management Plans

Relevant local, state, and regional recreation and land use management plans include Alaska's Outdoor Legacy Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2004-2009, Kenai Peninsula Borough Coastal Zone Management Plan, Kenai Peninsula Borough Comprehensive Plan, Kenai Area Plan, and the Kenai River Special Management Area (KRSMA).

4.8.4.1. Alaska's Outdoor Legacy Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2004-2009

Alaska's current SCORP guides recreation-related acquisition, facility development, and policy for the State of Alaska for 2004 through 2009 (ADNR 2004). The goals of the SCORP are to:

- Provide recreation agencies and communities with a reference to outdoor recreation preferences, use trends, and issues relevant to Alaska through 2009;
- Identify statewide capital investment priorities for acquiring, developing, and protecting outdoor recreation resources;
- Identify the State's priorities, strategies, and actions for the obligation of its Land and Water Conservation Fund (LWCF) apportionment; and
- Provide information that agencies and communities need to develop project proposals eligible for LWCF assistance.

The chief goal for outdoor recreation providers is to offer a range of opportunities for responsible use of Alaska's recreation resources while protecting natural values. The SCORP identifies four recreation issues and goals, one of which includes aspects related to aesthetic/visual resources, along with recommended strategies to meet these goals:

- Issue 1: Lack of Adequate Funding

  Goal: Secure a reliable source of funding for outdoor recreation in Alaska. Develop programs that allow important projects to be completed and maintained. Strengthen mutually beneficial relationships with other agencies, private sector and user groups.

  Recommended Strategies: support ongoing efforts to reform the Land and Water Conservation Fund Grant (LWCF) Program; continue interagency communication and cooperative efforts; privatize selected services, facility operation, and maintenance; strengthen alternative funding mechanisms and programs; develop alternative funding sources.

- Issue 2: Opportunities to Meet Recreation Needs in Communities

  Goal: Support efforts to assist communities in meeting the outdoor recreation needs of their citizens.

  Recommended Strategies: give some communities a higher priority for LWCF matching grants; develop alternative funding sources; design facilities to reflect economic realities and sustainable practices.

- Issue 3: Improved Access to Outdoor Recreation Resources (includes discussion of transportation enhancements [including acquisition of scenic easements and scenic or historic sites, scenic highway programs, and scenic beautification], Trails and Recreational Access for Alaskan (TRAAK) [including transportation enhancements, the Scenic Byways Program, and the Recreation Trails Program], disabled access, and trail identification/legal access)

  Goal: Provide more convenient, legal, and barrier-free access to outdoor recreation opportunities on Alaska's public lands and waters.

  Recommended Strategies: implement Intermodal Surface Transportation Efficiency Act (ISTEA) provisions; improve access to water based recreation; develop inventory of barrier free outdoor recreation facilities; continue cooperative planning efforts with "barrier-free" advocacy groups; consider incompatibility among users and user values; continue the identification and legal dedication of existing trails.

- Issue 4: Shortage of Tourism Opportunities on Public Lands

  Goal Support and promote balanced use and development of Alaska's public lands for outdoor recreation and nature-based tourism.

  Recommended Strategies: expand cooperative planning and marketing efforts; maintain and expand private-public nature-based tourism partnerships; promote private sector development on public lands where appropriate; develop year round tourism destinations and related services on public lands; increase capital spending to rehabilitate and expand

facilities, expand public use cabin system; promote the Alaska Public Lands Information Centers.

4.8.4.2. Kenai Peninsula Borough Coastal Zone Management Plan

The Kenai Peninsula Borough Coastal Management Plan was developed to provide local information and policies that carry out the objectives of the Alaska Coastal Management Program. The plan provides the Kenai Peninsula Borough with a tool for evaluating proposed developments within its coastal zone. The boundary of the Kenai Peninsula Borough and the Kenai coastal district are the same. Within that boundary, there is an area called the "coastal zone." This coastal zone is subject to coastal zone management.

State lands within the Project area are designated as "Recreation" use in the Kenai Peninsula Borough coastal zone management plan. Federal lands are excluded from the coastal zone and the recreation designation. The goals and objectives of the Kenai Peninsula Borough Coastal Management Plan (Kenai Peninsula Borough Coastal Management Program 2008) related to recreational resources include the following:

- Goal 3.1: To maintain the Borough's variety of high quality recreational opportunities to meet the needs of residents and visitors.
    - Objective 3.1.1: To encourage the well-planned development of recreation and tourism facilities and area wide trail systems by public agencies and private citizens where there is local support.
    - Objective 3.1.2: To minimize conflicting uses in designated recreation areas.
    - Objective 3.1.3: To maintain public access to water bodies and recreation areas and facilitate provision of additional access where necessary and desirable.
    - Objective 3.1.4: To minimize the adverse impacts of access on sensitive environments
- Goal 3.3: To encourage provision of facilities for outdoor and indoor recreational activities for borough residents and visitors.
    - Objective 3.3.1: Support improved, environmentally responsible angler access facilities on major rivers in the Borough.
- Goal 3.4: To plan for future recreational use of borough land that has recreational value.
    - Objective 3.4.1: Identify borough lands with recreational value that provide access to coastlines or recreational areas.

- Objective 3.4.2: To maintain information about and support other groups in establishing and maintaining a network of trails to provide recreation and transportation opportunities.
- Objective 3.4.3: Work with the ANDR and local organizations to inventory existing and potential recreational trails on the Kenai Peninsula.
- Objective 3.4.4: Develop access management plans to avoid or minimize the adverse impacts of access.

The Statewide Standards relevant to recreational resources also address coastal access. Districts and state agencies shall ensure that projects maintain and, where appropriate, increase public access to, from, and along coastal water.

4.8.4.3. Kenai Area Plan

The Kenai Area Plan directs how ADNR will manage state uplands, tidelands, and submerged lands within the planning boundary, including the Project area (ADNR 2001). The state land use plans determine management intent, land-use designations, and management guidelines that apply to all state lands in the planning area. The plan is used by staff within the ADNR Division of Mining, Land, and Water when reviewing and making decisions on authorizations for use of state land, including permits, leases, sales, conveyances, and right-of-way. The plan is also used by the ADNR Divisions of Forestry, Agriculture, Parks and Outdoor Recreation. The Division of Oil and Gas also uses the plan in its mitigation measures. The Kenai Peninsula Borough and federal government also have plans and planning efforts that directly and indirectly affect state lands. Camping, hiking, boating, hunting, and fishing generally do not require authorization on state lands.

Goals of state lands in the planning area include:

- Economic development - provide opportunities for jobs and income by managing state land and resources to support a self-sustaining local economy;
- Fiscal costs - locate settlement uses where there is sustainable economic base and where necessary services can be efficiently provided;
- Public health and safety - maintain or enhance public health and safety for users of state land and resources;
- Public use - provide and enhance opportunities for public use of state lands, including hunting, fishing, boating, and other types of recreation;
- Quality of life -maintain or enhance the quality and diversity of the natural environments and protect heritage resources and the character and lifestyle of the community;
- Settlement - provide opportunities for private ownership and leasing of land currently owned by the state; and

- Sustained yield - maintain the long-term productivity and quality of renewable resources and all other state-owned replenishable resources on a sustained-yield or optimum-sustained yield basis, including fish, wildlife, rangelands, and forests.

Specific to public recreation, the goals of the plan include providing lands for accessible outdoor recreational opportunities with well-designed, maintained and conveniently located recreation facilities; providing undeveloped lands for recreation pursuits that do not require developed facilities. These opportunities would be realized by:

- Developing a State Park System of recreation areas, trails, waysides, rivers and sites that provide a wide range of year-round outdoor recreation opportunities for all ages, abilities and use preferences in close proximity to population centers and major travel routes.

- Providing recreation opportunities on less developed land and water areas both within the State Park System as well as areas outside the system, which serve multiple purposes.

- Encouraging commercial development of recreation facilities and services through land sales, leases, and permits where public recreation needs can most effectively be provided by private enterprise. In some units, the plan specifically allows for commercial recreation leasing.

- Providing for public open space that is readily accessible to communities and is sufficient to meet existing and future needs for public recreation land in developed areas.

- Protecting scenic beauty.

Specific to trails and access, the goals of the plan include the following:

- Public Use Opportunities - Ensure adequate opportunities for public use of important recreation, public access and historic trails of regional and statewide significance. Also provide for future trail and access needs.

- Local Trails - Assist in establishing local trail systems that provide access to public land and water and community facilities.

- Trail Corridors - Protect or establish trail corridors to meet projected future use requirements as well as protecting current use.

Management guidelines in the plan related to trails and access include consideration for aesthetic/visual resources.

Additionally, the plan identifies specific goals associated with the following resources related to public recreation and aesthetic resources:

- Transportation and utilities - Design a transportation system and authorize vehicle uses in a manner that has minimal adverse impacts on local residents, the environment, fish and wildlife resources, and aesthetic and cultural features.

- Shorelines, stream corridors and wetlands - Protect and enhance a variety of public recreation and tourism opportunities along waterbodies including both wilderness and developed recreational and tourism activities and protect the visual quality of waterbodies.

- Forestry - Ensure that the state forestlands support tourism, maintain opportunities for diverse recreational activities in a variety of settings, and promote scenic quality.

4.8.4.4. Kenai River Special Management Area

The Project area is located on the eastern edge of the Kenai River Special Management Area (KRSMA) managed by the ADNR. The KRSMA consists of more than 105 linear miles of rivers and lakes, including Kenai Lake, Skilak Lake, and the Kenai River from river mile 82 downstream to four miles above the river's mouth on Cook Inlet. Legislatively established in 1984, the purposes for which the KRSMA was established include:

- To protect and perpetuate the fishery and wildlife resources and habitat in the unit and adjacent area.
- To manage recreational uses and development activities in the unit and adjacent area

4.8.5. Designated Scenic and Protected River Segments

There are no river segments designated as part of, or under study for inclusion in, the National Wild and Scenic River System. There are no known state protected river segments in the Project area.

4.8.6. National Trails System and Wilderness Area Lands in the Region

The Iditarod Trail, managed by the BLM, has been recognized as a National Historic Trail and declared a Millennium Trail. Many secondary trails that connect with the Iditarod National Historic Trail are also considered eligible trails (USFS 2005).

4.8.7. Recreation Areas in the Project Vicinity

4.8.7.1. Grant Lake and Grant Creek

The U.S. Forest Service reports trail use in the Project area and water use of Grant Lake, but there are no developed recreation sites on the U.S. Forest Service Lands in the Grant Lake area (Simmons 2008a).

The nearest campground site is the Trail River campground, approximately one mile south of the Grant Creek mouth on Trail Lake.

4.8.7.2. Falls Creek

There is a campground located near the southwestern corner of the project vicinity of Falls Creek Development that is outside the proposed Project area. It is the largest campground on the Chugach National Forest, and the area is reserved for recreation under Public Land Order 1731 on September 17, 1958 (Simmons 2008b).

There are no developed recreation areas within the Falls Creek development area.

4.8.8. Non-Recreational Land-Uses and Management

Land ownership is the Project vicinity is shown in Figure 3.2-1. Land in the Project area and vicinity is primarily vacant with some private residential and limited private commercial use near the Seward Highway. Regionally, federal lands account for approximately 65 percent of the total land area in the Kenai Peninsula Borough (Kenai Peninsula Borough 2005). State-owned lands account for approximately 21 percent of the total land area in the Borough, followed by Native land (approximately 9 percent), borough land (approximately 0.7 percent), and city land (approximately 0.2 percent) (Kenai Peninsula Borough 2005). Large areas of historical federal land have been transferred to the Alaskan Native and the State of Alaska. A small amount of state land was subsequently transferred to the Kenai Peninsula Borough.

4.8.9. Potential Adverse Impacts

No adverse impacts on recreation resources have been identified at this time.

4.8.10. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro, LLC has not to date identified proposed protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es will occur following completion of effects analyses based on licensing studies.

4.9. Aesthetic/Visual Resources

The Seward Highway cuts through the Project area from south to north with many view points looking east. The Seward Highway is a designated "All American Road", the most scenic designation in the National Scenic Byway program administered by the Federal Highway Administration. Except for transmission line corridors, the Project facilities are not expected to be visible from the highway. Preliminary designs propose an 8-ft diameter by 110-ft high surge tank structure, which if built to this height; may be some visual impact on the immediate Project area.

4.9.1. Existing Aesthetic/Visual Resource Conditions

A visual resource assessment was conducted for the APA (1984) in the Project area and vicinity. The area is dominated by views of snow-capped mountain peaks. Vistas are generally limited by foreground and middle ground distance zones due to dense forest vegetation and steep mountain slopes.

Human elements currently exist in the Project vicinity aesthetics, including the Seward Highway, Alaska Railroad, and the community of Moose Pass. The primary views are from the Seward Highway towards the proposed Project area, however, Grant Lake is not visible from the scenic highway.

The highway and the railroad cross Falls Creek, and the Falls Creek Development may be visible. Currently, Falls Creek is covered with dense vegetation.

4.9.2. Potential Adverse Impacts

Project developments on Falls Creek may be visible from the scenic highway and hiking trails in the area. Grant Lake and its outlet where the Grant Lake Development will be located are not visible from the Seward Highway. There are existing transmission lines in the area, and additional visual impact is not expected. Scenic views from the Seward Highway, and potentially from watercraft on Grant Lake or the Trail Lakes may be impacted by the project. However, transmission line corridors and other Project facilities will be designed and placed to minimize visual impacts.

4.9.3. Proposed Protection, Mitigation, and Enhancement Measures

The Project will be designed to minimize visual impacts. Kenai Hydro, LLC has not to date identified proposed protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es will occur following completion of effects analyses based on licensing studies.

4.10. Cultural Resources

4.10.1. Introduction

Section 4.3.3 describes known historic mining locations in the area. The U.S. Forest Service noted that there are there are five of these known heritage sites on USFS lands within the proposed Project area (Simmons 2008a). This section summarizes available information on cultural resources.

4.10.2. Applicable Laws and Regulations

The passage of the National Historic Preservation Act (NHPA) of 1966 authorizes the Secretary of the Interior to "to expand and maintain a National Register of districts, sites, buildings, structures, and objects significant in American history, archaeology, engineering, and culture" (30 CFR 60.1). These sites, structures, and objects are records of a region's past that warrant listing in the National Register, the Alaska Heritage Resources Survey (AHRS), or are deemed significant by traditional cultural groups. The NHPA declares that "the preservation of this irreplaceable heritage is in the public interest…" (30 CFR 60.1). Section 106 of NHPA requires that the possible effects of federal undertakings on properties listed or eligible for the National Register be considered. The Project will comply with the NHPA and its implementing regulations (36 CFR 800) and the Alaska Historic Preservation Act (AS 41.35.010 – 41.35.240, and 11 AAC 16.010 – 11 AAC 16.900). Consultation with Tribal entities and identification of traditional cultural properties (TCPs) will be performed as required in 36 CFR Part 800, Protection of Historic Properties (FR, Vol. 65, No. 239, 12/12/2000). The term historic property includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization which meet the criteria for inclusion in the National Register of Historic Places.

4.10.3. Area of Potential Affect

The preliminary Area of Potential Affect (APE) will include the Project area, and will be specified during the FERC licensing process in consultation with Tribes, the SHPO, and other interested parties.

4.10.4. Identification of Historic Properties and Archaeological Sites in the Project Vicinity

Historic or archaeological sites in the proposed project vicinity with be identified, including, sites or properties either listed in, or recommended by the State Historic Preservation Officer or Tribal Historic Preservation Officer for inclusion in, the National Register of Historic Places.

4.10.5. Potential Adverse Impacts

No potential adverse impacts on cultural resources are known at this time. The impact of project construction and operation on the APE will be evaluated during licensing studies.

4.10.6. Existing Discovery Measures

A limited field archeological survey and literature review was conducted in the early 1980s. AEIDC (1983) identified the following sites within the Project vicinity and describes their status and location (if located on the ground). Previous site inventories and descriptions are provided in AEIDC (1983) for the following sites:

- Crown Point/Trail Creek Station and Stevenson Cabin (may be the same site) – mining property with cabin
- Alaska Northern Railway
- Iditarod Trail (on National Register of Historic Places) – located adjacent to the Alaska Northern Railway
- Baggs Cabin – lower end of Falls Creek (not located)
- Crown Point Mine (structures, Mountain Trail, and Mine) – located in Falls Creek drainage
- Solars Sawmill – near outlet of Grant Lake (located in the 1980s, but in deteriorating condition)

4.10.7. Affected Tribes

Tribes in the area have been contacted to determine their interest in the project and if there are cultural properties within the project area that may be impacted by the project. Consultation with Tribes will continue, with activities and reporting consistent with the Archaeological Resources Protection Act of 1979, 16 U.S.C. 470w-3, and the National Historic Preservation Act of 1966, 16 U.S.C. 470hh). Tribes contacted during development of the PAD include:

- Eklutna Village
- Kenaitze Indian Tribe
- Salamatof Native Association
- Qutekcak Native Tribe

Native organizations contacted during the development of the PAD include:

- Chenega Corporation
- Cook Inlet Region Inc. (CIRI)
- Kenai Natives Association
- Chugach Alaska Corporation
- Ninilchik Natives Association, Inc.

Of the Tribes contacted, only the Kenaitze Indian Tribe has indicated an interest in the Project area to date and representatives have indicated that they will provide information during the FERC process.

CIRI is a partner in the Project. CIRI and enXco are equal owners of Alaska Wind Energy, LLC (dba Wind Energy Alaska). Wind Energy Alaska is 50 percent owner of Kenai Hydro, LLC with Homer Electric Association owning the other 50 percent.

4.10.8. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro, LLC has not to date identified proposed protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es for cultural resources will occur following completion of effects analyses based on licensing studies.

4.11. Socioeconomic Resources

4.11.1. Introduction

The Project is located within the boundaries of the Kenai Peninsula Borough (KPB). The nearest community is the unincorporated town of Moose Pass – population approximately 206 – about 1.5 miles to the southeast of Grant Lake. The nearest major town is Seward, population approximately 2,830, located approximately 30 miles south of Moose Pass. (2000 U.S. Census Data).

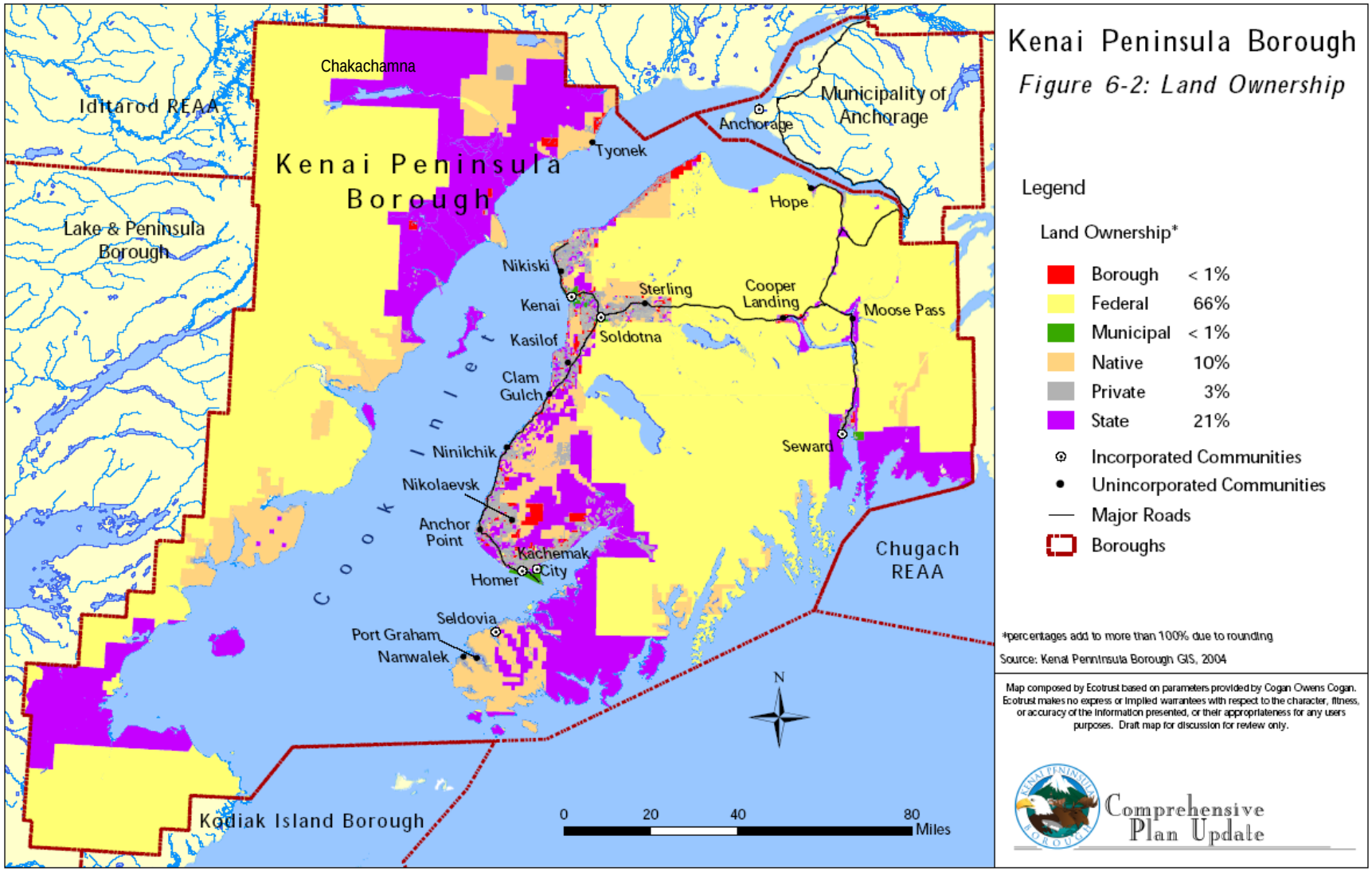

Figure 4.11-1. Kenai Peninsula Borough boundaries and land ownership (KPB 2005).

4.11.2. Land Use and Real Estate

The Project area lies entirely within the KPB. Land use patterns in the Project area are rural. Most of the lands in the Project area are public, either state or federal. However there are several areas of private ownership along the Seward Highway. Borough land management policies are described in the Kenai Peninsula Borough Comprehensive Plan and the Kenai Peninsula Borough Coastal Zone Management Plan (KPB 2005 and 2008). Table 4.11-1, from the KPB Comprehensive Plan (KPB 2005) lists landownership in the borough by category. Much of the land within the borough is either state or federally owned.

Figures 4.11-1 shows land ownership in the KPB. Land use is predominantly characterized as vacant and is shown in Figure 4.11-2.

Table 4.11-1. Land Ownership in the Kenai Peninsula Borough (KPB 2005).

Land Ownership by Major and Minor Category
2004

Owner	Acres	Percent of Total
FEDERAL		
Lake Clark National Park (NP)	1,523,000	
Katmai NP	588,000	
Kenai Fjords NP	574,000	
Kenai National Wildlife Refuge	1,894,000	
Alaska Maritime National Wildlife Refuge	24,000	
Chugach National Forest	1,216,000	
Public Domain and Other Federal	1,035,375	
Total Federal	**6,854,375**	**65.5%**
STATE		
Department of Natural Resources	2,180,794	
Aviation Division	1,087	
Fish and Game	407	
Department of Transportation	159	
Mental Health Trust	18,774	
State Parks	742	
University of Alaska	15,048	
Alaska Railroad Corporation	512	
Other State	49	
Total State	**2,223,923**	**21.3%**
BOROUGH	**72,409**	**0.7%**
CITY	**17,116**	**0.2%**
NATIVE CORPORATION OR TRIBE/VILLAGE		
Chugach Alaska Corporation	52,684	
Cook Inlet Region, Inc.	523,108	
English Bay Corporation	61,864	
Kenai Natives Association, Inc.	8,294	
Nanwalek Village and Council	82	
Ninilchik Native Association and Village Council	44,335	
Port Graham Corporation and Village Council	67,057	
Salamatof Native Association, Inc.	24,060	
Seldovia Native Association, Inc.	72,809	
Tyonek Native Corporation and Village	78,849	
Total Native Land	**929,174**	**8.9%**
OTHER PRIVATE LAND	**357,826**	**3.4%**
TOTAL ALL OWNERS	**10,458,699**	

Source: KPB Assessing Department, Cogan Owens Cogan

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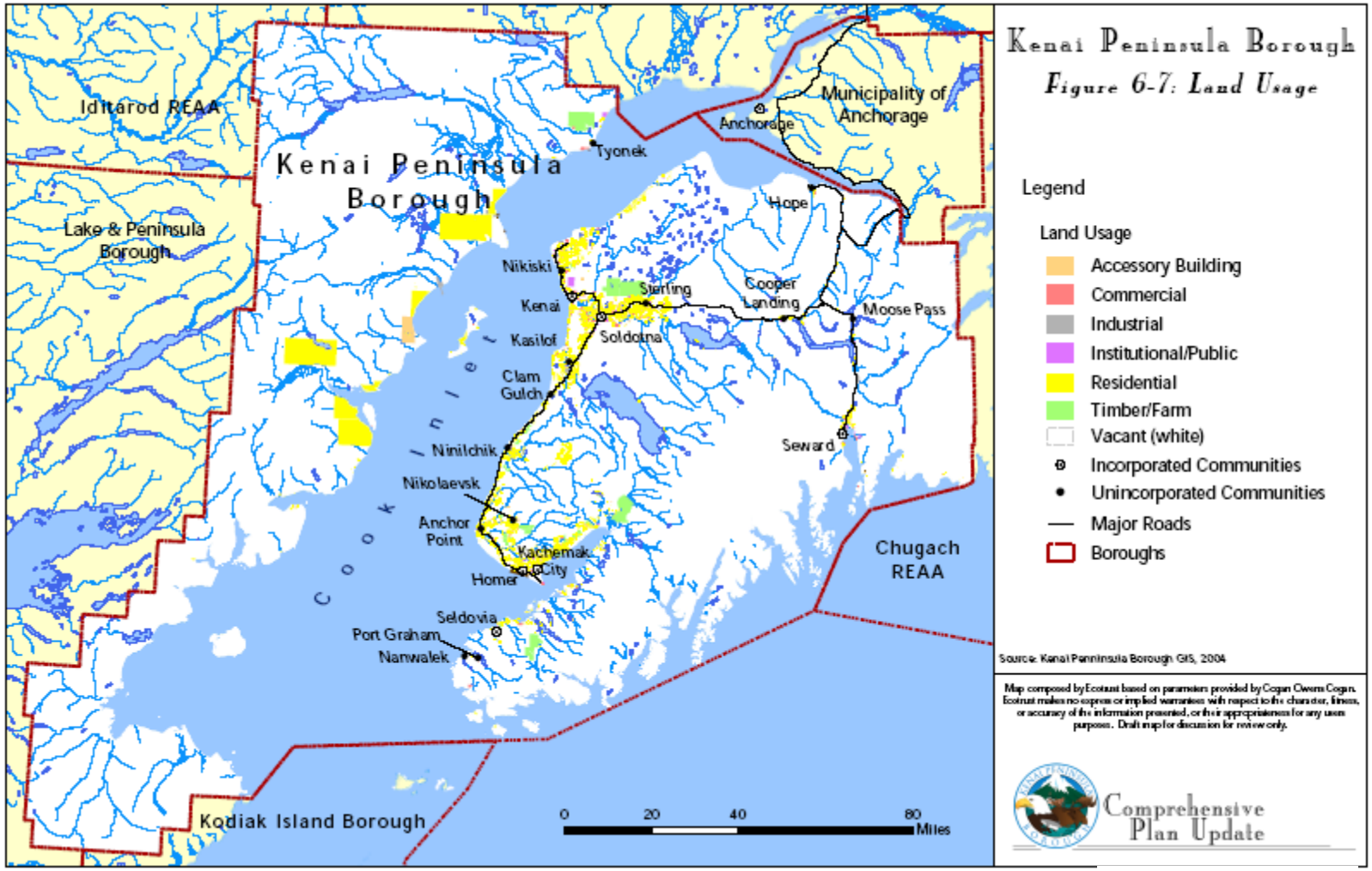

Figure 4.11-2. Land Use in the Kenai Peninsula Borough (KPB 2005).

4.11.3. Demographics

Population density in the Project vicinity is relatively low. The Project area is approximately 100 miles from Anchorage, Alaska's largest city. The population of the area is centered near the Seward highway.

The population characteristics of the Project area are similar to those of the Kenai Peninsula Borough, as whole. Population growth was greatest during the 1970's and early 1980's. Current populations for incorporated cities in the Borough are shown in Table 4.11-2, and current growth rates are estimated at less than 1% (KPB 2008), with negative population growth in several towns near the Project area.

Table 4.11-2. Population growth in the Kenai Peninsula Borough (KPB 2008).

Number and Annual Rate of Change in Population, Kenai Peninsula Borough and Incorporated Cities in the Borough: 2000-2006				
	2000	**2006**	**Total Change**	**Annual Rate of Change**
Kenai Peninsula Borough	49,691	51,350	1659	276.5
Homer (Increases partially due to annexation)	3,946	5,454	1,508	251.3
Kachemak City	431	458	27	4.5
Kenai	6,942	6,864	- 78	- 13.0
Seldovia	430	375	- 51	- 8.5
Seward	2,830	2,627	- 203	- 33.8
Soldotna	3,759	3,807	48	8.0

The racial composition of the borough is predominantly white, except for the small native villages (2000 U.S. Census Data).

In general, adjusted incomes in the KPB decreased during the last few of decades (KPB 2005). Table 4.11-3 summarizes occupations and income in the KPB.

Table 4.11-3. Income and occupations in Kenai Peninsula Borough (ADCRA 2009; 2000 U.S. Census Data).

Income, Poverty, and Occupation: 2000 U.S. Census Data	
Income and Poverty Levels: **Note:** Current socio-economic measures could differ significantly. Kenai Peninsula Borough located in the Kenai Peninsula Census Area.	
Per Capita Income:	$20,949
Median Household Income:	$46,397
Median Family Income:	$54,106
Persons in Poverty:	4,861
Percent Below Poverty:	10.0%
Total Potential Work Force (Age 16+):	36,781
Total Employment:	20,486
Employment by Occupation:	
Management, Professional & Related:	5,581
Service:	3,471
Sales & Office:	4,740
Farming, Fishing & Forestry:	485
Construction, Extraction & Maintenance:	3,394
Production, Transportation & Material Moving:	2,693

The KPB Comprehensive Plan (KPB 2005) points out the following issues regarding borough demographics:

- Aging population – the average age and percent of population in higher age groups has increased and is predicted to continue to do so.
- Declines in school age children – there are budget and service issues surrounding declining enrollment.
- Declining incomes – decreases in real income may signal increased demand on social and other services at the same time that there is less money to support taxes and fees.

4.11.4. Industry and Employment

Employment in the KPB is concentrated in several industries and summarized in Table 4.11-4. Moose Pass and Seward employment is consistent with Borough employment information.

Table 4.11-4. Employment in the Kenai Peninsula Borough (ADCRA 2009, 2000 U.S. Census Data).

Employment: 2000 U.S. Census Data	
Note: Current socio-economic measures could differ significantly. The Kenai Peninsula Borough is located in the Kenai Peninsula Census Area.	
Employment:	
Total Potential Work Force (Age 16+):	36,781
Total Employment:	**20,486**
Percent Unemployed:	11.4%
Adults Not in Labor Force (Not Seeking Work):	13,665
Percent of All 16+ Not Working (Unemployed + Not Seeking):	44.3%
Private Wage & Salary Workers:	13,691
Self-Employed Workers (in own not incorporated business):	2,578
Government Workers (City, Borough, State, Federal):	3,976
Employment by Industry:	

Agriculture, Forestry, Fishing & Hunting, Mining:	2,157
Construction:	1,898
Manufacturing:	1,046
Wholesale Trade:	383
Retail Trade:	2,568
Transportation, Warehousing & Utilities:	1,319
Information:	294
Finance, Insurance, Real Estate, Rental & Leasing:	638
Professional, Scientific, Management, Administrative & Waste Mgmt:	1,046
Education, Health & Social Services:	3,996
Arts, Entertainment, Recreation, Accommodation & Food Services:	2,209
Other Services (Except Public Admin):	1,283
Public Administration:	1,527

4.11.5. Public Sector

Kenai Peninsula Borough is incorporated as a second class borough and as such levees taxes and fees, which fund borough government and services. The KPB operates the schools and the landfill, but most other services such as sewer, water, fire, and law enforcement are managed locally by each city. There are 44 schools in the Kenai Peninsula School District with a total of 9,487 students and employing 716 teachers. Tables 4.11-5 and 4.11-6 summarize the finances for the KPB for 2005 (ADCRA, accessed 2009).

Table 4.11-5. Kenai Peninsula Borough revenues (ADCRA 2009).

2005 Municipal Revenues			
Local Operating Revenues		**Outside Operating Revenues**	
Taxes:	$58,372,872	Federal Operating:	$5,033,393
Service Charges:	$1,231,122	Other State Revenue:	$3,634,590
Enterprise:	$79,739,464	State/Federal Education Funds:	$59,617,943
Other Local Revenue:	$7,664,902		
Total Local Operating Revenues:	**$147,008,360**	**Total Outside Revenues:**	**$68,285,926**
Total Operating Revenues (local + outside):	$215,294,286	State/Federal Capital Project Revenues:	$1,673,099
			Total All Revenues: $216,967,385

Table 4.11-6. Kenai Peninsula Borough Expenditures (ADCRA 2009).

2005 Municipal Expenditures		
	General Government Expenditures:	$13,729,978
	Public Safety:	$9,782,444
	Roads:	$3,198,758
	Refuse/Landfill:	$4,348,928
	Clinic Hospital:	$68,867,214
	Parks and Recreation:	$1,383,393
	Education:	$95,553,345
	Capital Projects:	$17,209,587
		Total All Expenditures: $218,680,175

4.11.6. Electricity

The south and central portions of the Kenai Peninsula are supplied by Homer Electric Association. Currently, Chugach Electric supplies electricity to the Project area. The proposed Project will supply Homer Electric customers. Currently, Homer Electric purchases power from Chugach Electric and is a partner with them in the Bradley Lake Hydroelectric Project, receiving about 12 percent of that project's output. Homer Electric also has a 40 megawatt co-generation facility in North Kenai, which supplies the Railbelt electric grid.

The City of Seward owns its local electrical distribution system and transmission lines north of the city. Power is purchased from Chugach Electric. In addition, the city owns one percent of the output of the Bradley Lake Project and a 12 megawatt diesel generator for back up.

4.11.7. Potential Adverse Impacts

No adverse socioeconomic impacts have been identified at this time.

4.11.8. Proposed Protection, Mitigation, and Enhancement Measures

Kenai Hydro, LLC has not to date identified proposed protection, mitigation, and enhancement measures (PM&Es) for implementation under the project license. Identification of PM&Es will occur following completion of effects analyses based on licensing studies.

4.12. Tribal Resources

Tribes in the area have been contacted to determine their interest in the Project and if there are cultural properties within the Project area that may be impacted. Consultation with Tribes will continue, with activities and reporting consistent with the Archaeological Resources Protection Act of 1979, 16 U.S.C. 470w-3, and the National Historic Preservation Act of 1966, 16 U.S.C. 470hh).

5 PRELIMINARY ISSUES AND STUDIES LIST

5.1. Introduction

Based on review of the existing information and preliminary discussions with agencies, tribes, and other stakeholders, Kenai Hydro, LLC has identified potential impact types or information gaps that provide an organizing framework for the Grant Lake/Falls Creek licensing studies and future information gathering efforts. From this list, key questions or information needs are identified that will require a multi-disciplinary approach to reach an understanding of how the proposed Project may affect area resource values. Fifteen discreet study topics have been identified that will provide the basis for determining potential Project effects, as well as potential Protection, Mitigation, and Enhancement measures (PM&Es). These topics will be combined into logical study plans, and studies will be conducted commensurate with the scope and scale of

the proposed Project and potential resource impacts. The identified study topics will form the basis of the draft study plans to be developed in coordination with agencies and other interested Participants.

Although it was mainly completed in the 1980s, there is a significant body of baseline environmental data for the Project area which will inform analysis for the proposed Project. An initial objective of the study program will focus on developing or confirming existing baseline information. Reconnaissance data being collected in 2009 prior to the formal FERC study process will provide supplemental baseline information to inform development of the draft study plans. Project facilities and Project operations descriptions and associated engineering will inform and be informed by resource studies.

Section 4 of this PAD identifies potential Project impacts by resource area based on existing information. Proposed study topics indentified in the following section 5.2 were identified to evaluate the resource issues associated with the following potential Project impacts and information needs:

- Increased Grant Lake water level fluctuation
- Potential influence of Grant Lake intake structure on fish and wildlife populations
- Reduced flows in upper Grant Creek between the dam and powerhouse
- Altered average flows in lower Grant Creek below the powerhouse
- Flow fluctuations in lower Grant Creek below the powerhouse
- Reduced flows in Falls Creek below the point of diversion
- Water temperature changes in Grant Creek
- Tailrace outflow water quality (such as nitrogen gas saturation)
- Project construction and operation impacts on species with cultural or recreational value and other species of concern (Alaska non-game fish, designated Essential Fish Habitat, threatened or engendered species, etc)
- General project activity impacts on all resources, including ground disturbance associated with studies, construction, and operations
- Need for hydrologic data record for Grant Lake, Grant Creek, and Falls Creek
- Need for baseline water quality data record
- Development of baseline surveys and mapping tools for fisheries and wildlife habitat assessments

5.2. Grant Lake/Falls Creek Study List

A list of environmental studies that may need to be completed to inform the license application is provided below. The list is divided generally by resource areas; however, it should be noted that Kenai Hydro, LLC expects that these studies will be interdisciplinary. In addition to resource area studies, analyses that are primarily engineering in nature, including facilities (lands, roads, bridges, transmission lines), hazards and geotechnical risk assessment, power market and economic analysis, and project feature optimization will be on-going. Where engineering analyses have the potential to impact resources, the analysis questions will be included in the proposed study plans. Preliminary engineering analyses are presented in this PAD, and will be updated for the license application, pending results of the resource studies. The study list focuses on the Grant Lake/Grant Creek and Falls Creek watersheds, although study information will also be used to assess the impact of project construction and operation on resources in the Lower Trail Lake and Trail Creek watershed.

Geology and Soils

1. Grant Lake Shoreline Erosional Processes Study

Water Resources

2. Hydrology of Grant Lake/Grant Creek and Falls Creek Watersheds
3. Water Quality of Grant Lake/Grant Creek and Falls Creek Watersheds

Fisheries and Aquatic Resources

4. Grant Lake Fish Resources Distribution and Abundance
5. Grant Creek Fish Resources Abundance and Distribution
6. Grant Creek Habitat Modeling/Instream Flow Analysis
7. Falls Creek Fish Resources Distribution and Abundance

Terrestrial Resources

8. Wildlife and Bird Surveys and Habitat Use Mapping
9. Vegetation Surveys and Mapping
10. Wetlands Mapping

Cultural Resources

11. Subsistence and Cultural Use Study
12. Historical and Archeological Resources Survey

Recreation Resources and Land Use

13. Recreational Use Assessment
14. Land Use and Facilities Study (includes lands, roads, and construction practices)

Visual and Aesthetic Resources

15. Aesthetic/Visual Resources Study

5.3. Geology and Soils

Information collected during the proposed study efforts will be used to describe the existing environment, assess potential impacts, and provide essential information that will help to avoid or mitigate Project impacts. Potential impacts on geology and soils of the project area include impact of sediment releases into Grant Lake, Grant Creek, and Falls Creek and Lower Trail Lake and Trail Creek associated with the construction of the dam and diversions, possible down-cutting of Inlet Creek delta as a result of lowered water levels in Grant Lake, and possible soil erosion and sedimentation in the zone above normal full pond due to the increase in lake levels and water surface level fluctuations. There is also the potential for site specific erosion from road and transmission line construction and maintenance.

5.3.1. Proposed Study Topics

- Grant Lake Shoreline and Erosional Processes Study
- Land Use and Facilities Study

5.3.2. Relevant Plans

Relevant Management Plans regarding geology and soils in the proposed Project area include:

- ADNR (Alaska Department of Natural Resources). 1997. Kenai River Comprehensive Management Plan.
- Kenai Peninsula Borough (KPB). 2005. Kenai Peninsula Borough Comprehensive Plan.
- KPB Coastal Management Program and LaRoche and Associates. 2008. Kenai Peninsula Borough Coastal Zone Management Plan.
- U.S. Forest Service. 2005. Revised Land and Resource Management Plan for the Chugach National Forest.

5.4. Water Resources

Information collected during the proposed study efforts will be used to describe the existing environment, assess potential impacts, and provide essential information that will help to avoid or mitigate Project impacts. Potential impacts on water resources include long-term seasonal changes in flow regimes in Grant Creek and Falls Creek. Baseline hydrologic and water quality information is needed to assess potential Project impacts. In particular, potential temperature

impacts in Grant Creek will need to be assessed. Impact of Project construction and operation on water quality and hydrology of Lower Trail Lake and Trail Creek will be assessed. Reconnaissance water quality and hydrology information will be collected in 2009 prior to the formal FERC study process (HDR 2009b), and information will be used to inform the draft study plan process.

5.4.1. Proposed Study Topics

- Hydrology of Grant Lake/Grant Creek and Falls Creek Watersheds
    - Stream gaging of Grant Creek and Falls Creek
    - Aquatic Habitat Modeling/Instream Flow Study
- Water quality of Grant Lake/Grant Creek and Falls Creek Watersheds
    - Grant Lake Water Quality and Limnology
    - Grant and Falls Creek Water Quality and Productivity Monitoring (stream macroinvertebrates and periphyton)
    - Grant Creek Temperature Modeling
- Land Use and Facilities Study

5.4.2. Relevant Plans

The following resource management plans and directives provide guidance and direction for protection of water resources:

- ADF&G. 2006b. Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources.
- ADNR. 1997. Kenai River Comprehensive Management Plan.
- ADNR. Kenai River Special Management Area (KRSMA).
- KPB. 2005. Kenai Peninsula Borough Comprehensive Plan.
- KPB Coastal Management Program and LaRoche and Associates. 2008. Kenai Peninsula Borough Coastal Zone Management Plan.
- McCracken, B. W. 2007. Aquatic Resources Implementation Plan for Alaska's Comprehensive Wildlife Conservation Strategy, September 2006 - 2001. Alaska Department of Fish and Game.
- U.S. Forest Service. 2005. Revised Land and Resource Management Plan for the Chugach National Forest.

5.5. Fish and Aquatic Resources

Based on meetings with stakeholders, input from federal and state resource agencies, and its consultants Kenai Hydro, LLC has identified the following fish and aquatic resources study

needs. Information collected by the proposed studies will be used to describe the existing environment, assess potential impacts, and provide essential information that will help to avoid or mitigate Project impacts. Potential impacts to fish and aquatics resources include impacts related to fluctuating flows in Grant Lake, and Grant and Falls Creek, potential impacts of fish at the intake structure, potential reduced flows between the dam and the powerhouse on Grant Creek and below the Falls Creek diversion, potential impacts from the tailrace outflow, potential loss of habitat due to tunnel construction and disposal of rock spoil in drainage ways, and increased recreational fishing pressure due to increased access. Reconnaissance fish and aquatic habitat and distribution information will be collected in 2009 prior to the formal FERC study process (HDR 2009a), and information will be used to inform the draft study plan process.

Grant Creek, and Falls Creek below the respective diversions are each less than 1.5 miles long and the potential fish use zone of Falls Creek is very limited. Consequently, all of the aquatic resource study programs should be viewed from the perspective of a very limited impact zone. The scopes of study programs will necessarily be commensurate with the range of potential impacts. Potential impact of Project construction and operation on the fish an aquatic resources in Lower Trail Lake and Trail Creek will also be assessed.

5.5.1. Proposed Study Topics

- Grant Lake Fish Resources Distribution and Abundance
- Grant Creek Fish Resources Distribution and Abundance
    - Grant Creek Salmon Spawning Abundance and Distribution
    - Grant Creek Resident and Rearing Fish Distribution and Abundance
    - Grant Creek Habitat Mapping/Critical Factors Analysis
- Grant Creek Habitat Modeling/Instream Flow Analysis
    - Analysis of Habitat Changes under Varying Flow Regimes
    - Ramping and Flow Fluctuation Analysis
- Falls Creek Fish Resources Distribution and Abundance
- Land Use and Facilities Study

5.5.2. Relevant Plans

The following resource management plans and directives provide guidance and direction for protection of fish resources and aquatic habitats:

- ADF&G. 2006b. Our Wealth Maintained: A Strategy for Conserving Alaska's Diverse Wildlife and Fish Resources.
- ADNR. 1997. Kenai River Comprehensive Management Plan.
- ADNR. Kenai River Special Management Area (KRSMA).

- KPB Coastal Management Program and LaRoche and Associates. 2008. Kenai Peninsula Borough Coastal Zone Management Plan.
- McCracken, B. W. 2007. Aquatic Resources Implementation Plan for Alaska's Comprehensive Wildlife Conservation Strategy, September 2006 - 2001. Alaska Department of Fish and Game.
- U.S. Forest Service. 2005. Revised Land and Resource Management Plan for the Chugach National Forest.

5.6. Wildlife and Botanical Resources

Information collected by the proposed studies will be used to describe the existing environment, assess potential impacts, and provide essential information that will help to avoid or mitigate Project impacts. Impacts and information needs identified for wildlife and botanical resources (including wetland, riparian, and littoral habitat) include: a need for baseline mapping and field confirmation of existing information regarding wildlife habitat and vegetation cover types; assessment of potential impacts to species with cultural or recreational value and other species of concern (Alaska non-game species, sensitive, rare, threatened or engendered species, etc); impacts related to general project activity, including potential disturbance to wildlife due to increased human activity in the area; potential for loss of, or increase in, shoreline or wetland habitats used by wildlife species due to lake level rise and increased water surface level fluctuations and potential effects on wildlife, riparian vegetation, and wetlands; need for survey of TES plants and assessment of potential impacts to rare species tracked by the Alaska Natural Heritage Program; potential disturbance to plants and wildlife due to transmission lines or corridor maintenance; and the potential for spread of invasive species during Project construction and operation.

5.6.1. Proposed Study Topics

- Wildlife and Bird Surveys and Habitat Use Mapping
    - Wildlife Survey and Habitat Use Mapping
    - Breeding and Migratory Bird Surveys (raptors, songbirds, waterfowl and waterbirds)
- Vegetation Surveys and Mapping
    - Vegetation Mapping
    - Invasive Plant Species Survey
    - Threatened, Endangered, and Sensitive (TES) Plant Survey
- Wetlands Mapping
- Land Use and Facilities Study

5.6.2. Relevant Plans

Relevant management plans and management agency guidance documents for wildlife and botanical resources include:

- AKEPIC Database. Updated 2008. Alaska Exotic Plant Information Clearinghouse Database. Available at: http://akweeds.uaa.alaska.edu.
- Alaska Natural Heritage Program (AKHNP). 1997. Alaska Rare Plant Field Guide. Environment and Natural Resources Institute, University of Alaska Anchorage. http://aknhp.uaa.alaska.edu
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- ADF&G. 2000. Kenai Peninsula brown bear conservation strategy.
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- KPB Coastal Management Program and LaRoche and Associates. 2008. Kenai Peninsula Borough Coastal Zone Management Plan.
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- McDonough, T. 2007b. Units 7 & 15 caribou management report. Pages 1-13 in P. Harper, editor. Caribou management report of survey and management activities 1 July 2004 – 30 June 2006. Alaska Department of Fish and Game.
- McDonough, T. 2007c. Unit 7 moose management report. Pages 110-115 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2005–30 June 2007. Alaska Department of Fish and Game.
- Selinger, J. 2006. Units 7 & 15 wolf management report. Pages 59-64 in P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2002 – 30 June 2005. Alaska Department of Fish and Game.
- Selinger, J. 2008. Units 7 & 15 black bear management report. Pages 143-148 in P. Harper, editor. Black bear management report of survey and inventory activities 1 July 2004–30 June 2007. Alaska Department of Fish and Game.
- Selinger, J. 2005. Units 7 & 15 brown bear management report. Pages 64-74 in P. Harper, editor. Brown bear management report of survey and inventory activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game.
- U. S. Army Corps of Engineers Research and Development Center. 2007. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0). Vicksburg, MS.

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- U. S. Forest Service. 1995. Forest Service Manual. Part 2600 - Wildlife, Fish, and Sensitive Plant. Habitat Management, WO Amendment 2600-95-7. Effective 6/23/95. Chapter 2670 – Threatened, endangered, and sensitive plants and animals.
- U. S. Forest Service. 2005. Revised Land And Resource Management Plan for the Chugach National Forest.
- U.S. Code 16 Subchapters II and III. 1918, as amended 1936, 1960, 1968, 1969, 1974, 1978, 1986, and 1989. Migratory Bird Treaty Act and Migratory Bird Conservation.
- U.S. Code 16 668-668d, 54 Stat. 250. 1940, as amended 1940, 1959, 1962, 1972, and 19778. Bald Eagle and Golden Eagle Projection Act of 1940.
- U.S. Code 33 1343 Section 404. 1977. Clean Water Act. (Section 404 - discharge of dredged or fill material into the navigable waters of the U.S.).

5.7. Recreation and Land Use

Information collected by the proposed studies will be used to describe the existing environment, assess potential impacts, and provide essential information that will help to avoid or mitigate Project impacts on recreation and existing land use. Potential impacts identified include: effects on travel around the shoreline of Grant Lake in summer and winter; potential impacts to recreational uses such as boating, fishing, and hunting, potential effects of reduced/altered flows in Falls and Grant Creek on recreational fishing; and potential increased recreational pressure (such as hunting, fishing, and boating, snow machining, etc) due to increased access.

5.7.1. Proposed Study Topics

- Recreational Use Assessment
- Land Use and Facilities Study (includes lands, roads, and construction practices)
- Aesthetic/Visual Resources Study

5.7.2. Relevant Plans

Relevant local, state, or regional land use and recreation plans include:

- ADNR. 2001. Kenai Area Plan
- ADNR. 2004. Alaska's Outdoor Legacy Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2004-2009.
- KPB. 2005. Kenai Peninsula Borough Comprehensive Plan.
- KPB Coastal Management Program and LaRoche and Associates. 2008. Kenai Peninsula Borough Coastal Zone Management Plan.

- McDonough, T. 2007a. Unit 7 & 15 furbearer management report. Pages 91-96 in P. Harper, editor. Black bear management report of survey and inventory activities 1 July 2003 – 30 June 2006.
- McDonough, T. 2007c. Unit 7 moose management report. Pages 110-115 in P. Harper, editor. Moose management report of survey and inventory activities 1 July 2005–30 June 2007. Alaska Department of Fish and Game.
- Selinger, J. 2006. Units 7 & 15 wolf management report. Pages 59-64 in P. Harper, editor. Wolf management report of survey and inventory activities 1 July 2002 – 30 June 2005. Alaska Department of Fish and Game.
- Selinger, J. 2008. Units 7 & 15 black bear management report. Pages 143-148 in P. Harper, editor. Black bear management report of survey and inventory activities 1 July 2004–30 June 2007. Alaska Department of Fish and Game.
- Selinger, J. 2005. Units 7 & 15 brown bear management report. Pages 64-74 in P. Harper, editor. Brown bear management report of survey and inventory activities 1 July 2004–30 June 2006. Alaska Department of Fish and Game.
- U.S. Forest Service. 1979. Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research. Pacific Northwest forest and Range Experiment Station, General Technical Report PNW-98.
- U.S. Forest Service. 2005. Revised Land And Resource Management Plan for the Chugach National Forest.

5.8. Aesthetic/Visual Resources

Information collected by the proposed studies will be used to describe the existing environment, assess potential impacts, and provide essential information that will help to avoid or mitigate Project impacts on aesthetic and visual resources. Potential impacts identified include: changing water surface elevations in Grant Lake and flows in Grant Creek and/or Falls Creek may impact visual resources; potential impacts on road viewpoints and views from existing recreational trails will be assessed; and new road or transmission line corridors may impact aesthetic or visual resources.

5.8.1. Proposed Study Topics

- Land Use and Facilities Study (includes lands, roads, and construction practices)
- Aesthetic/Visual Resources Study

5.8.2. Relevant Plans

Management plans relevant to aesthetic/visual resources include:

- ADNR. 2001. Kenai Area Plan.

- ADNR. 2004. Alaska's Outdoor Legacy Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2004-2009.
- KPB. 2005. Kenai Peninsula Borough Comprehensive Plan. KPB Planning Department.
- U.S. Forest Service. 2005. Revised Land And Resource Management Plan for the Chugach National Forest.

5.9. Cultural Resources

Information collected by the proposed studies will be used to avoid or mitigate Project impacts. Kenai Hydro, LLC will identify an Area of Potential Effects (APE), including the Project area. Establishment of the APE will be a collaborative effort between Kenai Hydro, LLC, the SHPO, tribes, federal agencies, and FERC. Additional information is needed to assess potential Project effects on cultural resources on the APE due to construction, Project operations, or increased recreational and other uses in the area; potential impacts on cultural resources due to fluctuating water surface elevations in Grant Lake; and assessment of subsistence use in the area and potential effects of reduced flows in Grant and Falls Creek.

5.9.1. Proposed Study Topics

- Subsistence and Cultural Use Study
- Historical and Archeological Resources Survey

5.9.2. Relevant Plans

Management and land use plans relevant to cultural resources studies include:

- KPB. 2005. Kenai Peninsula Borough Comprehensive Plan. KPB Planning Department.
- USFS. 2005. Revised Land And Resource Management Plan for the Chugach National Forest.
- U.S. Department of the Interior. 1966. National Historic Preservation Act. 36 CFR Part 60.
- U.S. Department of the Interior. 2004. 36 CFR Part 800. Protection of Historic Properties: incorporating amendments effective August 5, 2004.

5.10. Socioeconomic Resources

Kenai Hydro, LLC has identified the following socioeconomic resource issues. There is existing information sources referenced in this PAD that will be used to describe the existing environment, assess potential impacts, and provide essential information that will provide information on potential Project impacts on socioeconomic resources. Issues to be addressed by Kenai Hydro, LLC include an assessment of socioeconomic effects of the proposed Project on the local and regional economy related to Project construction and operations.

5.10.1. Proposed Study Topics

- Socioeconomic Assessment

5.10.2. Relevant Plans

Management and local or regional land use plans relevant to socioeconomic resources include:

- KPB. 2005. Kenai Peninsula Borough Comprehensive Plan. KPB Planning Department.
- KPB Coastal Management Program and LaRoche and Associates. 2008. Kenai Peninsula Borough Coastal Zone Management Plan.

5.11. Tribal Resources

Tribes in the general Project vicinity have been contacted to begin consultation on their interest in the Project and their concerns surrounding its development. The studies are being planned that will provide information on potential impacts to tribal resources. These studies include Subsistence and Cultural Use Study, Historical and Archaeological Resources Survey, Fisheries and Aquatic Resources studies, Terrestrial Resources studies, Recreational Use Assessment and Land Use Study, and Socioeconomic Assessment. As information becomes available, it will be shared with appropriate tribal contacts and next steps determined.

5.11.1. Relevant Plans

The federal, state, and tribal comprehensive waterway plans and resource management plans that are listed as relevant for other resource areas described in this section 5 of the PAD are also relevant to tribal resources, to the extent that there are tribal interests in the other resources areas.

6 SUMMARY OF CONTACTS

6.1. Introduction

KHL began early consultation with agencies and the public upon filing of the Preliminary Permits for the Grant Lake/Grant Creek and Falls Creek projects. The objectives of the consultation efforts included:

- Gathering information from agencies, tribes, and other potential stakeholders regarding their interests in the proposed project areas

- Distributing information regarding the preliminary permit process, the FERC licensing process steps, reconnaissance study efforts, regional power production needs and goals, and project design development

- Developing contact information for stakeholders
- Identifying and obtaining relevant information for development of the PAD and subsequent
- Identifying information gaps to be addressed during the reconnaissance study efforts, and in the formal FERC study process

6.2. Summary of Outreach Efforts and Contacts

Beginning in early 2009, KHL engaged in public outreach to provide information on the proposed Project to all interested parties. In addition, KHL engaged with agencies and interested stakeholders regarding development of draft and final study plans for the pre-formal study season in 2009, and formed an Instream Flow Technical Workgroup to begin developing the needed information for an instream flow study to be conducted as a part of the formal pre-licensing study program. Appendix 3 includes a summary table of KHL's consultation to gather information for this PAD and to inform the study program. Records of all consultation efforts recorded in Appendix 3 are included in the PAD document library, available on Kenai Hydro, LLC's website (www.kenaihydro.com).

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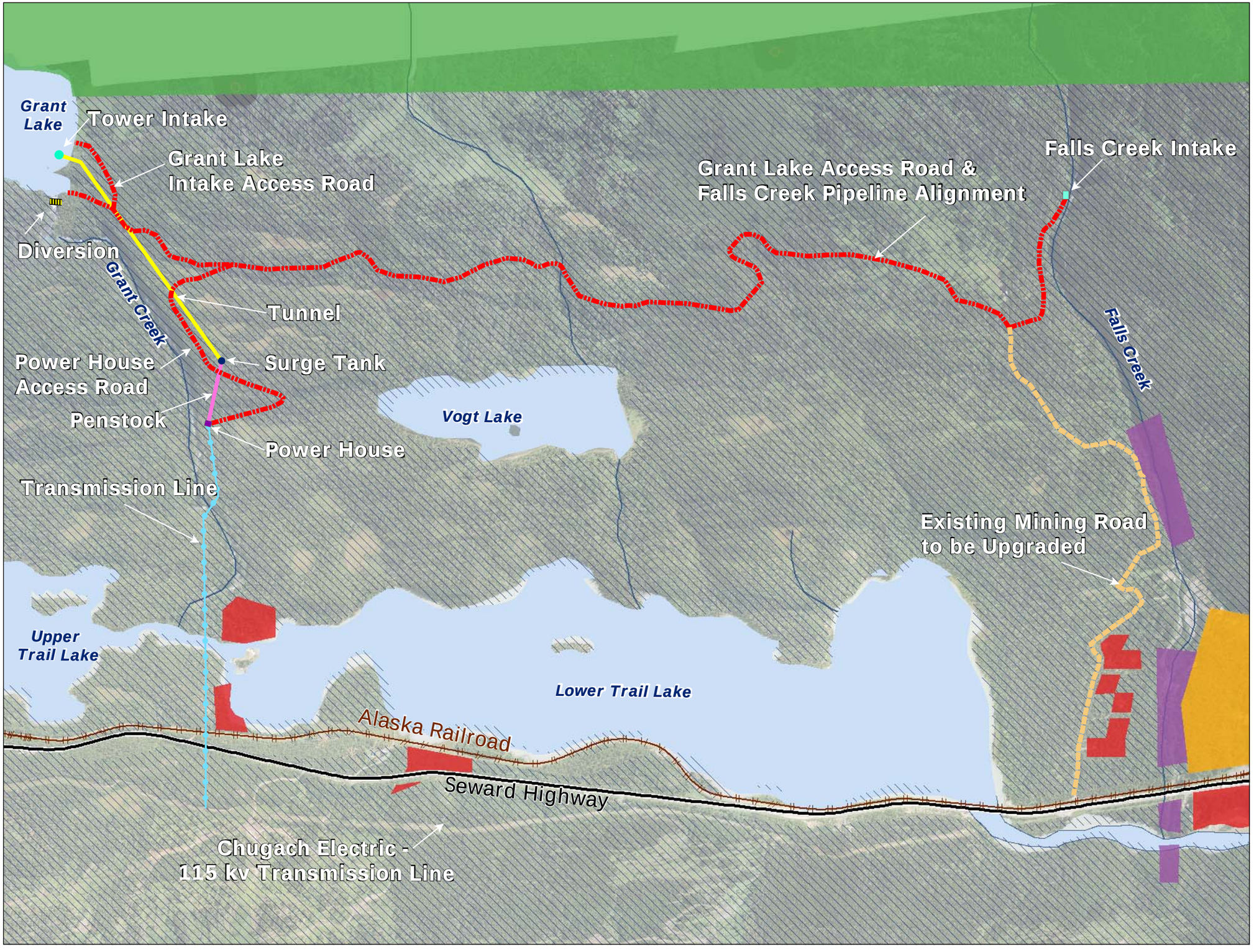
APPENDIX 1: LARGE SCALE FIGURES

Proposed project facilities and land ownership

Figure 3.2- 1



Project Features
- Intake
- Power House
- Access Road
- Diversion
- Existing Mining Road
- Penstock
- Transmission Line
- Tunnel

Land Ownership
- State
- ARRC
- BLM
- USFS
- Private
- Seward Highway
- Alaska Railroad

NORTH

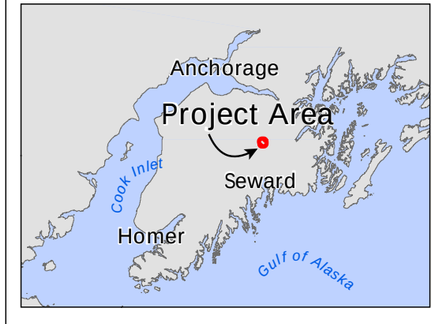
Feet
0 1,000 2,000

Map Projection: NAD 83 ASP Zone 4 Feet
Data Sources: HDR Alaska , Aerometric, Lounsbury and Associates, Kenai Peninsula Borough, AK DNR, USFS
Author: HDR Alaska, Inc.
Date: 27 July 2009

These maps are for review purposes only.

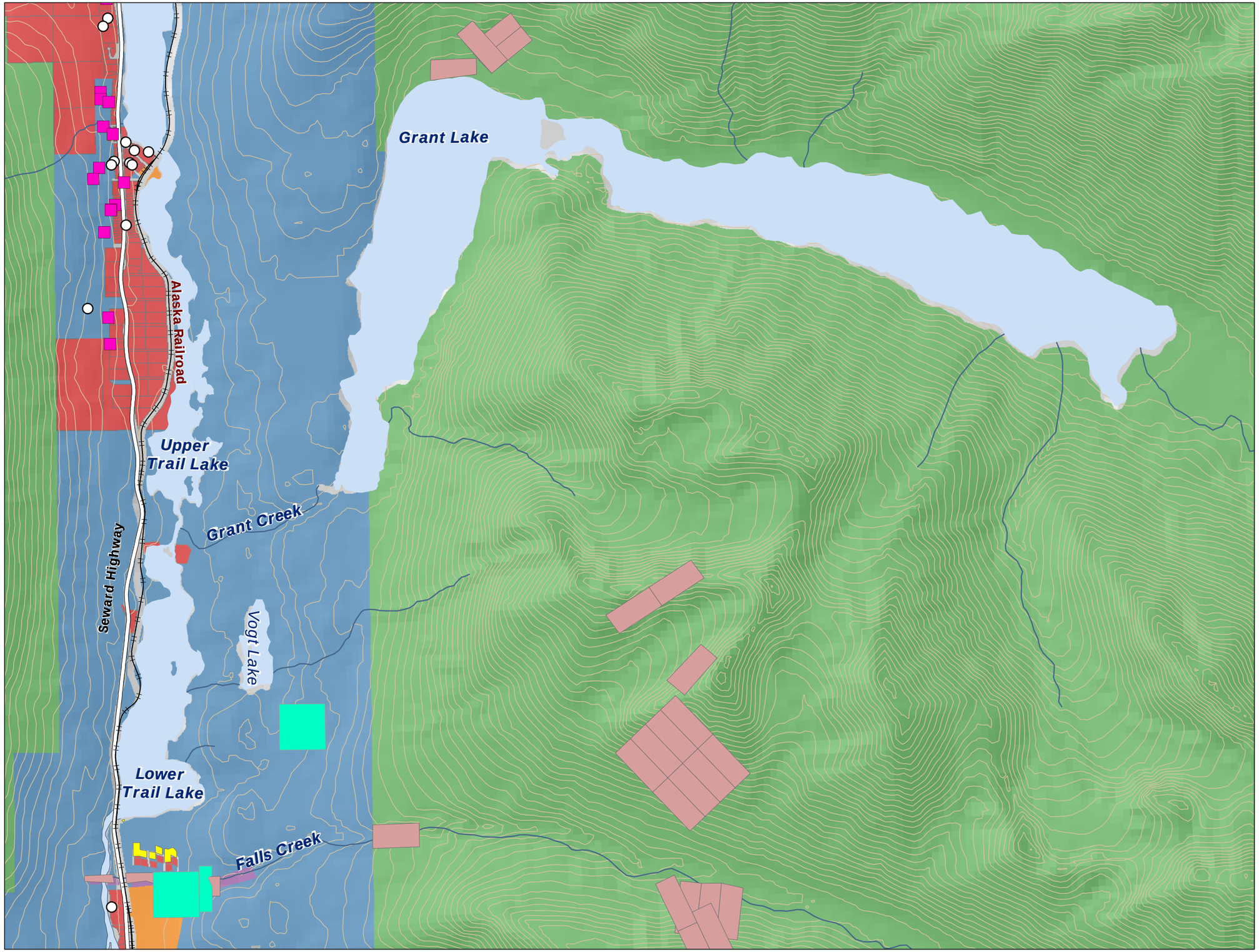
Kenai Hydro LLC

HDR ALASKA



Land status, ownership, water rights, and mineral claims in the proposed Project vicinity

Figure 4.2- 1



Legend

Land Ownership
- ARRC
- Alaska DNR
- Private
- BLM
- USFS

Water Rights
- Surface Water Rights
- Sub- Surface Water Rights

Mineral Claims
- Mineral Closing Order
- State Mining Claim
- Federal Mining Claim

- Alaska Railroad
- Seward Highway

NORTH

Feet
0 2,000 4,000

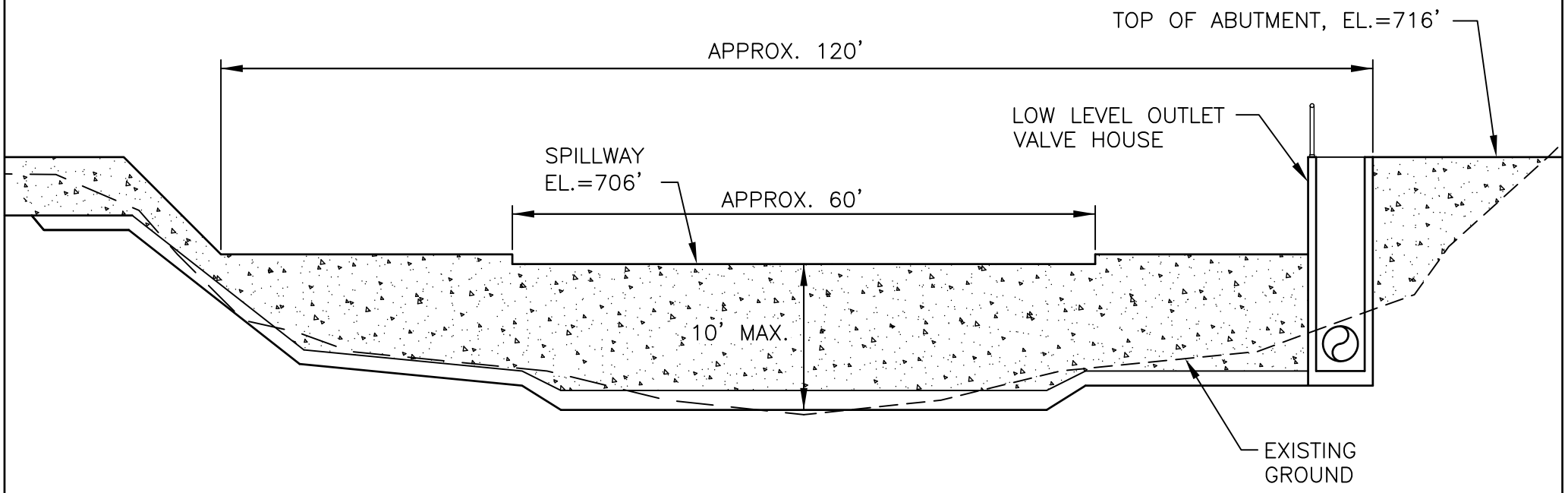
Map Projection: NAD 83 ASP Zone 4 Feet
Data Sources: HDR Alaska , Aerometric, Lounsbury and Associates, Kenai Peninsula Borough, AK DNR, USFS
Author: HDR Alaska, Inc.
Date: 27 July 2009

This map represents a conceptual level of utility, detail,and accuracy. The information displayed here is for planning purposes only. Base information shown constitutes data from various federal, state, public, and private sources. These maps are for review purposes only.

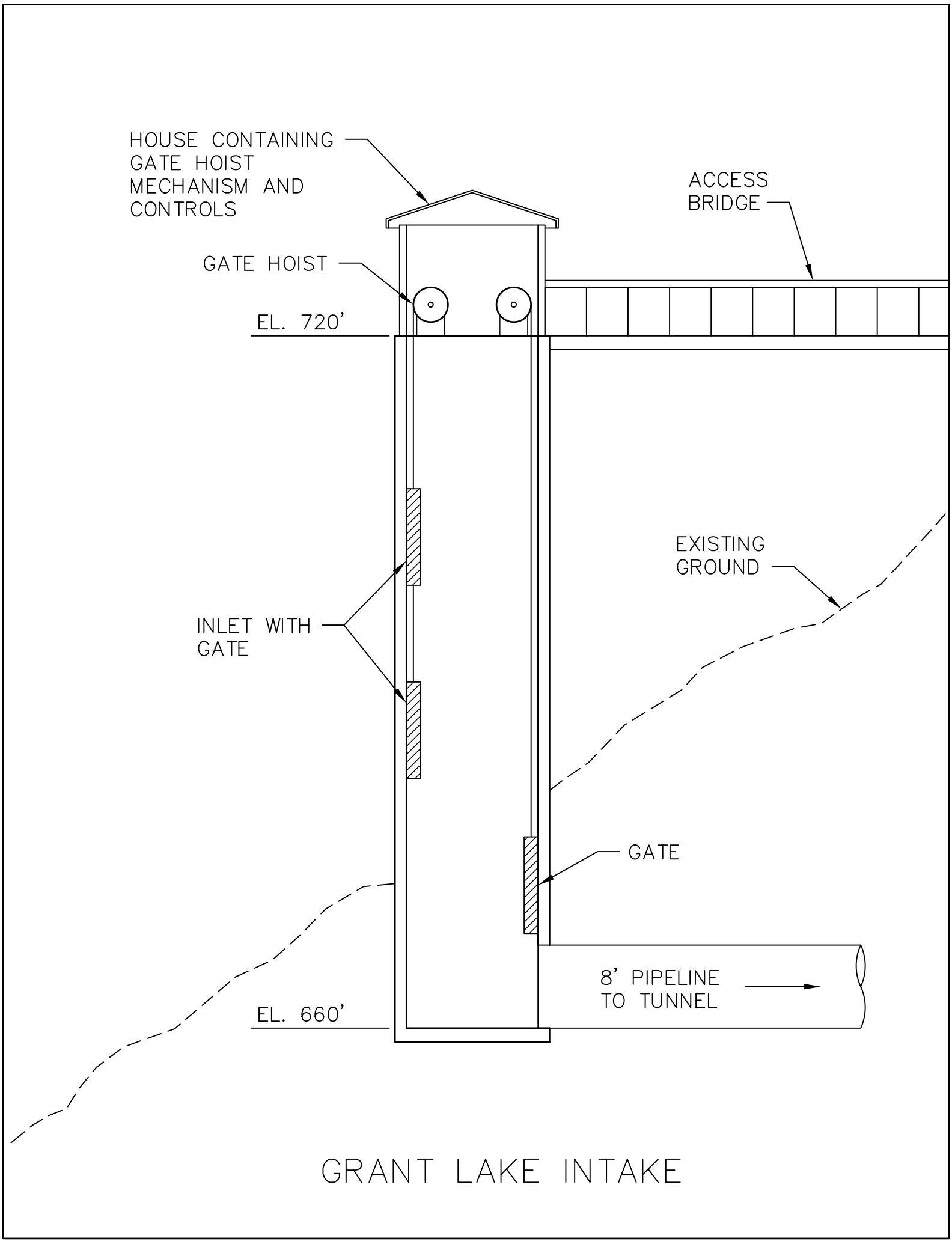
Kenai Hydro LLC

HDR ALASKA

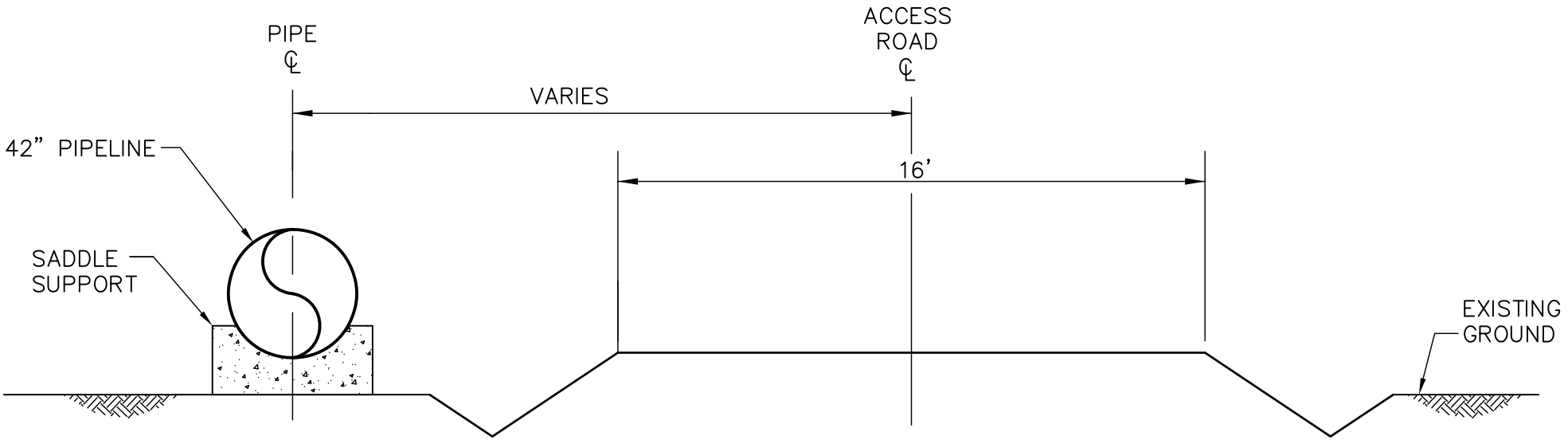
APPENDIX 2: CONCEPTUAL DRAWINGS OF PROPOSED PROJECT FACILITIES



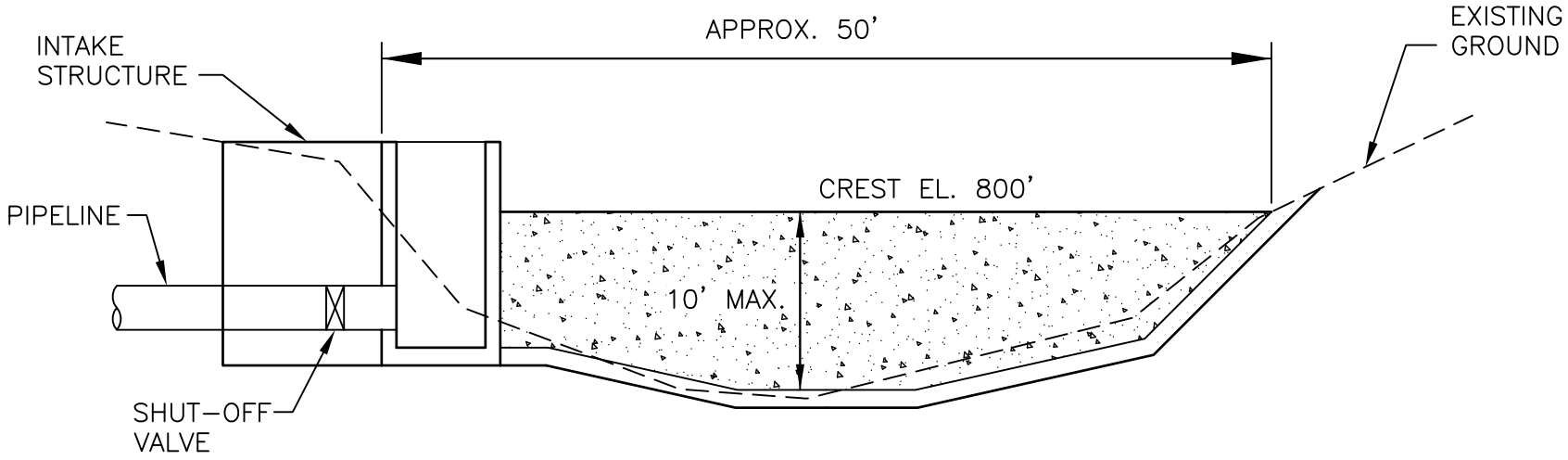
GRANT LAKE DIVERSION
LOOKING UPSTREAM



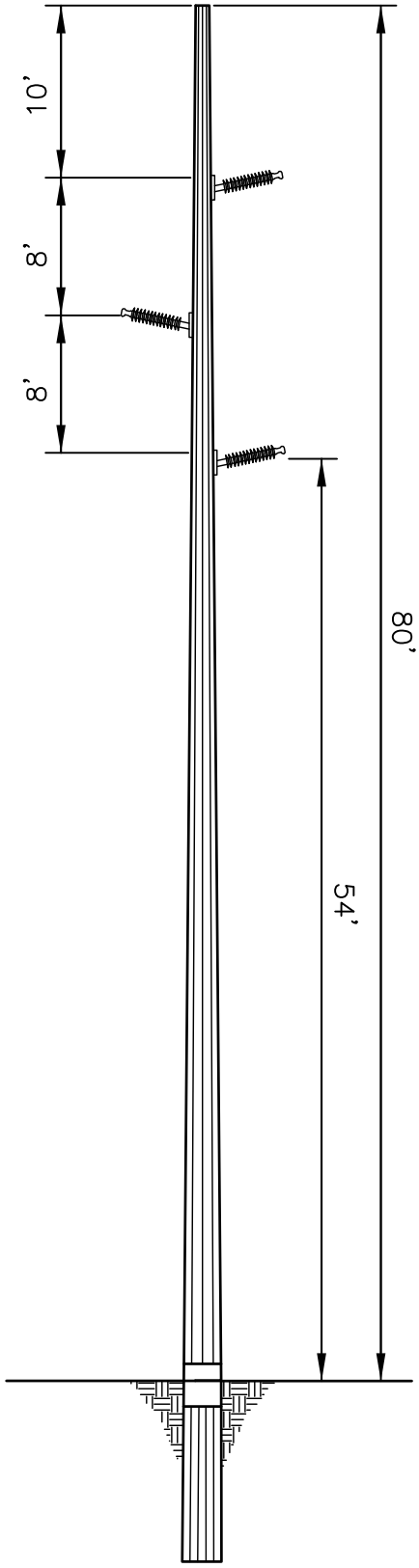
GRANT LAKE INTAKE



FALLS CREEK
ACCESS ROAD AND PIPELINE



FALLS CREEK DIVERSION/INTAKE
LOOKING UPSTREAM



115kV TRANSMISSION LINE
TYPICAL POLE

APPENDIX 3: SUMMARY OF CONSULTATION

APPENDIX 3

This appendix summarizes contacts with Federal, state, and interstate resource agencies, Indian tribes, non-governmental organizations, or other members of the public made in connection with preparing the pre-application document sufficient to enable the Commission to determine if due diligence has been exercised in obtaining relevant information. Communication records for each of the contacts summarized below are available in the document library at www.kenaihydro.com.

Date	Summary of Contact	Agency/Organization Contacted
12/19/2008	Steve Gilbert (Kenai Hydro, LLC [KHL]) provided notice to FERC of public meetings to be held to discuss Grant Lake/Grant Creek, Falls Creek (and Crescent Lake and Ptarmigan Creek) Projects.	FERC
1/5/2009	Information packets and invitations to attend agency and public meetings on January 20-21, 2009.	Friends of Cooper Landing, ADFG, ADNR, Kenai Peninsula Borough (KPB) Planning Department, Trout Unlimited, USFWS, Salamatof Native Association Inc, US Army Corps of Engineers, Alaska Center for the Environment, KPB Kenai River Center, USDA Forest Service – Chugach National Forest, Resurrection Bay Conservation Alliance, Alaska Fly Fishers, Alaska Conservation Foundation, National Heritage Institute-Hydropower Reform Coalition, National Wildlife Federation, Moose Pass Sportsman's Club, Fish for Cooper Creek Coalition, Sierra Club, Kenai Watershed Forum, ADNR State Parks, American Rivers Hydropower Reform Coalition, Cook Inletkeeper, Kenai Natives Association Kenaitze Indian Tribe, Alaska Conservation Alliance, Anchorage Fish and Game Advisory Committee, Kenai

Date	Summary of Contact	Agency/Organization Contacted
		Princess Lodge, Renewable Resources Foundation, public
1/20/2009	KHL hosted at meeting in Anchorage, Alaska to solicit input on the Grant Lake/Grant Creek, Falls Creek (and Crescent Lake and Ptarmigan Creek) Projects .	Alaska Center for the Environment, FOCL, Hydropower Reform Coalition, National Park Service, USFS, Resurrection Bay Conservation Alliance, Alaska Conservation Alliance
1/21/2009	KHL hosted at meeting in Cooper Landing, Alaska to solicit input on the Grant Lake/Grant Creek, Falls Creek (and Crescent Lake and Ptarmigan Creek) Projects.	ADFG, ADNR, Kenai River Float and Fish, FOCL, Homer Electric, Anchorage Fish and Game Advisory Committee, Kenai River Center, public
1/28/2009	KHL hosted at meeting in Moose Pass, Alaska to solicit input on the Grant Lake/Grant Creek, Falls Creek (and Crescent Lake and Ptarmigan Creek) Projects.	Resurrection Bay Conservation Alliance, FOCL, KPB Planning Department, public
1/29/2009	Steve Gilbert (KHL) exchanged emails with Blake Kowal (CIRI) regarding CIRI's land interests in the Moose Pass area.	CIRI
3/13/2009	Paul McLarnon (HDR) emailed agencies and interested parties an invitation to a March 24, 2009 meeting to discuss study plans for the Fish-Instream Flow, Water Quality and Hydrology reconnaissance studies for the Grant Lake/Falls Creek Project.	All agencies and interested parties
3/17/2009	Paul McLarnon (HDR) emailed agencies and interested parties information on the location of the March 24, 2009 meeting to discuss study plans for the Fish-Instream Flow, Water Quality and Hydrology reconnaissance studies.	All agencies and interested parties
3/23/2009	Paul McLarnon (HDR) emailed agencies and interested parties a website link to access draft study plans prior to the March 24, 2009 meeting.	All agencies and interested parties

Date	Summary of Contact	Agency/Organization Contacted
3/24/2009	Aquatics Workgroup Meeting in Moose Pass, Alaska to discuss draft fish and aquatics and water quality study plans for 2009 reconnaissance studies, and to identify participants for an instream flow technical workgroup.	ADFG, ADNR, NOAA, USFWS, USFS, NPS, FOCL, KRSA, AEC
3/25/2009	Brad Zubeck (KHL) emailed the sign-in sheet from the March 24, 2009 meeting to Mike Cooney (FOCL).	FOCL
3/27/2009	Paul McLarnon (HDR) emailed meeting participants a website link to access PowerPoint presentations from the March 24, 2009 meeting.	ADFG, ADNR, NOAA, USFWS, USFS, NPS, FOCL, KRSA, AEC
4/7/2009	Jason Kent (HDR) emailed agency biologists and potentially interested water resource professionals an invitation to join the Grant Creek/Falls Creek instream flow technical workgroup.	ADFG, ADNR, NOAA, USFWS, USFS, NPS, FOCL, KRSA, AEC, Kenai River Center, EPA
4/13/2009	Paul McLarnon (HDR) emailed agencies and interested parties that revised study plans were posted to the Kenai Hydro website, and requested comments.	All agencies and interested parties
4/13/09 Sterling, 4/15/09 Homer, & 4/16/09 Nikiski	Brad Zubeck (KHL) gave a PowerPoint presentation on small hydropower projects and the Grant Lake/Falls Creek Project at Homer Electric Associations Renewable Energy Forums in Sterling, Homer and Nikiski.	Public
4/15/2009	Mike Cooney (resident) emailed Jason Kent (HDR) with questions regarding the scope of the proposed Grant Lake/Grant Creek and Falls Creek Project.	FOCL
4/20/2009	Jason Kent (HDR) emailed Instream Flow Technical Workgroup members an agenda for the April 21, 2009 meeting.	Instream Flow TWG
4/21/2009	Instream Flow Technical Workgroup Meeting in Kenai, Alaska to discuss hydrology station locations, 2009 reconnaissance studies, and to instream flow study needs.	See Meeting Participant List
4/29/2009	Jason Kent (HDR) emailed April 21, 2009 meeting participants additional information on proposed instream flow methodologies.	Instream Flow TWG
4/22/2009	Brad Zubeck (KHL) gave a PowerPoint presentation on small hydro and the Grant Lake/Falls Creek Project to the Kenai Area Fisherman's Coalition in Kenai, Alaska.	Kenai Area Fisherman's Coalition
4/29/2009	Jason Kent (HDR) spoke with Gary Prokosch (ADNR) on the phone regarding a revised approach to the hydrology station locations discussed at the April 21, 2009 TWG meeting.	ANDR

Date	Summary of Contact	Agency/Organization Contacted
5/7/2009	Jason Kent (HDR) emailed the Instream Flow TWG that a meeting summary for the April 21, 2009 meeting and a memo regarding hydrology station locations were posted to the Kenai Hydro website.	Instream Flow TWG
5/12/2009	Brad Zubeck (KHL) gave a PowerPoint presentation to the Kenai River Professional Guides Association in Sterling, Alaska.	Kenai River Professional Guides Association
5/14/2009	Paul McLarnon (HDR) and Melinda O'Donnell (ADNR) exchanged emails about ADNR's review of study permit applications and Melinda requested that she be added to Kenai Hydro's interested party list.	ADNR
5/18/2009	Jason Kent (HDR) emailed Instream Flow Technical Workgroup members an agenda for the May 19, 2009 conference call.	Instream Flow TWG
5/19/2009	Instream Flow Technical Workgroup conference call to discuss instream flow studies methodologies.	Instream Flow TWG
5/27/2009	Brad Zubeck exchanged emails with Matt Cutlip (FERC) following a phone conversation on 5/22/2009 to determine a contact at FERC for filing of the NOI and PAD for the Grant Lake/Falls Creek Project.	FERC
5/27/2009	Brad Zubeck (KHL) spoke with Lynnda Kahn (USFWS) by phone to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Lynnda with information on the Kenai Hydro website and document library.	USFWS
5/27/2009	Brad Zubeck (KHL) left a voicemail for Phil North (EPA) to request relevant information for the Grant Lake/Falls Creek Project.	EPA
5/27/2009	Brad Zubeck (KHL) left a voicemail for Vern Stanford (Kenai Natives Association) to inquire whether he had any concerns about the Projects and to request relevant information for the Grant Lake/Falls Creek Project.	Kenai Natives Association
5/27/2009	Brad Zubeck (KHL) spoke with Doug Palmer (USFWS) by phone to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Doug with information on the Kenai Hydro website and document library.	USFWS
5/27/2009	Brad Zubeck (KHL) spoke with Gary Williams (Kenai River Center) by phone to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Gary with information on the Kenai Hydro website and document library.	Kenai River Center

Date	Summary of Contact	Agency/Organization Contacted
5/27/2009	Brad Zubeck (KHL) spoke with Karen O'Leary (USFS) by phone to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Karen with information on the Kenai Hydro website and document library.	USFS
5/27/2009	Brad Zubeck (KHL) spoke with Dave Casey, and Katy McCafferty (USACE) by phone to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Katy with information on the Kenai Hydro website and document library.	USACE
5/28/2009	Brad Zubeck (KHL) left a voicemail for Brenda Trefon (Kenaitze Indian Tribe) to request relevant information for the Grant Lake/Falls Creek Project.	Kenaitze Indian Tribe
5/28/2009	Brad Zubeck (KHL) spoke with John Johnson (Chugach Alaska Corporation) by phone to inquire regarding the Chugach Corporation's interest in the Projects and to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided John with information on the Kenai Hydro website and document library.	Chugach Alaska Corporation
5/28/2009	Brad Zubeck (KHL) left a voicemail (5/27/2009) and subsequently spoke with Mary King (ADFG) by phone to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Mary with information on the Kenai Hydro website and document library.	ADFG
5/28/2009	Brad Zubeck (KHL) spoke with Melanee Stevens (Qutekcak Native Tribe) by phone to inquire regarding the Qutekcak's interest in the Projects and to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Melanee with information on the Kenai Hydro website and document library.	Qutekcak Native Tribe
5/28/2009	Brad Zubeck (KHL) emailed Melanee Stevens (Qutekcak Native Tribe) to follow-up on the request by phone for relevant information on the Grant Lake/Falls Creek Project and to provide contact and Kenai Hydro website information.	Qutekcak Native Tribe
5/28/2009	Brad Zubeck (KHL) attempted to contact Penny Carty (Salamatof Native Association) by phone and email.	Salamatof Native Association
5/28/2009	Brad Zubeck (KHL) exchanged emails with Phil North (EPA) to request relevant information for the Grant Lake/Falls Creek Project and to provide information on the Kenai Hydro website and document library.	EPA

Date	Summary of Contact	Agency/Organization Contacted
5/28/2009	Brad Zubeck (KHL) exchanged emails with Brenda Trefon (Kenaitze Indian Tribe) to request relevant information for the Grant Lake/Falls Creek Project and to provide information on the Kenai Hydro website and document library. Brenda indicated that the Kenaitze Tribe will have an interest in the FERC process for this Project.	Kenaitze Indian Tribe
5/28/2009	Brad Zubeck (KHL) emailed Bruce Oskolkoff (Ninilchik Native Association) after phoning the Ninilchik Native Association office to request relevant information for the Grant Lake/Falls Creek Project and to provide information on the Kenai Hydro website and document library.	Ninilchik Native Association
5/28/2009	Jenna Borovansky (LVA) emailed Karen O'Leary a copy of the Grant Creek stream nomination form.	USFS
5/28/2009	Brad Zubeck (KHL) exchanged emails with John Johnson (Chugach Alaska Corporation) following a request by phone for relevant information on the Grant Lake/Falls Creek Project. Brad also provided his contact information and Kenai Hydro website information.	Chugach Alaska Corporation
5/28/2009	David Phillips (Chugach Alaska Corporation) emailed Brad Zubeck (KHL) regarding Chugach owned land near Grant Lake.	Chugach Alaska Corporation
6/1/2009	Brad Zubeck (KHL) and Jenna Borovansky (LVA) held a conference call with Joe Adamson and Patty Leppert (FERC) regarding preparation for filing of the PAD and NOI for the Grant Lake/Falls Creek Project.	FERC
6/1/2009	Phil North (EPA) emailed Brad Zubeck (KHL) to inform him that he did not have additional information to add to the record for the Grant Lake/Falls Creek Project at this time.	EPA
6/2/2009	Brad Zubeck (KHL) completed an email FOIA request to the ACOE for information regarding the Grant Lake/Falls Creek area.	ACOE
6/8/2009	Brad Zubeck (KHL) and Joe Adamson (FERC) exchanged emails regarding a list of Tribal contacts for the Project.	FERC
6/9/2009	Brad Zubeck (KHL) spoke with Mark Lamoreaux (Eklutna Village) by phone to inquire regarding the Eklutna Village's interest in the Projects and to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Mark with information on the Kenai Hydro website and document library.	Eklutna Village
6/9/2009	Brad Zubeck (KHL) spoke with Sherian Soaries (Kenai Natives Association) by phone to inquire regarding the Kenai Native Association's interest in the	Kenai Natives Association

Date	Summary of Contact	Agency/Organization Contacted
	Projects and to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Sherian with information on the Kenai Hydro website and document library	
6/9/2009	Brad Zubeck (KHL) spoke with Patty Andrews and Deb Daisy (Chenega Corporation) by phone and left a voicemail with Peter Nosek (Chenega Corporation) to inquire regarding the Chenega Corporation's interest in the Projects and to request relevant information for the Grant Lake/Falls Creek Project. Brad also provided Patty and Deb with information on the Kenai Hydro website and document library	Chenega Corporation
6/10/2009	Jenna Borovansky (LVA) spoke with Gary Prokosch (ANDR) by phone to request relevant information for the Grant Lake/Falls Creek Project. Jenna also provided Gary with information on the Kenai Hydro website and document library, and requested feedback regarding use of the TLP.	ADNR
6/10/2009	Jason Kent (HDR) emailed Instream Flow Technical Workgroup members relevant literature reviews on instream flow methodologies provided by Jason Maow (ADFG).	Instream Flow TWG
6/12/2009	Jenna Borovansky (LVA) left a voicemail (6/11/2009) and spoke with Jim Ferguson (ADFG) by phone to request relevant information for the Grant Lake/Falls Creek Project. Jenna also provided Jim with information on the Kenai Hydro website and document library, and requested feedback regarding use of the TLP.	ADFG
6/16/2009	Paul McLarnon and Erin Cunnignham (HDR) and Jason Mouw and Tom Cappiello conducted a site visit to discuss current and proposed fisheries and instream flow methodologies.	ADFG
6/19/2009	Jenna Borovansky (LVA) emailed all interested parties information on the Kenai Hydro website and login instructions, and requested relevant information for the PAD.	All interested parties
6/19/2009	Jenna Borovansky (LVA) emailed Instream Flow Technical Workgroup members information on the Kenai Hydro website, login instructions, and notice that draft May 19, 2009 meeting notes were available.	Instream Flow TWG
6/21/2009	Mike Cooney (FOCL) emailed comments on the draft May 19, 2009 TWG meeting notes to Jenna Borovansky (LVA).	FOCL
6/24/2009	Jenna Borovansky (LVA) left a voicemail and sent a follow-up email to Susan Walker (NOAA) to request relevant information for the Grant Lake/Grant Creek Project and to request feedback regarding Kenai Hydro's intent to	NOAA

Date	Summary of Contact	Agency/Organization Contacted
	request use of the TLP.	
7/01/2009	Jason Kent (HDR) emailed Instream Flow Technical Workgroup members notice of a July conference call to discuss field work and a memo summarizing 2009 habitat suitability data collection.	Instream Flow TWG
7/09/2009	Paul McLarnon (HDR) emailed TWG members to change the July conference call date to July 16, 2009.	Instream Flow TWG
7/10/2009	Jenna Borovansky (LVA) left a phone message, and followed up with an email to request relevant information on the Grant Lake/Falls Creek Project area from Cassie Thomas (NPS). Cassie emailed information on trail projects supported by the NPS near the proposed Project area.	NPS
7/10/2009	Jenna Borovansky (LVA) left a voicemail, and exchanged emails with Travis Moseley (USFS) to request relevant information on the Grant Lake/Falls Creek Project area and to provide information on the Kenai Hydro website.	USFS
7/13/2009	Brad Zubeck (KHL) contacted interested agencies, Tribes, and key stakeholders requesting feedback on a proposed communications protocol and use of the Traditional Licensing Process.	Agencies, Tribes, and Stakeholders (See record for list.)
7/14/2009	Paul McLarnon (HDR) and Jason Mouw (ADFG) exchanged emails regarding a potential collaboration to conduct a piezometer study in Grant Creek.	ADFG
7/14/2009	Brad Zubeck (KHL) emailed Valerie Cooper (Alaska Center for the Environment) a copy of KHL's request to use the TLP and proposed communications protocol, and answered questions regarding the public process.	Alaska Center for the Environment
7/15/2009	Paul McLarnon (HDR) emailed Instream Flow Technical Workgroup members a mid-season update on field studies and an agenda for the July 16, 2009 conference call.	Instream Flow TWG
7/15/2009	Brad Zubeck (KHL) and Mike Cooney (FOCL) exchanged emails regarding the request to use the Traditional Licensing Process and opportunities for public comment.	FOCL
7/16/2009	Instream Flow Technical Workgroup conference call to discuss methodologies and field study updates.	ADFG, ADNR, FOCL, USFWS
7/20/2009	Valerie Cooper (Alaska Center for the Environment) exchanged emails with Jenna Borovansky (LVA) regarding the process for public participation and comment on Kenai Hydro proposals.	Alaska Center for the Environment

Date	Summary of Contact	Agency/Organization Contacted
7/22/2009	Paul McLarnon (HDR) and Tom Cappiello (ADFG) exchanged emails regarding the gill net methods being used in Grant Lake.	ADFG
7/22/2009	Robert Baldwin (FOCL) commented by email in opposition to the proposed TLP and communications proposal.	FOCL
7/22/2009	Jason Aigeldinger commented by email in opposition to the proposed use of the TLP and communications proposal.	Public
7/22/2009	Laura Aigeldinger commented by email in opposition to the proposed use of the TLP and communications proposal.	Public
7/28/2009	Jenna Borovansky (LVA) exchanged phone calls with Lynnda Kahn to (USFWS) to confirm there were no listed species in the proposed Project area.	USFWS
7/28/2008	Jim Ferguson (ADFG) provided feedback to Brad Zubeck (KHL) on ADFG's ability to comment on the proposed use of TLP and communications protocol.	ADFG