Terrestrial Vegetation Study
Cooper Lake Project (FERC No. 2170)

Final Report

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Prepared for
Chugach Electric Association, Inc.

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Terrestrial Vegetation Study
Cooper Lake Project (FERC No. 2170)

INTRODUCTION AND BACKGROUND

Study Purpose

The Cooper Lake Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) Project No. 2170, is owned and operated by Chugach Electric Association, Inc. (Chugach). The Project was originally licensed by FERC in May 1957, and the current license term expires at the end of April 2007. To retain its status as owner and operator of the Project, Chugach must file a final license application with FERC no later than April 30, 2005. As part of the process of developing an application to relicense the Project, Chugach has undertaken a program of studies designed to determine the ongoing and potential future effects of the Project on environmental resources.

This document reports the results from the terrestrial vegetation study. The objectives of this study are to map and inventory plant cover types in the Project area and identify current Project impacts and potential future changes to those cover types associated with Project-related activities. Because wildlife use is related to vegetation type, understanding present and future vegetation will also allow descriptions of existing and future wildlife use (see Terrestrial Wildlife Study). Plant communities in the Project area have been affected by continuing maintenance and operation of the Project, including reservoir operations and routine vegetation clearing. To assess impacts on surrounding plant communities, baseline plant community information was collected and used to predict future changes to existing plant communities.

The research and fieldwork for this study were conducted during 2003. The study was conducted by biologists on staff at HDR Alaska, Inc. The study was conducted according to the approach described in the Terrestrial Vegetation Final 2003 Study Plan (HDR 2003), which was developed in consultation with resource agencies and other relicensing participants.

Description of the Project

Location and Project Lands

The Project dam and powerhouse are located within the Kenai Peninsula Borough, in southcentral Alaska, approximately 55 miles south of Anchorage. The closest community to the Project dam and powerhouse is Cooper Landing, approximately 4 miles north of Cooper Lake. Project facilities are located on Cooper Creek, Cooper Lake, and Kenai Lake. In addition, the 90-mile-long Project transmission line between the Quartz Creek Substation (near Cooper Landing) and Anchorage crosses land located in both the Kenai Peninsula and Municipality of Anchorage boroughs. Lands occupied by the Project are owned and/or managed by the USDA Forest Service (USFS), Alaska Department of Natural Resources, and private landowners. The Project area, licensed Project boundary, and ownership/management of Project-area lands are shown in Figure 1 and 2.

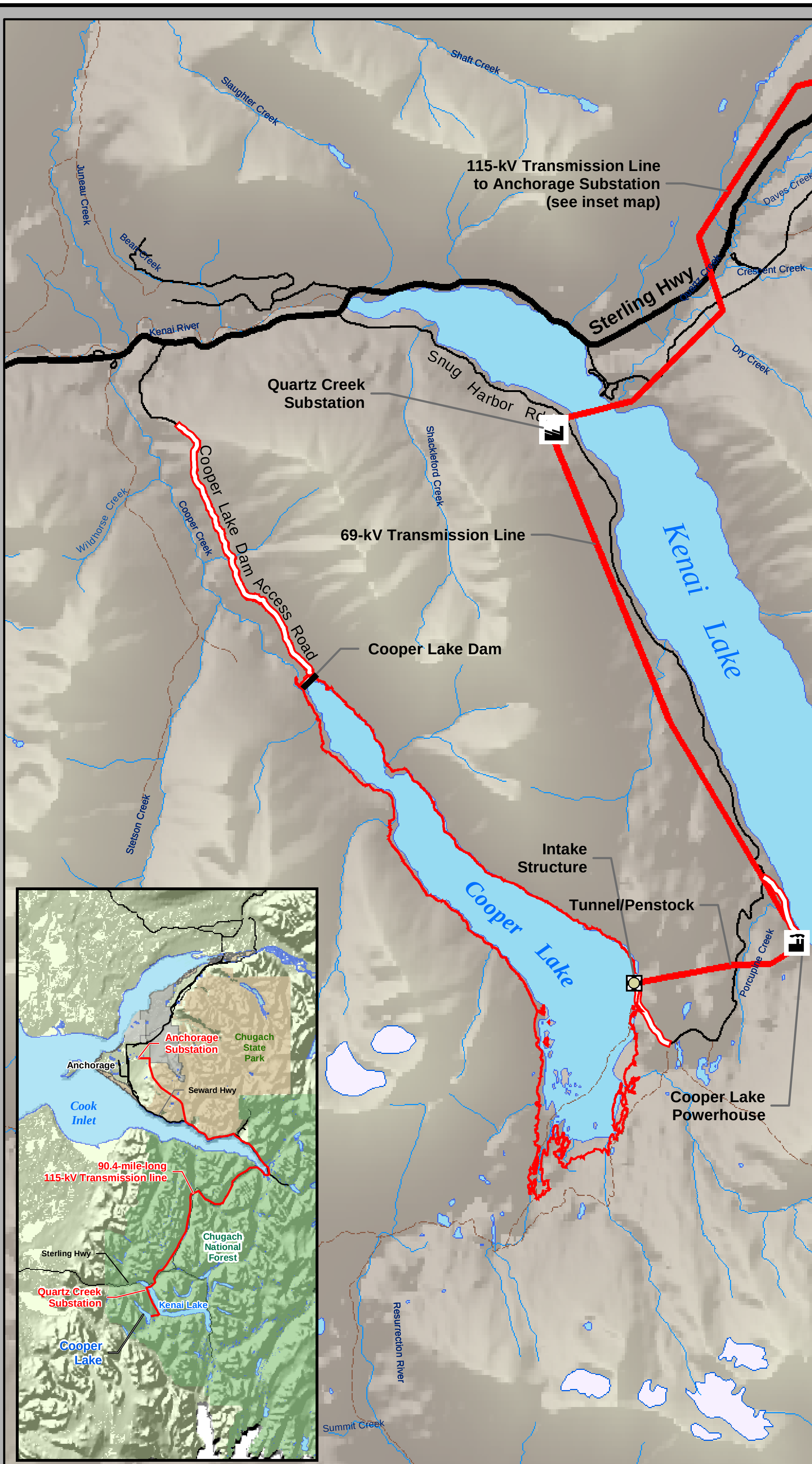
Project Components

Cooper Lake Dam was constructed in 1957–1959 on Cooper Creek, approximately 4.8 river miles from the mouth of the creek at the outlet of Cooper Lake. The dam raised the elevation of Cooper Lake to provide increased storage capacity for hydroelectric generation. Storage below the base of the dam (at elevation 1,168 feet) above mean sea level [MSL]) is provided by the natural lake; storage above that level to the top of the Cooper Lake Dam spillway (elevation 1,210 feet MSL) is created by the dam. At its licensed normal maximum operating level of 1,210 feet MSL, Cooper Lake covers approximately 3,100 acres and has a mean depth of 187 feet.

The Project diverts water at the intake on Cooper Lake through the tunnel/penstock to the powerhouse on Kenai Lake. The Project powerhouse is located on the southwest shore of Kenai Lake, approximately 7 miles from the outlet of the lake. Cooper Creek and Kenai Lake both flow into the Kenai River.

The primary components of the Project are as follows:

- Cooper Lake Dam, a rock-and-fill structure across Cooper Creek at the outlet of Cooper Lake.
- Cooper Lake, a natural lake that has been increased in area to a maximum of approximately 3,100 acres by the dam. (*Note*: The surface area of the reservoir at its current maximum operating level of 1,194 feet MSL is approximately 2,600 acres.)
- An intake structure, located approximately 5 miles (8 km) southeast of the dam on Cooper Lake. Elevation of the invert (base) of the opening to the tunnel/penstock is at 1,151 feet MSL (43 feet below the water surface at the normal maximum operating elevation of 1,194 feet MSL).
- A tunnel, conduit, and penstock extending 10,300 feet east from the intake structure on Cooper Lake to the Cooper Lake Powerhouse on Kenai Lake.
- Cooper Lake Powerhouse, containing two turbine/generator units, each rated at 9.69 megawatt (MW); (upgraded from 7.5 MW in 2000).
- A single-phase 4.16-kV distribution line from the powerhouse to the intake structure.
- A 6.3-mile-long 69-kilovolt (kV) transmission line from the Cooper Lake Powerhouse to the Quartz Creek Substation in Cooper Landing.
- 69/115-kV step-up transformer and appurtenant facilities at the Quartz Creek Substation.
- A 90.4-mile-long 115-kV transmission line from the Quartz Creek Substation to the Anchorage Substation.



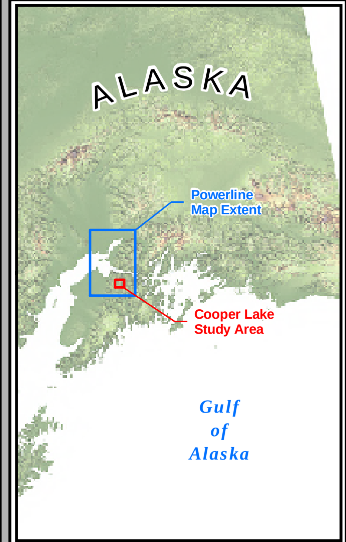


Figure 1
Project Components

Cooper Lake Project
FERC #2170

LEGEND

- Powerline
- 1210-ft Elevation
- Project Roads
- Highways
- Roads
- Trails
- Lakes
- Rivers & Streams
- Glacier

1. Mapping completed by HDR Alaska, Inc.
2. All data shown is projected in Alaska stateplane zone 4, North American datum of 1927

0.5 0.25 0 0.5 1 1.5 Miles

HDR Alaska

Date: 1/24/2004
File: figure1.mxd
Author: PM

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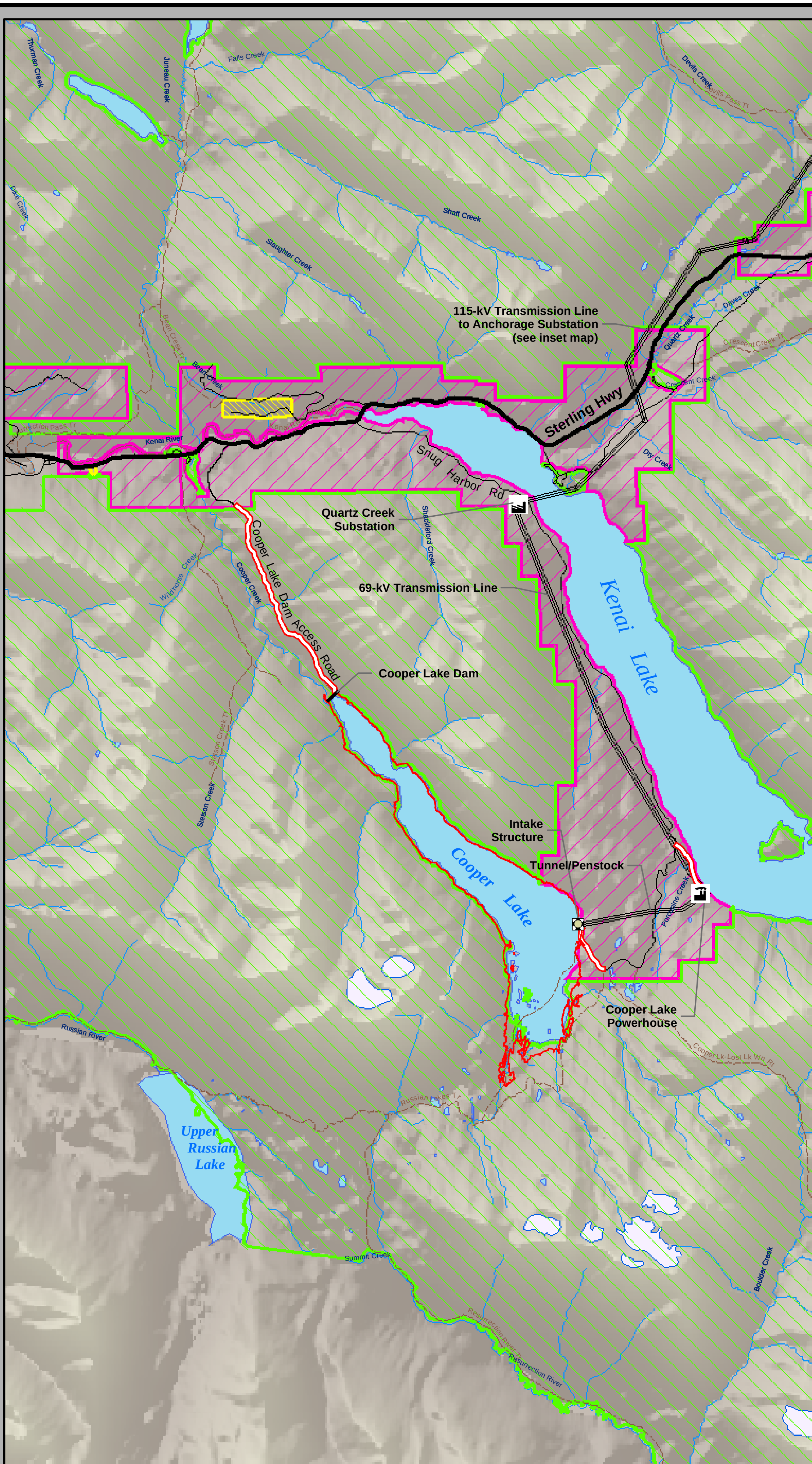

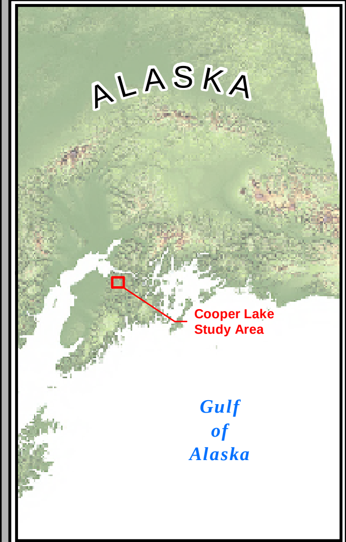

Figure 2
Land Ownership

Cooper Lake Project
FERC #2170

LEGEND

- Powerline
- 1210-ft Elevation
- Project Roads
- State of Alaska
- Chugach National Forest
- Private Land
- Highways
- Roads
- Trails
- Lakes
- Rivers & Streams
- Glacier

1. Mapping completed by HDR Alaska, Inc.
2. All data shown is projected in Alaska stateplane zone 4, North American datum of 1927

0.5 0.25 0 0.5 1 1.5 Miles

HDR Alaska

Date: 1/22/2004

File: figure1.mxd

Author: PM

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Project-related roads and access routes, as shown on Figure 1 are:

- Snug Harbor Road, an improved USFS easement across State-owned lands, extending from Cooper Landing to the vicinity of the Project powerhouse. This road was established to allow construction of the Project, but is open to the public and is now used for multiple purposes (including access to private homes along Kenai Lake and nearby recreation areas). Snug Harbor Road and spurs off this road provide access to the Project powerhouse and intake structure. The following spur roads off Snug Harbor Road are used primarily or solely for Project operations and maintenance, and are proposed for inclusion in the Project boundary under the new license:
    - Spur to the Project powerhouse
    - Spur from the Russian Lakes Trailhead to the intake structure on Cooper Lake
    - Spur road to the surge tank on the penstock
    - Spur road to the lower portal of the tunnel.
    - Spur road to the Quartz Creek Substation.
    - Spur road to an old logging area (FDR 1030300)
    - Six access routes to the powerline between the powerhouse and the Quartz Creek Substation.
- Cooper Lake Dam access road, an unimproved road from Cooper Landing up the Cooper Creek canyon. Most of this road is located on USFS land. This gated road is officially used solely for access to Cooper Lake Dam for the purpose of operations and maintenance related activities; however, it is also informally used by the public for hiking, off-road vehicle use, horseback riding, mountain biking, and snowmachine use. This road is proposed for inclusion in the Project boundary.
- Developed and undeveloped access routes to the 90-mile-long Quartz Creek to Anchorage transmission line. These routes are located on USFS and State-managed lands. All existing and potential future access routes that have been identified by Chugach for possible Project-related use during the next license term are proposed for inclusion in the Project boundary.

Overview of Project Operations

The Project stores all inflow to Cooper Lake and diverts the entire outflow from the reservoir through the tunnel/penstock to the powerhouse, which discharges into Kenai Lake. For the period 1985–2002, the diverted natural flow ranged on average from around 20 cubic feet per second (cfs) during late winter / early spring to about 260 cfs during early summer snowmelt, based on calculated inflows to Cooper Lake. Average annual inflow to / discharge from the reservoir for the same period was approximately 74,000 acre-feet (Chugach 2002).

The licensed maximum normal operating elevation of Cooper Lake is 1,210 feet MSL. However, since the mid-1980s, the reservoir has been operated at a normal maximum level of 1,194 feet MSL; the upper 16 feet of licensed reservoir storage is reserved for flood surcharge to ensure that the theoretical probable maximum flood (PMF) can be passed through the spillway without overtopping the dam. The reservoir typically is drawn down during late fall – early spring, experiences its most rapid refilling during the period of late spring – summer snowmelt runoff, and continues to fill through early fall. Within any given year, the reservoir typically fluctuates (on average) within a zone of about 15 feet (Chugach 2002).

The absolute range of reservoir operations varies from year to year, but generally remains within a relatively consistent band. The extreme high reservoir level (i.e., in a wet year) is approximately 7 or 8 feet above the annual high-water level experienced in an average year. Similarly, the extreme low reservoir level (i.e., in a dry year) is about 7 or 8 feet below the lowest level experienced in an average year (Chugach 2002).

Electricity generated at the powerhouse (which averages approximately 50,500 megawatt-hours [MWh] per year) is transmitted to the Quartz Creek Substation, where it is transferred to the 90-mile-long Project transmission line to the Anchorage Substation and the non-Project transmission line to the Kasilof Substation. Electricity is also distributed to local communities located along the transmission line route.

Project-Related Resource Issues Addressed by this Study

Plant communities in the Project area have been affected by the continued maintenance and operation of the Project, including reservoir operations and routine vegetation clearing. In addition, potential future changes in Project operation, such potential releases of flow to Cooper Creek, could affect vegetation communities in the future. To assess ongoing and potential future impacts on surrounding plant communities, baseline information on plant community composition, structure, and sensitivity to perturbations (i.e., how they have responded to existing Project activities) was collected and used to predict future changes to existing plant communities. This study evaluates changes to plant communities that have been affected by Project operations (i.e., clearing and burning of vegetation adjacent to the lake, vegetation clearing along the powerline, road and facility construction). Information gained from this study would likely support the identification of future appropriate mitigation options addressing any adverse impacts to plant communities and wildlife habitats.

At the time the 2003 study plans were developed, Chugach was considering proposing modifications to the dam spillway that would allow the reservoir to be operated safely at an increased maximum normal level of 1,206 feet MSL. The original Terrestrial Vegetation Study Plan was written to address this proposed change. However, this proposal has since been removed by Chugach and is not evaluated in this report.

STUDY AREA

The study area is intended to cover vegetation and terrestrial wildlife habitat that may be affected by Project operation and maintenance activities. The study area is defined as follows:

1. ***Cooper Lake Reservoir.*** Vegetation cover types were mapped to a line 50 feet (measured along the ground surface) beyond the licensed normal maximum reservoir elevation of 1,210 feet MSL around Cooper Lake.
2. ***Cooper Creek.*** Vegetation cover types were mapped to include the entire estimated floodplain of Cooper Creek. The study area was originally intended to be variable in width (see 2003 Terrestrial Vegetation Study Plan). In confined areas within the canyon, the floodplain limits would be the toes of the canyon walls. Along the lower half mile of Cooper Creek, where it emerges from its canyon and crosses an alluvial fan, the mapping

width would increase to include the entire floodplain area. Instead, a 200-foot-wide corridor was mapped that includes all of these features. It extends 100 feet either side of Cooper Creek.

3. ***Snug Harbor Road.*** Vegetation cover types were mapped along a 100-foot swath surrounding the road, including Project-related spur roads, defined as 50 feet on either side of road centerline.
4. ***Cooper Dam Access Road.*** Vegetation cover types were mapped along a 100-foot swath surrounding the road, defined as 50 feet on either side of road centerline.
5. ***Penstock (Surge Tank) Access Road.*** Vegetation cover types were mapped along a 100-foot swath surrounding the road, defined as 50 feet on either side of road centerline.
6. ***Transmission and Distribution Lines.*** Vegetation cover types were mapped along the two Project transmission lines (the 6.3-mile-long transmission line from the powerhouse to the Quartz Creek Substation, and the 90-mile-long transmission line from the Quartz Creek Substation to Anchorage) and the distribution line from the powerhouse to the intake structure. The mapping extends to 100 feet beyond the clearing limits on either side of these powerline corridors. Included in this mapping were areas adjacent to the Project intake structure, powerhouse, and Quartz Creek Substation.
7. ***Powerline Access Routes.*** Vegetation cover types were mapped along a 100-foot swath surrounding each access route, defined as 50 feet on either side of route centerline.
8. ***Other Structures.*** Vegetation cover types were mapped within 50-foot-wide area surrounding the intake structure, powerhouse, and Quartz Creek Substation.

METHODS

Vegetation mapping and characterization was completed in three primary steps: (1) review existing information and complete office-based preliminary vegetation mapping; (2) collect field data to verify preliminary vegetation mapping and inventory plant community characteristics; and (3) prepare final vegetation cover type mapping and plant community characterization using field data, aerial photography, and existing documentation.

The methodology used to map and describe plant communities in the study area was selected using a combination of USFS vegetation mapping protocols (DeVelice et al. 1999; USDA Forest Service 1993; Viereck and Little 1992; and USDA Forest Service 2002b) and through agency coordination and input (contributing agencies include the USFS, U.S. Fish and Wildlife Service [USFWS], and Alaska Department of Fish and Game [ADFG]). The primary objective of the study was to produce the most accurate, up-to-date mapping and database reasonably possible that is consistent with the needs of other project resource studies. The methods used in this study are described below under Task 1, Task 2, and Task 3.

Task 1: Review existing information and complete office-based preliminary mapping

Existing information, including aerial photography, digital elevation models, stream coverages, wetland mapping, habitat layers, and regional vegetation mapping already completed by the USFS (see Table 1), was compiled for use in a Geographic Information System (GIS) database.

Table 1. Existing Vegetation Mapping for the Project Area

Study	Year	Description	Usefulness to Study
Cover Type Mapping	1978	Using source data from 1950-1970, the USFS categorized vegetation cover in Chugach National Forest. A sub-set of data from the USFS timber type mapping.	*Low*- minimum size of mapped plant communities is 10 acres. Too large for the purpose of this study.
Land Cover Classification	1997	Using source data from 1990, the USGS categorized vegetation communities throughout Southcentral Alaska using satellite imagery.	*High*- minimum size of mapped plant communities is 30 sq.m. Limited ground truthing. Good descriptions of Level II/III communities.
Timber Type Mapping	1978	Using source data from 1950-1970, the USFS categorized timber production areas in Chugach National Forest.	*Low*- mapping is oriented to timber activities and does not accurately describe plant communities.
Kenai Peninsula Earth Cover Classification	1999	Using Landsat TM satellite imagery from July 10, 1989, Ducks Unlimited, Inc. and Spatial Solutions, Inc. categorized vegetation communities across the Kenai Peninsula.	*High*- minimum size of mapped plant communities is 28.5 sq.m. Field verification and accuracy assessment were conducted. Overall accuracy was 81%, with good description of Level II/III communities.
Forest Vegetation Plots	1999	A database of vegetation community composition from 76 sites sampled in 1989 and 1991 in the vicinity of Cooper Lake and Cooper Creek. Information collected at each site includes canopy cover estimates for all vascular plant species present.	*Medium*- the database provides detailed descriptions of forest vegetation composition and structure at points within a portion of the project study area.
Pre-dam vegetation around Cooper Lake	2002	Using 1950 and 1951 aerial photography, the USFS mapped plant communities surrounding Cooper Lake and at the alluvial fan of Cooper Creek at the Kenai River before the dam was constructed. This mapping was completed for the Cooper Creek Watershed Analysis study (USDA Forest Service 2002a).	*Medium*- detailed historical mapping specific to areas surrounding Cooper Lake.
Current vegetation around Cooper Reservoir	2002	Using recent aerial photography (date unknown), the USFS mapped plant communities surrounding Cooper Lake and at the alluvial fan of Cooper Creek at the Kenai River. This mapping was completed for the Cooper Creek Watershed Analysis study (USDA Forest Service 2002a).	*High*- detailed mapping specific to areas surrounding Cooper Lake.

Initially, project scientists gathered existing vegetation information for the Project area to evaluate the level of effort that would be needed to accurately describe plant communities. Several datasets exist for both Cooper Lake and Cooper Creek, but these do not describe the communities in enough detail to understand community structure and habitat characteristics. One disadvantage of the existing mapping has to do with the overall accuracy of the datasets.

All were completed using either satellite or aerial photograph imagery interpretation, with limited ground truthing. The datasets that were reviewed, and their usefulness for the purposes of this study, are described in Table 1.

Preliminary mapping of Cooper Lake and Cooper Creek was completed by discerning vegetation cover types on color contact prints (Table 2) with a stereoscope, and then digitizing those vegetation boundaries into the Project GIS database. Vegetation characteristics, including vegetation cover type and forest canopy cover class were identified from aerial photography to the degree possible. Differences in these characteristics that are discernable on the photos were the primary basis for delineating vegetation boundaries.

The original intention was to map cover types to a minimum scale of 2 acres, as requested by the USFS. However, given the study area's generally narrow shape, mapping 2-acre minimum size polygons proved too gross in resolution to accurately describe plant communities. Instead, mapping was completed at a finer resolution. Mapped vegetation cover types identifiable on project aerial photography were included in the mapping regardless of size. Cover types were typically larger in overall size, extending beyond the study area boundary, but much smaller than a minimum size of 2 acres within the confines of the mapped boundary. All mapped polygons were classified using the system shown in Table 3.

Table 2. Aerial Photography Datasets

General Location	Date taken	Scale
Cooper Lake	May 7, 2003	1:12,000
Cooper Lake	September 24, 1998	1:12,000
Cooper Lake	August, 1984	1:60,000
Cooper Lake	June 25, 1951	1:40,000
Cooper Creek	May 7, 2003	1:8,400
Cooper Creek	July 11, 1975	1:18,000
Cooper Creek	July 28, 1974	1:18,000
Powerline	August 2, 2002	1:18,000
Anchorage Bowl	September 10, 2002	1:12,000
Summit Lake to Kenai Lake	June 30, 2003	1:18,000

Similar methods were used for mapping cover types along and adjacent to the powerlines, access roads, and access routes as were used for Cooper Lake and Cooper Creek, but the intensity of ground truthing was less. The intensity was less because no major changes in Project operations that affect vegetation, including vegetation clearing maintenance practices, are expected to occur to the powerline and access routes in conjunction with future Project operations. Also, the linear shape of the powerline and access route corridors, their length, and difficult access make it relatively time consuming to field verify the mapping.

Based on the 2003 Terrestrial Vegetation Study Plan, vegetation cover types were intended to be mapped at a minimum scale of 5 acres along the powerline and access routes, as requested by the USFS. However, given the study area's narrow shape along the linear features of the powerline, access roads, and access routes, mapping 5-acre minimum size polygons proved too gross in resolution to accurately describe plant communities. Instead, mapping was completed at a finer resolution. Mapped cover types identifiable on project aerial photography were included in the mapping regardless of size. Cover types were typically larger in overall size, extending beyond the study area boundary, but much smaller than a minimum size of 5 acres within the confines of the mapped boundary. All mapped polygons were classified using the system shown in Table 3.

Table 3. Plant Community Mapping Codes

<table>
<tr><th colspan="6">Vegetation cover type</th></tr>
<tr><td colspan="3">A. spruce</td><td colspan="3">K. alder tall scrub</td></tr>
<tr><td colspan="3">B. hemlock</td><td colspan="3">L. willow tall scrub</td></tr>
<tr><td colspan="3">C. hemlock-spruce</td><td colspan="3">M. low scrub</td></tr>
<tr><td colspan="3">D. birch</td><td colspan="3">N. dwarf scrub</td></tr>
<tr><td colspan="3">E. cottonwood</td><td colspan="3">O. graminoid herbaceous</td></tr>
<tr><td colspan="3">F. aspen</td><td colspan="3">P. forb herbaceous</td></tr>
<tr><td colspan="3">G. spruce-birch</td><td colspan="3">Q. free water</td></tr>
<tr><td colspan="3">H. spruce-cottonwood</td><td colspan="3">R. frozen water</td></tr>
<tr><td colspan="3">I. spruce-aspen</td><td colspan="3">S. barren/sparsely vegetated</td></tr>
<tr><td colspan="3">J. hemlock-birch</td><td colspan="3"></td></tr>
<tr><th colspan="6">Forest canopy cover class</th></tr>
<tr><td colspan="6">A. Closed - ≥60 percent</td></tr>
<tr><td colspan="6">B. Open - 25-59%</td></tr>
<tr><td colspan="6">C. Woodland - 10-24%</td></tr>
<tr><th colspan="6">Vegetation community type group</th></tr>
<tr><td colspan="2">Forest Types</td><td colspan="2">Scrub Types</td><td colspan="2">Herbaceous Types</td></tr>
<tr><td colspan="2">A. alder</td><td colspan="2">J. alder</td><td colspan="2">R. bluejoint</td></tr>
<tr><td colspan="2">B. bluejoint</td><td colspan="2">K. cassiope</td><td colspan="2">S. fern</td></tr>
<tr><td colspan="2">C. devil’s club</td><td colspan="2">L. crowberry</td><td colspan="2">T. fireweed</td></tr>
<tr><td colspan="2">D. dwarf scrub</td><td colspan="2">M. dwarf birch</td><td colspan="2">U. horsetail</td></tr>
<tr><td colspan="2">E. fern</td><td colspan="2">N. salmonberry</td><td colspan="2">V. rough fescue</td></tr>
<tr><td colspan="2">F. menziesia</td><td colspan="2">O. sweet gale</td><td colspan="2">W. sedge</td></tr>
<tr><td colspan="2">G. moss</td><td colspan="2">P. willow</td><td colspan="2">X. not differentiated</td></tr>
<tr><td colspan="2">H. tall blueberry</td><td colspan="2">Q. not differentiated</td><td colspan="2"></td></tr>
<tr><td colspan="2">I. not differentiated</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="6">Vegetation community type group: The appropriate indicator of the undergrowth community type group is appended to the vegetation cover type name. Determinations of the indicator species will be made using Plant Community Types of the Chugach National Forest: Southcentral Alaska (Technical Publication R1O-TP-76), including the key to community types presented in Appendix A of that document.</td></tr>
<tr><th colspan="6">Height Class</th></tr>
<tr><td colspan="3">Upper Canopy</td><td colspan="3">Subcanopy</td></tr>
<tr><td colspan="3">A. 0-5 feet</td><td colspan="3">A. 0-1 feet</td></tr>
<tr><td colspan="3">B. 5-10 feet</td><td colspan="3">B. 1-5 feet</td></tr>
<tr><td colspan="3">C. 10-20 feet</td><td colspan="3">C. 5-10 feet</td></tr>
<tr><td colspan="3">D. 20-30 feet</td><td colspan="3">D. >10 feet</td></tr>
<tr><td colspan="3">E. 30-40 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">F. 40-50 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">G. 50-60 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">H. 60-70 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">I. 70-80 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">J. 80-90 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">K. 90-100 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">L. 100-110 feet</td><td colspan="3"></td></tr>
<tr><td colspan="3">M. >110 feet</td><td colspan="3"></td></tr>
</table>

Task 2. Collect field data to verify preliminary vegetation mapping and inventory plant community characteristics

Project scientists ground truthed representative cover types defined from aerial photograph interpretation. A minimum of 10 percent of all polygons identified from stereoscopic interpretation, and at least one representative site for each cover type, were visited to accurately define plant community characteristics. Locations of data plots were selected to coincide with locations to be used for the wildlife use study and wetland study. By coordinating data sampling locations, baseline data collected could be used to assess habitat quality. Fieldwork efforts were focused on describing representative cover types and areas identified during preliminary mapping that are difficult to delineate using aerial photography.

Field data collection methods generally followed those described in DeVelice et al. (1999). Data were collected from sampling plots that represent a homogeneous 500sq.m area within a cover type polygon mapped by aerial photographic interpretation. Size and shape of each sampled plot was documented and justified. The location of each plot was recorded using a hand-held global positioning system (GPS) unit. Sampling locations were distributed over a range of physical conditions (i.e., elevation and slope). Data plot locations were selected subjectively, based on the logistics of access, distribution across the geographic range of their occurrence in the Project area, and their interpretation difficulty on aerial photos, with particular emphasis on locating plots in areas likely to be directly affected by future Project operations. Parameters measured at each plot include:

a. Percent cover of vascular plant species. This was obtained by a visual estimate.
b. Average height and breast height diameter (dbh) of tree species. Along Cooper Creek, average height and dbh were collected for shrubs, in addition to trees. Average height and dbh of species were estimates. Standard forestry measurement methods were used at the first and last vegetation plots of each day to calibrate measurement estimates.
c. Wildlife sign relevant to comparing wildlife use by habitat type (droppings, browsing, bird singing, carcasses, tracks and burrows).
d. Vegetation structure and composition based on the coding system shown in Table 3.

Task 3. Prepare final vegetation mapping and plant community characterization using field data, aerial photography, and existing documentation.

Modifications to preliminary vegetation mapping were made to address new information gained during the field verification. This included extrapolating findings from the representative sites visited to the others not visited. Field data collection sites were added to the digital coverages. GIS technology was used to analyze cover type abundance, complete a database for all cover types with community features in Table 3, and summarize results of the mapping. Additionally, vegetation information was provided to the project wildlife, waterbird and fisheries scientists to support their studies.

RESULTS

A total of 15 cover types, including 13 vegetated (Table 4) and 2 unvegetated types (Table 5), were identified in the 8,075-acre study area. These types are briefly described below and generally match many of the communities that DeVelice et al. (1999) described in the publication "Plant Community Types of the Chugach National Forest: Southcentral Alaska." Plant names are identified in the descriptions by their common name; scientific names for all species described in this technical report are included in Appendix A. Figures showing the cover types mapped in the study area, overlaid on aerial photographs, are included in Appendix B. Photographs taken at each data form location are included in Appendix C.

Table 4. Summary of Mapped Vegetative Cover Types

Cover Type	Acres Mapped	% Area Mapped
Needleleaf Forest Type	**1,823.8**	**36.8%**
Spruce	*509.5*	*10.3%*
Hemlock	*567.0*	*11.4%*
Hemlock-Spruce	*747.3*	*15.1%*
Broadleaf Forest Type	**253.8**	**5.1%**
Birch	*139.4*	*2.8%*
Cottonwood	*114.4*	*2.3%*
Mixed Needleleaf/Broadleaf Forest	**419.2**	**8.5%**
Mixed Forest	*419.2*	*8.5%*
Scrub Cover Type	**1,562.5**	**31.5%**
Alder Tall Scrub	*495.4*	*10.0%*
Willow Tall Scrub	*479.1*	*9.7%*
Low Scrub	*455.0*	*9.2%*
Dwarf Scrub	*132.9*	*2.7%*
Herbaceous Cover Type	**893.6**	**18.0%**
Graminoid	*419.0*	*8.4%*
Forb	*285.8*	*5.8%*
Mixed Forb/Graminoid	*188.8*	*3.8%*
Total mapped vegetated areas (acres)	**4,952.9**	**100%**

Needleleaf Forest Type

Three types of needle-leaved forest communities occur in the study area. These types include spruce forest, hemlock forest, and spruce-hemlock forest. Needleleaf forests are common to southcentral Alaska and generally occur throughout the study area from Anchorage south to Cooper Lake. Variations in percent cover, understory composition, and tree size occur throughout the geographic region.

Spruce Cover Type

***General Characteristics**:* In the mapped study area, two types of spruce forest occur. These are visibly and ecologically separate communities, but fall under the same mapped cover type category. They include stands of large, mature spruce trees and stands of stunted spruce trees. Spruce forests are one of the most abundant cover types mapped in the study area, occurring on 509.5 acres, making up 10.3 percent of the vegetated area (Table 4). Within southcentral Alaska, four species of spruce exist, including Sitka, white, black, and Lutz spruce. Field surveys identified all four species in the study area.

The most abundant spruce forest type is stands of mature Sitka, white, and/or Lutz spruce trees. Large, continuous areas of this mature forest community are present surrounding Cooper Lake, Cooper Creek, and Snug Harbor Road, and extend along much of the powerline from the powerhouse north to Upper Summit Lake. Common understory species in these mature spruce forests include false azalea, tall blueberry, early blueberry, Beauverd spirea, prickly rose, and five-leaved bramble.

Less abundant in the Project area are small stands of stunted black spruce trees. An open canopy of black spruce dominates this community type. Common understory species include low-bush cranberry, Labrador tea, bog blueberry, sedges, shrubby cinquefoil, crowberry, and sweetgale. In the study area, stunted black spruce forests occur in low, flat areas with saturated soils. The small size of spruce trees is a result of suppressed growth in response to the saturated soils (Viereck et al. 1992; Post, 1996). Although black spruce-dominated forests are one of the least abundant plant communities sampled in the study area, they are one of the most common vegetation types found throughout Alaska (Viereck et al. 1992; Post 1996). The areas mapped occur in the Anchorage bowl (directly south of Tudor Road, adjacent to the powerline) and in several areas along the western side of Snug Harbor Road, between the powerline and the road.

***Mapping Codes**:* Spruce forest communities have a cover type code of "A". Thirteen data forms were completed for this cover type (data form ID numbers 4, 22, 53, 63, 64, 65, 95, 110, 113, 115, 126, 127, and 147). Representative photographs of this cover type are included in Appendix C, photographs 1 and 2.

Hemlock Cover Type

***General Characteristics**:* Hemlock forests are common between Cooper Lake and Kenai Lake; occur intermittently north of the Quartz Creek/Sterling Highway intersection to the Hope Cutoff; and are common between the community of Indian and the Chugach State Park Glen Alps trailhead. Hemlock forests are one of the most abundant cover types mapped in the study area, occurring on 567 acres, making up 11.4 percent of the vegetated area (Table 4).

The overstory in this community is dominated by mountain hemlock, with a few spruce (Sitka, white, and/or Lutz) trees intermixed (generally less than 15 percent). Common understory species include false azalea, tall blueberry, early blueberry, pink wintergreen, and five-leaved bramble. Two distinct structure types of this cover type occur, relating to tree height and canopy characteristics. These differences are correlated with the physical and topographical position of individual stands. At upper elevations, near Glen Alps trailhead and several areas east of Cooper Lake, mountain hemlock trees are stunted (less than 10 feet tall), providing a dense cover over a sparse understory. In contrast, hemlock-dominated communities that occur along mountain slopes and at valley bottoms have much taller trees (up to 70 feet tall), an open canopy, and a denser understory with a greater number of species.

***Mapping Codes**:* Hemlock forests have a cover type code of "B". Ten data forms were completed for this cover type (data form ID numbers 11, 12, 74, 97, 105, 122, 125, 135, 137, and 140). Representative photographs of this cover type are included in Appendix C, photographs 3 and 4.

Spruce-Hemlock Mix Cover Type

***General Characteristics**:* Spruce-hemlock forests are mapped throughout large, contiguous areas stretching between Cooper Lake and Turnagain Pass, along mountain slopes between Twenty Mile River valley and Girdwood, and from Bird Creek northwest to Powerline Pass. It is the most common cover type mapped in the study area, comprising 747.3 acres, making up 15.1 percent of the vegetated area mapped (Table 4).

This forest type has an overstory dominated by mature Sitka, white, and/or Lutz spruce, and mountain hemlock. Trees are generally tall (about 60 feet tall), forming a nearly closed canopy (40–60 percent cover), and have an understory similar to that described above in the spruce forest and hemlock forest cover types. Common understory plant species include false azalea, tall blueberry, early blueberry, and five-leaved bramble. Between Cooper Lake and Turnagain Pass, a large number spruce snags occur, most likely killed by the Kenai Peninsula spruce bark beetle outbreak in the 1990s.

***Mapping Codes**:* Spruce-hemlock forests have a cover type code of "C". Ten data forms were completed for this cover type (data form ID numbers 20, 31, 32, 43, 57, 69, 70, 72, 73, and 120). Representative photographs of this cover type are included in Appendix C, photographs 5 and 6.

Broad-leaved Forest Type

Birch Cover Type

***General Characteristics**:* Birch forests cover 139.4 acres of the study area, making up 2.8 percent of all vegetated areas mapped (Table 4). Mature paper birch trees dominate the forest overstory, with a variety of species growing throughout the understory. In general, two different types of understory were sampled during field investigations. The first type consists of understory dominated by a thick shrub layer of alder and willow. Below the shrub-dominated understory, sparsely distributed herbaceous plants include common horsetail and wintergreen. The second observed type of understory was a mixture of graminoid and forb growth. Common understory species in this type include cow parsnip, devil's club, high-bush cranberry, red elderberry, goat's beard, twisted stalk, pink wintergreen, fireweed, bluejoint grass, and lady fern.

Forests with a shrub-dominated understory occur in the Anchorage Bowl near the Stuckagain Heights neighborhood, alongside the Seward Highway near Canyon Creek gorge, and in areas paralleling the powerline and Snug Harbor Road. Birch forests with a graminoid/forb understory were mapped along Turnagain Arm and throughout areas between the Hope Cutoff and Kenai Lake.

***Mapping Codes**:* Birch forests have a cover type code of "D". Three data forms were completed for this cover type (data form ID numbers 68, 81, and 117). Representative photographs of this cover type are included in Appendix C, photographs 7 and 8.

Cottonwood Cover Type

***General Characteristics**:* Cottonwood forests cover 114.4 acres of the study area, making up 2.3 percent of all vegetated areas mapped (Table 4). Communities dominated by an overstory of black cottonwood are common along stream floodplains, adjacent to riparian corridors, and encompassing raised elevated areas in the wetland flats of the Twenty Mile / Portage / Placer River valleys. In the Cooper Creek drainage, this cover type is common along the wide alluvial fan near the confluence of the creek with the Kenai River. This cover type is also mapped along the southern flats of Cooper Lake, just beyond the lake margin that is frequently inundated as a result of hydroelectric plant operations. Common understory species include devil's club, high-bush cranberry, alder, willow, one-sided wintergreen, pink wintergreen, twisted stalk, starflower, fireweed, lady fern, wood fern, common horsetail, and bluejoint grass.

***Mapping Codes**:* Cottonwood forests have a cover type code of "E". Four data forms were completed for this cover type (data form ID numbers 39, 100, 145, and 146). Representative photographs of this cover type are included in Appendix C, photographs 9 and 10.

Mixed Needleleaf/Broadleaf Forest Type

Mixed Forest Cover Type

***General Characteristics**:* Mixed needleleaf and broadleaf forests were mapped throughout approximately 420 acres (8.5 percent of vegetated areas mapped) of the study area (Table 4). Three types of mixed forest communities were surveyed: spruce-birch, spruce-cottonwood, and spruce-aspen.

Spruce-birch forests are the most common mixed forest cover type mapped in the study area (337 acres). This cover type has an overstory of Sitka, white, and/or Lutz spruce and paper birch. Common understory species include alder, false azalea, fireweed, lady fern, wood fern, and bluejoint grass. This mixed forest type occurs throughout the Anchorage Bowl, near the communities of Indian and Bird Creek, southwest of the Hope Cutoff, and along the powerline corridor west of Kenai Lake.

Few spruce-cottonwood forests were mapped in the study area (18 acres mapped; see Table 4). This cover type has an overstory of Sitka, white, and/or Lutz spruce and black cottonwood. Common understory species include alder, devil's club, fireweed, and bluejoint grass. This mixed forest type was mapped primarily in an area northwest of Summit Lake near Butcher and Colorado Creek.

Spruce-aspen forests were moderately abundant in the mapped study area (65 acres mapped; see Table 4). This cover type has an overstory of Sitka, white, and/or Lutz spruce and quaking aspen. The common understory species is fireweed. This mixed forest type was mapped adjacent to the powerline between Quartz Creek campground at Kenai Lake and extending northeast to the Quartz Creek/Sterling Highway intersection.

Mapping Codes*:* Spruce-birch forests have a cover type code of "G" (data form ID numbers 2, 6, 14, 61, 62, 67, 77, 83, and 155); spruce-cottonwood forests a cover type code of "H" (data form ID number 102); and spruce-aspen forests a cover type code of "I" (no data forms were collected for spruce-aspen mixed forest). Representative photographs of this cover type are included in Appendix C, photographs 11 and 12.

Scrub Community Types

Alder Tall Scrub Cover Type

General Characteristics*:* Alder scrub thickets are one of the most common cover types mapped in the study area, occurring over 495 acres (10 percent of vegetated area mapped) of the mapped study area (Table 4). They are abundant in both disturbed and undisturbed areas. Within disturbed areas, they form thin, narrow strips along roads. Alder thickets are also common within the cleared powerline right-of-way between Anchorage and Cooper Lake.

In undisturbed areas, this community is common along narrow strips adjacent to streams (notably the most common community type paralleling Cooper Creek along much of its length), forming much of the vegetated landscape along the eastern and western sides of Cooper Lake, along avalanche and landslide areas on Turnagain Pass, alongside the steep mountain slopes on the western side of the Seward Highway near Summit Lake, and just below the alpine areas near Powerline Pass.

Alder dominates the overstory; few areas also had low numbers of willow, cottonwood and spruce saplings in the canopy. Common understory species include common horsetail, meadow horsetail, twisted stalk, devil's club, red elderberry, wood fern, lady fern, oak fern, bluejoint grass, and willow.

Mapping Codes*:* Alder thickets have a cover type code of "K". Thirty-two data forms were completed for this cover type (data form ID numbers 7, 15, 16, 25, 26, 30, 36, 51, 55, 56, 58, 66, 75, 85, 87, 130, 132, 134, 138, 139, 142, 148, 149, 150, 151, 152, 153, 201, 204, 206, 207, and 208). Representative photographs of this cover type are included in Appendix C, photographs 13 and 14.

Willow Tall Scrub Cover Type

General Characteristics*:* Tall scrub willow thickets are common between Anchorage and Cooper Lake, covering 479.1 acres (9.7 percent of the vegetated area mapped) of the study area (Table 4). This cover type is one of the dominant cover types that exist along the cleared powerline corridor. Common willow species in the shrub overstory include Barclay's willow, felt-leaf willow, and Sitka willow. Common understory species include fireweed, dwarf birch, lupine, beach pea, common horsetail, bluejoint grass, and sedges.

This cover type is common along the southern flats of Cooper Lake, often occurring between a band of herbaceous growth (closest to the reservoir shoreline) and stands of cottonwood and spruce-hemlock forest (farthest from shoreline). Willow thickets also are common along the powerline between the Quartz Creek electrical substation and Quartz Creek Campground; between Lower Summit Lake and Saxton; adjacent to Sixmile Creek; along Turnagain Pass; throughout the Twenty –Mile / Portage / Placer River valley bottoms; and along several areas west of Flat Top Mountain near Anchorage.

***Mapping Codes**:* Willow thickets have a cover type code of “L”. Fifteen data forms were completed for this cover type (data form ID numbers 9, 23, 27, 28, 29, 35, 38, 92, 96, 107, 109, 114, 119, 136, and 203). Representative photographs of this cover type are included in Appendix C, photographs 15 and 16.

Low Scrub Cover Type

***General Characteristics**:* Low scrub plant communities were mapped along 455 acres (9.2 percent of the vegetated area mapped) of the study area (Table 4). Dominant community types that occur in the cover type include alder, willow, and salmonberry. Common understory species include fireweed, lady fern, oak fern, bluejoint grass, and Merten’s sedge. This cover type is abundant throughout much of the cleared powerline corridor from Powerline Pass south to Cooper Lake and within several large areas mapped at the southern flats of Cooper Lake.

***Mapping Codes**:* Low scrub communities have a cover type code of “M”. Thirteen data forms were completed for this cover type (data form ID numbers 13, 19, 46, 47, 52, 86, 91, 94, 104, 106, 133, 154, and 205). Representative photographs of this cover type are included in Appendix C, photographs 17 and 18.

Dwarf Scrub Cover Type

***General Characteristics**:* Dwarf scrub communities were mapped throughout 133 acres (2.7 percent of the vegetated area mapped) of the study area (Table 4). Dominant community types that occur in this cover type include willow, dwarf birch, and crowberry. Common understory species, including a wide variety of forb and graminoid species, were not differentiated. This cover type was primarily mapped along the powerline corridor in the alpine areas of Powerline Pass.

***Mapping Codes**:* Dwarf scrub communities have a cover type code of “N”. One data form was completed for this cover type (data form ID number 10). Representative photographs of this cover type are included in Appendix C, photographs 19 and 20.

Forb and Graminoid Community Types

Graminoid Cover Type

***General Characteristics**:* Throughout the study area, two dominant types of graminoid (grass-like) communities occur: bluejoint grass meadows and sedge meadows. The two plant community types cover 419.0 acres (8.4 percent of the vegetated area mapped) of the study area (Table 4). Bluejoint grass meadows are common throughout the study area. They are widespread in both disturbed (i.e., along roadsides, lakeshores, previously cleared areas) and undisturbed areas.

Bluejoint grass is the dominant plant species, almost making up the entire vegetation composition of the open meadows; however, small amounts of other species are common in the plant community type: fireweed, common horsetail, sedges, willow, and other grasses.

Sedge meadows occur in lowland areas surrounding Cooper Lake, in wetland areas between Cooper Lake and Turnagain Pass, in wet areas adjacent to Tudor Road in Anchorage, along coastal flats near Girdwood, and throughout the wetland areas of Twenty Mile / Portage / Placer River valleys. Common plant species in this community type vary by the physical setting. Sedge meadows surrounding Cooper Lake typically were dominated by fewflower sedge, with varying amounts of bog rosemary, sundew, Labrador tea, bog cranberry, low-bush cranberry, bog blueberry, and crowberry. In bog areas along the powerline between Cooper Lake and Turnagain Pass, common species include fewflower sedge, sundew, sphagnum moss, and sticky false asphodel. Along the coastal flats of Girdwood valley, the dominant sedge species is Lyngby's sedge. Other, non-dominant species include Pacific silverweed and beach rye.

***Mapping Codes**:* Bluejoint herb meadow and sedge meadow communities have a cover type code of "O". Ten data forms were completed for bluejoint herb meadows (data form ID numbers 41, 49, 54, 59, 71, 80, 88, 90, 98, and 103) and ten completed for sedge meadows (data form ID numbers 3, 18, 24, 33, 37, 44, 45, 89, 118, and 209). Representative photographs of this cover type are included in Appendix C, photographs 21 and 22.

Forb Cover Type

***General Characteristics**:* Open forb meadows occur on 285.8 acres (5.8 percent of the vegetated area mapped) of the study area (Table 4). Generally, in these forb meadows, it is common to see a mix of many species, which makes it difficult to differentiate separate forb meadows from aerial photography alone. Forb meadows are common along much of the powerline, often occurring in areas where forested communities were cleared to allow construction of the powerline corridor. Many of the disturbance communities found in the powerline corridor are not natural forb communities and commonly include non-native and weedy species (see Exotic Plants Study). Forb meadows are also common in undisturbed areas intermixed with scrub and forest communities.

The most common forb meadow seen in the study area is dominated by tall fireweed. These meadows occur throughout the Project area in both disturbed and undisturbed areas. They are common within the cleared powerline corridor, in areas adjacent to the Cooper Lake Dam access road, and in many small pockets surrounding Cooper Lake. The dominant plant species is fireweed, often making up 60–90 percent of the vegetative cover. Other non-dominant species occurring in these meadows include common horsetail, salmonberry, pink wintergreen, lupine, bluejoint grass, and cow parsnip.

Mapping Codes*:* Forb meadows have a cover type code of "P". Twenty-two data forms were completed for this cover type (data form ID numbers 5, 21, 34, 40, 42, 50, 60, 78, 99, 101, 108, 112, 123, 124, 128, 129, 131, 141, 143, 144, 200, and 202). Representative photographs of this cover type are included in Appendix C, photographs 23 and 24.

Mixed Forb/Graminoid Cover Type

General Characteristics*:* This cover type is a mix of graminoids and forbs, it occurs on 188.8 acres (3.8 percent of the vegetated area mapped) of the study area (Table 4). Much of the cleared powerline corridor has this cover type. Common plant species include fireweed, bluejoint grass, cow parsnip, Merten's sedge, salmonberry, tall blueberry, rush, willow, calthaleaf avens, dandelion, and rattlebox.

A large, relatively contiguous area that is mapped as a graminoid-forb meadow occurs within the Twenty–Mile / Portage / Placer River valley flats near the Seward Highway and Alaska Railroad. Common plant species in this coastal mudflat area include beach rye, lupine, beach pea, tufted hairgrass, and Pacific silverweed.

Mapping Codes*:* Graminoid-forb meadows have a cover type code of "O-P". Five data forms were completed for this cover type (data form ID numbers 1, 8, 82, 84, and 210). Representative photographs of this cover type are included in Appendix C, photographs 25 and 26.

Unvegetated Cover Types

Two unvegetated cover types were mapped in the study area: barren/sparsely vegetated areas and open water areas. These unvegetated cover types make up 3,122.6 acres (Table 5), or 38.7 percent of the entire 8,075-acre mapped study area.

Table 5. Summary of Mapped Unvegetated Areas

Cover Type	Acres Mapped	% Area Mapped
Free Water	2,569.3	82.3%
Barren/Sparsely Vegetated	553.3	17.7%
Total mapped unvegetated areas	**3,122.6**	**100%**

Barren/Sparsely Vegetated

General Characteristics*:* This cover type identifies areas that are unvegetated or sparsely vegetated. Many of areas are frequently disturbed by either natural or human-induced impacts, and many are roads. Species common to these areas tend to be weedy species, including both exotic and native species of weeds. Plant species seen in these areas include fireweed, rattlebox, common mustard, yarrow, Jacob's ladder, white clover, Pacific silverweed, mountain timothy, bluejoint grass, and Merten's sedge.

Mapping Codes*:* Barren/sparsely vegetated areas have a cover type code of "S". Three data forms were completed for these areas (data form ID numbers 17, 48, and 79). Representative photographs of this cover type are included in Appendix C, photographs 27 and 28.

Open Water

General Characteristics*:* This cover type includes inundated areas that are generally void of vegetation. Mapped areas include Cooper Lake, Cooper Creek, Turnagain Arm, and all waterways discernable by aerial photograph interpretation.

Mapping Codes*:* Open water areas have a cover type code of "Q". Three data forms were completed for open water sites (data form ID numbers 76, 116, and 121). Representative photographs of this cover type are included in Appendix C, photographs 29 and 30.

ANALYSIS AND DISCUSSION

Descriptions of study area vegetation patterns and ongoing Project-related effects on vegetation are discussed below for Cooper Lake; Cooper Creek; and the powerline, access roads, and access routes. Specific information describing Cooper Lake shoreline types and erosion processes to lakeshore vegetation communities are included in the Shoreline Processes Study (Appendix D).

Cooper Lake

Vegetation Description

Mapped cover types surrounding Cooper Lake are shown on Set 1—Cooper Lake, Figures 1 through 13 of Appendix B.

The south end of Cooper Lake is generally topographically flat. A low, sloping rise in elevation occurs along the shoreline, extending outward toward the study area boundary. This area has the greatest diversity of cover types compared to the central portion and north end of the lake. Common plant communities include graminoid meadows, forb meadows, low scrub communities, willow thickets, alder thickets, cottonwood forest, and spruce-hemlock forest.

Extending outward from the southern shoreline of the reservoir, through the fluctuation zone to the study area boundary, is a gradient of cover types with transition zones of mixed cover types between them. Closest to the shoreline, within the reservoir fluctuation zone, are graminoid meadows and areas of exposed gravels (classified as barren/sparsely vegetated cover type). At the upper reaches of the fluctuation zone are communities of low scrub, alder, and willow. Beyond the scrub communities, the farthest mapped communities from the reservoir are usually cottonwood and spruce-hemlock forests.

The topography in the central and northern shoreline areas of Cooper Lake is considerably different from that of the south portion of the reservoir. The central section of the shoreline consists of steep mountain slopes on either side of the reservoir. Much of the central shoreline that is within the reservoir fluctuation zone is unvegetated and made up of exposed bedrock. Little variation of cover types occurs in the central shoreline area. The area is dominated by alder thicket and exposed bedrock shoreline (mapped as barren/sparsely vegetated cover type), generally extending from the lakeshore to the study area boundary. Within the fairly continuous bands of alder are several small stands of spruce-hemlock forest, usually in the areas farthest from the shoreline near the study area boundary.

The north end of the reservoir has a mix of steep shorelines, moderately sloping hillsides, and flat areas adjacent to the reservoir, and thus more diverse cover than the central section of the shoreline. Common cover types along the steep portions of the northern shoreline are alder thickets and exposed gravels and bedrock (mapped as barren/sparsely vegetated cover type). Along moderately sloped areas of the shoreline are spruce-hemlock forest, alder thicket, and pockets of forb meadows. In flat areas near the Cooper Lake Dam and near the narrow part of the reservoir along the eastern shoreline, graminoid meadows dominate.

Project Effects on Vegetation Around Cooper Lake

The reservoir level fluctuations caused by Project operations greatly influences vegetation surrounding Cooper Lake. Because reservoir operations are not proposed to change during the new license term, vegetation should not change. Lake levels typically fluctuate about 15 feet in an average year. That annual fluctuation occurs within a broader, approximately 25-foot-wide zone of fluctuation experienced over multiple years.

Between elevations 1,168 and 1,194 feet MSL (the multi-year fluctuation zone), most of the steeper shorelines, and the gentler shorelines exposed to waves generated by summer winds from the south are gravel/cobble or bedrock with little or no vegetation. Results of the Shoreline Processes Study (Appendix D) indicate the steep slopes in that zone, particularly those exposed to summer wind-driven waves from the south but also even more gradual slopes in that zone that are exposed to waves, experience too much shifting of the gravel substrate to support vegetation, or have lost the soil mantle over bedrock or large rock that is necessary to support vegetation. These factors are in addition to the periodic inundation related to seasonal reservoir level fluctuation that also limit plant survival.

Lower gradient shorelines at the south end of the reservoir, particularly those above 1,185 feet, support denser vegetation. The south shoreline area is not exposed to summer wind-driven waves because the higher summer winds are from the south (Appendix D). Thus, the wave-driven effects on substrate are lesser factors in vegetation establishment along the south end of the reservoir. However, the periodic inundation due to seasonal reservoir level fluctuation does effect vegetation in this area. In an average year, areas above 1,185 feet (where dense vegetation becomes established) are not inundated until after the growing season. But in half of the years, those areas may become inundated at any time after early June. The area within the fluctuation zone has been exposed to decades of this inundation regime, so only the plants that can survive those conditions have become established, and these plants comprise the graminoid meadows and low scrub thickets found there. Surprisingly, the graminoid meadows must occasionally survive inundation throughout more than half of the growing season, and the scrub thickets must occasionally tolerate some part of late summer under water. However, the inundation in these areas is long enough to prevent colonization of the tree species. Cottonwoods have re-colonized the area between elevation 1,195 and 1,210 feet MSL that was cleared in 1959, but have not succeeded in becoming established below approximately elevation 1,195 feet MSL.

For comparative analysis, two additional scenarios were evaluated to determine the response of plant communities surrounding the reservoir if exposed to (1) a theoretical static reservoir level of 1,168 feet MSL, and (2) a theoretical maximum reservoir operating level of 1,206 feet MSL.[1]

Under the first scenario, a static reservoir level at 1,168 feet MSL, some existing plant communities currently surrounding the reservoir would likely change permanently. The loss of periodic, seasonal inundation, which influences the occurrence and character of several shoreline plant communities, could change species richness and composition in certain community types. Generally, existing shoreline forb and graminoid meadow communities could slowly be converted into low willow scrub communities without the existing seasonal inundation. Likewise, existing willow communities could become forested with cottonwood or spruce over time without the periodic inundation. This change would likely happen over a range of many years and would not happen to all areas surrounding the reservoir because of other factors, such as slope, aspect, and soil composition, which can all influence plant community characteristics.

Under the second scenario, any mature plant communities below 1,206 feet MSL would probably be eliminated gradually because of periodic inundation as the fluctuation zone essentially shifted to 12 feet higher than the current fluctuation zone. Generally, the greatest loss of plant communities would be forb and graminoid meadows and to a lesser degree low willow scrub thickets. Some plant communities adjacent to the newly created shoreline could change because of the raised water level. Specifically, low scrub communities and forested communities, over time, could change to forb/graminoid meadows and scrub thickets, respectively. However, the extent of these plant community changes could be just as heavily influenced by other abiotic factors such as slope, aspect, and soil composition as the raised water level. The transition in vegetation types from the new maximum fluctuation level to the lowest level of the fluctuation zone would gradually become similar to the pattern that currently exists within this zone.

Cooper Creek

Vegetation Description

Mapped plant communities along Cooper Creek are shown on Set 2—Cooper Creek, Figures 1 through 15 of Appendix B.

A continuous band of alder occurs adjacent to Cooper Creek along much of its length. Different cover types occur in areas where canyon walls are steep, within avalanche debris areas, areas near the dam, and throughout the flat alluvial floodplain near the confluence of the creek with the Kenai River. The greatest difference in vegetation composition is seen between areas above the Stetson Creek confluence with Cooper Creek and below the confluence. In areas above the confluence, alder thickets generally border the creek. Overhanging plants covering the entire

[1] Chugach is not proposing either of these hypothetical scenarios for the new license term.

creek are common, and the number of understory species is high. Below the confluence, alder thickets are also common along either side of the creek; overhanging plants covering the entire creek are rare, and the number of understory plant species is lower.

Above the narrow bands of alder surrounding the creek are spruce forests with an alder understory, usually occurring along the sloped canyon walls and above the canyon. Within the many side drainages and avalanche debris areas, a mix of forb meadow and exposed gravels and dirt (mapped as barren/sparsely cover type) are present. These areas are likely frequently exposed to disturbances from avalanches, heavy rains causing the drainages to flood, and erosion along the steep slopes. The forb meadows indicate that the areas are exposed to enough disturbances to prevent the establishment of forests.

Directly below Cooper Lake Dam are cottonwood forest, spruce-cottonwood forest, low-scrub communities, and forb meadows. This stretch of Cooper Creek has abundant beaver dam activity, large pools of slow-moving water, and is surrounded by gradual valley slopes rather than the steep, cliff- faced slopes characteristic of Cooper Creek below the first waterfall.

Throughout the alluvial floodplain near the confluence of Cooper Creek and the Kenai River and near the USFS Cooper Creek Campground, the dominant cover type is cottonwood forest. Alder parallels the creek through this flat area as well, primarily only occurring in areas directly adjacent to the creek.

The plant communities within Cooper Creek are generally the same communities that were seen and mapped along similar creeks in the study area. The dominant community of alder with an understory of willow, forb, and graminoid species is a characteristic plant community of stream banks in southcentral Alaska.

Potential Future Project Effects on Vegetation Along Cooper Creek

Chugach has been asked to consider modifying the existing flow regime in Cooper Creek. This type of modification could entail adding flow to the creek upstream of the Stetson Creek confluence, using water either from Cooper Lake or Stetson Creek. Depending on the water source(s), the increase in flow could be just in the reach upstream of Stetson Creek or in the entire creek below the new water input point. A change in flow regime could affect vegetation along Cooper Creek, in particular in the reaches above the Stetson Creek confluence. The absence of Cooper Lake outflow has allowed overhanging vegetation to colonize much of the waterway above Stetson Creek and has allowed the establishment in these upper reaches of some forb species that are not well adapted to frequent flooding and increased stream flow. With the addition of flow from Cooper Lake, plant community characteristics in the reaches above Stetson Creek would likely become more similar to the stream bank communities observed below the Stetson Creek confluence. Because the proportion of additional flow (if any) would be smaller in the reaches of Cooper Creek below Stetson Creek under a modified flow regime, any vegetation changes would be expected to be much more subtle. The portion of lower Cooper Creek that would be most likely to be affected would be the flat, alluvial floodplain of the creek near Kenai River.

Powerlines and Other Structures, Access Routes, and Access Roads

Mapped cover types along the Project powerlines, access roads, and access routes are shown on Set 3—Powerline and Access Roads, Figures 1 through 117 of Appendix B. Vegetation is described below for the areas.

Vegetation Description

All of the cover types described in the Results section of this report occur along the powerline running from Cooper Lake to Anchorage. Vegetation surrounding the Cooper Lake intake structure, Cooper Lake powerhouse, and the powerline and access routes between those structures (Figures 3:1 through 3:3) is primarily composed of hemlock forest, spruce-hemlock forest, and alder thicket. Alder thicket occurs along much of the cleared powerline corridor. The 6.3-mile powerline and Sung Harbor Road extending between the Cooper Lake powerhouse and the Quartz Creek Substation (Figures 3:3 through 3:10) traverses hemlock forest, spruce-hemlock forest, birch forest, spruce-birch forest, alder thicket, and mixed forb/graminoid meadows. Narrow bands of alder are common along the border of Snug Harbor Road. The cleared portion of the powerline is dominated by mixed forb/graminoid meadows.

Between the Quartz Creek Substation and the Daves Creek Substation (immediately north of the Sterling Highway, adjacent to Quartz Creek; see Figures 3:10 through 3:17), the powerline crosses Kenai Lake and vegetated land areas composed of spruce forest, spruce-aspen forest, alder thicket, low scrub, and graminoid cover types. Low scrub and graminoid meadows dominate most of the cleared powerline corridor. Similar cover types and physical setting occur between Daves Creek Substation and the USFS Granite Creek Campground (near the southern end of the Turnagain Pass area; see Figures 3:17 through 3:45). Large, continuous areas of spruce forest, hemlock forest, and spruce-hemlock forest occur throughout the region. Spruce-cottonwood forests are common near creeks in this area. Along the hillside west of the Seward Highway, near Summit Lake and Lower Summit Lake, are large areas of alder thicket, willow thicket, low scrub, and forb meadows. Several small graminoid meadows occur in low, flat areas northeast of Summit Lake. Most of the cleared powerline corridor along this section is composed of alder, willow, low scrub, and forb/graminoid meadows.

The Turnagain Pass area (Figures 3:46 through 3:58) is comprised of a mixture of forest, scrub, and meadow communities. Along the southern and northern ends of the pass area, spruce-hemlock forests are common. Along the areas of the pass at the highest elevation, hemlock forest is most common. Low scrub and forb/graminoid meadows are the dominant cover type within the cleared powerline corridor.

Between Ingram Creek and Twenty Mile River valley (Figures 3:59 through 3:67), including Placer River and Portage Creek valleys, the dominant plant cover types include cottonwood forest, alder, willow, low scrub, forb and graminoid meadows and marshes, and many areas of open water. Much of the cleared powerline corridor is comprised of low scrub and forb or graminoid meadows. This coastal area is characteristically flat with abundant inundated areas and unvegetated mudflats.

From the Twenty Mile River valley to the community of Girdwood, the powerline is located between the Seward Highway and the mountain slopes, or on the steep slopes (Figures 3:67 through 3:75). In this section, the slopes are dominated by spruce-hemlock forest, with alder thicket occurring within drainages and along avalanche areas. Along the toe of the slope are several large, flat areas dominated by graminoid meadows and open water. Within the cleared powerline corridor on the mountainsides, the dominant cover type is a mix of low scrub and forb meadows. On the coastal flats, the powerline corridor retains the undisturbed graminoid meadows and open water areas that exist outside of the corridor. At the mouth of the Girdwood valley (Figures 3:75 through 3:77), the powerline traverses a coastal community with graminoid cover.

Between Girdwood and the community of Indian (Figures 3:77 through 3:97), the powerline traverses the shoreline of Turnagain Arm before heading up the Indian Creek valley. From Girdwood to Bird Point, the powerline is primarily located between the Seward Highway and the waters of Turnagain Arm, covering unvegetated areas of open water, paved roadway, and large boulders placed along the road embankment. From Bird Point to Indian, the powerline is generally along the northern side of the Seward Highway, frequently on the mountain slopes. The dominant cover types in this area include spruce forest, spruce-birch forest, birch forest, alder, low scrub, and forb meadows. At Indian, the powerline corridor leaves the shoreline of Turnagain Arm and heads northwest up the Indian Creek valley towards the alpine areas of Powerline Pass. In the Indian Creek valley, the dominant vegetation is hemlock forest. Within the cleared powerline corridor between Bird Point and Powerline Pass, the dominant cover type is low scrub and forb meadows.

From Powerline Pass to the Glen Alps trailhead in Anchorage, the powerline traverses alpine areas of Chugach State Park (Figures 3:97 through 3:107). Near the pass, the cover types are dwarf scrub and unvegetated, barren areas. Near the Glen Alps trailhead, common cover types include stunted hemlock scrub forest, alder, willow, low scrub, and forb/graminoid meadows. Within these alpine areas, short vegetation communities reduce the need to provide clearing maintenance. However, a Project access roadway that is also used as a recreation trail is maintained and cleared.

Within the Anchorage Bowl (Figures 3:107 through 3:117), dominant cover types include spruce forest, birch forest, spruce-birch forest, alder thicket, and forb and graminoid meadows, with many unvegetated, developed areas in the populated parts of the study area (near Tudor Road to the end of the study area). Alder, forb, and graminoid cover types dominate the cleared powerline corridor.

The Cooper Lake dam access road (mapping included on Set 2—Cooper Creek, Figures 2:1 through 2:15 of Appendix B) crosses six vegetation cover types. Near the Sterling Highway (the northern terminus) the road crosses a small section of spruce-hemlock forest before crossing a large area of low scrub/graminoid mixed cover type. This mixed scrub/graminoid community has been logged. The roadway then traverses a large stand of mature hemlock trees before it parallels the mountainside of Cecil Rhode Mountain. Along this mountain slope until the road ends at the dam, the roadway traverses three cover types: cottonwood forest, alder, and forb meadows.

Project Effects on Vegetation along Powerlines and Around Other Structures

A prominent feature of study area vegetation is the cleared area along the powerline corridor. Within forested communities, the portion of the powerline corridor cleared of trees is typically 100 feet wide. This swath of cleared vegetation is maintained by Chugach to prevent reestablishment of forested communities. Clearing the powerline of vegetation reduces the threat of overgrown vegetation coming into contact with the electrical lines and prevents large trees from falling onto the lines as well. Vegetation has typically been cleared, depending on physical setting, accessibility, and plant cover type, on a cycle of 6 to 8 years; Chugach has recently shifted to a longer cycle of clearing of about 8 to 10 years. Fast-growing species, notably cottonwoods (O'Brien 2003), are cleared as needed, often at more frequent intervals than slower growing communities of spruce, hemlock, and birch.

Clearing is done by a hydro-axe machine and supplemented by hand clearing with chainsaw in some locations. No herbicides are used in the clearing process. Plant material that is cut down is typically left on site and not removed. Plant communities within these cleared zones are primarily made up of graminoid, forb, or low scrub vegetation (as described above). In powerline corridor areas that historically were non-forested, the plant species and community structure of the pre-Project, undisturbed communities generally persist because there has been no need for vegetation clearing.

Another type of vegetation clearing is done along access roads and access routes, and in areas surrounding the intake structure, powerhouse, and substations in the study area. To prevent roadways and Project structures from being overgrown by surrounding plant communities, vegetation is cleared along their edges. Often, trees and shrubs are trimmed rather than removed.

Project operation requires continued regular maintenance along these linear features, which routinely exposes corridor plant communities to disturbance. This disturbance has been going on for decades and will continue to occur through the new license term. In areas that would otherwise be forested, vegetation-clearing practices will continue to prevent re-colonization of trees. Plant communities in the powerline and road corridors, including scrub thickets and forb and graminoid meadows are early successional communities, and are resilient to frequent disturbances. Many of the disturbance communities found in the powerline corridor are not natural plant communities and commonly include non-native and weedy species (see Exotic Plants Study). Therefore, because no changes in vegetation management practices are proposed for the new license term, no Project-related changes in vegetation cover type are expected to occur along the powerline, access road, and access route corridors or around other Project structures.

CONCLUSIONS

Regular vegetation clearing along the 90-mile powerline corridor, access roads, access routes, and areas subject to overgrowth surrounding the powerhouse and substations will maintain study area plant communities in their existing condition through future operations of the Project. Plant communities that will be cleared regularly in the future have experienced regular periodic clearing for decades. Scrub thickets, forb meadows, and graminoid meadows are the dominant plant communities in cleared areas today and are likely to be the same communities occurring in the future.

Similarly, plant communities surrounding Cooper Lake are likely to remain the same into the future, as no changes to reservoir operations are proposed. The ongoing disturbances created by seasonal inundation and wave-driven erosion will continue to affect the establishment and survival of plant communities surrounding the reservoir.

Within the Cooper Creek floodplain, plant communities surrounding the creek are expected to remain the same through the new license term if Project operations remain unchanged. If flows were increased above the Stetson Creek confluence, there would likely be some loss of overhanging vegetation and a decrease of understory species richness caused by regularly higher flows and by higher flood levels. Similarly, if a modified flow regime also included an increase in flows below Stetson Creek, a decrease of understory species richness in areas adjacent to the creek could occur in the flat, alluvial floodplain of the creek near Kenai River, depending on the flow regime.

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