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Angoon Hydroelectric Project

Draft Environmental Impact Statement

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DRAFT ENVIRONMENTAL IMPACT STATEMENT

ANGOON HYDROELECTRIC PROJECT

Admiralty Island National Monument

Tongass National Forest

April 2007

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ABSTRACT: The Forest Supervisor of the Tongass National Forest will decide what terms and conditions to apply, through Special Use Authorizations (SUAs) and easements, to allow the construction and operation of a hydroelectric facility on Thayer Creek. The hydroelectric facility would serve the community of Angoon, as directed in the Alaska National Interest Lands Conservation Act of 1980 (ANILCA). The project is within the Kootznoowoo Wilderness on Admiralty Island National Monument, Admiralty Island, Tongass National Forest, in Southeastern Alaska. The project area is approximately 60 air miles southwest of Juneau. In November 2003, Kootznoowoo, Inc., the village corporation for the Angoon Community Association, asked the Forest Service to begin the National Environmental Policy Act (NEPA) process necessary to develop an hydroelectric facility. On April 21, 2004, Kootznoowoo submitted an application requesting Forest Service authorization for the project. Kootznoowoo's proposal is to construct a hydroelectric plant and related facilities at Thayer Creek on Admiralty Island, using a pipeline and penstock arrangement. The development would include a diversion dam, intake structure, port facilities, three access roads, two staging areas, transmission cable, a power plant, a surge tank, and 6,100 feet of 42-inch diameter pipeline in addition to 510 feet of 36-inch diameter pipe. The hydroelectric plant would be a modified run-of-river facility, which means the hydroelectric power facility would use water that is available in the natural flow of the river. Under normal conditions, run-of-river facilities involve minimal water storage, and power generation fluctuates with the stream flow. The proposed facility would create a 10-20 acre pond behind a small dam. This environmental impact statement describes and evaluates the environmental effects of the two action alternatives and the no-action alternative. Alternative 2 is the preferred alternative.

Commenting on the Draft EIS

Reviewers should provide the Forest Service with their comments during the review period of the draft environmental impact statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decisionmaking process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519, 553 (1978). Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. City of Angoon v. Hodel (9th Circuit, l986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3). Comments must be received within 45 days following EPA publication of the Notice of Availability in the Federal Register.

Summary

PURPOSE AND NEED

The purpose and need for the Angoon Hydroelectric project is to establish and document in a Special Use Authorization (SUA), the terms and conditions for the construction and operation of a run-of-river hydroelectric facility on Thayer Creek, Admiralty Island National Monument. The hydroelectric facility will provide power to the community of Angoon, Alaska, as provided in the Alaska National Interest Land Claims Act (ANILCA) (Section 506(a)(1) and 506 (a)(3)). The Forest Service has prepared this Environmental Impact Statement (EIS) to analyze the potential effects of the proposed Angoon Hydroelectric Project in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations.

In addition to the need to provide a source of power development to Angoon, the Forest Service needs to determine resource protection measures necessary to offset the effects of hydroelectric project development. ANILCA granted Kootznoowoo, Inc. the right to develop the hydroelectric project subject to conditions prescribed by the Forest Service for protection of water, fishery, wildlife, recreation, and scenic values.

The project area is located within the Kootznoowoo Wilderness but ANILCA exempted the project from provisions of the Wilderness Act. Hydroelectric facility development would occur largely on the lower section of Thayer Creek, but transmission facilities and service roads would extend the affected area. Wilderness values would be lost on the lower section of Thayer Creek and along the transmission cable corridor. The project would also compromise water, fishery, wildlife, recreation, and scenic values.

ISSUES

Public scoping for the Angoon Hydroelectric Project started with publication of the Notice of Intent (NOI) in the Federal Register on October 14, 2004 (Volume 69, No. 193, pages 60976-60978). A project scoping notice was also sent to interested members of the public at that time, and has been listed on the Schedule of Proposed Actions since winter of 2004. The Juneau Empire advertised an invitation to attend a scheduled open house (October 14, 2004 in Angoon and October 15, 2004, in Juneau). Representatives of the Forest Service and Kootznoowoo, Inc. hosted the scoping meetings to describe the project and solicit public comments. Written comments were received and accepted throughout the scoping period (through October 29, 2004).

Internal and public scoping processes identified no significant issues that would require consideration of alternatives beyond the three alternatives analyzed in this document. Some respondents expressed concerns about procedural matters and the potential for effects to resources in the project area. None of the resource-specific concerns provided a specific link to the potential effects of the alternatives. Concerns that were considered, but determined not to be significant for the project decisions to be made are discussed in detail in Chapter 1, Section 1.8:

ALTERNATIVES

Alternative 1 displays the existing condition of the project area, and provides a basis of comparison between the alternatives. Alternative 2 is the proposed project submitted by Kootznoowoo, Inc and interpreted by the Forest Service. Some aspects of the proposal were not clearly defined so the Forest Service assumed a standard so the analysis could proceed. Alternative 2a is similar to Alternative 2 but proposes a longer submarine transmission cable in Chatham Strait as an alternative to the overland transmission cable. Alternative 2a would decrease project effects on Wilderness and scenic values because the transmission and road corridors would not be needed from the port facilities to Kootznahoo Inlet.

The Tongass Forest Supervisor will decide the terms and conditions to include in the SUA that will protect the water, fisheries, wildlife, recreation, and scenic values of Admiralty Island National Monument and Kootznoowoo Wilderness as specified in the Forest Plan. He will base his decision on the environmental analysis in this EIS.

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List of Acronyms

°F	degrees Fahrenheit
ADF&G	Alaska Department of Fish and Game
ANILCA	Alaska National Interest Land Conservation Act
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
USACE	United States Army Corps of Engineers
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
Forest Plan	1997 Tongass Land and Resource Management Plan
Forest Service	United States Department of Agriculture Forest Service
FSM	Forest Service Manual
LTA	Land Type Association
LWD	Large Woody Debris
MIS	Management Indicator Species
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NWI	National Wetlands Inventory
ROD	Record of Decision
SHPO	State Historic Preservation Office
TUS	Transportation and Utility System
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
VCU	Value Comparison Unit
VQO	Visual Quality Objective

1. Purpose and Need

1.1 INTRODUCTION

The United States Department of Agriculture Forest Service (Forest Service) has prepared this Environmental Impact Statement (EIS) on the potential effects of the proposed Angoon Hydroelectric Project in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. The project area is located within Admiralty Island National Monument, Tongass National Forest, Alaska. The City of Angoon is approximately 50 miles south of Juneau. The project area is approximately 6 miles north of Angoon. This EIS discloses the direct, indirect, and cumulative environmental effects and any irreversible or irretrievable commitment of resources that would result from the two action alternatives and the no-action alternative.

The purpose and need of this project is for Kootznoowoo, Inc. to provide a reliable and sufficient source of power, at reasonable rates, to meet the intermediate and long range needs of the community of Angoon. The Alaska National Interest Lands Conservation Act of 1980 (ANILCA 506(a)(3)(B)) specifically recognized the right of Kootznoowoo, Inc. to develop hydroelectric resources on Admiralty Island within T. 49S., R.67E., and T.50S. R.67E. Copper River Base and Meridian.

This EIS is prepared according to the format established by Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500-1508). Chapter 1, in addition to explaining the purpose and need for the proposed action, discusses how the Angoon Hydroelectric Project relates to the 1997 Tongass Land and Resource Management Plan (Forest Plan), and identifies the significant issues driving the EIS analysis. Chapter 2 describes all alternatives considered, compares the alternatives, and summarizes the significant environmental consequences by issue. Chapter 3 describes the natural and human environments potentially affected by the alternatives, and discloses the potential effects. Chapter 4 contains the list of preparers, the EIS distribution list, literature cited, and an index. Appendices provide additional information on specific aspects of the proposed project. This EIS incorporates documented analyses by summarization and reference where appropriate.

The project interdisciplinary team used a systematic approach to analyze the proposed project and alternatives to it, estimating the environmental effects, and preparing this EIS. The planning process complies with NEPA and the CEQ regulations. The project team coordinated planning with the appropriate federal, state, and local agencies, and local federally recognized tribes.

Project information and additional copies of this draft EIS can by obtained by contacting Kathy Rodriguez, District Ranger, Admiralty Island National Monument, 8465 Old Dairy Road, Juneau, AK 99801. Public comments on the Draft EIS will be analyzed, leading to a Final EIS and Record of Decision (ROD) to be issued winter of 2007/2008.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Admiralty Island National Monument

Office in Juneau, Alaska. Other reference documents, such as the Forest Plan and the Tongass Timber Reform Act, are available at public libraries throughout Southeast Alaska as well as at the Forest Supervisor's Offices in Ketchikan, Petersburg, and Sitka. The Forest Plan is also available on the internet and on CD-ROM.

1.2 PROPOSED ACTION

A proposed action is defined early in the project-level planning process. This serves as a starting point for the NEPA analysis, and gives the public and other agencies specific information on which to focus comments. Using these comments (see discussion of issues later in this chapter), and information from preliminary analysis, the interdisciplinary team then develops alternatives to the proposed action. Based on these comments, some elements of the proposed action were clarified and/or refined to reduce or eliminate adverse impacts to the environment. These are discussed in detail in Chapter 2.

The Forest Service proposed action is to establish, and document in a SUA, the terms and conditions for the construction and operation of a run-of-river hydroelectric facility on Thayer Creek. The hydroelectric facility will provide power to the community of Angoon, as granted in the ANILCA. The development would include a diversion dam, intake structure, port facilities, three access roads, two staging areas, transmission cable, a power plant, a surge tank, and 6,100 feet of 42-inch diameter pipeline in addition to 510 feet of 36-inch diameter pipe. The hydroelectric plant would be a run-of-river facility, which means the hydroelectric power facility would use only the water that is available in the natural flow of the river. Under normal conditions, run-of-river facilities involve minimal water storage, and power generation fluctuates with the stream flow. Section 2.7.2 describes the proposed action in greater detail.

1.3 DECISION FRAMEWORK

ANILCA specifically recognized the needs of the community of Angoon. Section 506(a)(1) of the Act states:

> Congress hereby recognizes the necessity to reconcile the national need to preserve the natural and recreation values of the Admiralty Island National Monument with the economic and cultural needs and expectations of Kootznoowoo, Incorporated, and Sealaska, Incorporated, as provided by the Alaska Native Claims Settlement Act and this Act.

ANILCA Section 506(a)(3) further states:

> …subject to valid existing right, there is hereby granted to Kootznoowoo, Incorporated… (B) The right to develop hydroelectric resources on Admiralty Island within township 49 south, range 67 east, and township 50 south, range 67 east, Copper River Base and Meridian, subject to such conditions as the Secretary of Agriculture shall prescribe for the protection of water, fishery, wildlife, recreational, and scenic values of Admiralty Island.

This means that Congress has mandated that Kootznoowoo, Incorporated (hereafter referred to as Kootznoowoo) can develop, own, and operate a hydroelectric power plant within the confines of the legal description. It also means that the Forest Service (for the Secretary of Agriculture) will be responsive to this mandate, and that the Forest Service is bound to prescribe certain conditions on how Kootznoowoo will develop, own, and operate a hydroelectric facility on National Forest System (NFS) land defined in ANILCA.

On January 23, 2001, the Federal Energy Regulatory Commission (FERC) filed an order finding that no FERC license would be required for the Angoon Hydroelectric Project. The ruling basis was that FERC has no jurisdiction on National Monument status lands administered by the Forest Service.

The NEPA decision made by the Forest Service will determine the terms and conditions in the SUA to protect water, fisheries, wildlife, recreational, and scenic values. Authorities to prescribe these conditions are found in the Federal Land Policy and Management Act of October 21, 1976 and ANILCA. The terms and conditions will be based on the basic framework for a hydroelectric proposal as submitted by Kootznoowoo, per the March 2000 Feasibility Evaluation Report (FER) prepared by HDR Alaska for Kootznoowoo. The design and construction of the project will follow the decision documented in the EIS Record of Decision. Any changes to the design and construction of the project will be the responsibility of Kootznoowoo and may require Kootznoowoo to prepare a supplemental EIS before the Forest Service issues them a Special Use Authorization (SUA).

On August 11, 2004, the Regional Forester delegated the authority to sign the ROD and SUA for this project to the Tongass Forest Supervisor. The Forest Service will not issue a SUA to Kootznoowoo until all required state water use permits have been secured by Kootznoowoo.

ANILCA Section 506(a)(3)(D) limits the extent of the conditions that the Secretary of Agriculture (through the Forest Service) can prescribe by excluding the provisions of the Wilderness Act of 1964 on the right to develop hydroelectric resources:

> (D) Any right or interest in land granted or reserved in paragraphs (3) (A, B, and C) shall not be subject to the provisions of the Wilderness Act.

Hence, excluding the development of hydroelectric resources by Kootznoowoo, the actual land within the Kootznoowoo hydroelectric right legal description, as well as the rest of the Kootznoowoo Wilderness, will continue to be managed by the Forest Service as a designated Wilderness under the 1964 Wilderness Act and ANILCA.

1.3.1 Decisions to Be Made

Based on the environmental analysis in this EIS, the Tongass Forest Supervisor will decide the terms and conditions in the SUA to protect water, fisheries, wildlife, recreation, and scenic values of Admiralty Island.

1.4 PROJECT AREA

The project is within the Kootznoowoo Wilderness on Admiralty Island National Monument, Admiralty Island, Tongass National Forest, in Southeast Alaska. The project area is located approximately 60 air miles southwest of Juneau (Figure 1-1).

Land ownership in the project area is mixed. The Forest Service manages the majority of the land within the project area as a part of the Kootznoowoo Wilderness. In the southern portion of the project area, the lands within section 25, T. 50 S., R. 67 E. and section 30, T. 50 S., R. 68 E. are private land, with surface rights owned by Kootznoowoo, Inc., and subsurface interests owned by Sealaska, Inc. The City of Angoon boundaries include Section 24, T. 50 S., R. 67 E. and section 19, T. 50 S., R. 68 E.

1.5 PURPOSE AND NEED

The purpose of the proposed action is to respond to Kootznoowoo's April 21, 2004, request for Forest Service terms and conditions for the Angoon Hydroelectric Project. In November 2003, Kootznoowoo, the Alaska Native Settlement Claims Act (ANSCA) corporation for the village of Angoon, asked the Forest Service to begin the NEPA process necessary to develop a hydroelectric project.

The Forest Service needs to determine resource protection measures for the development of the hydroelectric project on Admiralty Island National Monument. ANILCA granted Kootznoowoo the right to develop the hydroelectric project subject to conditions prescribed by the Forest Service for protection of water, fishery, wildlife, recreational, and scenic values of Admiralty Island.

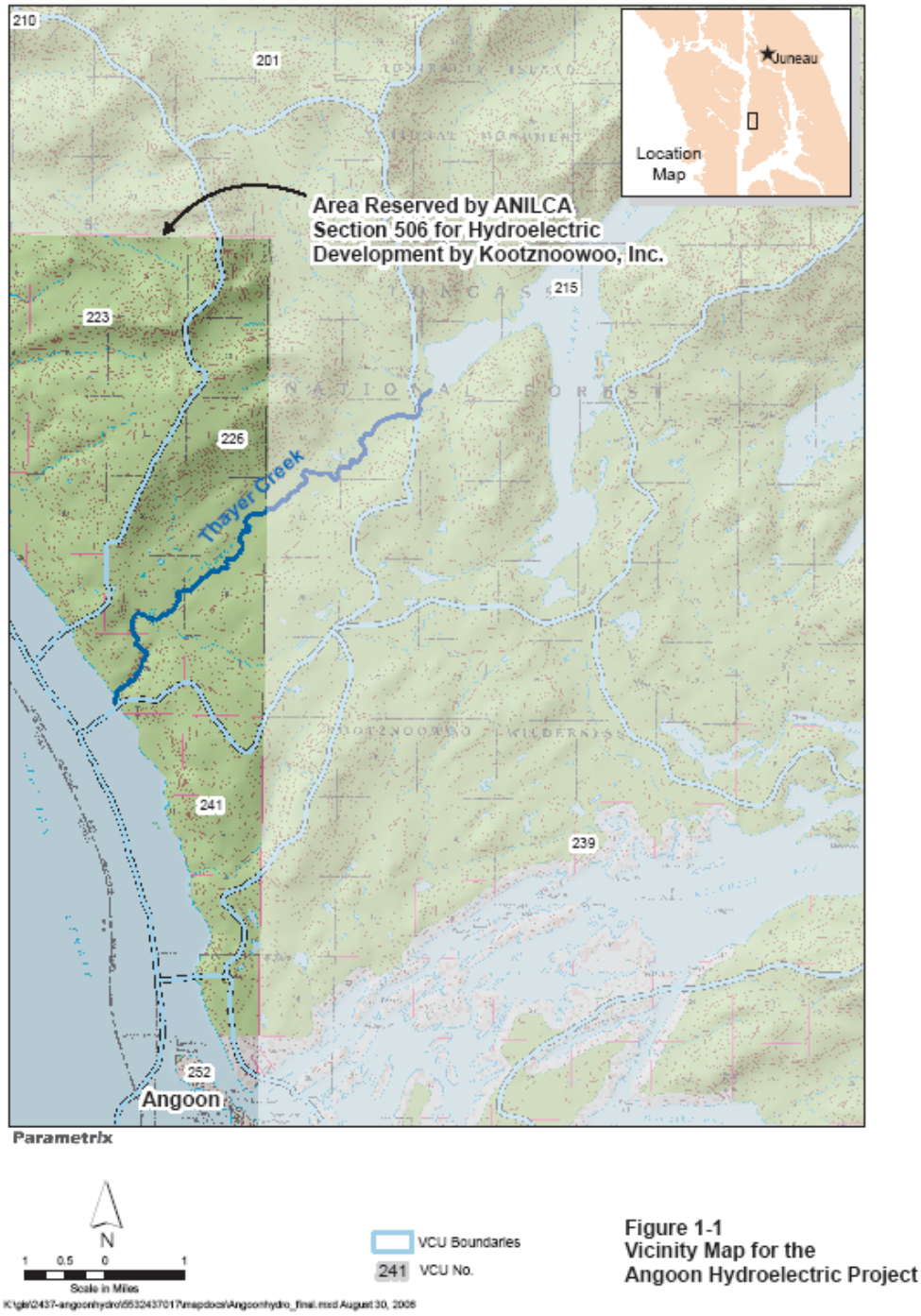
Kootznoowoo, the City of Angoon, and the Angoon Community Association are pursuing funding to develop this hydroelectric project with the expectation that it would reduce the cost of power generation in Angoon and result in lower electric rates for Angoon residents. The project is expected to benefit the local economy by providing sufficient power for future growth of the community.

1.6 RELATIONSHIP TO THE FOREST PLAN

National Forest planning takes place at several levels, including the national, regional, forest, and project levels. The Angoon Hydroelectric Project EIS is a project-level analysis; its scope is confined to addressing the significant issues and possible environmental consequences of the project. It does not attempt to address decisions made at higher levels. It does, however, implement direction provided at those higher levels.

The Forest Plan embodies the provisions of the National Forest Management Act, its implementing regulations, and other guiding documents. The Forest Plan sets forth in detail the direction for managing the land and resources of the Tongass National Forest. The Forest Plan is the result of extensive analysis, which is addressed in the Forest Plan FEIS (USDA Forest Service 1997) and the Forest Plan Supplemental EIS (USDA Forest Service 2003). Where appropriate, the Angoon Hydroelectric Project EIS tiers to the Forest Plan, as

Figure 1-1. Vicinity Map for the Angoon Hydroelectric Project



encouraged by the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1502.20).

Kootznoowoo's right to develop hydroelectric resources within the Kootznoowoo Wilderness Area was designated under ANILCA and is not specifically addressed in the Forest Plan. The Forest Plan does, however, specify a management prescription for Transportation and Utility Systems (TUS). This Land Use Designation (LUD) most closely approximates a designation under which a hydroelectric facility would be managed. The Forest Plan standards and guidelines for TUS serve as the basis for evaluating the proposed action.

The Forest Plan (p. 3-158) provides the following objectives for the TUS LUD:

> Transportation and Utility Systems may dominate the seen foreground area, yet are designed with consideration for the existing form, line, color, and texture of the characteristic landscape.
>
> Minimize and/or mitigate adverse effects to wildlife habitat and populations to the extent feasible.
>
> Maintain the present and continued productivity of Anadromous fish and other fish habitat to the extent feasible.

The LUD adjacent to the project area is Wilderness National Monument. ANILCA Section 506(a)(3)(D) specifically excludes the provisions of the 1964 Wilderness Act on Kootznoowoo's right to develop hydropower. Under NEPA, however, the Forest Service is obligated to disclose the anticipated effects to key resources, including Wilderness.

The Forest Plan includes Forest-wide goals and objectives, as well as area-specific, LUD goals, objectives, and desired conditions. Applicable Forest-wide goals and objectives (Forest Plan, pages 2-3 through 2-5) include the following:

- Develop and manage roads and utility systems to support resource management activities; recognize the potential for future development of major Transportation and Utility Systems.
- Manage designated Wilderness to maintain an enduring wilderness resource while providing for public access and uses consistent with the Wilderness Act of 1964 and ANILCA.
- Provide a diversity of opportunities for resource uses that contribute to the local and regional economies of Southeast Alaska.
- Minimize sediment transported to streams from land-disturbing activities.
- Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms.
- Minimize the destruction, loss, or degradation of wetlands and preserve and enhance wetland functions and values.
- Maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities.
- Provide Forest visitors with visually appealing scenery, with emphasis on areas seen along the Alaska Marine Highway and from popular recreation

places; recognize that in other areas where landscapes are altered by management activities, the activity may visually dominate the characteristic landscape.

- Identify, evaluate, preserve, and protect heritage resources.

1.6.1 Management Prescriptions

In addition to the Forest-wide standards and guidelines for all resource areas, the management prescriptions for the TUS Land Use Designation provide specific direction for several resource areas that may be affected by the Angoon Hydroelectric Project. These include geology and soils, water resources, fisheries, vegetation, wildlife, visual resources, and cultural resources, and are included below.

1.6.1.1 Geology and Soils, Water Resources

Watershed Resource Planning: S&W112

A. Delineate the location of high hazard soils, riparian, and other sensitive areas on project maps to insure their recognition, proper consideration, and protection on the sale area.

Wilderness is withdrawn from mineral entry; therefore, no consideration of mineral resources is necessary for this project area.

1.6.1.2 Fisheries

Fish Habitat Planning: FISH112

Planning/Mitigation

A. Design Transportation and Utility System activities to maintain the present and continued productivity of anadromous fish and other fish habitat to the extent feasible.

B. Stress protection of fish habitat to prevent the need for mitigation. Mitigation, rehabilitation, and monitoring of impacts to fish habitat or populations shall be identified in environmental documents.

1.6.1.3 Wildlife

Wildlife Habitat Inventory: WILD111

A. Establish a baseline inventory, or use an existing inventory of wildlife habitat conditions, preceding or coinciding with Transportation and Utility Systems development.

Wildlife Habitat Planning: WILD12

A. Reduce impacts to wildlife habitat and populations to the extent feasible.

1. Use the habitat needs of MIS to evaluate opportunities for wildlife.

2. In the design of projects, consider measures which reduce or eliminate electrocution of animals on powerlines, prevent road kills, and provide for public safety.

1.6.1.4 Visual Resources

Scenery Operations: VIS1

A. The landscape may be dominated by activities associated with Transportation and Utility Systems. Although TUS developments may dominate the seen area, they are designed with consideration for existing form, line, color, and texture found in the characteristic landscape.

1. Apply Forest-wide Standards & Guidelines for the Modification Visual Quality Objective. Perform view shed analysis in conjunction with project development to provide direction for retaining or creating a visually attractive landscape over time.
2. Work with topographic and vegetative features to screen the development when seen from Visual Priority Travel Routes and Use Areas (see Forest Plan Appendix F).
3. Consider the following during the design phase of routes which are, or are seen from, Visual Priority Travel Routes and Use Areas (see Forest Plan Appendix F):
   - Vegetation of slopes seen from the road
   - Providing "planting pockets" or terraces or slopes, where needed
   - Maintaining landforms through road location and design
   - Breaking up the straight line effect of linear corridors by considering special treatment of vegetation on clearing slopes or application of other design techniques and principles
   - Requiring roadside clean-up on all roads receiving general public use or expected to have such future use.

The Adopted Visual Quality Objective (VQO) for the hydroelectric development TUS will be Modification.

1.6.1.5 Cultural Resources

Heritage Resource Activities: HER

Inventory/Evaluation

A. Develop priorities and schedule management activities to implement heritage resource inventory, evaluation, protection, and interpretation within this Land Use Designation.

1. Identify, classify, and evaluate known Heritage Resources.

2. Identify heritage properties to be nominated to the National Register of Historic Places.
3. Identify heritage properties that require stabilization or other protective measures.
4. Identify opportunities for interpretation of Heritage Resources for public education and enjoyment.

1.6.2 Standards and Guidelines

Standards and guidelines were defined for all resources and documented in Chapter 4 of the Forest Plan. Standards and guidelines were designed so that all activities are integrated to meet land allocation objectives. The standards and guidelines applicable to the Angoon Hydroelectric Project are listed in Chapter 2 under Elements Common to All Action Alternatives.

1.7 PUBLIC INVOLVEMENT

The CEQ defines scoping as "...an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). Among other things, the scoping process is used to invite public participation, to help identify public issues, and to obtain public comment at various stages of the NEPA process. Although scoping is to begin early, it is really an iterative process that continues until a decision is made. In addition to the specific activities described below, the Angoon Hydroelectric Project has been listed on the Tongass National Forest Schedule of Proposed Actions since April 2004.

Public scoping for the Angoon Hydroelectric Project started with publication of the Notice of Intent on October 14, 2004 (Volume 69, No. 198, pages 60976-60978). In addition, a project scoping notice was sent to interested members of the public at that time. The mailing list for the notice consisted of 84 individuals, agencies, private businesses, and nongovernmental organizations. The *Juneau Empire* advertised an invitation to attend the public meetings. Representatives of the Forest Service and Kootznoowoo, Inc. hosted scoping meetings on October 14, in Angoon and October 15, 2004, in Juneau. Public comments were solicited at the meetings, and comments were also received in writing throughout the scoping period (through October 29, 2004).

Total attendance at the two public meetings was 22 individuals. Angoon and Juneau residents contributed both spoken and written comments. The letters include the following:

- Federal agencies: One letter was received from the National Marine Fisheries Service (NMFS).
- State agencies: One letter was received from the Alaska Department of Fish and Game (ADF&G).
- Organizations: Two letters were received, one from Friends of Admiralty Island and one from the Sierra Club.

- Individuals: Three e-mail messages were received from members of the public. One member of the public submitted a written comment at the Juneau public meeting.

Availability of this Draft EIS was announced in the Federal Register and through notices in the *Juneau Empire*. These notices started a 45-day comment period. The Forest Service also mailed copies of the EIS to federal and state agencies, Alaska native and municipal offices, and anyone else who had requested them.

1.8 ISSUES

Through the processes of internal and public scoping, no significant issues that would require consideration of alternatives to the proposed Angoon Hydroelectric Project were identified. Some respondents expressed concerns about procedural matters and the potential for effects to resources in the project area. None of the resource-specific concerns provided a specific link to the potential effects of the proposed action. Concerns that were considered, but determined not to be significant for the project decisions to be made, are discussed below.

Issue 1: The Forest Service must ensure adequate review of fisheries, water quantity, and water quality in Thayer Creek; wildlife; road construction and maintenance; watershed analysis; subsistence, recreation, and commercial use; cultural and historic sites; and alternatives, mitigation, and financial assurances. Also ensure consistency with Magnuson-Stevens Act and Clean Water Act requirements.

Conclusion after Consideration: These are not issues but rather standard elements of the NEPA process.

Issue 2: The proposed action has the potential for negative effects to the area, wildlife, and cultural resources.

Conclusion after Consideration: Potential effects to resources are addressed in the resource reports and summarized in this EIS. There are no threatened and endangered species issues in the project area. The proposed action requires that final construction design meets Forest Plan Standards and Guidelines. Cultural and heritage resources have been surveyed and identified. Identified areas (from the Cultural Resources field survey) will be avoided in the design and construction phase of the project. On-site monitoring will be required during the construction phase of the project. This is not an issue that can be used to develop an alternative.

Issue 3: The Forest Service should consider lowering the height of the transmission cable from 35 to 25 feet.

Conclusion after Consideration: This is a design element that could be incorporated into the proposal. It would provide no change to the proposed action and therefore would not drive an alternative. It is not a design element in the proposed action because it would offer no benefits.

1.9 PERMITS, LICENSES, AND CERTIFICATIONS

To proceed with the proposed hydroelectric project as addressed in this EIS, and prior to construction, Kootznoowoo, Inc. must obtain various permits from federal and state agencies:

U.S. Army Corps of Engineers

- Approval of discharge of dredged or fill material into waters of the United States (Section 404 of the Clean Water Act of 1977, as amended)
- Approval of construction of structures or work in navigable waters of the United States (Section 10 of the Rivers and Harbors Act of 1899)

U.S. Environmental Protection Agency

- Storm water discharge permit
- National Pollutant Discharge Elimination System (NPDES) review (Section 402 of the Clean Water Act)

State of Alaska, Department of Natural Resources

- Authorization for occupancy and use of tidelands and submerged lands
- Alaska Coastal Management Program
- Water Rights Permit
- Title 41 Permit

State of Alaska, Department of Environmental Conservation

- Certification of compliance with Alaska Water Quality Standards (Section 401 Certification)
- Solid Waste Disposal Permit (Section 402 of the Clean Water Act)

1.10 APPLICABLE LAWS AND EXECUTIVE ORDERS

Shown below is a partial list of federal laws and executive orders pertaining to this project. While most pertain to all federal lands, some of the laws are specific to Alaska. Disclosures and findings required by these laws and orders are contained in Chapter 2 of this EIS.

National Historic Preservation Act of 1966 (as amended)

National Environmental Policy Act (NEPA) of 1969 (as amended)

Clean Air Act of 1970 (as amended)

Costal Zone Management Act of 1972 (as amended)

Alaska Native Claims Settlement Act of 1971

Marine Mammal Protection Act of 1972

Endangered Species Act (ESA) of 1973 (as amended)

Clean Water Act of 1977 (as amended)

American Indian Religious Freedom Act of 1978

Alaska Native Interest Lands Conservation Act (ANILCA) of 1980

Archaeological Resource Protection Act of 1980
Cave Resource Protection Act of 1988
Magnuson-Stevens Fishery Conservation and Management Act of 1996
Executive Order 11593 (cultural resources)
Executive Order 11988 (floodplains)
Executive Order 11990 (wetlands)
Executive Order 12898 (environmental justice)
Executive Order 12962 (aquatic systems and recreational fisheries)

2. Alternatives, Including the Proposed Action

2.1 INTRODUCTION

This chapter describes and compares the alternatives considered by the Forest Service for the Angoon Hydroelectric Project. It includes a discussion of how alternatives were developed, an overview of project design elements intended to reduce or eliminate adverse environmental impacts, features common to the alternatives, a description of the alternatives considered in detail, and a comparison of the alternatives focusing on the significant issues. Chapter 2 is intended to present the alternatives in comparative form, sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public (40 CFR 1502.14).

Some of the information used to compare alternatives at the end of Chapter 2 is summarized from Chapter 3, Affected Environment and Environmental Consequences. Chapter 3 contains the detailed scientific basis for establishing baselines and measuring the potential environmental consequences of each of the alternatives. For a full understanding of the effects of the alternatives, readers will need to consult Chapter 3.

2.2 ALTERNATIVE DEVELOPMENT PROCESS

In January 1999, Kootznoowoo authorized HDR Alaska, Inc. to conduct a study to provide a basis for deciding whether the Angoon Hydroelectric Project was feasible enough to proceed with permitting and design efforts. Among other tasks, the study evaluated the feasibility of several alternative project arrangements, evaluated the hydrology of Thayer Creek, and analyzed the economic feasibility of the project (HDR Alaska 2000). The report evaluated three primary alternative arrangements for the project: (1) pipeline and penstock, (2) directional-drilled tunnel, and (3) conventional tunnel. At a review meeting in April 1999, Kootznoowoo selected the pipeline-and-penstock alternative for further refinement, particularly to reduce construction costs and improve access to the project site. The other two alternatives were found to be too risky and costly or to have too little power generation capacity.

The HDR pipeline alternative was presented to the Forest Service. It was accepted as the agency Proposed Action after modifying certain design elements to meet the requirements of the Forest Plan for resource protection. In addition, certain assumptions were made about the construction and operation of the facility under the Proposed Action (see section 2.7.2, below).

2.3 ALTERNATIVES CONSIDERED IN DETAIL

2.3.1 Alternative 1 (No Action)

Under the No Action alternative, the Forest Service would not issue a special use authorization (SUA) for the project, and the proposed project would not be constructed. There would be no change in the existing environment, no environmental protective measures would be implemented, and diesel generators would continue to supply energy for the community of Angoon. CEQ regulations (40 CFR 1502.14d) require that a "no action" alternative be analyzed in every EIS. This alternative represents the existing condition against which any other alternatives are compared.

2.3.2 Alternative 2 (Proposed Action)

The Forest Service Proposed Action is to stipulate, through SUAs and easements, the terms and conditions necessary for the protection of resources during the construction and operation of a run-of-river hydroelectric facility on Thayer Creek within the limits authorized under ANILCA. Major improvements associated with the 1,000-kilowatt hydroelectric power facility are displayed in Figure 2-1 and include the following:

1. Port facilities located 1.8 miles south of the outlet of Thayer Creek consisting of mooring buoys and a garage for operation and maintenance vehicles.
2. A diversion dam, approximately 10 feet high, on Thayer Creek, just over one and a half miles from the outlet.
3. An intake structure at the diversion dam.
4. A pipeline, approximately 1.2 miles long, from the intake structure to the powerhouse. The pipeline would be secured to the ground by a system of nylon straps and galvanized steel cable, and to the maximum extent possible would be routed around trees and other obstacles.
5. A penstock, about 510 feet long, from the pipeline to the powerhouse.
6. A surge tank near the junction of the pipeline and penstock.
7. A power plant structure, about 30 feet by 68 feet and 25 feet high, to house two generating units.
8. Three access roads, including almost 2 miles of road from the port facilities to the power plant, 1.4-miles road from the powerhouse to the diversion dam/intake structure, and about 4.2 miles of road from the port facilities to Kootznahoo Inlet.
9. A transmission cable consisting of two overhead segments and one submarine crossing. One overhead segment would extend 1.9 miles from the powerhouse to the port facilities; the other would extend 4.2 miles from the port facilities to Kootznahoo Inlet. The submarine crossing would cross from the northern shore of Kootznahoo Inlet to the City of Angoon, approximately 0.9 mile.

In addition, various temporary facilities, including a barge landing, staging areas, and a construction camp, would be needed during project construction. The feasibility evaluation

Figure 2-1. Alternative 2 – Approximate Layout of Hydroelectric Facilities for the Angoon Hydroelectric Project

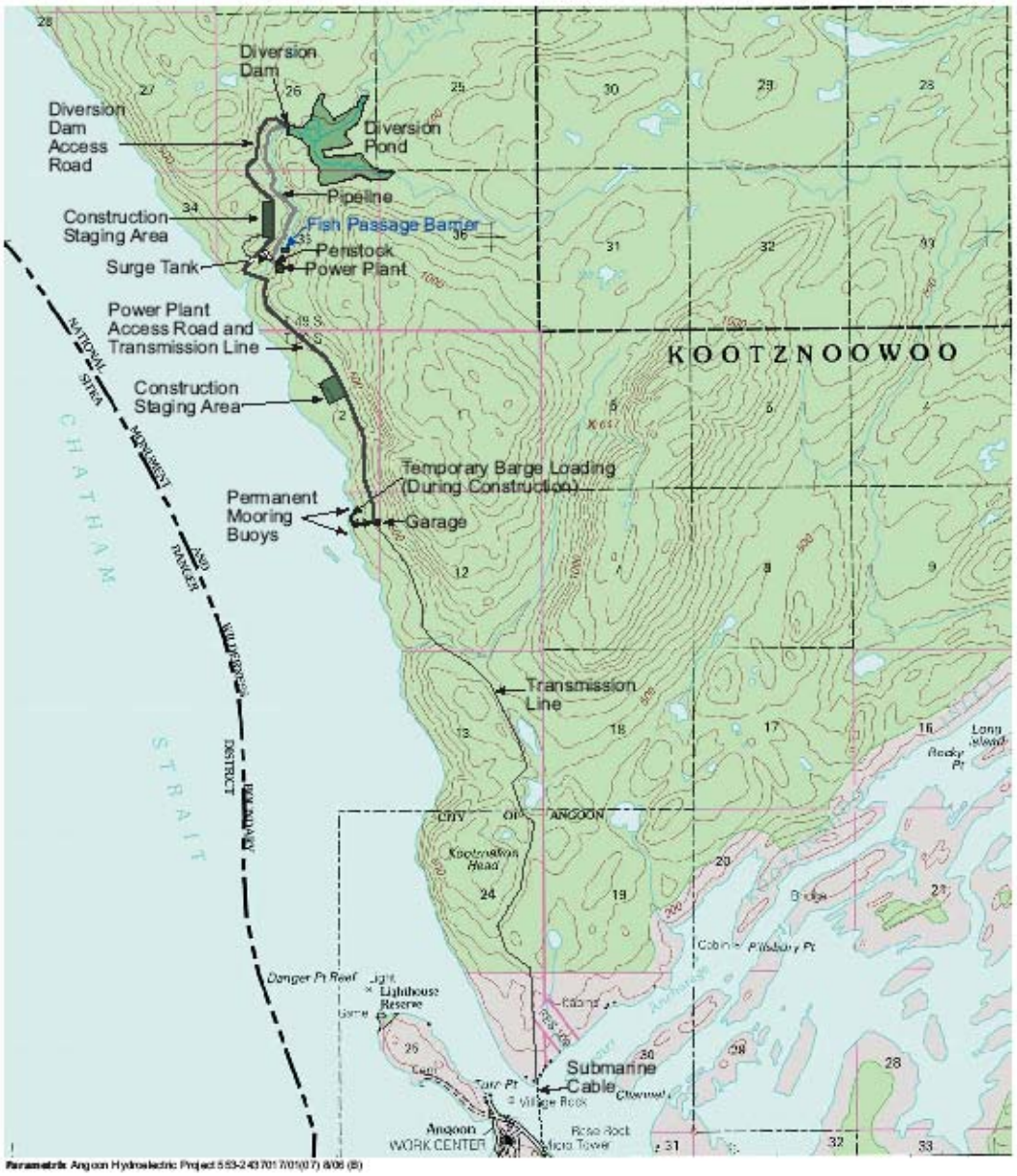


Figure 2-1
Approximate Locations of Proposed Features for the Angoon Hydroelectric Project

report (HDR Alaska 2000) describes existing Angoon electrical loads and resources and includes a development schedule and economic analysis.

2.3.3 Alternative 2a

This alternative would be the same as Alternative 2, except the transmission cable would be approximately five miles of power cable laid off-shore of Admiralty Island to the City of Angoon (Fig. 2-2). Approximately two miles of overhead, 12.5 kV transmission line would be installed along the access road between the powerhouse and the port facilities. About five miles of submarine cable would connect the transmission line at the port facility to the existing diesel power plant at Angoon. The power cable would be submerged up to 600 feet in Chatham Strait. The cable would pass to the outside of Danger Point and connect to the distribution system at the existing diesel power plant.

The design and locations of the diversion dam, intake structure, pipeline, surge tank, penstock, port facility , access roads and transmission lines, and power station would be the same as in Alternative 2. The section of road and transmission cable from the port facilities to Kootznahoo Inlet would not be constructed, and the submarine cable would not be laid across Kootznahoo Inlet.

2.4 ELEMENTS COMMON TO THE ACTION ALTERNATIVES

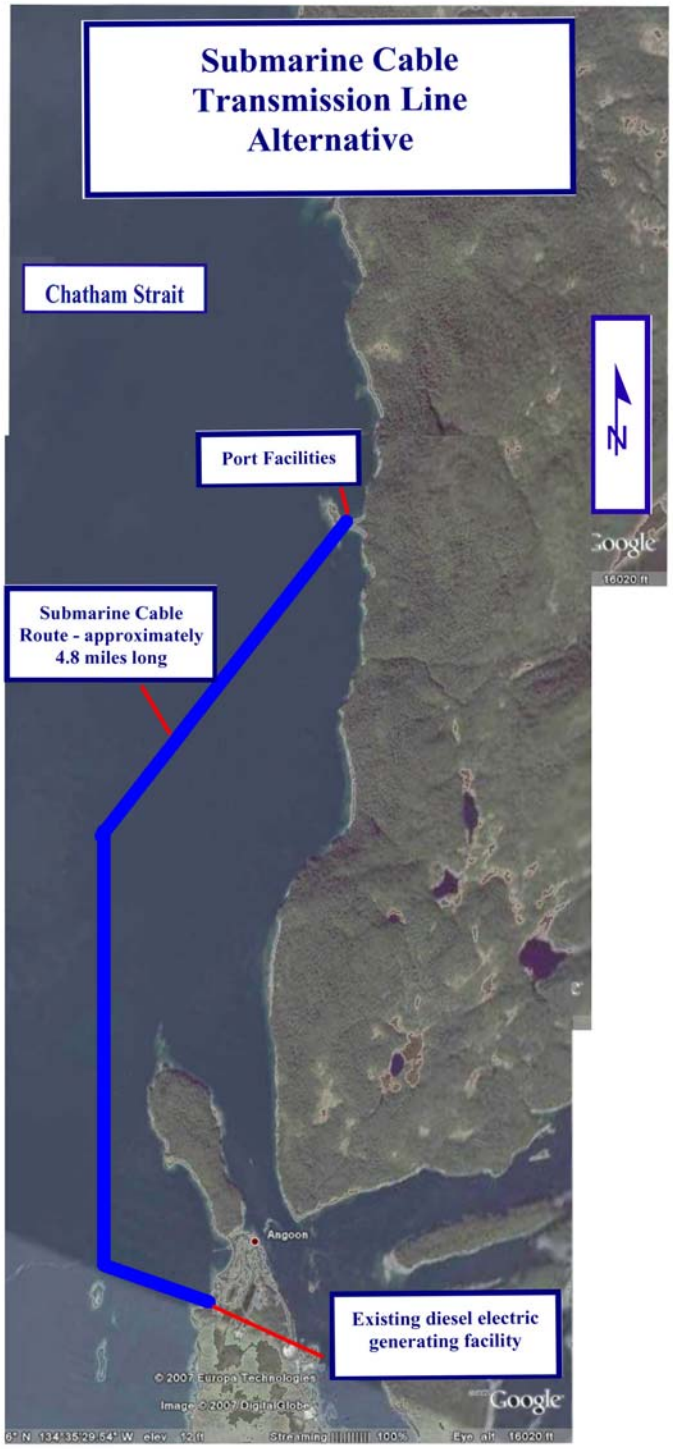
The Alternatives are consistent with the Tongass Forest Plan. All applicable Forest-wide and Land Use Designation standards and guidelines have been incorporated. The Forest Service uses mitigation and preventive measures when planning and implementing land management activities. Additional direction comes from applicable Forest Service manuals and handbooks.

It is worth noting that the intake capacity of the pipeline would be less than the stream flow under most conditions. As a result, water would back up behind the diversion dam, creating a 10- to 20-acre pond. When the backed-up water reaches the level of the spillway, it would overflow and run down the natural stream course. By definition, a run-of-river project operates without an impoundment. Nevertheless, this project is considered run-of-river because it would not depend on a storage reservoir for continuous operation. Instead, power generation would depend on the volume of water flowing through the system at any given time. Water in the impoundment would not offer any storage that could be regulated for additional generating capacity when flows are not sufficient to meet all generation requirements.

During extreme low-water conditions, water would be allowed to pass over the spillway and into the natural stream course, and the remainder would pass through the pipeline and penstock system. Analyses in this document assumed a minimum instream flow of 20 cubic feet per second. At current load levels, this would be expected to supply all of Angoon's power needs for all but 2 days per year.

The following assumptions for the construction sequence and design parameters were taken from the Angoon Hydroelectric Project Feasibility Evaluation Report (March 2000) and

Figure 2-2. Alternative 2a – Approximate Layout of Hydroelectric Facilities for the Angoon Hydroelectric Project



modified by the Forest Service when needed to protect fish and wildlife habitat as authorized in ANILCA. This sequence provides the framework for the analyses. If the design and construction of the project do not follow these assumptions, a supplemental EIS may be required, and will be the responsibility of Kootznoowoo before a SUA is issued.

A. Construction sequence and timing will be as follows:

   i. Year 1: The contract for construction of port facilities and roads would be awarded at the end of March. The contractor would construct the port facilities in April and May, the power plant access road in June, and the intake access road during July through September.
   ii. The supply contract for the generating equipment would be awarded by the end of March of Year 1, and the equipment would be delivered to the site by April of Year 2. The generating equipment would be installed in May through July of Year 2.
   iii. The powerhouse structure would be constructed between August and November of Year 1, and the installation of the interior mechanical and electrical systems would occur between December and April of Year 2.
   iv. Construction of the diversion and intake structure would begin in late winter of Year 1, when stream flows are normally at their lowest level.
   v. Construction of the pipeline and penstock would follow the construction of the diversion and intake; expected completion will be in summer of Year 2.

B. The access road and transmission cable between the port facilities and the power plant would share the same corridor, which would be 1.9 miles long by 45 feet wide.

C. Clearing widths for road construction only would average approximately 30 feet along the horizontal cross section, but would be wider in places with slope cut-and-fill needs.

D. Two 6 acre staging areas would be built for storing construction equipment and building materials. Vegetation would be cleared from the staging areas and a shot rock base would be laid down. The staging areas would be used during construction, and intermittently during maintenance for the life of the permit. If the staging areas are not to be needed after construction, they would be reclaimed and returned to the previous natural state.

E. The transmission cable route would be designed to meet or exceed Forest Plan standards and guidelines for visual resources. The adopted Visual Quality Objective for the TUS Land Use Designation is Modification. The transmission cable alignment incorporates a design element that obscures the corridor profile from the sea-level view point, which would meet the Partial Retention Visual Quality Objective. A 500-foot section of the transmission cable immediately south of the port facilities would be aligned so the corridor is not be perpendicular to the slope.

Before project implementation, the Forest Service will require the proponent to prepare a plan, subject to approval by the Forest Service and other government agencies with permitting jurisdiction, to set performance criteria for achieving objectives related to beach fringe and estuary, scenery, and heritage resources. The Forest Service would also review the construction plans, specifications, and geotechnical information as part of the SUA operating plan. The roads, transmission corridor, and power generating facilities would be included in

these reviews. Before issuing the SUA, the Forest Service will require a final review of the project design. Best Management Practices (BMPs) would be applied during project implementation, and would be part of the SUA operating plan.

The facilities, roads, and transmission cables would be designed to meet all applicable Forest Plan standards and guidelines, with particular emphasis on scenery management and ensuring minimum impact to beach fringe and wetlands.

In addition to the design elements described above, the following conditions would be applied to reduce or mitigate adverse effects on natural resources in the project area:

Geology and Soils

Site-specific geologic, hydrologic, and geotechnical studies would be completed before final layout and design of the project to avoid building project features on unstable slopes, and to protect project features from surface water and groundwater problems. A 100-foot wide buffer would separate the karst features from project facilities.

All project facilities would have site-specific erosion and drainage control designed into the final project plans. Project facilities include the port facilities, diversion dam and intake, pipeline, penstock, surge tank, powerhouse and switchyard, access roads, transmission cable, barge landing, staging areas, construction camp, and rock and borrow sites.

A low-level outlet built into the diversion structure would allow flushing of sediment past the structure on an as-needed basis to provide sediment downstream of the diversion. The powerhouse would be designed to provide flow downstream of the powerhouse in the event of an unplanned shutdown of the intake or pipeline.

Construction of the penstock crossing would incorporate erosion controls to minimize sedimentation. The design of the penstock crossing should allow high flows and debris to pass through the channel unobstructed with the natural range of bed elevations in the crossing reach.

The bridge over Thayer Creek and all Class I, II, or III stream crossings would be adequate designed to pass 50-year flood events and large woody debris (BMP 14.17).

Water Resources

All handling of hazardous materials during construction and operation will be consistent with BMPs and other State and Federal Regulations.

The collection and disposal of solid and human waste from the facilities during construction and operation would meet all applicable laws and incorporate BMPs into the final design to protect hydrologic and habitat resources.

Fisheries

The intake structure would be properly screened to prevent entrainment of fish.

Bedload monitoring would occur throughout the operation of the dam. Based on the results of the monitoring, periodic flushing of sediment through the sluicing facility would occur, if necessary, to mimic the natural sediment transport processes.

Dam construction would occur during low-flow periods and employ sediment and erosion control BMPs to minimize direct impacts and downstream sedimentation.

The design of the discharge structure would include outfall protection, such as a concrete pad or placed riprap, which would serve to decrease or eliminate scouring and sedimentation.

Following construction, the temporary barge landing would be regraded and revegetated to pre-project condition.

Vegetation

To avoid the introduction of invasive species into the project area, plants native to the area and originating near the project area would be used for any revegetation or restoration work. Also, construction vehicles and equipment would be washed before being delivered to the project site.

Wetlands

The project proponent would need to acquire a Section 404 permit from the Army Corps of Engineers (USACE).

During project construction and operation, proponent would implement BMPs prescribed for the soil and wetland types identified in the project area. Some examples of BMPs or mitigation measures include crossing wetlands with the shortest length and width of roads, providing adequate cross drainage, using geotextiles and lightweight fill or log corduroy at road crossings, and avoiding high-value wetlands .

Rock pits and staging areas would not be located on wetlands. .

Overburden from road construction would be disposed of away from wetlands. In addition, minimum road clearing limits and side ditching would be used when building roads in wetlands. Road layout would avoid rare or high-value wetlands.

Project features would be sited to avoid sedge fen wetlands, which are scarce wetland types on the Tongass National Forest and provide valuable habitat to several terrestrial animals.

Wildlife

Between March 1 and August 31, vegetation removal would not be permitted within a 330-foot radius of an active bald eagle nest. In addition, activities such as blasting or helicopter use would not be allowed within a quarter mile of active nests. Any restrictions placed upon project activity to minimize disturbance to nesting eagles may be removed if the nest(s) becomes inactive after May 31. No active or inactive bald eagle nest trees would be cut down.

The power cable would be built to Avian Protection Plan construction design standards to reduce electrocution hazards (Avian Power Line Interaction Committee and USFWS 2005, pages 30 - 42).

To reduce the risk of adverse encounters between humans and brown bears, and to reduce the vulnerability of marten to trapping, roads constructed for the project would be closed to all uses unrelated to project construction and operation. Also, all camps and work sites would be required to store food and garbage in bear-proof containers.

Where practical, road construction and other development activities would not be allowed within 500 feet of the anadromous portion of Thayer Creek. This would reduce the likelihood of project implementation diminishing brown bear use of key foraging areas.

Threatened, Endangered, and Sensitive Species

If any previously undiscovered sensitive plants are encountered before or during implementation of the project, the populations would be protected by avoiding disturbance in the area containing the population (and similar habitats in that vicinity). The district or forest botanist or ecologist would be notified immediately to evaluate the population and recommend avoidance or mitigation measures.

Surveys to determine the presence of nesting goshawks would be completed in the project area before construction activities begin, using the most current inventory protocols developed in cooperation with the appropriate state and federal agencies. If any active nests are found, no continuous disturbance likely to result in nest abandonment would be permitted within the surrounding 600 feet between March 15 and August 15 (USDA 1997, pg.4-90 – 4-91).

A minimum 330-foot buffer would be marked around any osprey nest tree found in or near the project area before or during implementation of the project (USDA 1997, pg 4-92). Activities "likely to disturb nesting activity" would halt until the nesting season ends.

Visuals

The smallest area needed for the landing site would be cleared of trees and vegetation. During construction, shoreline rocks would be protected from scarring or damage with removable materials. Following construction, the landing site and connector road would be restored to a condition that would promote natural revegetation.

In the Lakes landscape unit, at least a 100-foot wide buffer of mature trees would be maintained between the project elements and lakeshores.

A buffer of mature trees would be left along the shoreline in the Chatham Strait Shoreline landscape unit to screen the transmission facilities, access road and construction staging area from the Visual Priority and Use Areas.

Project elements, including buildings, the pipeline, transmission towers, and generation facilities would be constructed of visually compatible materials or painted earth-tone colors to blend with the surroundings.

Cultural Resources

Forest Service archaeologists have surveyed the proposed project area and "footprints" of the proposed facilities. We believe project facilities can be located to avoid known heritage sites. However, a Forest Service archaeologist would be present on-site during project layout and construction to monitor changes between the proposed and actual layout. Project work would cease until we develop a mitigation plan if an historic property cannot be avoided during layout, or a new site is discovered during construction. The Forest Service would develop the mitigation plan in consultation with the State Historic Preservation Office (SHPO), Kootznoowoo, Inc. and their contractors, the Angoon community, and other

interested parties. A Memorandum of Agreement about how work would continue would be signed before project work proceeds.

An archaeological monitor would be present at the south end of the overhead transmission cable and associated road construction, especially where the overhead transmission cable transitions to the submarine cable, during initial layout and construction.

The archaeologist and the Admiralty National Monument Ranger would be contacted immediately and work would cease if historic properties or cultural material is noted during the project implementation. The Forest would follow Native American Graves Protection and Repatriation Act regulations set forth in 43 CFR 10 if Native American remains are encountered in the project area,.

2.5 ALTERNATIVES ELIMINATED FROM DETAILED STUDY

Kootznoowoo considered two other alternatives to the pipeline and penstock design of the proposed action during project development. These two alternatives involved a directional-drilled tunnel and a conventional tunnel, respectively. In the alternative using the directional-drilled tunnel, a 4,200-foot long and 42-inch wide tunnel would be drilled from the intake structure to the power plant. The tunnel would be lined with 36-inch steel pipe. The rest of the alternative design was similar to the Proposed Action alternative. Directional drilling, while advancing in its capabilities, has not yet been used successfully for a hydroelectric project, and is experimental technology in this application. This alternative was not carried through analysis because of the slightly higher costs and the high probability of unexpected costs because the technology is experimental.

The conventional tunnel alternative would have drilled an 11-foot diameter horseshoe tunnel approximately 2,650 feet long. Two 36-inch steel pipes would have been stacked on the north side of the tunnel, leaving the rest of the tunnel open to narrow-wheelbase access to the diversion dam and intake structure. This alternative was not carried through this analysis because of the slightly higher cost of drilling the tunnel and the lower power generation capacity. This alternative would not have met the power needs of Angoon for approximately 10 days a year, and 19 days per year if Angoon grew by 50%.

Some scoping comments encouraged the consideration of underground and submarine cable. The premise for considering alternatives that are driven by these design approaches is that they would reduce effects to all the resources on National Forest System lands. We did not consider laying underground transmission cable along the overland route in Alternatives 2 and 2a because there would be no real difference in visual effects but more ground disturbance and higher costs. Both underground and overland designs would require clearing a corridor of similar proportions. Maintenance during the life of the project would be similar because the growth of large diameter trees would be prevented in the corridor. From a visual analysis perspective, the 45-foot wide corridor not the 35-foot tall power poles and transmission cables would create the visual impact.

Another alternative proposed a route that would follow existing road systems on Chichigof Island and would require two underwater cable crossings. Specifically, the cable would follow the Game Creek road system from Hoonah, cross over to the Indian River road system, and connect to Tenakee Springs. Submarine cable would cross Tenakee Inlet from

Tenakee Springs, to Corner Bay, and then follow the road system to either Basket or Sitkoh Bays. Submarine cable would then cross Chatham Strait to Angoon from one of these locations. This alternative would require approximately 60 miles of overland route and 13 miles of submarine route, and would be very expensive. The cost of a submarine cable from Hawk Inlet to Hoonah, about 20 miles, is approximately $28 million (FY05 dollars) in the current project to connect Juneau, Green's Creek, and Hoonah. There would be two submarine cable crossings under this alternative. In addition the road systems aren't continuous and the overland or overhead transmission cable routes would need to be surveyed between the Game Creek and Indian River road systems and between the Corner Bay and Basket Bay road systems. The breaks in the road systems are at high elevation, heads of drainages and may be difficult to maintain during storms.

An alternative was proposed that would run a submarine cable from Hawk Inlet to Angoon. Again, the estimated cost of the submarine cable is $40-50 million (FY05 dollar estimate).

In addition, some people commented that the Forest Service should consider Favorite Creek as an alternative site. This alternative could not be pursued because it is outside the scope of the Proposed Action. The Forest Service is obligated to be responsive to ANILCA Section 506(a)(3)(B) - the right to develop hydroelectric resources on Admiralty Island within township 49 south, range 67 east, and township 50 south, range 67 east. Favorite Creek is not in the ANILCA legal description and would not be responsive to this Congressional mandate.

2.6 MONITORING

The monitoring program provides a means to assess the effects of the selected alternative, and application of the BMPs and Forest Plan Standards and Guidelines. Monitoring requirements are established in the approved Plans of Operations required by the Forest Service SUA and permits and approvals issued by other State and Federal agencies. Table 2.1 summarizes the monitoring requirements and authority for each resource.

2.7 COMPARISON OF ALTERNATIVES

The following subsections summarize the effects of Alternative 1 (No Action), Alternative 2 (Proposed Action), and Alternative 2a as presented in Chapter 3 of this EIS. Under Alternative 1, the Forest Service would not issue an SUA to Kootznoowoo for a hydroelectric facility at Thayer Creek, and we would expect no ground disturbance and associated resource effects to occur.

2.7.1 Geology and Soils

Under both action alternatives, Alternatives 2 and 2a, the access road corridor between the power plant and diversion dam has the potential to cross slopes greater than 67 percent. Slopes greater than 67 percent have higher landslide risks. Both alternatives have the same potential for landslides since the road is needed for both alternatives, and the layout and design would be the same. BMPs 14.7 and 14.12 would be applied to both alternatives to limit the risk of landslides and sedimentation.

Alternative 2a would affect the geology and soils less than Alternative 2 because there would be approximately 4 miles less of above ground transmission cable and associated roads.

Construction activities may contribute to surface erosion and short-term plumes of sediment in surface waters. These effects from construction of power generation facilities would be the same for Alternatives 2 and 2a because these facilities are the same in both alternatives. Surface erosion associated with road construction would be less under Alternative 2a because less road mileage is needed. We expect these effects would be temporary and mitigated by BMPs 13.11, 14.3, 14.8, 14.14, and 14.17.

Alternative 2a would have fewer effects to the geology and soils than Alternative 2. Alternative 1 would have no effects on geology and soils because there would be no facility development and associated soil disturbance.

2.7.2 Water Resources

Construction and maintenance of instream project features under the Proposed Action and Alternative 2a would be expected to cause temporary and short-term turbidity in Thayer Creek. Gravel road segments near creeks or ditches that drain to creeks would deliver some fine sediment to the creek during storm runoff periods. Limited traffic on the roads and use of BMP 14.8 would reduce sedimentation. Sedimentation would be more extensive in Alternative 2 than in Alternative 2a because the road system in more extensive and there would be more stream crossings in Alternative 2.

Diversion of stream flow through the power plant would reduce stream flow in the bypass reach in both Alternative 2 and Alternative 2a. Alternative 1 would not divert stream flow so natural channel processes would continue.

Sedimentation levels would not increase in Alternative 1 since no ground-disturbing activities would occur.

2.7.3 Fisheries

Alternative 2 and Alternative 2a would equally affect stream flow in Thayer Creek. Both alternatives would impound the stream behind the diversion dam and reduce flow in Thayer Creek between the dam and the fish barrier. Anadromous and resident fisheries habitat would be reduced, both in quality and quantity by the flow attenuation in this section of stream. However, there is not much fish habitat in this section of stream and there is a relatively large amount of high-quality fish habitat above and below this section of stream.

Alternatives 2 and 2a would have only minor effects on fish production and would not have deleterious effects on overall runs or populations within the project area.

Thayer Creek would flow unimpeded under Alternative 1, and no negative effects would accrue to fish habitat or production.

Table 2.1 – Monitoring						
Resource Item or Activity to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action to be Taken	Authority	Responsible Party
Karst and Cave Resources						
Locations for roads, transmission cables, and all related facilities	Review and approve plans, drawings, and location of facility and development staking.	Once prior to authorizing start of construction.	Karst surface features will be located and identified in the field. A 100-foot, no disturbance buffer will separate construction activities from karst surface features (USDA Forest Service 1997)	Construction will only be authorized if field review of survey staking and submitted plans and drawings are approved by the Forest Service.	Federal Cave Resources Protection Act, Tongass Forest Plan, Forest Service ROD	Forest Service
Botany						
Rare and sensitive plant populations	Conduct inspections of facility and development staking.	Prior to construction, a District botanist will mark the boundaries of all populations of known rare plants within or near the development areas. Populations not within the footprint will be undisturbed.	Evidence of sensitive/rare plant populations in development areas.	If any previously undiscovered rare plants are encountered at any time prior to or during implementation, work will be halted until the Regional Botanist and/or Forest Ecologist is consulted and necessary mitigation measures are determined.	Forest Service ROD.	Forest Service
Timber Removal: Compliance with timber sale contract provisions and brush disposal plan	Conduct onsite inspections	Before, during and after harvest activities	Compliance with contract clauses and brush disposal plan provisions.	Return to compliance	36 CFR part 233	Forest Service
Visual Resources						
Operations monitoring; compliance with visual quality objectives	Photo document field observations from established viewpoints	After construction, and during operations..	Determine whether visual impacts exceed anticipated impacts	Consider additional mitigation	Forest Service Handbook 2309.22	Forest Service

Table 2.1 – Monitoring						
Resource Item or Activity to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action to be Taken	Authority	Responsible Party
Soils and Wetlands						
Locations for roads, transmission cables, and all related facilities	Review and approve plans, drawings, and location of facility and development staking.	Once prior to authorizing the start of construction.	Nonconformance with approved design specifications or permit requirements	Determined by authorized agencies	Forest Service ROD, Plans of Operations, NPDES permit, Section 404 permit, ADNR title 41permit.	Forest Service, USEPA, USACE, and ADNR, Kootznoowoo Inc.
Cultural Resources						
Authorized ground disturbing activities	A qualified archaeologist will monitor ground disturbing activities for cultural resources according to SUA Terms and Conditions, which includes an Archeological Resources Protection Plan.	During all ground disturbing activity for term of permit.	If a site is discovered during project implementation	The project administrator will suspend work to avoid site damage. The Forest Supervisor shall notify the State Historic Preservation Office (SHPO). The forest Supervisor will authorize work to resume only after the consultation process has been completed.	Native American Graves Protection and Repatriation Act, 36 CFR 800	The operator and Kootznoowoo Inc. with Forest Service and SHPO review
Fisheries/Water Resources						
Maintain Thayer Creek instream flows	Use stream gauge to monitor flows	As established by ADNR water rights	Instream flow levels set by ADNR water rights.	Limit water withdrawal/diversion.	Forest Service ROD, ADNR water rights.	Forest Service and ADNR
Project Final Design Plans						
Design and construction plans of all authorized facilities in the project proposal	Review and approve plans, drawings, and location of facility and development staking.	Once prior to authorizing the start of construction.	Nonconformance with approved design specifications or permit requirements	Determined by authorized agencies	Forest Service ROD, Plans of Operations, NPDES permit, Section 404 permit, ADNR title 41 permit	Forest Service, USEPA, USACE, and ADNR, Kootznoowoo Inc.

2.7.4 Vegetation and Wildlife

Normal patterns of vegetation change would continue under Alternative 1. Vegetation would be cleared from the following areas as long as the project is in operation under Alternatives 2 and 2a:

1. within the footprint of the power plant (less than 0.5 acre)
2. the port facility garage
3. within road prisms (typically 20 feet width over an approximate total length of 7.5 miles in Alternative 2 and 3.3 miles in Alternative 2a.
4. total non-vegetated area would be about 18 acres in Alternative 2, and eight acres in Alternative 2a).
5. where water would back up behind the diversion dam (10 to 20 acres).

Vegetation would be cleared from two staging areas in Alternatives 2 and 2a. The staging areas would be about 6 acres each, and cleared for the life of the SUA. If the staging areas are not be needed for equipment and material storage after construction is complete, the sites would be reclaimed and returned to their previous natural condition. In the cleared corridors for the road rights-of-way and transmission cables, approximately 12 acres of existing vegetation would be changed to shrub-dominated vegetation types. Affected vegetation types would include old-growth spruce/hemlock forest, and forested wetlands. The conversion of spruce/hemlock forest or forested wetland would be much less under Alternative 2a because there would be much less road corridor development.

Cleared corridors for roads and transmission cables may facilitate the introduction and spread of noxious weeds. Construction equipment brought in from other areas may be contaminated with seeds and other parts of invasive plant species. Once established, some invasive plant species crowd out native species, be unpalatable to native wildlife, and have other undesirable effects on species and ecosystems in the project area. Again these effects would be more extensive in Alternative 2 than in Alternative 2a since the road corridor development is more extensive in Alternative 2.

Avoidance of wetlands where practicable, along with implementation of mitigation measures, would reduce but not entirely eliminate adverse impacts to wetlands. Such impacts would include permanent loss of wetlands within road prisms and at construction sites (e.g., power plant, port facilities). In addition, the introduction of fill material for road construction may affect surface or subsurface hydrology. In some cases, ponding may occur on the upstream side of the road bed; in others, side ditches or coarse fill may act as a conduit, reducing saturation of soils in the vicinity of the roadway. These and other effects may also influence wetland vegetation in the vicinity of road corridors. Again, these effects would be more extensive in Alternative 2 than in Alternative 2a because the transmission corridor is more extensive in Alternative 2. None of these effects would occur under Alternative 1.

Development of a hydroelectric facility and associated project components would affect wildlife species in several ways. Vegetation clearing for road and transmission cable corridors, the power plant, and other project features would reduce the availability of nesting and foraging habitat for some bird species and denning habitat for mammals such as marten. Roads constructed for project access may increase the vulnerability of marten populations to

trapping. Elevated levels of human activity associated with construction and maintenance of the hydroelectric facility and related project components may disturb species that are sensitive to human presence. Brown bears in particular may be affected by reduced availability of fish spawning habitat, reduced habitat effectiveness of riparian areas, and increased risk of human/ bear encounters. Reduced stream flow in Thayer Creek below the diversion dam would reduce the availability of habitat and foraging opportunities for river otter and some migratory bird species. These effects would be similar between Alternative 2 and Alternative 2a because the core development areas would be similar.

There would be no changes to wetlands or wildlife habitat under Alternative 1 since the project wouldn't be implemented and no ground disturbing activities would occur.

2.7.5 Threatened, Endangered, and Sensitive Species

Alternative 2 and Alternative 2a would not be expected to adversely affect any threatened, endangered, or sensitive plant or animal species. Project implementation would increase the risk of disturbance to sensitive animals or damage to undetected populations of sensitive plants. Clearing vegetation for the transmission cable, access roads, and construction staging areas would reduce the availability of potential nesting and foraging habitat for Queen Charlotte goshawks. Alternative 2a has less potential to reduce Queen Charlotte goshawk habitat since there is less area dedicated to transmission and road corridor.

2.7.6 Visual Resources

Effects on visual resources would be the same under Alternatives 2 and 2a for the Thayer Creek and Chatham Strait Shoreline Landscape Units because the developments in these units would be the same under both alternatives. Project modifications in the Thayer Creek Landscape Unit would largely be screened from the Chatham Strait Visual Priority and Use Area by terrain. Sections of road and the power plant may be visible in the foreground but would meet the Modification Visual Quality Objective (VQO). Project developments would meet the Retention VQO in the middleground and background.

The forested beach fringe buffer would screen most of the project developments in the Chatham Strait Shoreline Landscape Unit. The port facility and point where the road crosses Thayer Creek would not be screened. However, the alternatives would meet the Modification VQO for the foreground and Retention VQO for the middleground and background.

Under Alternative 2, the visual character of some locations in the Chatham Straits Hillside and Lakes landscape units would be modified in the middleground. The project area would be visible from Visual Priority Travel Routes and Use Areas. In general, the proposed action would be expected to meet the standards and guidelines for the TUS land use designation of Modification. No development would occur in the landscape unit under Alternatives 1 and 2a, and they would continue to meet the Retention VQO.

2.7.7 Cultural Resources

Alternative 2 and Alternative 2a would not be expected to impact any historic properties, but would result in an elevated risk of impacts to undetected sites. The risk would be less under Alternative 2a because there would be less ground disturbance and less extensive development under this alternative. Any ground-disturbing activity carries the risk of damage to buried or otherwise hidden historic properties. The presence of archaeological monitors during project implementation and other mitigation measures would reduce the potential of damaging undiscovered sites.

2.7.8 Subsistence

The conversion of forested habitats to shrub habitats in construction areas and road and transmission cable corridors would reduce the capability of the affected area to support Sitka black-tailed deer during winter. Placement of a 42-inch pipeline on the ground may present a movement barrier for fawns. These effects would be similar in Alternative 2 and Alternative 2a and would not result in significant restrictions on the abundance and distribution of, access to, or competition for subsistence resources in the project area. A large amount of deer habitat would remain undisturbed and the pipeline is perpendicular to the beach, so it would not block their route between the beach and alpine areas.

2.7.9 Wilderness

Vegetation clearing and ground-disturbing activities under Alternative 2 would diminish the untrammeled quality of the project area. Natural qualities would similarly be diminished by the development of roads in the area, and by potential adverse effects on fish and wildlife habitat. The undeveloped quality of the project area would be reduced by the construction of human structures such as the diversion dam, powerhouse, and port facilities. Opportunities for solitude would be dramatically reduced during project construction, as construction crews would be present in the project area on an almost-daily basis for several months. Notably, ANILCA Section 506(a)(3)(D) specifically excludes the provisions of the 1964 Wilderness Act on Kootznoowoo's right to develop hydropower resources. The area outside of the TUS would continue to be managed as wilderness.

Alternative 2a would have less impact than Alternative 2 on the untrammeled and natural qualities of the area because the road and transmission cable corridor would be less extensive. Less of the Kootznoowoo Wilderness Area would be affected by the project under Alternative 2a.

2.7.10 Socioeconomics

Alternative 2 and Alternative 2a would provide a stable, and cheaper power supply to the community of Angoon than would Alternative 1. A stable power supply would enhance the economic growth and stability of Angoon.

2.8 PREFERRED ALTERNATIVE

Alternative 2 is the preferred alternative.

3. Affected Environment and Environmental Consequences

3.1 INTRODUCTION

This chapter describes the affected environment and assesses the environmental consequences of the three alternatives presented in Chapter 2. For each resource area, the analysis is broken into four subsections – affected environment, effects of project components, comparison of effects, unavoidable adverse impacts. The affected environment subsections describe the current conditions of the resource, against which the anticipated direct and indirect environmental effects of the alternatives are evaluated. Then, for each resource, the next subsection discusses the effects of individual project components or phases (e.g., diversion dam, pipeline, transmission cable corridors, etc., or construction and operation). The next subsection compares the effects of the three alternatives, followed by a summary of any unavoidable adverse impacts. Cumulative effects are presented at the end of this chapter. The specific order of the sections is as follows:

Geology and Soils (section 3.2)
Water Resources (section 3.3)
Fisheries (section 3.4)
Vegetation and Wildlife (section 3.5)
Threatened, Endangered, and Sensitive Species (section 3.6)
Visual Resources (section 3.7)
Cultural Resources (section 3.8)
Subsistence (section 3.9)
Wilderness (section 3.10)
Socioeconomics (section 3.11)
Cumulative Effects (section 3.12)

3.2 GEOLOGY AND SOILS

This section discusses land types, geology, soil productivity, surface erosion, and mass wasting in the Angoon Hydroelectric Project area, as well as the potential effects associated with the alternatives. The information in this section was drawn from the soils and wetlands report, karst and cave resource report, and supplemental soil, geologic, and wetland report prepared for this project. All of these reports are on file at the Admiralty Island National Monument office.

3.2.1 Affected Environment—Land Types and Geology

Watersheds are defined as the area that contributes surface and subsurface water to a single point. Key Thayer Creek watershed components include stream channels, groundwater, riparian areas, wetlands, lakes, hillslopes, and soils. These components transport, filter, and store water and sediment. This section discusses project features that influence hillslope stability, soil erosion, and karst features.

The project area spans three ecological subsections -- Hood-Gambier Carbonates (HGC), Mitchell-Hasselborg Lowlands (MHL), and Thayer Lake Granitics (TB) (Fig. 3.1). The names of these ecological subsections are indicative of project area geology (Fig. 3-2).

3.2.1.1 Hood-Gambier Carbonates (HGC)

Most of the project facilities lie in the HGC ecological subsection. Because of fractures in the carbonates, high annual precipitation, and peat lands adjacent to the carbonate bedrock, karst has developed to varying extents. Twenty five karst features have been identified and inventoried between Thayer Creek and the proposed port facility. Generally, glacial deposits cover the carbonate rock at lower elevations.

The land types associations (LTA) found in this ecological subsection are hills and lowlands. The Hills LTA has gently sloping terrain with relief less than 2,000 feet, and is without alpine vegetation on the summits. Most of the soils are derived from glacial till, are well-drained, and support productive forest cover types. Sedge fens and forested wetlands are the most common wetlands.

Lowlands are gentle, glacial topography with a higher percentage of wetland. Mineral soils are derived from glacial till and somewhat poorly drained. Wetlands types are bogs, poor fens, or forested wetlands.

3.2.1.2 The Mitchell-Hasselborg Lowlands (MHL)

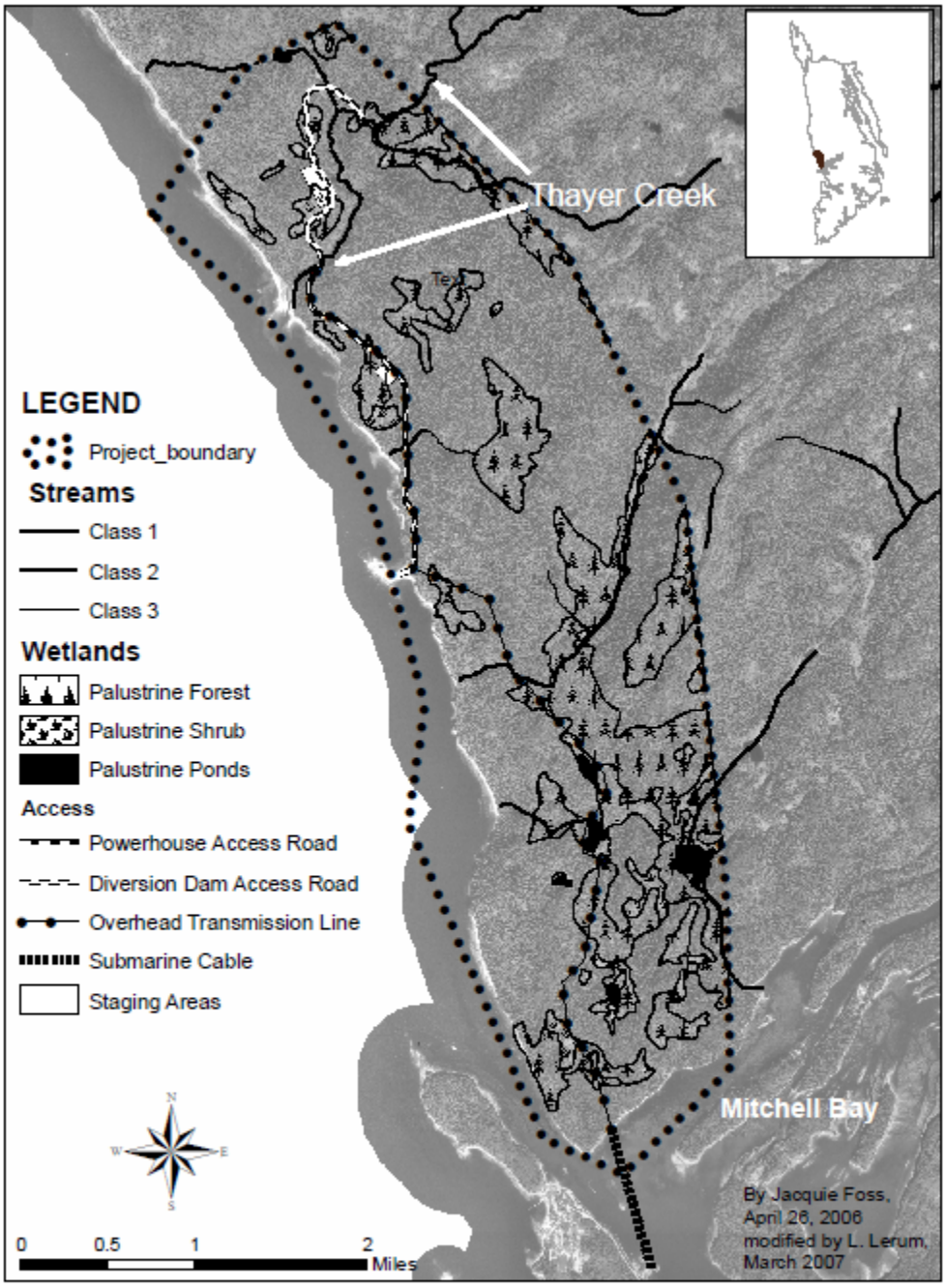
Glaciers eroded the dominantly quartz arenite tertiary sediments of the Kootznoohoo formation and the older basalts and chertsof the Devonian/Silurian volcanics to form the MHL. Glaciation has a stronger effect on the development of the MHL ecological subsection than geology.

Hills and lowlands are the LTAs found in this ecological subsection of the project area. Relief is the only difference between the two land types in MHL. All mineral soils are derived from glacial till with thick, organic horizons. Mineral soils are well-drained and support highly productive forest cover. Organic soils are very thick, and support forested and bog wetlands.

3.2.1.3 Thayer Lake Granitics (TB)

The TB ecological subsection is a glacially scoured granitic body with little relief and gentle slopes. It is largely made up of quartz monzonite and quartz diorite from the cretaceous period. The LTA is primarily lowland, typified by glacial till slopes and plains. Mineral soils are ‘poorly drained’ to ‘somewhat poorly drained’. They support low productivity, mixed conifer forest. Organic soils are ‘poorly drained’ to ‘very poorly drained’. Bogs and poor fens

Figure 3-1. Ecological Subsections and Wetlands (National Wetlands Inventory) in the Angoon Hydroelectric Project Area



Angoon Hydro Project
Streams, Ecosubsections, and Wetlands
(from National Wetlands Inventory)
Figure 3-1

are the wetlands that develop in this ecological subsection and LTA. These types of wetlands are common in Southeast Alaska.

3.2.1.4 Karst Geology

Karst is a unique landform that develops by the dissolving of carbonate rock, primarily limestone and marble. As the rock dissolves, underground drainage systems develop that can be expressed as surface features. Examples of these features include: streams that sink below ground (losing streams), depressions, sinkholes, collapsed channels, and caves.

According to the current USGS geologic mapping, dark gray to white, medium to thick-bedded marble of the Gambier Bay Formation underlays much of the project area. Geologic inventory within the project area confirmed the presence of marble underlying portions of the proposed access road alignment. The cliffs exposed along the beach south of Thayer Creek consist of dark gray to white marble. Glacial till and glacial marine sediments overlie much of the bedrock in the area. These conditions may have created the surface flow drainage networks that led to the development of the karst systems.

In the northern third of the project area, section 2, T. 50 S., R. 67 E., karst systems have developed where surface drainages flow to one of the marble beds striking roughly parallel to the shore. Twenty-five karst features were inventoried. These features included sinkholes, losing streams, resurgences, and one cave. Though dye tracing was not completed for these systems, we believe the streams sink along the eastern side of the marble band, flow along the strike, and resurge at either end of the band. We consider all these features high vulnerability karst, as are the streams that sink or lose into them. A no disturbance buffer with a minimum width of 100 feet is required around the karst features and losing streams (TLMP 1997). The access road between the port facilities and the power generating facilities would be routed around these buffers. This would limit the sediment and debris associated with road construction from entering the karst system via the losing streams.

The area from the mouth of Thayer Creek following the proposed access road and pipeline to the proposed diversion dam was not inventoried for karst and cave resources. Neither was the route proposed for the transmission cable corridor. Geologic mapping, and karst and cave resource inventories and assessments need to be completed prior to the design and layout of these facilities.

3.2.2 Affected Environment—Project Area Soils

The effects analysis area for soil resources are the watersheds in which development is proposed. Watersheds are used as the analysis area because erosion processes and specific erosion events are contained within them. Also, project-related sedimentation would be most noticeable within the watershed where it occurs.

Detailed site-specific soil investigations have not been conducted within the project area. However, general soil characteristics such as depth of organic matter, and infiltration capability are inferred from the underlying geology, LTA, and soil great groups. Table 3-1 displays the soil great groups and wetlands potential within ecological subsections and LTAs in the project area. Project effects relative to erosion, soil productivity, and landslide

potential can be inferred from the general soil characteristics and topography of the project area. Site-specific soil information is not needed to anticipate effects of this project.

Table 3-1. Soil Great Groups and Potential for Wetlands Within Ecological Subsections and Land Type Associations in the Angoon Hydroelectric Project Area

Ecological Subsection	LTA	Great Group	Wetland (Yes/No)
Hood-Gambier Carbonates	Hill	Humicryods	No
		Haplocryods	No
		Spodosol	No
	Lowland	Haplocryods	No
		Inceptisol	No
		Cryohemists	Yes
Mitchell-Hasselberg Lowlands	Hill	Haplocryods	No
		Cryorthods	No
		Haplocryods	No
	Lowland	Cryorthods	No
		Haplocryods	No
		Cryaquods	Yes
		Humicryods	No
		Cryofolists	Yes
		Cryosaprists	Yes
		Cryohemists	Yes
		Cryofibrists	Yes
Thayer Lake Granitics	Lowland	Haplocryods	No
		Inceptisols	No
		Cryaquepts	Yes
		Cryumbrepts	No
		Cryosaprists	Yes

3.2.2.1 Soil Productivity

Soil productivity is the capacity of soil to support plant growth based on the chemical, physical, and biological properties of the soil. Virtually all soils in the project area have an intact, organic mat that prevents erosion or keeps it at a low level. Removal of this horizon exposes the soil to erosion and loss of the organic rooting substrate. Keeping the surface horizon intact is vital to maintain soil productivity.

3.2.2.2 Surface Erosion

Surface erosion is not pervasive in the project area. No development or natural disturbance event has occurred in the project area prior to this proposal.

3.2.2.3 Landslides (Mass Wasting)

Landslides transport large volumes of soil, rock, and debris off the original site which adversely affects soil productivity, and is a source of surface erosion. If landslides occur adjacent to aquatic resources they dramatically alter stream flow and habitat. Landslides are most likely to occur on steep valley side slopes and within steep, deeply incised streams (V-notches) (Swanston 1969). Steep valley side slopes exist in the project area, particularly between the proposed power plant site and the diversion dam.

Landslides usually occur on steep slopes that have soils with distinct subsurface layers such as compact glacial till or bedrock that slopes parallel to the ground surface. These parallel subsurface layers form a smooth slip-plane on which slides occur (Flaccus 1959, as cited in Bishop and Stevens 1964). Landslides typically occur during or immediately after periods of heavy rainfall, when soils are saturated (Swanston 1970). Though slopes over 67% exist between the port facilities and the diversion dam, we did not observe any evidence of landslides. We did not survey the transmission corridor that runs south from the port facilities but topographic maps do not indicate that the transmission corridor and associated road would cross steep slopes.

Road building on slopes exceeding 67 percent, regardless of soil drainage, increases landslide potential and should be avoided where feasible (USDA Forest Service 1997a).

3.2.3 Effects on Soils

3.2.3.1 Soil Productivity

Regional Soil Quality Standards state, “a minimum of 85 percent of an area is left in a condition of acceptable productivity potential for trees and other managed vegetation following land management activities.” Although road construction and rock pit development remove forest soils from timber production, classified roads are considered part of the transportation system not the productive soil base. Consequently, classified roads, the rock pits needed to support them, and project facility sites are not considered detrimental disturbance from a soil productivity perspective (Forest Service Manual 2554.03). Temporary roads, sidecast and other materials involved in road building and facility construction, as well as, landslides resulting from land development practices are considered detrimental disturbance of soil productivity. Naturally occurring landslides are not included in soil productivity effects because they are part of the natural variability of the watershed.

Soil productivity losses would be in areas where project facilities induce erosion and landslides. Soil disturbance would be confined to the constructed facilities which are not considered productivity losses since the intended use does not to support plant growth. There may be some small, localized areas of decreased soil productivity adjacent to the proposed facilities, but soil productivity would recover as plants recolonized the areas.

Roads would be designed to maintain the natural drainage pattern and prevent or reduce soil movement and sedimentation, and minimize soil displacement (BMP 14.3, FSH 2509.22). Steep slopes, greater than 67%, require subsurface, stability and geotechnical analyses to determine landslide potential before roads cross them (BMP 14.7, FSH 2509.22, Forest Plan 1997, pg. 4-106). The proposed access road to the diversion dam crosses an area with slopes greater than 67% and would need to have these analyses completed before road construction would be approved.

3.2.3.2 Erosion and Drainage

The access roads needed under Alternatives 2 and 2a are classified roads. They would be maintained to Maintenance Level 1 and open to motorized use by only the Forest Service and SUA holder to maintain and administer the power generation facilities. The roads would be closed to public motorized use, though they'd be available for hiking and other non-motorized uses. No temporary roads would be built under either Alternative 2 or Alternative 2a.

The proposed access roads would be a source of surface erosion. We control surface erosion through facility design (BMP 14.3) and an erosion control plan (BMP 14.5). These controls would prevent or reduce sediment delivery to streams at road crossings, from hillslope roads, potential pipe failures, or landslides.

Surface erosion would be expected during road construction. Because of the wet climate, even low slope areas like dirt road surfaces have the potential to erode and deliver sediment to adjacent streams or other waterbodies. This effect would be short-term and controlled through application of erosion control measures such as physically protecting the soil surface, physically inhibiting the transport of sediment to streams, re-establishing vegetation, and reducing the amount of soil disturbance near streams (BMP14.5). Road construction would also be restricted to periods when the risk of erosion is lower and temporary erosion control measures would be required (BMP 14.6). Short-term plumes of sediment may occur during construction but are temporary and typically within the range of natural flood conditions and would last less than 48 hours (BMP 14.5e).

Once the road is constructed, the exposed road surfaces and cut-and-fill slopes are susceptible to long-term erosion. Road cuts intercept subsurface flow and concentrate runoff into ditches, which may erode exposed surface soils and deliver sediment to streams. This process of intercepting runoff and subsurface flow, and concentrating it in ditches increases the efficiency of the drainage network because it accelerates the transport of water to streams. Less water is able to percolate into the soil and recharge the groundwater when the drainage network is made more efficient.

Runoff that is not properly controlled forms channels and causes the erosion of loose to medium compact surface materials. The road designs would use crowning, outsloping, or insloping with cross drainage and grade changes, as appropriate (BMP 14.3b). The use of these methods would prevent or reduce erosion of the road surface and cut-and-fill slopes, and prevent the sediment from reaching streams.

Another potential source of erosion would come from poorly placed or maintained culverts. Undersized culverts or culverts plugged with sediment would be washed out during high flow events and release road bed sediments to the streams. A sufficient number of relief

culverts and culverts sized to maintain natural drainage and flow patterns would be placed in roads (BMP14.3 b).

Steep slopes with unconsolidated soils are at higher risk of erosion and storm drainage problems. Cut bank, fill erosion, and slumping are also potential sediment sources in steep areas where piles, retaining walls, or other approaches are used to stabilize steep or unstable cut-and-fill slopes. Full bench construction, minimizing the width of disturbance, geotechnical and slope stability studies would be required for final project design for the access road between the power plant and diversion dam (BMP 14.7).

No specific guidelines are in place to limit quantifiable surface erosion rates. Regional soil quality standards limit detrimental disturbance to 15 percent (productivity guidelines) of the project area, including surface erosion risks. There will be no ground disturbance beyond the facilities footprints in this project. Estimated acres exposed to surface erosion for alternatives 2 and 2a are displayed in Table 3-3. These estimates are based on past experience with road construction in Southeast Alaska in which 4.8 acres of disturbance is associated with the construction of one mile of road, and one acre of disturbance per mile of road is associated with rock pit development. All alternatives would be well within the Regional Soil Quality Standard of 15 percent of the project area. The proposed hydroelectric facility and associated development are the first and only developments allowed within the project area, and no future development is planned. Consequently, cumulative effects would be identical to direct effects.

Table 3-2. Potential Effects of the Angoon Hydroelectric Project on Surface Erosion

Disturbance Type	Alt. 2	Alt. 2a
	Acres	Acres
Classified Road Construction	39	7
Rock Pit Development	8	2
Man-Induced Landslides	0[1]	0[1]
Total Affected Acres	**47**	**9**
Percent of Soils Analysis Area	**0.09**	**0.02**

[1] This analysis assumes the surface erosion effects of the proposed action would be fully addressed through erosion control measures and BMPs.

3.2.3.3 Landslides (Mass Wasting)

The road corridor between the port facilities and the power plant is entirely on slopes less than 67 percent. The road between the power plant and the diversion dam would cross slopes greater than 67 percent and increase the risk of landslides. BMPs 14.7 and 14.12 would offset this risk by determining the slope stability, and requiring full bench road construction and end haul and stabilization of excavated materials where needed.

3.2.4 Project Components

3.2.4.1 Diversion Dam

The diversion dam would be constructed of concrete slabs and would not affect soil productivity, erosion, or mass wasting.

3.2.4.2 Pipeline, Surge Tank, and Penstock

The proposed pipeline would be buried in the diversion dam access road for about 2,200 feet and then be laid on grade through the forest for about 3,600 feet. The pipeline would create no additional erosion beyond that created by the access road.

Ground disturbance would result from the placement of the surge tank and penstocks in order to maintain the grade to the powerhouse turbines. The penstocks would cross Thayer Creek adjacent to the powerhouse in Alternatives 2 and 2a. Bedding the surge tank, laying the penstock, and constructing the penstock crossing would incorporate erosion controls to minimize sedimentation (BMP 14.5, 14.6, 14.11, and 14.12).

3.2.4.3 Powerhouse

The proposed powerhouse would be located south of Thayer Creek below the barrier falls in Alternatives 2 and 2a. Surface erosion controls (BMP 14.25) would be needed to prevent sedimentation of Thayer Creek..

3.2.4.4 Roads and Bridges

The road corridor between the port facilities and the power plant is entirely on slopes less than 67 percent. The road between the power plant and the diversion dam would cross slopes greater than 67 percent and the risk of landslides would increase. Application of BMPs 14.7 and 14.12, Measures to Minimize Mass Failures and Control of Excavation and Sidecast Material, respectively, would reduce the risk of the road triggering landslides. Additional geotechnical and slope stability studies, and karst surveys are required for final layout and design of the access roads.

3.2.4.5 Port Facilities and Transmission cables

Sedimentation from road construction activities would be minimized with construction and operation phase erosion control measures and BMPs included in the final project plans and construction contracts. Long-term erosion of the road prism and associated cut-and-fill slopes are addressed by post-construction BMPs, which include revegetation and road maintenance.

Site-specific erosion and drainage design as part of the final project plans would include all project facilities, including the port facilities, diversion dam and intake, pipeline, penstock, surge tank, powerhouse and switch yard, access roads, transmission cable, barge landing, staging areas, construction camp, and rock and borrow sites.

3.2.5 Comparison of the Alternatives

3.2.5.1 Soil Productivity

No roads or other facilities would be constructed under Alternative 1, No Action alternative, so soil productivity would remain static.

While land area converted to power house, diversion dam, and port facilities would be the same under Alternatives 2 and 2a, less land area would be converted to roads under Alternative 2a. Soil productivity would remain unchanged under Alternatives 2 and 2a because the use of the disturbed land area would change from supporting vegetation growth to providing power to Angoon. This change in land use is not considered a loss in soil productivity.

3.2.5.2 Soil, Surface Water Drainage, and Erosion Hazards

Soil, surface water drainage, and erosion hazards would remain at current levels under Alternative 1 because no construction would occur and no soil would be disturbed.

Alternative 2 would have a higher potential for soil, surface water drainage, and erosion hazards than Alternative 2a because it has a more extensive road system. The access road between the port facilities and Kootsnawoo Inlet in Alternative 2 also has a higher potential of crossing or encroaching on wetlands.

3.2.5.3 Mass Wasting Hazards

The threat of landslides would remain static under Alternative 1 since no development would occur on steep slopes. Evidence of landslides or mass wasting was not observed during field surveys of the steep slopes between the proposed power plant location and the diversion dam.

Alternatives 2 and 2a have the same risk of triggering landslides since the proposed development is the same in each alternative. The risks would be mitigated through the application of BMP 14.7, specifically through the requirements to perform subsurface and slope stability analyses, design the road with balanced cut slopes to fill slopes, and the end haul of excavated materials. Timing restrictions (BMP 14.6) would also be applied to avoid road construction during periods of high precipitation. Small sidecast, cutslope, and road failures are common on most road construction projects, but are typically localized and on a similar scale to natural levels of mass wasting.

3.2.6 Unavoidable Adverse Impacts

Once a road cut is made across the landscape it is difficult to return to the natural slope profile and drainage conditions. The facilities proposed for this project are the only sources of ground disturbance in the area. Consequently, erosion or drainage from them, as controlled through the application of BMPs described above, would be small relative to the project area. If in the future the project is abandoned, an abandonment plan prepared as part of the SUA would prescribe the removal of all authorized improvements and restoration of the sites (SUA clause V.d). In addition the Code of Federal Regulations (36CFR 261.9, 261.10) provides the means to enforce the removal and restoration of improvements, if necessary.

BMPs 14.5, 14.8, 14.18, 14.24, and 14.25 would be applied during site restoration operations to reduce erosion and restore vegetation.

3.3 WATER RESOURCES

This section discusses water quantity and water quality in the Angoon Hydroelectric Project area, as well as the potential effects associated with the alternatives. The information in this section was drawn from the water resources specialist report prepared for this project, which is on file at the Admiralty Island National Monument office.

3.3.1 Affected Environment

The project area has a maritime climate with cool summers and relatively mild winters. Precipitation is abundant year-round and conditions are frequently overcast or foggy. Annual precipitation is estimated at about 100 inches (HDR Alaska 2003). The average annual temperature is approximately 41 degrees Fahrenheit (°F), ranging from winter lows to -10°F and summer highs to about 85°F (HDR Alaska 2000).

The Thayer Creek watershed extends from tidewater to 3,890 feet at Thayer Mountain and encompasses 64 square miles. Many unnamed streams drain into Thayer Lake between surrounding mountains, including Thayer Mountain and Thayer Peak. Thayer Lake, at an elevation of approximately 368 feet, has a surface area of approximately 2,809 acres (4.4 square miles) and provides some natural regulation of the flows in Thayer Creek below the lake (HDR Alaska 2000).

Thayer Creek flows from the west-southwest arm of Thayer Lake for approximately 6 miles through a broad, flat valley at a mild grade. It then enters a deeply incised, steep forest canyon for approximately 6,800 feet with grades up to 12 percent. Approximately 2,000 feet from tidewater, there is an 8-foot waterfall, after which the gradient decreases to approximately one percent. A small, unnamed tributary joins Thayer Creek from the north just below the proposed dam site

Several unnamed streams, lakes, and ponds occur in the project area. Project components occurring outside of the Thayer Creek watershed includes the port facilities, transmission cable, and access roads. The transmission cable and access road traverse the West Admiralty Island Frontage and Mitchell Bay-Kootznoowoo watersheds. The West Admiralty Island Frontage watershed is a complex of small watersheds that drain directly to Chatham Strait. It is approximately 65 square miles, and extends from Game Cove at Hawk Inlet, south to Kootznahoo Head. Project developments in Alternative 2 would affect approximately 4 square miles of the West Admiralty Island Frontage watershed south of the Thayer Creek watershed. Alternative 2a would affect about 2 square miles of this same watershed.

Approximately 1 ½ square miles of the Mitchell Bay-Kootznoowoo watershed would be affected by the transmission cables and associated access road under Alternative 2. The Mitchell Bay-Kootznoowoo watershed is approximately 47 square miles and encompasses the small watersheds draining directly into Kootznahoo Inlet and Mitchell Bay.

3.3.1.1 Water Quantity

Streamflows

HDR Alaska gauged stream flows at Thayer Creek between August 1999 and September 2001. The stream gauge was placed approximately 200 feet downstream of a small falls at an elevation of 16 feet above mean sea level. Figure 3-3 shows the recorded discharge at Thayer Creek between October 1, 1999 and September 10, 2001. Flows typically ranged between lows of near 100 cubic feet per second (cfs) in the winter or during summer dry times to nearly 1,000 cfs during spring runoff or fall wet period events. A high flow of nearly 2,000 cfs occurred during the winter of Year 2000.

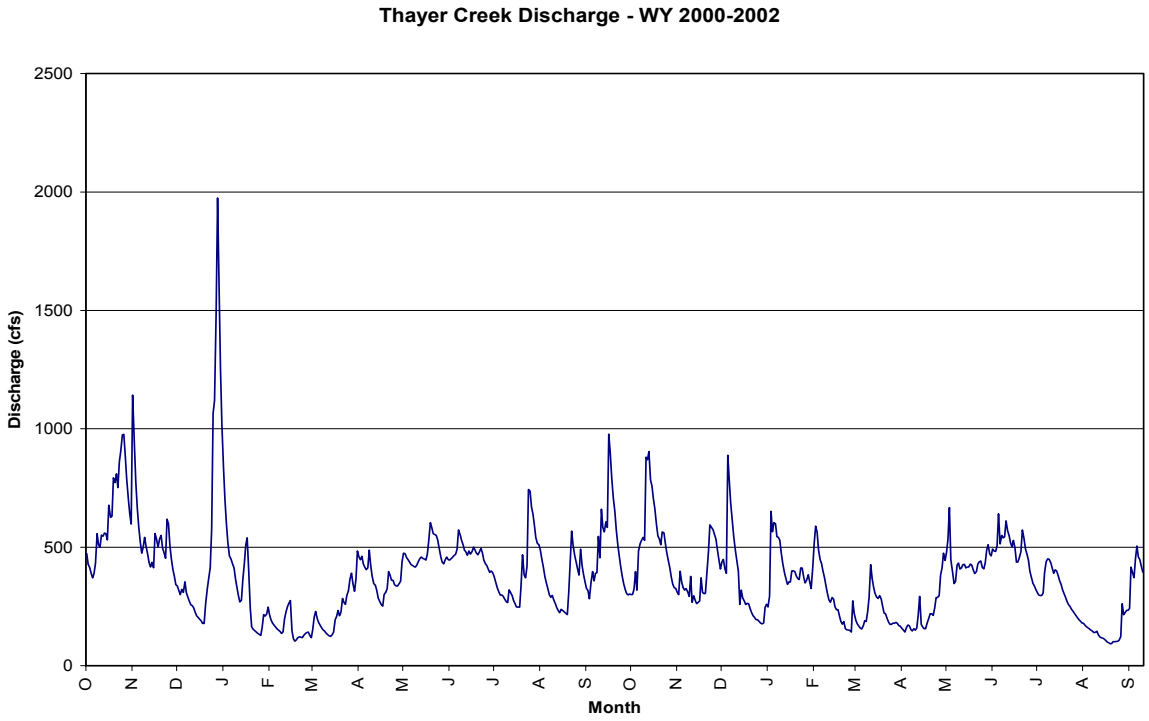


Figure 3-2. Mean Daily Discharge, Thayer Creek, October 1, 1999 to September 10, 2001

Because of the short time period that Thayer Creek was gauged, a comparison was made to the Hasselborg Creek drainage for the purpose of evaluating project feasibility (HDR Alaska 2003). Hasselborg Creek is east of Thayer Creek and has a drainage area of about 56 square miles. The USGS maintained a gauging station on Hasselborg Creek between July 1951 and September 1968. Lakes and ponds make up a greater portion of the Hasselborg drainage. More of the Hasselborg drainage basin is broad and flat. Some differences in precipitation could be expected due to orographic effects, timing of snowmelt due to the lower elevation of the Hasselborg drainage, and hydrograph response time due to topography, ice, and vegetation. Nevertheless, this is likely a reasonable comparison for the purpose served.

Based on this comparison to Hasselborg Creek, HDR Alaska (2003) estimated the Thayer Creek 10-, 100-, and 1,000-year frequency flood magnitudes to be 2,100 cfs, 2,600 cfs, and 3,100 cfs, respectively. Stream Channel

The proposed project would impact the lower 1.7 miles of Thayer Creek. The section from saltwater to the mean high tide line is listed as an ES4-Large Estuarine Channel. The creek then changes to an LC2-Moderate Gradient Contained Narrow Valley Channel for approximately one-eighth of a mile. Upstream from the anadromous barrier the channel type changes to an MC3-Deeply Incised Contained Channel. This section is approximately 1.5 miles in length and is the section of Thayer Creek in which stream flow would be reduced under Alternatives 2 and 2a. Immediately above the proposed dam site the channel type changes again to an FP5-Wide Low Gradient Flood Plain Channel.

Preliminary field investigations found that the last 0.2 mile of Thayer Creek, up to its outlet into Chatham Strait, is composed of river deposit consisting of gravelly sand and cobbles (Harza Northwest 1995). The gravels and cobbles, predominantly diorite, granodiorite, phyllite and schist, are subround to round.

3.3.1.2 Water Quality

Thayer Creek above the proposed dam site is classified as channel type FP5-Wide Low Gradient Flood Plain Channel. Sediment tends to deposit in these channels, which would reduce sediment delivery at the proposed dam site. Thayer Lake, located above the FP-5 reach, also acts as a sediment trap and further reduces downstream bedload sediment supply. Turbidity and suspended solids in Thayer Creek occur during higher flows and during periods with expanded surface runoff. Dissolved oxygen and nitrogen, pH, and other water quality parameters are not likely to be influenced by the project, and so are not discussed further.

3.3.2 Effects on Hydrology

3.3.2.1 Water Quantity

Under the action alternatives, water would run through the hydroelectric pipeline and power plant and return to Thayer Creek. Stream flow would be reduced in the bypass reach. This becomes important only during low flows when a most of the total flow would be taken by the project. The influence of reduced flow in the bypass reach depends on the magnitude of the instream flow that is set in the bypass reach. The small tributary below the proposed dam would continue to provide some flow to the affected reach, though how much flow is unknown. Very low flows would affect water temperature and aquatic and terrestrial habitats in the bypass reach.

Because most large woody debris (LWD) in this system comes from the valley walls and streambanks, the LWD typically forms jams or wash over bank fairly close to the source area. When LWD does move downstream it is during flood peaks that would likely not be altered by the diversion flows.

3.3.2.2 Water Quality

Short-term and temporary turbidity would occur during instream construction of the intake, dam, pipeline, and road crossings. Most construction areas could avoid sediment runoff and delivery to streams through application of BMPs 14.6, 14.14, 14.15, and 14.17.

Temperature would increase if the minimum instream flow is not large enough, but stream temperature would not be affected during moderate to high flows because the quantity of water removed from the stream would be relatively small. Very low winter or late summer flow during a dry year could be slightly modified depending on the season and established minimum instream flow.

The collection and disposal of solid and human waste from the facilities during construction and operation would meet all State and Federal permit requirements, and incorporate BMPs 12.15 – Management of Sanitary Facilities and Sanitary Guidelines for Temporary Camps and Primitive Developments, and 12.16 – Control of Solid Waste Disposal. The SUA under which this project would be administered would detail the design and management of waste disposal and treatment (BMP 12.10).

3.3.3 Effects of Project Components

3.3.3.1 Diversion Dam

Steep-gradient, confined, and coarse-bedded streams, like the stream reach from which flows would be diverted, transport bedload sediment and some LWD during high flow periods. Because the amount of flow diverted by the proposed project would be small relative to the expected high flows, changes in the overall sediment budget would not be likely. The amount of bedload transport during normal and low flows is very small, so the project would result in minor changes to channel conditions.

The intake structure of the diversion dam includes a sluice for moving bedload downstream once the diversion pond fills. This design feature, along with bedload monitoring, would mitigate potential impacts to the stream channel and downstream aquatic habitat resulting from disruption of the natural sediment supply. A low-level outlet built into the diversion structure would also allow flushing of sediment past the diversion dam on an as-needed basis and provide sediment downstream of the diversion.

A short-term reduction in bedload sediment supply would occur while the pond fills, as would some coursing of the downstream channel substrate. Once the pond fills, sediment passing through the sluice of the intake and flood transport of sediment over the dam spillway would maintain downstream bedload sediment through the long run. Also, there is some bedload sediment supply from tributaries, stored sediment along the channel, and steep valley walls, so the downstream channel should not change relative to current conditions. Bank vegetation would encroach on the stream channel because the wetted width would be smaller during the summer growing season, but natural flood peaks regularly wash out this channel zone.

3.3.3.2 Pipeline and Penstock

The penstocks would cross Thayer Creek adjacent to the powerhouse under Alternatives 2 and 2a. Construction of the penstock crossing would incorporate erosion controls to minimize sedimentation. The design of the penstock crossing would allow high flows and debris to pass through the channel unobstructed with the natural range of bed elevations in the crossing reach (BMP 12.4).

3.3.3.3 Powerhouse

The proposed powerhouse would be located on the south side of Thayer Creek below the barrier falls in Alternatives 2 and 2a. Floodplain sediments have been noted in the area and the depth to groundwater could be shallow. The final powerhouse and switchyard layout and design would comply with BMPs 12.4, 12.6, 12.10 and 14.25. A floodplain analysis and evaluation will be made before facility construction begins. Facility design and construction plans would minimize impairment of the natural functions and values of the floodplain (BMP 12.4d).include adequate geologic, engineering, and geotechnical studies and incorporate adequate measures to protect the project features from surface water and groundwater problems.

The tailrace from the powerhouse would direct water to the base of the barrier falls. The tailrace would be designed to prevent scour at the discharge point, and prevent anadromous fish from moving up the tailrace.

The powerhouse would be designed to allow flow downstream of the powerhouse in the event of an unplanned shutdown of the intake or pipeline. In that event, water levels would quickly decrease below the tailrace, stranding anadromous fish or dewatering redds. The addition of flow-through facilities would mitigate this risk.

3.3.3.4 Roads and Bridges

Roads and stream crossings have the potential to increase sedimentation in streams and wetlands. Sedimentation resulting from the construction and use of access roads would be prevented or reduced by applying BMPs 14.2, 14.3, 14.5, 14.6, 14.7, 14.9, 14.11, 14.12, 14.14, 14.15, and 14.17. Crossing structures on Class I, II, or III streams, including the Thayer Creek Bridge, would be designed to pass 50 year flood events (BMP 14.17 - Bridge and Culvert Design and Installation), pass LWD and prevent culvert failure. Roads would be designed with sufficient number of relief culverts and culverts sized to maintain natural drainage and flow patterns (BMP14.3 b).

Sediment transport from road construction activities would be minimized by construction and operation phase erosion control measures and Control of In-Channel Operations (BMP 14.14) (FSH 2509.22) included in the final project plans and construction contracts. Long-term erosion of the road prism and associated cut-and-fill slopes would be prevented or reduced through application of BMP 14.5 – Road and Trail Erosion Control Plan, 14.8 – Measures to Minimize Surface Erosion, and 14.9 – Drainage Control to Minimize Erosion and Sedimentation. These BMPs require revegetation of exposed soils, measures to physically inhibit the transport of sediment, protect the soil surface, or reduce the velocity of runoff.

Roads built on wetlands disrupt natural drainage patterns by compacting the underlying peat and soils. The road surface must be properly drained to be suitable for traffic, so the acreage converted to roads represents a net loss of wetland habitat. The transmission-cable-access road, south of the port facilities, has the highest potential of affecting wetlands. Roads developed across or near wetlands would be designed to minimize alteration of the function and connectivity of the wetlands (BMP 12.5).

3.3.3.5 Port Facilities and Transmission Cables

The transmission cable would have minimal effects on hydrology. Under Alternative 2, transmission cable would extend aerially from the power plant to Kootznoowoo Head, and then be submerged across Kootznahoo Inlet to the float plane dock at Angoon. The effects of the roads associated with the transmission cables are described above. The transmission cable would be carried on poles. The poles would be spaced to avoid placement in wetlands and would not otherwise affect hydrologic resources.

In Alternative 2a, transmission cables would extend aerially from the power plant to the dock facility. A submarine cable would extend about 4.8 miles from the port facility to the existing Angoon power plant. The submarine cable would be submerged 600 feet in Chatham Strait.

Construction of the port would involve some in-water construction and the potential for short-term sedimentation and turbidity. The garage associated with the port would be sited above the high tide line, and away from streams and wetlands, and therefore won't affect the hydrology.

Final project facility plans would design site-specific erosion and drainage controls for all project facilities, including the port facilities and garage, diversion dam and intake, pipeline, penstock, surge tank, powerhouse and switch yard, access roads, transmission cable, barge landing, staging areas, construction camp, and rock and borrow sites.

3.3.4 Comparison of the Alternatives

Under the No Action alternative, stream flows would retain their current volume and pattern. Water quality would remain the same as well.

Alternatives 2 and 2a would affect Thayer Creek and the Thayer Creek watershed similarly. Stream flows would be diverted from the section of stream between the diversion dam and power plant. Both alternatives would require the penstock and a bridge would cross Thayer Creek.

The transmission corridor and associated road cross about 14 streams and have the potential to cross numerous wetlands under Alternative 2. Fewer stream crossings would be needed in Alternative 2a because the road and transmission corridor is shorter.

3.3.5 Unavoidable Adverse Impacts

Short-term turbidity and sedimentation would increase in Thayer Creek below the diversion because of the developments that would occur under Alternatives 2 and 2a. Gravel road segments near creeks, or ditches that drain to the creek would deliver fine sediment to Thayer

Creek during storm runoff periods. The application of BMPs, limited use of the roads, and regular maintenance of the roads and facilities would prevent or reduce the level of sedimentation to near natural levels.

The reduction of stream flow between the diversion dam and the power plant would continue as long as the plant is in operation. Required instream flows would maintain sufficient flows to maintain channel configuration and function. In addition, high flows would continue to flow through the stream channel and would maintain a flow pattern similar to natural conditions.

If in the future the power plant is abandoned the natural level and pattern of flow would be restored by removal of the diversion dam and pipeline.

3.4 FISHERIES

This section discusses fish and fish habitat in the Angoon Hydroelectric Project area, as well as the potential effects associated with the alternatives. The information in this section was drawn from the fisheries specialist report prepared for this project, which is on file at the Admiralty Island National Monument office.

3.4.1 Affected Environment

The Thayer Creek watershed is 64 square miles with elevations ranging from 0 feet at tidewater to 3,890 feet at Thayer Mountain. Thayer Creek, a 6.7-mile-long stream, is the primary drainage in the watershed, draining Thayer Lake on the west side of Admiralty Island and discharging into Chatham Strait. Thayer Lake is a large (2,809 acres) natural lake with a surface water elevation at about 365 feet mean sea level. It is fed by numerous unnamed streams located between the surrounding mountains, including Thayer Mountain and Thayer Peak.

Thayer Lake provides some natural attenuation of base and peak flows in Thayer Creek. The average annual flow of Thayer Creek is estimated at 370 cfs, with an estimated 10-year peak flow of 2,100 cfs and an estimated 100-year peak flow of 2,600 cfs. Discharge was recorded at Thayer Creek between October 1, 1999 and September 10, 2001. Measured low flows were near 100 cfs, while the high flows were near 2,000 cfs. Typical of Southeast Alaska, high flows occur late in the spring and early summer, due to snowmelt runoff and again in fall due to high rainfall, while low flows occur in winter and late summer.

Downstream of its source at Thayer Lake, the stream flows for approximately 6 miles through old-growth spruce-hemlock forest in a broad valley at a mild grade. Only a small part of the upstream project area is located within this broad valley. Downstream, the stream enters a 6,800-foot long narrow forested canyon with steep grades (up to 12 percent). The gradient then becomes milder for the last 2,000 feet of stream before it enters Chatham Strait. Near the upper end of the entrenched reach, a small, unnamed tributary stream joins Thayer Creek from the north.

The majority of Thayer Creek contains only resident fish, due to a natural fish barrier approximately 1,500 feet upstream from the mouth that precludes anadromous access

upstream. However, the lower 1,500 feet of the stream, much of it tidally influenced, estuarine-type channel, supports anadromous salmonids and contains salmon spawning habitat. Fish use of the anadromous reach likely includes chum, pink, and coho salmon; steelhead; and Dolly Varden. Upstream of the fish barrier, resident fish, primarily cutthroat trout, are present.

3.4.1.1 Fish Habitat

The Forest Service geographic information system (GIS) stream layer mapping identified four distinct channel types in Thayer Creek within the project area (Table 3-4) differentiated according to the Southeast Alaska Channel Type Classification Guide (Paustian et al. 1992). A Forest Service resource fisheries specialist conducted a site visit in July 2004. Although the site visit did not involve measurements of channel dimensions, visual observations confirmed compatibility with the channel type descriptions listed in Table 3-4. For the purposes of this discussion, the four reaches of Thayer Creek will be referred to as A through D, progressing from the mouth in an upstream direction.

Table 3-3. Thayer Creek Channel Types within the Angoon Hydroelectric Project Area

	Reach Label and Channel Type			
	A	B	C	D
Parameter	Large Estuarine Channel (ES4)	Moderate Gradient Contained Narrow Valley Channel (LC2)	Deeply Incised Contained Channel (MC3)	Wide Low Gradient Flood Plain Channel (FP5)
Channel Length (feet)	<1,300	<330	8,000	Unknown
Stream Gradient (%)	<2	<5	<4	<2
Incision Depth (feet)	>15	46	>33	<10
Bankfull Width (feet)	>33	33 to 99	<66	>66
Dominant Substrate	Gravel to cobble	Coarse gravel to bedrock	Small gravel to bedrock	Sand to cobble
Process Group	Estuarine	Large contained	Moderate gradient contained	Floodplain
Function	Sediment deposition	Sediment transport	Sediment transport	Sediment deposition

Several waterfalls are located in Reach B, preventing upstream use of Thayer Creek by anadromous salmonids. Within Reach B, a downstream barrier falls appears to be passable to coho salmon, Dolly Varden, steelhead, and cutthroat trout, but not pink or chum salmon. Roughly 50 feet upstream from these falls is a second set of 8- to 10-foot high falls, which form an upstream migration barrier to all fish.

Reaches A and B have a shallow, anadromous channel morphology, with few pools deeper than 5 feet, and only small amounts of LWD. It is unlikely that adult fish overwinter in these stream reaches. Overall, the quality of anadromous spawning habitat is good but limited,

which in turn limits fish production. Substrate of the lowest 0.2 mile of Thayer Creek is composed of river deposit consisting of gravelly sand and rounded cobbles (Harza 1995).

Harza (1995) reported that the habitat within Reach C was relatively poor, with extremely limited fish spawning, rearing, and holding habitat throughout the reach, although they indicated that the reach may be used by a small number of resident cutthroat trout. Visual observations from the canyon rim noted numerous riffle and fall complexes, some of which may be barriers to upstream migration.

Reach D contains very productive spawning and rearing habitat for resident fish, consisting of numerous LWD complexes, side channels, beaver ponds, robust vegetation, clean gravels, and deep undercut banks.

3.4.2 Fish Species

The ADF&G Anadromous Waters Catalog lists only pink and chum salmon in Thayer Creek. However, in early July 2004, Forest Service resource specialists sampled fish species within Thayer Creek using minnow traps. They trapped both coho salmon fry and juvenile steelhead trout downstream of the anadromous barrier (Reaches A and B). Coho fry ranging in size from 40mm to 80mm were observed, with many located in quiet side pools along the main channel. Steelhead juveniles were approximately 150mm long. No adult salmon of either species were seen during the survey probably because of the unusually warm weather and below average stream flows during the survey. Based on the presence of coho and steelhead fry, it is reasonable to assume that Dolly Varden could be present within Reaches A and B during the fall spawning season. No fish were noted in Reach C, while numerous cutthroat trout ranging in size from 100mm to more than 200mm were observed within Reach D.

Federally listed salmon and steelhead stocks (e.g., Puget Sound Chinook salmon) are not present within the project area; they are found only on the outer coast of the Tongass National Forest (USDA Forest Service 1997b). The Tongass Land and Resource Management Plan (USDA Forest Service 1997a) identified three sensitive fish species that occur on the Forest. These include the Fish Creek chum salmon, the Island Chinook salmon, and the northern pike. The northern pike is found only on the Yakutat forelands and the Fish Creek chum salmon occurs near Hyder. The Island Chinook salmon occurs naturally on islands including runs in King Salmon Creek and Wheeler Creek. However, although these sites are on Admiralty Island, they are not within the project area and would thus not be affected by the proposed project.

3.4.3 Effects on Fisheries

3.4.3.1 Stream Flow Alteration

Development of the hydroelectric project would reduce flows in approximately 1.5 miles of Thayer Creek, which includes all of Reach C and a portion of Reach B. Approximately 300 feet of anadromous fish habitat below the fish passage barrier would be affected. The ADF&G would require minimum, year-round instream flow below the dam to provide some level of habitat and connectivity for resident and anadromous fishes. The instream flow

would be provided through the sluice constructed in the dam. A small tributary below the proposed dam would provide additional flow to the affected reaches.

Once the storage capacity of the dam is attained, flows in excess of the intake capacity would spill over the dam into Thayer Creek. We would expect the pattern of high flows to be similar to natural conditions. Low flow periods would be extended to periods when flow matches the capacity of the intake and only the required minimum flow passes through the sluice.

The diversion would reduce low stream flows from approximately 100 cfs to 20 cfs which would prevent fish from overwintering in stream reach C. Therefore, under the Proposed Action, Reach C would support few, if any, resident fish.

3.4.3.2 Alteration of Stream Processes and Habitat

Changes to the flow regime and volume of flow would have little effect on sediment and LWD transport (See hydrology effects, above). A short-term reduction in bedload sediment supply would occur while the pond fills, as would some coursing of the downstream channel substrate.

Minimum instream flows of 20 cfs may not be adequate to maintain water temperatures. The stream may freeze in winter or increase to lethal temperatures during the summer. Minimum instream flows would be increased if monitoring stream temperature indicates that 20 cfs is insufficient to maintain cutthroat habitat.

3.4.4 Effects of Project Components

Alternatives 2 and 2a would affect all four reaches (A through D) of Thayer Creek and the aquatic life that inhabits the stream, with negligible effects on small amounts of beach, intertidal, and benthic habitat within Chatham Strait. The effects can be divided into several major components, for which effects from project construction and operation are discussed in detail below. The primary project elements that have potential to affect fish and aquatic resources are: (1) diversion dam and intake; (2) power plant discharge; (3) access roads, overhead transmission cables, and staging areas; and (4) marine facilities.

3.4.4.1 Diversion Dam, Sluicing Facility, and Intake

Several potential effects are associated with the construction and operation of the diversion dam, sluice, and intake. The 10 foot high dam would completely block all upstream fish passage and most downstream passage. It would interfere most with the movement of cutthroat trout in Reach C as salmon are incapable of navigating the falls in Reach B.

The operation of the diversion dam would reduce streamflow in approximately 1.5 miles of Thayer Creek, affecting all of Reach C and a portion of Reach B. This includes approximately 300 feet of anadromous fish habitat below the fish passage barrier. The ADF&G would require minimum, year-round instream flows below the dam of at least 20 cfs to provide resident and anadromous fish habitat and connectivity. The instream flow would be provided through a sluice constructed in the dam. The small tributary below the dam would provide additional flow to the affected reach.

Alternatives 2 and 2a would substantially reduce stream flow in the reach below the dam, which would reduce the quantity of rearing and overwintering habitat. Currently the habitat quality of in Reach C is poor with steep gradients and numerous cascades and small falls. Though resident cutthroat trout have been noted in this reach, the low quality habitat makes it unlikely that it supports large numbers of them. The diversion would reduce low stream flows from approximately 100 cfs to 20 cfs and would prevent fish from overwintering in stream reach C. Therefore, Reach C would support few, if any, resident fish under Alternatives 2 and 2a.

The flow reduction in the 300 feet of anadromous fish habitat in Reach B would cause a loss of spawning and rearing habitat for coho salmon, and steelhead, cutthroat and Dolly Varden trout. Competition for habitat between individual fish may increase, although the lower 1,200 feet of Thayer Creek below the power plant discharge contain high-quality rearing and spawning habitat, and natural hydrologic regimes would remain in this area. Therefore, constructing the dam across Thayer Creek would not cause a reduction in anadromous fish populations.

The water intake at the dam would be screened to keep fish out of the pipelines and turbines. We would not expect operation of the dam to cause direct fish injury or mortality.

Timing dam construction during low-flow periods, exclusion of fish from the work area (BMP 14.15), and the application of BMP 14.14, Control of In-Channel Operations, would minimize injury or death of fish during dam construction. Fish could be injured or killed during construction due to human or mechanical disturbance within the stream channel or increased downstream sedimentation without these controls in place.

A 10- to 20-acre pond would be impounded behind the 10 foot high dam for 750 feet upstream (HDR Alaska 2000). This ponded area in Reach D would flood riparian forest and result in the submersion of spawning riffles. Although some spawning habitat would be lost, a large quantity of high-quality spawning habitat exists upstream. The loss of spawning habitat would be compensated by increased cutthroat trout rearing and overwintering habitat provided by the diversion pond. We would expect the cutthroat trout population to remain stable.

3.4.4.2 Power Plant Discharge

The discharge structure of the power plant would be designed with a perched ledge and a concrete pad or rip-rap to dissipate outfall. The perched ledge would prevent fish from entering the discharge structure and getting caught in the turbines. The outfall protection, rip-rap or concrete pad, would decrease or prevent scouring and downstream sedimentation. Without these design features fish could swim up the discharge pipe and be injured or killed, or redds could be smothered by fine sediment created by scour and erosion at the outfall. Therefore, operation of the power plant and the discharge of water would not kill or injure salmon or reduce their populations.

3.4.4.3 Access Roads, Overhead Transmission Cables, Powerhouse, and Staging Areas

Construction and operation of access roads, overhead transmission cables, the powerhouse, and associated staging areas would require permanent and temporary clearing of vegetation

and ground-disturbing activities that could potentially serve as sediment sources. These features, if placed immediately adjacent to the Thayer Creek, could degrade riparian habitat and increase the suspended sediment load. Potential effects to aquatic resources from riparian disturbance could include reduced stream shading, litterfall, and LWD recruitment.

The access roads and transmission cables would generally be located at least 200 feet from Thayer Creek. Reach C, the primary stream reach potentially affected by these features, is entrenched in a steep canyon with vertical separation from project facilities. The separation between the facilities and the Creek and the application of BMPs described in the soils and hydrology sections above, would prevent or reduce sedimentation in Thayer Creek.

In Alternative 2, transmission cable and associated access road extend from the power plant on the south side of Thayer Creek to Kootznahoo Inlet. There would be several Class I, II, and III stream crossings on this route. These crossings would need to pass 50 year flood events and allow fish passage during normal and low flows with minimal downstream scour ((BMP 14.17 - Bridge and Culvert Design and Installation. Roads would be designed with sufficient number of relief culverts and culverts sized to maintain natural drainage and flow patterns (BMP14.3 b).

The transmission cable and access road in Alternative 2a would have to meet the same criteria as in Alternative 2. There would be fewer stream crossings because the road in Alternative 2a is about one-third the length of the road in Alternative 2.

3.4.4.4 Port Facilities and Submarine Cable

Construction and operation of the port facilities, and installation of the submarine cable would have minor effects on aquatic habitat. Effects from the construction of the temporary barge landing could result in the alteration or loss of a small amount of beach and nearshore habitat. However, based on the small area of habitat disruption, the temporary nature of the facilities, and the planned regrading and revegetation of the beach to a pre-project condition, these effects would not affect aquatic life, including salmonids.

Aquatic resources would not be affected by the installation of two mooring buoys because of the relatively small area they would occupy. Similarly, the laying of 4,600 feet of submarine cable on the bottom of Kootznahoo Inlet (Alternative 2) or the laying of about 5 miles of submarine cable 600 feet deep in Chatham Strait would not affect nearshore, littoral, or benthic habitats. The amount of space taken up by the cable relative to the habitat within Kootznahoo Inlet or Chatham Strait would be minor.

3.4.5 Comparison of the Alternatives

3.4.5.1 Stream Flow Alteration

Stream flow would not change under Alternative 1, No Action, and no changes in fish habitat would occur.

Stream flow in Thayer Creek would be attenuated by the dam and diversion under Alternatives 2 and 2a and flow patterns would change. A 10 – 20 acre pond would be impounded behind the dam, and streamflow would be reduced in Reaches B and C. Stream flow reduction in these two stream reaches would further reduce resident fish and salmonid

habitat. Cutthroat trout is the only resident fish species known to inhabit Reach C and reductions in flow would further degrade the poor habitat in this reach. Reach D of Thayer Creek, above the dam, provides high quality habitat for resident fish species and the pond created by the dam would provide high quality cutthroat trout rearing and overwintering habitat.

Flow attenuation would reduce anadromous fish spawning and rearing habitat quality and quantity in Reach B for coho salmon, and steelhead, cutthroat, and Dolly Varden trout. However, Reach A below this reach and the power plant outfall would have more natural flow regimes and provides high quality anadromous fish rearing and spawning habitat. Alternatives 2 and 2a would have negative effects on fish habitat in two reaches of Thayer Creek, but the effects would be compensated by the high quality fish habitat in the adjacent stream reaches and fish populations and production would remain stable in Thayer Creek and adjoining areas.

3.4.5.2 Alteration of Stream Habitat and Processes

No hydroelectric power plant facilities would be constructed under Alternative 1, so stream habitat and processes would remain static.

Alternatives 2 and 2a would change stream habitat and processes by trapping sediment, reducing stream flow, and modifying the transport and distribution of sediment and LWD. These changes would affect Reach C and a portion of Reach B. Reach C has marginal habitat so changes is stream processes would affect few fish.

Alternative 2 would require a longer transmission corridor and associated access road. These facilities would cross numerous streams and wetlands, and have the potential to create sedimentation and impede fish passage at each crossing. Application of BMPs would mitigate these risks. Alternative 2a would have similar risks and effects, however the road in one-third the length of the road in Alternative 2 and wetlands aren't as common.

3.4.6 Unavoidable Adverse Impacts

Reduction of Thayer Creek flows and loss of cutthroat trout and anadromous fish habitat would be an unavoidable adverse impact associated with this project. If in the future the project is abandoned, an abandonment plan prepared as part of the SUA would prescribe the removal of all authorized improvements and restoration of the sites (SUA clause V.d), including the dam. Stream flows and the sediment budget would be restored in Reaches C and B, and fish would be able to recolonize them.

3.5 VEGETATION AND WETLANDS

This section describes the vegetation and wetland resources of the Angoon Hydroelectric Project area, as well as the potential effects associated with the proposed alternatives. Information in this section was drawn from the botany, biological evaluation of plants, soils and wetlands, and supplemental soil, geologic, and wetland information resource reports.

Threatened, endangered, and sensitive plant and animal species are addressed separately in Section 3.7; fish and wildlife species that provide subsistence resources are addressed in Section 3.10.

3.5.1 Affected Environment

3.5.1.1 Vegetation

Plant communities in the project area include conifer forest, deciduous/spruce woodland, scrub-shrub habitat, beach meadows, forested wetlands, wet meadows, fens, and muskeg. Most vegetation in the beach fringe is high-volume old-growth spruce-hemlock forest. Elsewhere in the project area, common vegetation types include muskeg and old-growth forest in other volume classes. Vegetation along Thayer Creek includes shrubby and open gravel bars, wet meadow with ponds in an old oxbow, riparian vegetation, and forest edge. Beaches and adjacent areas support sandy, gravelly, and rocky areas; uplifted beach meadow; and forest fringe.

Much of the forest along Thayer Creek, downstream of the proposed diversion dam, is on steep slopes with a sparse understory, interspersed with shrubby gaps and patches of devil's club in seepy areas. Two large wet meadow areas occur along the road and transmission cable corridor between Thayer Creek and the port facility proposed under Alternative 2. The meadow nearest the stream had a few small western hemlock trees on mounds and thick, tall shrubby areas among the dense herbaceous cover. The second meadow is more open and less shrubby, with meandering wet trenches. The proposed route between the power plant and Kootznahoo Inlet passes through forested areas that include patches of young second growth, dense shrubs in gaps, and large areas with little or no understory. Meadows and muskegs are also present along this route, as well as two small lakes.

Rare Plants

Five species of rare plants were found in the project area. Three species are ranked 'critically imperiled' (S1) or 'imperiled because of some factor and vulnerable to extirpation' (S2) in the State of Alaska, though they are ranked globally secure (G5). The three ranked species are: rattlesnake grape fern (*Botrychium virginianum*), inland sedge (*Carex interior*), and marsh bluegrass (*Poa leptocoma*).

Rattlesnake grape fern was found in the meadow surrounding a small lake near the southern end of the road and transmission cable corridor proposed under Alternative 2. These widely dispersed plants were growing away from the wettest areas near the lake in sites dominated by *Carex viridula, Deschampsia cespitosa, Empetrum nigrum*, and patches of *Myrica gale*.

A small population of inland sedge inhabited the wetter portions of a large, rich, herb meadow east of the proposed road route above Thayer Creek. This meadow developed in an abandoned beaver pond and is slated as a primary spoils disposal site. Only one of nine state records of this species is in southeast Alaska.

Marsh bluegrass was found along the upper beach fringe of the small island at the port facility proposed in the action alternatives, and in a large herb meadow outside of the immediate project area. Both populations were sparse and scattered. Marsh bluegrass is

usually found in wet places along streams, in open subalpine to alpine ridges and meadows. It has been documented four times in southeast Alaska.

Two other plants are not ranked but have scattered populations in Alaska, or represent a range extension. Leathery grape fern (*Botrychium multifidum*) has been recorded in southeast Alaska 14 times. A few individuals were scattered in a mesic, mixed herb meadow on a bench in open western hemlock/blueberry/skunk cabbage forest. The proposed access road and staging area above Thayer Creek encroach on this site. Wooly fruit sedge (*Carex lasiocarpa*) represents a range extension. Its range is thought to be interior Alaska above Cook Inlet, and not to extend into southeast Alaska. Scattered plants were found in low, wet parts of an herbaceous meadow at the lower end of an abandoned municipal reservoir outside of the immediate project area.

Invasive Plant Species

Three species of exotic grass and two species of exotic herbs were found at the proposed port facility, a common landing location for people using the area. The grasses, fowl bluegrass (*Poa palustris*), Kentucky bluegrass (*Poa pretensis*), and foxtail barley (*hordeum jubatum*), and the herbs, field mustard (*Brassica rapa*), and common chickweed (*Stellaria media*) were present along the upper beach fringe. Common chickweed was also found in the beach fringe just south of the mouth of Thayer Creek. Another population of fowl bluegrass was found in a meadow at the lower end of an abandoned municipal water reservoir just outside of the project area.

The only one of these species with an invasive ranking is Kentucky bluegrass. It is usually found on disturbed sites and competes with native species. It changes the plant community composition and lowers its diversity. Kentucky bluegrass spreads by seed and rhizomes, has been used for roadside soil stabilization and is commonly used in lawns. It has a moderate invasive ranking of 57.

3.5.1.2 Wetlands

In August, 2005, the Forest Service soils scientist surveyed the route of the road corridor proposed in the action alternatives between the power plant and port facilities. The wetland boundaries were recorded using a Global Positioning System. These data served as the basis for calculating the acreage of different wetland types within the proposed road corridor. At the time of this analysis, final design locations had not been established for the road between the power plant and the dam site or the transmission cable between the port facilities and Kootznahoo Inlet. Consequently, the analysis of these corridors was based on a general reconnaissance of the area.

Existing Condition

Several types of wetlands occur in the analysis area, broadly grouped into estuarine and palustrine wetland systems (Cowardin et al. 1979). These wetlands have different soil types and vegetation communities, occupy different landscape positions, and have somewhat different functions and values. Table 3-5 summarizes the wetlands identified in the project area, based on National Wetlands Inventory data.

Table 3-4. Wetland Types Found in the Angoon Hydroelectric Project Area

System – Class / Subclass	Water Regime	Description
Estuarine – Aquatic Bed		
Algal/unconsolidated shore	Regularly flooded	Estuary
Algal/Rocky shore	Regularly flooded	Estuary
Palustrine – Aquatic Bed		
Rooted Vascular	Permanently flooded	Ponds with vegetation
Palustrine – Emergent		
Persistent/forested needle-leaved evergreen	Saturated	Sedge/grass fen-forested
Persistent/scrub-shrub, needle-leaved evergreen	Saturated	Sedge/grass fen-forested
Persistent	Saturated	Sedge/grass fen
Persistent	Seasonally Flooded	Sedge/grass fen
Persistent	Semi permanently Flooded	Sedge/grass fen
Persistent	Semi permanently Flooded - Beaver	Sedge/grass fen
Palustrine – Forested		
Needle-leaved evergreen/ emergent, persistent	Saturated	Forested-sedge/grass fen
Needle-leaved evergreen	Saturated	Forested
Dead	Saturated	Forested – modified by beaver activity
Palustrine – Scrub-shrub		
Broad-leaved deciduous/ forested, needle-leaved evergreen	Temporarily Flooded	Scrub-shrub/forest mosaic
Needle-leaved evergreen/ hyperline	Saturated	Scrub-shrub bog
Needle-leaved evergreen/ emergent, persistent	Saturated	Scrub-shrub bog/open fen mosaic
Palustrine – Unconsolidated bottom		
	Permanently flooded	Ponds

Source: GIS coverage, National Wetlands Inventory wetlands for Admiralty Island.

Estuarine Wetlands

Estuarine wetlands fall into two groups, intertidal and subtidal. The Forest Service manages only the wetlands above mean high tide (i.e., intertidal) because it is not chartered to manage ocean areas (USDA Forest Service 1997b). Estuaries are zones where brackish saltwater mixes with fresh water from rivers or streams. They provide high-value habitat for vegetation, fish, and wildlife. Intertidal estuarine wetlands extend the entire length of the project area along Chatham Strait and Kootznahoo Inlet. They generally have algal aquatic beds and rocky or unconsolidated shores. Estuaries are regionally recognized as the most important wetland type for the fisheries, wildlife, and marine habitat they provide. The mooring buoys and temporary barge landing would occur in estuarine wetlands.

Palustrine Wetlands

Palustrine wetlands are nontidal, inland wetlands that lack ocean salts. Three types of palustrine wetlands occur in the project area – emergent, forested, and scrub-shrub. Individual wetlands can also be mosaics of two or more of these, for example, emergent/forested or scrub-shrub/forested.

Palustrine Emergent: Emergent wetlands, most commonly sedge fens, are characterized by a diverse community of sedges dominated by Sitka sedge, with a variety of forbs and occasional stunted trees, usually spruce or hemlock. Most sedge fens are considered high-value wetlands. Soils are typically deep organic peat or muck, often with thin layers of alluvial soil material. Palustrine emergent wetlands in the project area occur in landscape positions that receive nutrient-rich runoff from adjacent slopes, creating somewhat richer conditions than scrub-shrub or forested wetlands. Some palustrine emergent wetlands are abandoned beaver ponds that provide high-quality waterfowl and salmon rearing habitat. The sedge fens are scarce wetland on the Tongass National Forest. They are very rich in species diversity and provide valuable habitat to several terrestrial animals. Palustrine emergent wetlands in the project area are located on the north and south ends of the project area. On the north end they occur in the vicinity of the proposed dam and to the north of the proposed access road. They are most dense on the south end of the project area and may influence the location of the transmission cable access road.

Palustrine Forested: Forested wetlands include a number of forested plant communities with hemlock, cedar, or mixed conifer overstories, and ground cover dominated by skunk cabbage. Forested wetlands are found on poorly or very poorly drained hydric mineral or organic soils. They are most common on broad glacial valley bottoms, swales, and gently sloping hill slopes or benches. These wetlands function as recharge areas for groundwater and streams, and for deposition of sediment and nutrients. They also produce commercial forest products. Palustrine forested wetlands are common across the Tongass National Forest and throughout the project area. Access road and transmission cable corridors, and staging areas would encroach on this type of wetland, especially on the south end of the project area.

Palustrine Scrub-Shrub: Scrub-shrub wetlands, colloquially called muskegs, are bogs or peat lands dominated by sphagnum moss with a wide variety of other plants adapted to very wet, acidic, organic soils. The drainage in scrub-shrub wetlands varies from poorly to very poorly drained, so organic materials are less decomposed than in other wetland systems. Due to the rapid growth and the slow decomposition rates of the sphagnum moss, these bogs typically become slightly elevated and much of the nutrient-rich water runs off to slightly lower-lying areas (such as palustrine emergent wetlands). Palustrine scrub-shrub wetlands are gently sloped and are typically made up of raised bogs with some shrubby coniferous vegetation. They typically contain some stunted lodgepole pine and hemlock trees less than 15 feet high. Muskegs are very common throughout the Tongass National Forest, but are not well represented in the project area. One such wetland would be inundated by water impounded by the dam.

3.5.2 Effects on Vegetation and Wetlands

3.5.2.1 Vegetation Effects

Implementation of nearly all project components would require some clearing of existing vegetation. Permanent removal of vegetation would occur in the following areas:

- (1) within the footprint of the power plant (less than 0.5 acre);
- (2) for the garage at the port facility (large enough to house a pickup and small backhoe);
- (3) within road prisms (20 feet by 7.5 miles (18 acres) in Alt. 2, or 20 feet by 3 miles (8 acres) in Alternative 2a); and
- (4) in the area in which water would be backed up behind the diversion dam (10 to 20 acres).

Vegetation clearing for the two construction staging areas (estimated at 6 acres each) would be permanent during the life of the permit. The sites would be reclaimed and revegetated if they are not needed for equipment and material storage following construction.

Additional effects on vegetation would occur in the cleared corridors for the road rights-of-way and transmission cables. Effects in these areas would consist largely of changing the existing vegetation type from forest to shrub-dominated communities in most areas. The corridor width would be approximately 45 feet wide where the access road and transmission cable share a single corridor. In Alternative 2 this distance would be between the power plant and Kootznahoo Inlet, approximately six miles. In Alternative 2a the distance would be between the power plant and port facility, about two miles. Approximately 19 acres of forest community would be converted to shrub under Alternative 2, and 7.5 acres in Alternative 2a. This estimate was made by subtracting the 20 feet of permanent clearing on the road prism from the corridor width, leaving 25 feet of vegetation type conversion over a length of the road. The average clearing width for the road between the powerhouse and the dam would be 30 feet. This distance is the same for both Alternatives 2 and 2a, approximately 1.3 miles. About 37 acres of vegetation would be removed or converted to other vegetation types for road and transmission cable corridors in Alternative 2, and seven acres would likewise be affected under Alternative 2a. The vegetation would be permanently modified in and adjacent to two wet meadows, as well as the surrounding forest by the construction of the shared transmission cable/road corridor in Alternative 2.

The feasibility evaluation report (HDR Alaska 2000) noted that few trees would probably need to be cut along the pipeline route between the diversion dam and the power plant. Instead, the pipeline would be routed between trees and secured to the ground by a system of nylon straps and galvanized steel cable. Pipeline installation would crush, trample, or uproot vegetation for the current growing season. Shade from the pipeline may inhibit or prevent plant growth by occupying the space otherwise available for plants or by shading the plants.

Under Alternatives 2 and 2a, the access road and transmission cable between the power plant and port facility, as well as the garage at the port facility and a staging area would necessitate the clearing of old-growth spruce/hemlock forest in the beach fringe. In Alternative 2, road and transmission cable corridor clearing between the port facilities and Kootznahoo Inlet

would primarily affect old-growth forest with interspersed patches of second growth, meadows, muskegs, and two small lakes.

Vegetation changes both upstream and downstream of the dam would be indirect effects of modifying the hydrology under Alternatives 2 and 2a. Plant species adapted to greater soil moisture and occasional inundation would become established in areas adjacent to water impounded above the dam. Downstream, riparian vegetation would change in response to decreased water availability.

Cleared corridors for roads and transmission cables may also facilitate the introduction and spread of noxious weeds. Construction equipment brought in from other areas may be contaminated with seeds and other parts of invasive weed species. Once established, invasive plant species may crowd out native species, be unpalatable to native wildlife, and decrease plant species diversity in the project area.

3.5.2.2 Effects on Wetlands

Management objectives for wetlands are to avoid the alteration of, or new construction in wetlands, wherever there is a practicable, environmentally preferred alternative considering wetland functions and values (Forest Plan 1997, pg 4-111). Management activities try to maintain the natural and beneficial wetland values and functions, and avoid adverse impacts and the loss of high value wetlands, especially fens (Forest Plan 1997, pg 4-111). Wetlands would be affected by dredging and filling associated with road development and staging areas. Location of the roads to avoid wetlands would be preferable but may not be possible given terrain and the density and proximity of wetlands. An Army Corps of Engineers (USACE) 404 permit would be needed to dredge or fill in a wetland. Their guidelines state that no discharge of dredged or fill material shall be permitted in wetlands if there is a practicable alternative to the proposed discharge which would have less adverse impact. They presume that practicable alternatives exist unless clearly demonstrated otherwise. Where it is necessary to cross wetlands, roads would be of the minimum length and width necessary to achieve their purpose. Roads would also be designed to prevent the restriction of flood flows and the disruption of aquatic species migration or movement (BMP 12.5 – Wetland Identification, Evaluation, and Protection). Other BMPs, for example 14.2 – Location of Transportation Facilities, and 14.3 – Design of Transportation Facilities, would be applied to minimize the disruption of wetland function and value.

Road construction and spoil disposal cover vegetation with rock and soil and cause the permanent loss of wetlands covered by the road prism and subtle changes in vegetation for distances of up to 20 feet on the downhill side of the road. By minimizing the amount of side-ditching, effects on groundwater flow and alteration of soil moisture levels are reduced. McGee (2000) found that drainage ditches collect and divert overland flow and shallow subsurface flow to the nearest stream channel, and do not greatly reduce soil wetness adjacent to the road prism.

Classified roads typically include a road surface approximately 14 feet wide. The widths of associated roadside ditches and/or fill slopes may vary depending upon slope, topography, soil type, and drainage. For this analysis, the Forest Service soils scientist estimated potential impacts to wetlands along the road segment between the power plant and port facilities by assuming a 40-foot road corridor . Of approximately 10 acres that fall within this 2-mile

corridor, 3 acres are wetlands (Table 3-6). Field surveys conducted along this corridor did not identify any high value wetlands such as tall sedge fens or alpine scrubland/short sedge wetlands.

Table 3-5. Area of Various Wetland Types Associated with Components of the Angoon Hydroelectric Project.

	Project Components							
	Road from Kootznahoo Inlet to Port Facilities to		Road from Port Facilities to Power Plant		Road from Power Plant to Diversion Dam		Rock Pits	Staging Areas
Wetland Type	linear feet		linear feet	acres	linear feet	acres	acres	acres
Forested Wetland	944		944	0.9	unknown		0.0	0.0
Forested Wetland (associated with small streams)	270		270	0.2	unknown		0.0	0.0
Scrub-Shrub/Short Sedge/ Muskeg	513		513	0.5	unknown		0.0	0.0
Alpine Scrubland/ Short Sedge	0		0	0.0	0	0.0	0.0	0.0
Lakes and Ponds	0		0	0.0	0	0.0	0.0	0.0
Forested Wetland/Upland	1,686		1,686	1.5	unknown		0.0	0.0
Tall Sedge Fens	0		0	0.0	0	0.0	0.0	0.0
Total Wetlands	3,413		3,413	3.1	unknown		0.0	0.0
Total Non-Wetlands	7,604		7,604	7.0	unknown		3.4	1.0
Total Area	11,017		11,017	10.1	6,851	6.3	3.4	1.0

Source: GIS coverage, National Wetland Inventory wetlands for Admiralty Island.

Tall sedge fens and alpine scrubland/short sedge wetlands were not found during a reconnaissance of the likely route for the proposed road between the power plant and the proposed dam. However, rare plants were found inhabiting wet meadows adjacent to this road that were proposed for spoil disposal. Spoil disposal on top of the rare plants would crush individual plants and possibly extirpate the population in the meadow.

3.5.3 Effects of Project Components

Alternatives 2 and 2a would affect some vegetation and wetlands in the project area. The effects are divided into the major components of construction and operation of the hydroelectric project, and are discussed in detail below. The primary project elements that have potential to affect vegetation and wetland resources are: (1) diversion dam and intake; (2) power plant discharge; (3) access roads, overhead transmission cables, and staging areas; and (4) marine facilities.

3.5.3.1 Diversion Dam

Several potential effects are associated with the construction and operation of the diversion dam. The 10 foot high dam would impound stream flow and form a 10-20 acre pond. The pond would flood palustrine emergent, palustrine shrub/scrub, and palustrine forested wetlands. Similar wetland communities may develop adjacent to the pond, and vegetation species changes to more saturated conditions would be expected. Below the dam, species adapted to drier soil condition would encroach into the current riparian zone as stream volume decreases, especially during the growing season.

3.5.3.2 Access Roads, Overhead Transmission Cables, Powerhouse, and Staging Areas

Construction and operation of access roads, overhead transmission cables, the powerhouse, and staging areas would require permanent and temporary clearing of vegetation. Beyond the actual construction sites, plants would be exposed to crushing, trampling, or being uprooted as workers move between jobs and sites. In addition, rare plants would be crushed and the populations possibly extirpated if spoil from full-bench road construction is disposed of in the wetlands adjacent to the road between the dam and powerhouse.

Effects vary with the plant species, vegetation community, and soils. Generally, graminoids, grass-like plants such as sedges, rushes, and grasses, and woody plants are more resistant to trampling than broad-leaved herbs, although herbs may recover more readily (Cole 1995a, 1995b). Forest understory plants are more susceptible to disturbance than those with more light and gravelly soils because of the thick, soft organic soil horizons and slow plant regeneration in coastal Alaska forests (Monz 1998).

Vegetation would be permanently removed from the road prism, powerhouse site and possibly the staging areas. Vegetation would be converted from forest to shrub communities in the transmission cable corridor beyond the road prism. Under Alternative 2, vegetation would be permanently removed from 18 acres of road and possibly 12 acres in staging areas; it would be converted to shrub communities on about 19 acres. Alternative 2a would have the same area taken up in staging areas and the power plant, but it would have fewer miles of road and transmission cable corridor creating about 8 acres of permanent vegetation removal and 7.5 acres of vegetation conversion.

Plant communities would also change in response to changes in hydrology created by road cuts, raised road beds, and spoils disposal. Blocking flow across roads or increasing the efficiency with which water flows through a meadow would decrease the water levels in the meadow, and shift plant species to those that are adapted to drier sites.

The spread of exotic plant species would be associated with the road corridor and the movement of equipment and people through the project area. Exotic plant species inhabit the area where equipment and supplies would be brought into the project area under the action alternatives.

The road and transmission cable corridor, and staging areas would encroach on wetlands, especially in the southern portion of the project area. These facilities may be routed around wetlands in the north end of the project area because there are relatively few of them. Avoidance of wetlands may not be feasible on the southern end of the project area because

the wetlands connect. Forested wetlands would most often be affected, but some palustrine emergent wetlands would be affected on the south end.

3.5.3.3 Port Facilities and Submarine Cable

Construction and operation of the port facilities would have similar affects as described above for access roads and the powerhouse. Plants would be removed at the building site and road prism, and exposed to crushing, trampling, and being uprooted during construction. Construction effects from the temporary barge landing could cause the alteration or loss of a small amount of beach and near-shore habitat. However, based on the small area of habitat disruption, the temporary nature of the facilities, and the planned regrading and revegetation of the beach, the effects would be minor.

Invasive plants were found at the proposed port facilities. The plants are adapted to spread and compete well with native plants on exposed soils. Equipment brought to the project area at this site has strong potential of bringing in new invasive plant seed or transporting the seed at the site along roads in the project area.

Installation of the submarine cable would have minor effects on vegetation or estuarine wetlands.

3.5.4 Comparison of the Alternatives

Under the No Action alternative, no vegetation clearing or any disruption of wetland function and values would occur. Implementation of Alternatives 2 and 2a would remove vegetation, and have the potential of disrupting wetland function. Alternative 2 would have greater potential of negative effects than Alternative 2a because the amount of road construction would be greater. The road and associated facilities above Thayer Creek are the same in Alternatives 2 and 2a, so the effects would be the same for both alternatives. Alternative 2a also has the least amount of soil disturbance so less invasive plant habitat would be available.

3.5.5 Unavoidable Adverse Impacts

Even with the implementation of design elements intended to minimize the potential negative effects of Alternatives 2 and 2a, project implementation would result in unavoidable adverse impacts to vegetation (including beach fringe), and wetlands.

Avoidance of wetlands where practicable, along with implementation of mitigation measures, would likely reduce but not entirely eliminate adverse affects to wetlands. Such affects would include permanent loss of wetlands within road prisms and at construction sites, e.g., power plant, port facilities. In addition, the introduction of fill material for road construction may affect surface or subsurface hydrology. In some cases, ponding may occur on the upstream side of the road bed; in others, side ditches or coarse fill may act as a conduit, reducing saturation of soils in the vicinity of the roadway. These and other effects may also influence wetland vegetation in the vicinity of road corridors.

3.6 WILDLIFE

This section describes the wildlife resources of the Angoon Hydroelectric Project area, and the potential effects associated with the proposed alternatives. Information in this section comes from the management indicator species, bald eagle nest survey, and migratory birds, birds of conservation concern, and priority species resource reports.

3.6.1 Affected Environment

The following subsections characterize the wildlife species and habitat in the project area. Threatened, endangered, and sensitive plant and animal species are addressed separately in Section 3.7; fish and wildlife species that provide subsistence resources are addressed in Section 3.10.

3.6.1.1 Management Indicator Species

Management Indicator Species (MIS) are species whose response to land management activities can be used to predict the likely response of other species with similar habitat requirements (FSM 2631.3). The Forest Service Manual (FSM 2621.4) requires analyses to assess the effects of proposed projects on MIS and ensure that Forest Plan requirements, goals, and objectives are met at the project level (FSM 2621.4).

Thirteen MIS have been identified for the Tongass National Forest (USDA Forest Service 1997b), three of which (black bear, wolf, and mountain goat) do not occur on Admiralty Island and are not addressed in this discussion. Table 3-6 summarizes the known occurrence of MIS and their habitat in the project area. Three of these – bald eagle, brown bear, and marten – are of particular concern in the project area and are discussed further in the paragraphs below.

Bald Eagle: The USFWS conducted a bald eagle nest survey between Angoon and Thayer Creek in 1973, recording seven nests. Eight bald eagle nests were recorded during a survey in October 2006. Only one of the nests found in the 1973 survey was found in the 2006 survey. Bald eagles commonly re-use nests for many breeding seasons, but locations change over time. Along the Alaska coast, bald eagles prefer to nest in the tallest Sitka spruce trees, which usually average 5 feet in diameter, and are generally within 200 yards of the water (USFWS undated). Bald eagle habitat is managed under the Interagency Agreement between the Forest Service and the USFWS that establishes a 330-foot no-disturbance zone around nest trees.

Brown Bear: Of all species on Admiralty Island, the brown bear is most charismatic and best symbolizes Wilderness and Wilderness values. The Admiralty Island National Monument and the Kootznoowoo Wilderness designations were applied primarily to benefit protection of brown bears. Kootznoowoo means “Fortress of the Bears” in the Tlingit language.

Table 3-6. Management Indicator Species That May Occur in the Angoon Hydroelectric Project Area

Species	Rationale for Selection as MIS	Occurrence in the Project Area
Alexander Archipelago wolf	Represents a variety of habitats.	Wolves are found on the mainland of Southeast Alaska and islands, south of Frederick Sound. There are no documented records of wolves on Admiralty Island.
bald eagle	Associated with old-growth trees along the coast and within riparian areas.	Nesting bald eagles are common along the coastline, generally nesting in forested beach fringe habitats. Eagles are commonly seen in the area.
brown bear	Game species that use habitats from sea level to alpine.	Brown bears are common in the project area.
brown creeper	Represents a species that uses old-growth forests.	Brown creepers use snags or live trees with defects for nesting and foraging activities. There is ample old-growth snag habitat in the project area.
hairy woodpecker	Represents a species that uses snags in old-growth forests.	There is suitable habitat in the project area. See above discussion of effects to brown creepers.
marten	Furbearer and game species that represents high-volume old-growth forest.	Natural populations occur on Admiralty Island. There is suitable habitat in the project area and marten are likely to occur throughout the area. One marten was seen near the mouth of Thayer during surveys.
red-breasted sapsucker	Represents a species that uses snags in old-growth forests.	There is suitable habitat in the project area. See above discussion of brown creepers.
red squirrel	Represent a species that uses seed-producing second-growth timber stands.	There is suitable habitat, and red squirrels were seen during surveys. It is believed that they were introduced to the island in the late 1940s and early 1950s.
river otter	Associated with coastal and freshwater aquatic environments and immediately adjacent (within 100 to 500 feet) upland habitats.	There is suitable coastal habitat adjacent to the project area. One otter was seen near the mouth of Thayer Creek during wildlife surveys.
Sitka black-tailed deer	Game and subsistence species that represents low-elevation high-volume old-growth forest.	There is suitable habitat in the project area. Beach fringe habitats provide important deer winter range for the Sitka black-tailed deer. Deer sign was noted during wildlife surveys in the area.
Vancouver Canada goose	Represents species that use wetlands in the estuary, riparian, and upland areas of the Forest.	Nesting habitat for this species (forested and non-forested wetlands and lakes) occurs in the project area, but we do not know if geese use the area. No geese were seen during wildlife surveys.

Source: Rickards 2004; MacDonald and Cook 1999

A study conducted on nearby Chichagof Island by ADF&G (2006) found that brown bears use a significantly smaller area in unmodified riparian areas compared to riparian zones

where extensive clear-cut logging and road construction have occurred. Bears that use smaller areas expend less energy as they forage, which may contribute to greater population viability over the long term. The ADF&G recommends buffers of at least 500 feet along all salmon streams, and suggests buffers of 1,000 feet to maintain abundant populations. Tree removal in the proposed project would only occur as needed to clear road or transmission cable corridors, and building sites.

Marten: The American marten is currently considered a single species (*Martes americana*) with several distinct subspecies across North America. Recent genetic analyses have suggested that the population in the western United States should be considered a distinct species, *M. caurina* (Carr and Hicks 1997). Some studies suggest that the marten on Admiralty Island are genetically distinct from other populations in Southeast Alaska and farther south along the Pacific Coast. This distinctive genetic signature reflects the long-term isolation of the endemic populations in the project area (Dawson et al. 2006).

Within Southeast Alaska, marten spend the majority of their time in forested habitats and depend on expanses of old-growth forest because they require large stumps and tree hollows for denning. Marten are extremely vulnerable to trapping, particularly in roaded landscapes.

Migratory Birds

Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, provides for the conservation of migratory birds and their habitats. It directs federal agencies to take conservation actions for birds and consider project effects on them in the NEPA process. Federal agencies are required to support the conservation and intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird habitats when conducting agency actions.

The Boreal Partners in Flight Working Group (1999) has identified 19 bird species of conservation priority in Southeast Alaska. The Partners in Flight prioritization scheme ranks breeding bird species based on seven measures of conservation vulnerability, using both global and regional criteria. This approach assumes that if conservation measures are focused on high-priority species and their habitats, other species in the area will benefit as well (Boreal Partners in Flight Working Group 1999). In addition to those priority species, the USFWS (2002) identified 27 bird species of conservation concern in the Northern Pacific Forest Bird Conservation Region. The ranges of 21 of these species include Southeast Alaska. These species, along with their seasonal occurrence, local abundance, and habitat associations, are detailed in the migratory birds resource report for this project.

More than 100 species of birds migrate from the lower 48 states and Central and South America to nesting, breeding, and rearing grounds in Alaska. Most of these birds only pass through Southeast Alaska on their way to breeding grounds in interior or northern Alaska. The migratory species that stay in the area use most, if not all, of the habitats in the project area to breed, nest, and raise their young. Habitats used in the project area include hemlock/Sitka spruce/cedar forest, shrub thickets, streams, beaches, tidal flats, and rocky shores.

Neotropical migratory birds are wide-ranging species that require a variety of habitats for foraging, breeding, and wintering. Patterns of population declines are generally detected at

larger observational scales then those traditionally used to manage lands. Individual project areas are generally too small or restrictive to effectively detect population changes or to significantly affect habitats for migratory species and regional biological diversity. It is possible to implement positive conservation actions at the project level; however, the actions will be relatively minor over the entire range of the species. By assessing habitat at a larger geographic scale, effects to overall biodiversity, as well as avian diversity, can be better incorporated into the planning process (Finch and Stangel 1993).

3.6.2 Effects on Wildlife

Development of a hydroelectric facility and associated project components may affect wildlife species in several ways. Vegetation clearing for road and transmission cable corridors, the power plant, and other project features may reduce the availability of suitable nesting and foraging habitat for birds and denning habitat for mammals such as marten. Elevated levels of human activity associated with construction and maintenance of the hydroelectric facility and related project components may also disturb species that are sensitive to human presence. Additional effects associated with individual species or species groups are addressed in greater detail below.

3.6.2.1 Management Indicator Species

Bald Eagle: There are eight known and marked bald eagle nest trees in the analysis area. All of the nest trees are located in the beach fringe along the Chatham Strait coastline. Seven are between the port facilities and the mouth of Thayer Creek, and one is about one mile north of Thayer Creek.

One nest tree (#61) would be close to the garage site at the port facilities. No tree removal would occur within 330-feet of any nest tree. Construction activities, such as helicopters, road building equipment, and blasting, have the potential to disturb nesting and foraging bald eagles. Helicopter flight paths would be routed to avoid active nests by at least ¼ mile. Construction activities may need to have seasonal restrictions to avoid disturbing active nests, as appropriate. All nests are considered active from March 1 through May 31. Current year surveys will be necessary to determine nest activity status, and thus, seasonal restrictions beyond May 31.

Brown Bear: Alternatives 2 and 2a would have the potential to negatively affect brown bears because the development occurs in brown bear habitat. Direct effects include conversion of habitat, disturbance during construction and maintenance activities, new roads, and the potential for increased bear-human interactions. A very small percentage of habitat in the project area would be converted from forest to road, shrub, and pond. Disturbance during construction may inhibit bear use of the Thayer Creek area, and at stream crossings. Roads would be closed to motor vehicle use except as needed for maintenance of the transmission cable, dam, and powerhouse. Therefore, motorized use of the roads would be infrequent and low intensity. However, a road would still improve walk-in access to the area for hunting and fishing.

Enforcement of SUA requirements to maintain clean camps and properly store food (Clause IIIC) would prevent brown bear becoming habituated to the construction camps, and

decrease to potential for bear/human encounters. The Admiralty District Ranger may revoke or suspend the SUA if camps and facilities are not maintained to standards (Clause VB(2)).

A large portion of the Thayer Creek stream flow would be shunted into the power generating facilities and bypass the fish barrier. Fish barriers provide high quality foraging habitat for bears. Changing the flow regime at the fish barrier could change the suitability of the site for bear foraging either positively or negatively. The direction of change depends on how the fish respond to the change in discharge, and how the access changes for bears. Salmon productivity at the mouth of Thayer Creek may decline if spawning gravels are lost or stream flow declines. These situations are not expected to occur as sediment would be periodically washed through the dam, and outfall from the power plant would maintain flow levels. Foraging opportunities in the transmission cable corridor could improve because berry production should increase with the removal of the forest canopy.

Marten: Roads constructed for the proposed project may increase the vulnerability of local marten populations to trapping. Closure of roads to motorized use unrelated to project construction and operation would reduce the risk of over trapping because traplines would be limited by walking distances, and day length.

Reductions in the availability of suitable denning and foraging habitat by loss of forest canopy, snags, and down logs in the road corridors, staging areas, and building areas, would not reduce habitat capability of marten populations. The loss of habitat is minimal (37 acres in Alternative 2, 15 acres in Alternative 2a) relative to the available habitat in the project area.

Other MIS: The removal of trees and snags to accommodate construction activities would have a relatively small effect on brown creepers, hairy woodpeckers, red-breasted sapsuckers, and other species that depend on snags and live trees with defects. Ample habitat would remain and populations would not be affected.

Similarly, seed-producing trees for red squirrels would continue to be available within and adjacent to the project area.

Project-related changes in the hydrology and fisheries resources of Thayer Creek may reduce foraging opportunities for river otter.

No concentrations or nesting areas for Canada geese or other waterfowl were identified in the project area. If concentration or nesting areas are found during construction of hydroelectric facilities, human activities would be restricted within 330 feet of them.

Effects on Sitka black-tailed deer are addressed in Section 3.9, Subsistence.

3.6.2.2 Migratory Birds

The primary direct effect to birds would be nest destruction or abandonment if project activities occur in suitable nesting habitat during the breeding period. The magnitude of the effects would vary, depending on the season in which the disturbance occurred. Nesting in Southeast Alaska generally begins in May. By September, most young birds have fledged (personal communication, Gwen Baluss, Tongass National Forest, Juneau Ranger District).

Hemlock/Sitka spruce/cedar forest would be the habitat most affected by development of this project. Construction of the port facilities, powerhouse access road, dam access road, and

powerhouse is expected to occur between May and September of the first year (HDR 2000). Approximately 34 acres of forest would be removed, mostly for road corridor and staging areas in the action alternatives. The road from the port facilities to the powerhouse would be constructed in June, and the road from the powerhouse to the dam would occur between July and September. Nesting success would not decline as the area of forest removed is small relative to the area of forest remaining. Forest cover would be removed in stages so birds that nest early would have time to fledge.

Between April and June of year 2, the transmission cable and access road corridor from the port facility to Kootznahoo Inlet in Alternative 2 would be constructed. This corridor would disturb about 23 acres. Some of the construction would occur before the breeding season and during the time birds are selecting nesting sites. Birds are unlikely to select nest sites in areas of active construction. Nesting success would remain static because of the limited area of forest removal relative to the area of residual forest.

Indirect effects related to habitat modification would vary by habitat type. Effects on species that are associated with mature and old-growth forest habitat would derive from fragmentation and patch size reduction of suitable forest habitat. For species such as northern goshawk, marbled murrelet, and Townsend's warbler, the removal of old-growth habitat for the transmission cable would affect habitat quality by creating edge habitat adjacent to suitable nesting habitat. Edges reduce the effectiveness of interior habitat and increase the potential for nest-site predation from avian predators that are associated with forest edges and fragmented landscapes.

Species that prefer shrub habitats (as well as edge and brush-field habitats) would be affected in a positive manner because forest clearing would create more suitable habitat. Bird species of conservation concern that use brush and second-growth habitat for nesting include the varied thrush, MacGillivray's warbler, and golden-crowned sparrow. The brush habitats would be maintained in the transmission cable corridor by periodic clearing of encroaching trees as long as the hydroelectric project is in operation.

The reduction of stream flow in Thayer Creek would negatively affect species closely associated with stream habitats, such as the American dipper. Maintaining instream flows would reduce the extent of effects to these species.

Port facility construction and other human activities in beaches and tidal flats may disturb foraging northwestern crows, short-billed dowitchers, red knots, whimbrels, and Arctic terns. No effects to breeding individuals would be expected, however, because none of these species is expected to nest in beach and tidal flat habitats.

Small amounts of deciduous/spruce woodland habitat are found in the project area. Birds of conservation concern that nest solely in this habitat type include the Western wood peewee (uncommon), Olive-sided flycatcher (uncommon), and the Gray-cheeked thrush (rare).

3.6.3 Effects of Project Components

The project alternatives would affect wildlife habitat in Thayer Creek watershed and habitats between Thayer Creek and Kootznahoo Inlet. The effects can be discussed under the major components from project construction and operation. The primary project elements are:

1. diversion dam and intake;
2. pipeline and power plant discharge;
3. access roads, overhead transmission cables, and staging areas;
4. marine facilities.

3.6.3.1 Diversion Dam and Intake

The diversion dam would create a 10 to 20-acre pond. This would change 10-20 acres of riparian and upland forest to aquatic habitat. Riparian vegetation would likely re-establish along the new shoreline. Existing trees within the pond area would drown and provide snag habitat in the near term. This could improve habitat for some migratory birds and waterfowl but result in a loss of habitat for forest dwelling species. The amount of habitat conversion is inconsequential at the landscape level. These effects would be the same for alternatives 2 and 2a.

3.6.3.2 Pipeline and Power Plant Discharge

There would be minimal habitat change associated with the pipeline. However it could create a partial barrier to passage by deer and bear. These species make seasonal migrations from beach fringe to alpine, often using riparian corridors. Although adult animals could cross over the 42-inch diameter pipe, fawns and cubs would have a more difficult time getting over it.

The reduced flow of water over the fish barrier falls and location of the power plant discharge could affect the distribution of anadromous fish and thus, foraging success of brown bears using the site. These effects would be the same for both action alternatives.

3.6.3.3 Access Roads, Overhead Transmission cables, Powerhouse, and Staging Areas

Both action alternatives would result in the conversion of old-growth forest habitat to road, buildings, and shrub habitat. On a landscape scale the acreage converted is minor.

Construction activities, such as helicopters, road building equipment, and blasting, have the potential to disturb and displace a variety of wildlife species. Helicopters would be used throughout the life of the project for maintenance activities. Some migratory bird nests and individuals would likely be destroyed during construction activities.

The construction of roads and transmission corridors through intact forest will create more edge habitat. Edges provide favorable nesting and foraging habitat for corvids which prey on migratory birds and their nests.

Although project roads would be closed to motorized uses outside of project activities, they will improve walk-in access to the area. This may increase harvest of game species such as bear, marten, and deer.

The presence of humans living and working in bear habitat will increase the likelihood of undesirable bear/human interactions. Enforcement of SUA requirements to maintain clean camps and properly store food would mitigate the potential but not eliminate it.

3.6.3.4 Port Facilities and Submarine Cable

Construction and operation of the port facilities would have similar affects as described above for access roads and the powerhouse. Habitat would be removed at building sites and the road prism. Construction effects of the temporary barge landing would cause the alteration or loss of a small amount of beach and nearshore habitat. However, based on the small area of habitat disruption, the temporary nature of the facilities, and the planned regrading and revegetation of the beach, the effects would be minor.

3.6.4 Comparison of the Alternatives

Under the No Action alternative, no habitat conversion or any associated disruption of wetland function, wildlife habitat, or wildlife productivity would occur. Implementation of the Alternatives 2 and 2a would involve all of the effects described in Sections 3.6.2 and 3.6.3 above. There would be less habitat conversion and less disturbance associated with Alternative 2a compared to Alternative 2.

3.6.5 Unavoidable Adverse Impacts

Reduced stream flow in Thayer Creek below the diversion dam would reduce the availability of habitat and foraging opportunities for river otter and some migratory bird species. In addition, reduced availability of suitable spawning substrate would diminish foraging opportunities for wildlife species that depend on salmon, such as brown bear. Also, the increased human presence associated with project construction and operation would inevitably increase the risk of human/bear encounters. Some old-growth forest habitat would be converted to road, buildings, shrub, and aquatic habitat.

3.7 THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Forest Service staff prepared biological evaluations (BEs) of threatened or endangered species listed under the Endangered Species Act (ESA), as well as species on the Regional Forester's Sensitive Species list (FSM 2672.4). The objectives of the BEs were:

1) to ensure that Forest Service actions do not contribute to the loss of viability or trend toward federal listing of any native or desired non-native plant or animal species;
2) to ensure that actions of federal agencies do not jeopardize or adversely modify critical habitat of federally listed species; and
3) to provide a process and standard that ensures threatened, endangered, and sensitive species receive full consideration in the decision-making process.

The BEs for plants and animals are on file at the Admiralty Island National Monument office.

3.7.1 Affected Environment

The following sections describe the existing condition of threatened, endangered, and sensitive species and their habitats in the Angoon Hydroelectric project area. The wildlife biologist reviewed published literature, information on the NMFS web site, and interviewed staff at the USFWS to develop the discussions of ESA-listed species below. Information about Forest Service sensitive animal species was based on reviews of district wildlife files, letters, scientific literature, and Forest Plan standards and guidelines.

The botanist reviewed the Regional Forester's Sensitive Species List, Alaska Natural Heritage Program database records, the Tongass National Forest plant survey GIS database, botanical literature (Hitchcock et al. 1955; Hultén 1968), maps, and aerial photos. The Forest Service botanist conducted field surveys of the project area in July and August of 2004.

3.7.1.1 ESA-Listed Species

The following ESA-listed species may occur on or in waters adjacent to the Tongass National Forest (NMFS 2003, 2006, personal communication, E. Grossman, USFWS, September 16, 2005):

- humpback whale (*Megaptera novaeangliae*)
- Steller sea lion (*Eumetopias jubatus*)
- Chinook salmon (*Oncorhynchus tshawytscha*)
- sockeye salmon (*O. nerka*)
- steelhead (*O. mykiss*)

ESA-listed salmon and steelhead stocks are all from the lower 48 and found only on the outer coast (USDA Forest Service 1997b). These stocks are not known to inhabit the inland waters of Tongass National Forest, thus they will not be addressed further in this analysis.

Humpback whales are listed as endangered under the ESA. Humpbacks are regularly sighted in the inside passage and coastal waters of the Tongass National Forest from Yakutat Bay south to Queen Charlotte Sound. Humpback whales feed in Southeast Alaskan panhandle waters from about May through December, although some have been seen every month of the year. Peak numbers of whales are usually found in nearshore waters during late August and September (USDA Forest Service 1997b).

Humpback whales are very common near the project area in Chatham Strait. They use waters as close to shore as is possible for them to maneuver, and may come within a few hundred yards of the project area. Humpback whales have been sighted in Favorite Bay. The potential for humpback whales to enter the inner portions of Mitchell Bay is not known because the passages into the upper bay are narrow and tidal currents are often great.

The eastern Alaska distinct population segment of Steller (northern) sea lions is listed as threatened under the ESA. This species ranges from Hokkaido, Japan, through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, Gulf of Alaska, Southeast Alaska, and south to central California. The centers of abundance and distribution are the Gulf of Alaska and Aleutian Islands. Steller sea lion habitat includes both marine and terrestrial areas. Adult Steller sea lions congregate at rookeries for breeding and pupping. Rookeries are generally located on relatively remote islands, often in exposed areas that are

not easily accessed by humans or mammalian predators. Critical habitat has been designated in Southeast Alaska, and includes all major haulouts and rookery sites (NMFS 1993).

The nearest Stellar station rookery to the project area is approximately 120 miles south, on the outer coast. The nearest haulout, Lull Point, is approximately 18 miles southwest of Angoon in Chatham Strait, near the mouth of Kelp Bay.

3.7.1.2 Forest Service Sensitive Species

Animals

The Regional Forester's Sensitive Species List for Region 10 identifies four sensitive wildlife species on the Tongass National Forest. These are the Queen Charlotte goshawk (*Accipiter gentilis laingi*), Peale's peregrine falcon (*Falco peregrinus pealei*), osprey (*Pandion haliaetus*), and trumpeter swan (*Cygnus buccinator*). In addition, the BE addressed potential effects on Forest Service sensitive fish species and Kittlitz's murrelet, a candidate for listing under the ESA.

Queen Charlotte Goshawk

Queen Charlotte goshawks occur in low densities throughout most of the Tongass National Forest. Preferred breeding season habitat includes large tracts of mature and old-growth forest. Goshawks appear to prefer low elevations (less than 800 feet) and gentle slopes (less than 35 percent) (Iverson et al. 1996). Beach fringe habitats provide important nesting habitat. At least 600 acres of nesting habitat (defined as productive old growth - see Glossary) is desirable within each 10,000- to 30,000-acre watershed (USDA Forest Service 1997b). Suitable nesting habitat consists of forest stands of at least 20 to 30 acres in size, with large trees, closed canopy, and low understory vegetation (USDA Forest Service1991). Alternate nests can be widely separated or clustered in one stand. Males have a strong fidelity for their nest stands, residing in the area year round. Females are nomadic, leaving the nest area after the young have fledged.

Goshawks feed primarily on smaller birds. A range of forest age classes may provide suitable prey populations and be used by goshawks for foraging. Foraging habitat is generally characterized by a greater diversity of age classes and structural characteristics (e.g., snags, woody debris) than nesting areas. Foraging areas also make up the largest percentage of goshawk home ranges (Reynolds et al. 1991). The primary concern about goshawk population viability is habitat loss due to timber harvest.

No historic or current nests are known to occur within the project area, but extensive surveying has not been completed. Forest Service biological staff conducted opportunistic surveys for Queen Charlotte goshawks in the project area in July 2004, and detected no goshawks. The nearest known goshawk nesting area is between Thayer and Distin Lakes, approximately 5 to 10 miles from the project area. A nest was located in 1994, 1997, 1999, and 2005. During 2005, three juvenile goshawks were active around the nesting area. It is likely that the territory for these goshawks includes the project area because goshawk ranges in Southeast Alaska are very large, averaging nearly 10,000 acres during the breeding season (March 15 to August 15) and suitable habitat occurs in the project area. In one study in Southeast Alaska, foraging goshawks traveled more than 15 miles from their nest site during the breeding season (USDA Forest Service 1996).

Approximately 45 percent of the powerline corridor consists of suitable nesting habitat for goshawks. Nearly all forested areas in the project area provide potentially suitable foraging habitat.

Peale's Peregrine Falcon

The Peale's peregrine falcon is a subspecies of the peregrine falcon (*Falco peregrinus*). It breeds from the Aleutian Islands, east and southward through Southeast Alaska, to the Queen Charlotte Islands of British Columbia.

Peale's peregrine falcons nest on cliffs from 65 to 900 feet in height along the outer coast of the Gulf of Alaska (USDA Forest Service 1997b). Nest distribution is closely associated with large seabird colonies located on the outer coasts or nearby islands. Schempf (1992) found that seabird remains, including marbled murrelet, ancient murrelet, and Cassin's auklet, made up most of the prey remains found at aeries in Southeast Alaska.

There is no suitable nesting or foraging habitat for peregrine falcons in or near the project area. No sightings of Peale's peregrine falcons have been documented in or near the project area, and no falcons were observed during wildlife surveys conducted for this project.

Osprey

Osprey occur in low numbers throughout Southeast Alaska during the nesting period from late April through August, usually near lakes, rivers, and coasts (Armstrong 1995). Although the osprey population in Southeast Alaska has historically been low, the availability of nest sites and foraging areas do not appear to be limiting factors (USDA Forest Service 1997b). Ospreys are migratory, spending their winters in Mexico and Central and South America. Nests have been found in Southeast Alaska throughout the Tongass National Forest. Osprey nests are generally constructed in spruce/hemlock forest. Snags or trees with broken tops are preferred (Blatt 1995).

There is one reported record of an osprey at Killisnoo on Admiralty Island, approximately 5 miles from Kootznahoo Inlet (Blatt 1995). Suitable nesting habitat occurs along the coast of Admiralty Island from Thayer Creek to the mouth of Kootznahoo Inlet. Forest Service biologists conducted boat-based surveys along the coast during July of 2004, and found no ospreys in the area.

Trumpeter Swan

The breeding range of the trumpeter swan is concentrated along the Gulf of Alaska coast and in wetland areas of central and southern central Alaska (Bellrose 1980). Trumpeter swans that breed in Alaska winter along the Pacific Coast from the Alaska Peninsula to the mouth of the Columbia River (Bellrose 1980). Each spring and fall many swans pass through southern Southeast Alaska migrating between their breeding and wintering grounds. Swans that spend the winter in Southeast Alaska usually move to large, ice-free lakes and estuaries once the weather turns cold.

The USFWS conducted summertime surveys of nesting habitat in Southeast Alaska approximately every 5 years from 1968 until 2000. All of the nesting swans found in Southeast Alaska were located on the mainland; no trumpeter swans have been recorded

nesting on any of the islands. Between 1980 and 2000, the number of trumpeter swans cygnets increased from 11 to 129 (Conant et al. 2001).

Since 1968, the USFWS has also conducted aerial surveys of wintering swans in Southeast Alaska approximately every 5 years. In the latest survey, Hodges (2001) recorded 35 swans wintering on Salt Lake in the upper end of Mitchell Bay, approximately 9 miles east of the project area. This area hosts one of the largest trumpeter swan wintering areas in Southeast Alaska.

Kittlitz's Murrelet

On May 9, 2001, the Secretary of Interior was petitioned to list the Kittlitz's murrelet as endangered with concurrent designation of critical habitat under the ESA. Petitioners cited dramatic reductions in population size over the last decade and declining habitat quality as reasons for the requested listing. The species was officially designated a candidate species (warranted, but precluded) on May 4, 2004. The USFWS believes that glacial retreat and oceanic regime shifts are the primary factors causing species decline.

There is no suitable habitat for Kittlitz's murrelets in the project area.

The Kittlitz's murrelet is closely associated with glacially influenced habitats along the mainland coast of Alaska. Nest sites are generally in the vicinity of glaciers, cirques near glaciers, or recently glaciated areas. Nest sites have been found in unvegetated scree fields, coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains. In winter, Kittlitz's murrelets occur mostly offshore in the Gulf of Alaska.

The only known population of Kittlitz's murrelets in the United States occurs in Alaskan waters from Point Lay south to northern Southeast Alaska. The largest breeding populations are believed to be in Glacier Bay National Park and Preserve, Prince William Sound, Kenai Fjords, Malaspina Forelands, and Icy Bay. In Southeast Alaska, Kittlitz's murrelets breed in Port Houghton, Endicott Arm, and Tracy Arm. Small populations may also breed near the tidewater glaciers in Taku Inlet and the small glaciers of Baranof Island.

Sensitive Fish Species

The Forest Plan identified three sensitive species of fish that occur on the Tongass National Forest. These species include the Fish Creek chum salmon, the Island king salmon, and the northern pike. The northern pike is found only on the Yakutat forelands and the Fish Creek chum salmon occurs near Hyder. King Salmon Creek and Wheeler Creek on Admiralty Island have Island king salmon runs, though neither stream is in the proposed project area.

Plants

Table 3-8 summarizes the sensitive species of plants that are known or suspected to occur in the project area and their preferred habitats. Of the three species that are known to occur on the Juneau Ranger District, only one (*Poa laxiflora*) has been documented on Admiralty Island, approximately 20 to 30 miles from the project area. The nearest known locations of the other two species (*Arnica lessingii* ssp. *norbergii* and *Puccinellia kamtschatica*) are on the mainland, 40 to 50 miles from Angoon.

General habitats or plant communities in the project area include conifer forest, open forest, forest edge, riparian areas, gravel bars, beach, forested beach fringe, beach meadows, non-forested wetlands, wet meadows, fens, shallow freshwater, ponds and lakes and their margins, and muskeg. In July and August of 2004, the Juneau Ranger District botanist conducted field surveys in potential construction and clearing areas for this project. Survey

Table 3-7. Sensitive Plants Known or Suspected to Occur in the Vicinity of the Angoon Hydroelectric Project Area

Species	Occurrence	Habitat Associations
Norberg arnica (*Arnica lessingii ssp. norbergii*)	Known	Alpine and subalpine meadows, arctic and alpine tundra, heath, and open woods in south coastal Alaska.
no common name (*Botrychium tunux*)	Suspected	Maritime beach meadows, upper beach meadows, and well-drained open areas.
no common name (*Botrychium yaaxudakeit*)	Suspected	Maritime beach meadows, upper beach meadows, and well-drained open areas.
Wright filmy fern (*Hymenophyllum wrightii*)	Suspected	Humid shaded boulders, cliffs and damp woods and occurs at the base of trees and rock outcrops or in crevices of tree trunks. Occurs in coastal areas of Southeast Alaska.
truncate quillwort (*Isoetes truncata*)	Suspected	Aquatic. Grows immersed in shallow water of lakes and ponds.
Calder lovage (*Ligusticum calderi*)	Suspected	Subalpine boggy meadows, meadows and forest edges.
pale poppy (*Papaver alboroseum*)	Suspected	Open areas, rock outcrops, sandy, gravelly, well-drained soils, mesic to dry alpine. Sea level to ~6,000 feet elevation. Known in south-central Alaska.
loose-flowered bluegrass (*Poa laxiflora*)	Known	Upper beach meadows, open forests, and low-elevation streamside banks.
Kamchatka alkali grass (*Puccinellia kamtschatica*)	Known	Wet habitat on the coast and in upper beach meadows, limited to the south coast of Alaska from the Aleutian Islands to the northern portion of Southeast Alaska.
Unalaska mist-maid (*Romanzoffia unalaschcensis*)	Suspected	Beach terraces or moist banks, wet rock outcrops and rock crevices. Ranges from eastern Aleutians, Alaska Peninsula, and Kodiak to Southeast Alaska.
circumpolar starwort (*Stellaria ruscifolia ssp. aleutica*)	Suspected	Moist gravelly sites along creeks. Range limited to coastal Southeast and south-central Alaska and the Aleutian islands.

Source: Anderson 2004.

intensity varied among activity areas, depending on the likelihood for habitat in a particular area to support sensitive plant species. Areas with the greatest potential of supporting sensitive species (e.g., beach meadows, wet areas, streamside habitats) received the most scrutiny. In such areas, the botanist conducted a complete examination of specific areas of the project after walking through the project area. Surveys in areas with a lower likelihood of supporting sensitive species (e.g., open forest, forest edge) consisted of a single walk-through of the project area.

No sensitive plants were found within areas likely to be affected by project activities. Daily plant survey forms, completed according to protocol for the Alaska Region, are in the file for this project and at the Juneau Ranger District, along with detailed maps showing survey routes.

3.7.2 Effects of the Proposed Action

The proposed project would have no effect on ESA-listed species and most Forest Service-listed sensitive animals. The rationale given for this finding includes the following:

1. The project area does not provide suitable habitat for chinook salmon, sockeye salmon, steelhead, Fish Creek chum salmon, Island king salmon, northern pike, Peale's peregrine falcon, or Kittlitz's murrelet.
2. The project activities will occur primarily on land. Effects to the marine environment would be limited to installing mooring buoys and laying power cable on the bottom of Chatham Strait or across Kootznahoo Inlet. These developments would not occur in critical habitat or interfere with the species use of the area. The nearest Steller sea lion rookery is approximately 120 miles from the project area, and the nearest haulout is approximately 18 miles away.
3. All applicable Forest Plan standards and guidelines relating to soil, water, wildlife, and other resources will be implemented.
4. No developments will occur within 0.5 mile of wetlands used by nesting, brood-rearing, or wintering trumpeter swans. The nearest wintering area is approximately 9 miles east of the project area.
5. No overhead wires will be placed in areas that may interfere with the flight paths of swans.
6. No osprey nests occur in the project area. If any active nests are found before or during implementation of the project, activities that would likely disturb nesting osprey will be prohibited within a minimum 330-foot radius of the nest.
7. The nearest known Queen Charlotte goshawk nest site is 5 to 10 miles from the proposed project area.
8. Goshawks habitat exists in the project area and nesting or foraging may be disturbed by project activities. Surveys to determine the presence of nesting goshawks will be completed in the project area before construction activities begin. If any active nests are found, no continuous disturbance likely to result in nest abandonment would be permitted within 600 feet of the nest tree between March 15 and August 15.

The proposed project would not adversely affect sensitive plants. This determination was based on the following:

1. A qualified botanist conducted thorough surveys at the proper time of year and found no sensitive plants.
2. Plants native to the area and originating near the project area would be used for any re-vegetation or restoration work.

3. If any previously undiscovered sensitive plants are encountered at any time prior to or during implementation of this project, the population would be protected and any disturbance in the area containing the population (and similar habitats in that vicinity) would be avoided.
4. If any previously undiscovered sensitive plants are encountered at any time prior to or during implementation of the project, the district or forest botanist/ecologist would be notified immediately to evaluate the population and recommend avoidance or mitigation measures.

3.7.3 Comparison of Effects between the Alternatives

None of the alternatives would adversely affect any threatened, endangered, or sensitive plant or animal species. Implementation of Alternatives 2 or 2a would result in an elevated risk of disturbance to sensitive animals or damage to undetected populations of sensitive plants.

3.7.4 Unavoidable Adverse Impacts

Elevated levels of human activity associated with construction and maintenance of the hydroelectric facility and related project components may disturb species that are sensitive to human presence, such as Queen Charlotte goshawk and osprey. Clearing of vegetation for the transmission cable, access roads, and construction staging areas would reduce the availability of potential nesting and foraging habitat for Queen Charlotte goshawks. Clearing that occurs near the shoreline may reduce the availability of potential nesting, feeding, and perching trees for osprey. These habitat changes may affect individuals but would not cause a trend toward listing.

3.8 VISUAL RESOURCES

Visual resources analysis evaluates the likely perception of change to the project area's scenery. Potential changes to scenery are evaluated from Visual Priority Travel Routes and Use Areas identified in the Forest Plan. The effects of proposed project elements are discussed from the point of view of viewers looking toward the project area from those locations. Changes that viewers might perceive are based on potential modifications to the color, texture, reflectivity, shape, and other visual characteristics of the landscape and proposed project elements.

Potential changes to the scenery are also discussed from the perspective of viewers seeing the landscape in the foreground, middleground or background. These distance categories recognize that the perception of detail in the visual environment is much lower when a landscape is viewed from a distance than from nearby. Many types of changes that would be noticed by a viewer close to a modified landscape would not be perceived as a modification when viewed from farther away.

3.8.1 Affected Environment

This section describes the existing visual character of the scenery in the project area. The discussion emphasizes the areas that are visible from the Visual Priority Routes and Use Areas as identified in the Forest Plan. Portions of the project area not visible from designated Visual Priority Travel Routes and Use Areas are also discussed, although in less detail.

The project area is located in the Admiralty-Chichagof visual character type and displays many of the characteristic features of the type. Rugged, rocky shorelines are adjacent to forested hillsides with relatively little variation in vegetation. Beyond, in the far background behind the site, alpine features of Admiralty Island are sometimes visible. The flatter areas of the project area include chains of small lakes. Although it is not in the project area, nearby Thayer Lake is one of the landmarks of this visual character area.

Visual Priority Travel Routes and Use Areas near the project area are cruise ship and small boat routes in Chatham Strait. In general, topography and vegetation screen the views to many of the proposed project elements from Visual Priority Travel Routes and Use Areas. Portions of the project area that may be visible from Visual Priority Travel Routes and Use Areas include the proposed landing area and a segment of the transmission facility that is located on the hillside between the shoreline area and the top of the prominent ridge. The power generation and transmission facilities along Thayer Creek would be visible to occasional backcountry travelers. Similarly, a long section of the transmission corridor between Thayer Creek and Angoon would be screened from Visual Priority Travel Routes and Use Areas because they will be located behind a prominent ridgeline and would not be visible from Chatham Strait.

The visual resources analysis is based on two low-level overflights of the project area, general familiarity with the landscape character of the surrounding region, and discussions with local USFS staff. No site visits were made to the Thayer Creek portion of the project. Views to the site from boating routes in Chatham Strait were approximated by low-level floatplane flight.

The following subsections describe the visual character of the project area in more detail, describing the project area as a series of landscape units, shown in Figure 3-4. A landscape unit is defined as an area characterized by consistent patterns of topography, aspect, vegetation, and visibility from Visual Priority Travel Routes and Use Areas. While the area within an individual landscape unit is not uniform, it is similar enough that proposed project actions would be expected to have a similar effect throughout the unit.

3.8.1.1 Thayer Creek Landscape Unit

This landscape unit includes the reach of Thayer Creek from the location of the proposed diversion dam to the creek mouth. The landscape unit is generally a steep-sided creek channel with a narrow band of riparian forest adjacent to the creek and upland forest on the valley walls. In this landscape unit the riparian forest extends approximately one hundred feet from the stream, and riparian vegetation is generally more visually diverse and lighter colored than the adjacent hillside coniferous forest. The extension of riparian vegetation to the shoreline provides visual cues to viewers seeing the stream mouth in the foreground or middle ground that this is a location where a stream enters the strait. The contrast between

Figure 3-3. Scenery Analysis Landscape Units for the Angoon Hydroelectric Project Area

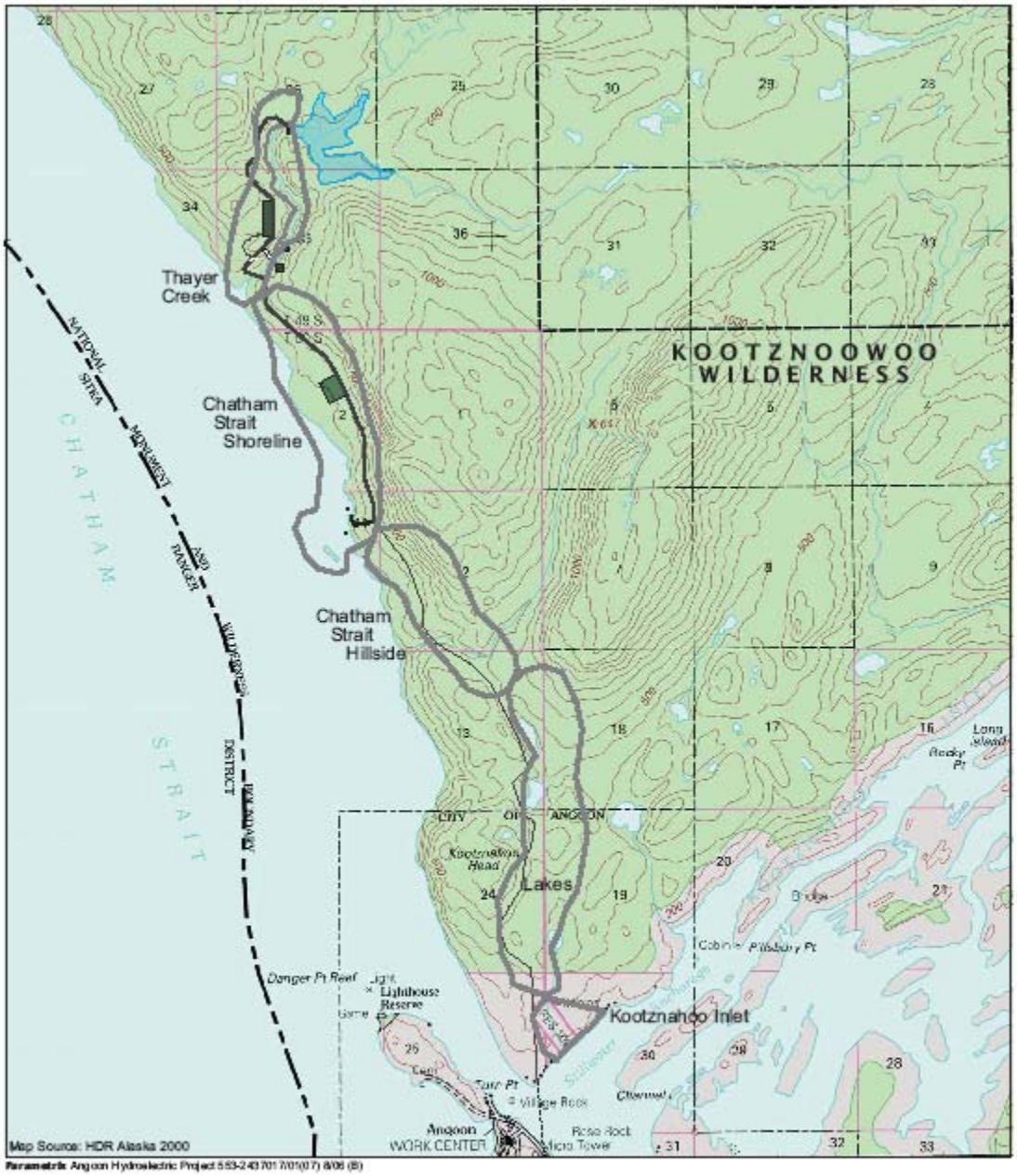


Figure 3-4
Scenery Analysis Landscape Units for the Angoon Hydroelectric Project Area

riparian vegetation and the nearby shoreline vegetation are not significant enough to be visible in the background.

Except for the creek mouth, this landscape unit is generally not visible from designated Visual Priority and Use Areas.

3.8.1.2 Chatham Strait Shoreline Landscape Unit

This landscape unit includes the area from the mouth of Thayer Creek to the proposed barge landing site. In this landscape unit steep forested hillsides rise behind a narrow forested plateau along the shoreline, with a very narrow fringe of rocky beach. The scenic character of the landscape at the shoreline is dominated by the horizontal banding of shoreline elements where the water meets the shore. The area at the water's edge and in the intertidal zone is unvegetated except for various seaweeds clinging to the rocky shore. This band is generally dark in color, with the regularly wetted rocks and intertidal vegetation blending into a dark gray-brown color. Horizontal bands of lighter-colored barnacles are visible to viewers near the shore. Immediately above the intertidal zone, the shrub understory is visible, blocking views into the trunks of the adjacent coniferous forest. The understory shrubs generally have a brighter green color than the adjacent conifers. Conifers growing near the shoreline are smaller than those growing further inland; light green lichen is a striking visual feature.

The horizontal banding of the shoreline scenery is prominent when viewed from the foreground or middle ground. Within each band, the color and texture of the scenery is generally uniform along the shoreline, with breaks in the pattern occurring only where there is an underlying landscape change, for example at a creek mouth or a large rock outcrop.

Directly inland from the shoreline vegetation, there is a relatively flat bench before the ground begins to rise to a prominent ridge. The vegetation on the bench is uniform coniferous forest, most of which is screened from view by the shoreline trees. The tops of trees on the bench are visible because of their height relative to shoreline vegetation, however. Further inland from the bench area, trees on the hillside rising to the ridge are visible from the Visual Priority Travel Routes and Use Areas. The character of this hillside forest is described in detail below (Section 3.8.1.3, Chatham Strait Hillside Landscape Unit).

The proposed barge landing site is a rocky outcrop extending into Chatham Strait. Depending on the tide, it could be perceived by viewers as a small island, although it is connected to the shoreline by a narrow, unvegetated strip of land. The portion of the outcrop furthest from the shore is large enough to support shoreline conifers. This section is oriented at a right angle to the portion of the outcrop connecting to shore; the area behind it is screened from most viewpoints in Chatham Strait by the vegetated section of the outcrop.

Portions of this landscape unit are prominently visible from designated Visual Priority Travel Routes and Use Areas. The shoreline area (including the proposed landing site) and the hillside inland of the bench area are important elements of the view to this area. The bench area is generally screened from view, and modifications in this part of the landscape unit would either not be visible or would show only a minor change from their current character from the Visual Priority Travel Routes and Use Areas.

3.8.1.3 Chatham Strait Hillside Landscape Unit

This landscape unit includes the area from the proposed barge landing site to the ridgeline above Chatham Strait. The hillside in this landscape unit rises gently for approximately 0.25 mile before steepening into a series of forested cliff bands. Above the cliffs, the slope eases to the ridgeline, a little over 0.5 mile from the shore. Slopes below the cliff average approximately 25 percent, with scattered benches and steeper areas. Vegetation in this landscape unit is uniform even-aged coniferous forest, with trees approximately 75 to 100 feet tall.

The texture of the hillside is generally fine and uniform. Color is gray-green typical of coniferous forest in Southeast Alaska – a combination of the underlying color of the conifers and lichen. The existing condition is a good representation of the typical visual character of the characteristic landscape, as would be used to evaluate consistency with scenery goals and objectives. Currently, no evidence of disturbance – either natural or as a result of management actions – is easily discernible by a casual viewer.

This landscape unit is prominently visible from designated Visual Priority Travel Routes and Use Areas.

3.8.1.4 Lakes Landscape Unit

This landscape unit begins on the far side of a ridgeline from Chatham Strait and continues to a ridgeline that then drops to Kootznahoo Inlet. This unit is more topographically and botanically diverse than the shoreline landscape units, including gently rolling hills and valleys and a few small lakes. The area is completely screened from Visual Priority Travel Routes and Use Areas by the prominent ridgeline separating this landscape unit from Chatham Strait. The landscape unit is also screened from the community of Angoon and boaters in Kootznahoo Inlet by topography and vegetation.

The scenery of this landscape unit is characterized by a matrix of uniform coniferous forest surrounding small complexes of lake and wetland vegetation. The coniferous forest is darker green than the shoreline forest, showing less of the lichen color that dominates the shoreline forest. There is a strong contrast between the forested matrix and the lake/wetland vegetation areas, which are lighter in color, more diverse in texture, and more likely to have seasonal variations in appearance because of the dominance of deciduous plants. There is also a prominent difference in scale between the forested and lake/wetland vegetation, which is generally less than one-quarter of the height of the surrounding forest.

The perception of this landscape depends strongly on the location of the viewer. Larger landscape patterns are likely seen only from the air because of the limited vantage points for seeing this unit from the ground. The relatively few visitors who view this landscape from the ground are likely to be limited to shorter views, either from within the forest or from one of the small lakes. Viewers on a boat or floatplane on one of the lakes may see a small portion of the landscape unit at any time because the forest directly adjacent to the lakes and associated wetlands effectively screens the relatively flat adjacent topography.

This landscape unit is not visible from designated Visual Priority Travel Routes and Use Areas.

3.8.1.5 Kootznahoo Inlet Landscape Unit

This landscape unit includes a hillside dropping towards Kootznahoo Inlet and the shoreline of the inlet. This unit is located outside of the National Forest, in the community of Angoon. This landscape unit is characterized by a gently sloping hillside extending to the shoreline. It is more topographically varied than the hillside rising from Chatham Strait described earlier, with some benches, rolls, and broken terrain, but without prominent cliff bands. Vegetation is generally uniform coniferous forest, with some diversity of texture and form resulting from the varying topography. The shoreline is characterized by a broader intertidal zone than the Chatham Strait shore, with some grassy flats before the beginning of the coniferous forest. There is also some scattered development along the shoreline in this landscape unit, including piers and shoreline facilities. The opposite shoreline is heavily developed with piers and structures supporting the community of Angoon, creating a fairly complex visual landscape for small boats and floatplanes on the inlet.

This landscape unit is not visible from designated Visual Priority Travel Routes and Use Areas. It is visible from the community of Angoon's waterfront area. Because it is not located in the National Forest, it is not subject to Forest Plan standards and guidelines for scenery.

3.8.2 Effects on Visual Resources

Under either action alternative, most of the proposed project would not be visible from Visual Priority Travel Routes and Use Areas. The effects of each proposed element are described in more detail below. Under both action alternatives the proposed power production facilities and associated transmission areas along Thayer Creek would be screened from view by topography and vegetation. Under Alternative 2 most of the transmission corridor from Thayer Creek to Kootznahoo Inlet would also not be visible. A portion of the transmission corridor near the top of the ridge may be visible. Under Alternative 2a the underwater transmission corridor would not be visible, although some project elements on the shoreline would be visible where the cable makes the transition from overland to underwater.

Under both action alternatives some elements of the project would be visible from the Visual Priority Travel Routes and Use Areas, modifying the scenery and having an effect on viewers' experience of the landscape. Changes to the visual environment would occur in two ways. First, clearing forest vegetation would change visual patterns in the landscape. The second type of change would be the addition of built elements to the landscape that contrast with the surrounding natural environment. Because the landscape surrounding the proposed project area is designated Wilderness, the contrast between the proposed facility and the adjacent forest would be greater than in other settings where more human modifications to the scenery are present.

For projects on National Forests, standards and guidelines for acceptable levels of change to scenery are adopted in the Forest Plan. The allowable standard for this project is "modification." Under this standard, management activities that may be visually prominent in the landscape are allowed, but they must use the form, line, color, texture, and/or scale of that landscape in the design of the activity where possible. The degree of the effects of the

project are evaluated from different viewing distances (foreground, middle ground, and background), and also their duration. For example, exposed road cuts may be visually prominent when first constructed, but become less so over time as vegetation matures and the road cut blends into the surrounding landscape.

3.8.3 Effects of Project Components

3.8.3.1 Port Facilities and Temporary Barge Landing

Under both action alternatives port facilities and a temporary barge landing would be constructed at a prominent rock outcrop in the Chatham Strait Shoreline landscape unit. The proposed port facilities would be permanent, while the barge landing site would be restored as closely as possible to original conditions following the completion of the project. Because of their location it is not possible to completely buffer the port facilities with vegetation. Modifications to this rocky point would be visible in the foreground and middleground from small boat routes in Chatham Strait. It may be possible to locate the port facilities between the outcrop and the shoreline, where they would be screened by the bulk of the outcrop from most viewing directions. All port and barge landing facilities, including any buoys, ramps, and access roads, would contrast with the undeveloped character of the wilderness coastline.

The frequency and intensity of use for the port facility are hard to anticipate at this time, and it is unclear whether ongoing access needs would create the need for permanent modifications to the coastline or vegetation. The permanent modifications for the port facilities would likely be small-scale, and would not be prominent from Visual Priority Travel Routes and Use Areas. They would mostly be visible to small boats, including human-powered craft, which follow the shoreline closely. Assuming that (1) all barge landing facilities would be temporary, (2) development impact would be limited, and (3) restoration would be included in the project, then effects of the barge landing on scenic resources would be temporary.

All permanent and temporary port and barge facilities proposed under the action alternatives would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

3.8.3.2 Diversion Dam and Intake

The diversion dam and intake would not be visible from any Visual Priority Travel Routes and Use Areas. These facilities may be seen by recreational users of Thayer Creek. Currently, the operators of the lodge on Thayer Lake offer trips down Thayer Creek to Chatham Strait as one of their recreational activities. It is uncertain whether this activity would continue following completion of the hydroelectric project.

The diversion dam and intake would largely be located within the stream channel. As such, they would likely be wet for most of the time, giving them a dark color. These project components would be relatively small. Any accessory structures or above-water components of these elements should be designed to minimize their contrast with the surrounding landscape, including the choice of materials, paint color, and final location. The diversion dam and intake facilities proposed under the action alternatives would meet or exceed the

modification visual quality objective as described in the standards and guidelines from all viewing distances.

3.8.3.3 Pipeline, Surge Tank, and Penstock

The proposed pipeline, surge tank, and penstock would not be visible from designated Visual Priority Travel Routes and Use Areas. The only likely viewers of these facilities would be guests from the lodge on Thayer Lake, mentioned above. For these viewers, the pipeline, surge tank, and penstock would likely contrast with the surrounding landscape in line and form. The pipeline would be a long, large scale horizontal element unlike naturally occurring forest landscape elements. Depending on the final location of the pipeline, it may be effectively screened by understory plants. The surge tank and penstock would also be large, geometric structures, but would probably be partially screened by topography.

All of these project elements should be designed to minimize contrast with the surrounding landscape. Where possible, the pipeline should be located where it would be screened from Thayer Creek by topography and vegetation. These project elements described under the action alternatives would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

3.8.3.4 Powerhouse and Switch Yard

The effects of the powerhouse and switch yard would be similar to those of the surge tank and penstock described above. These large features would not be visible from Visual Priority Travel Routes and Use Areas and would not likely be viewed except by occasional travelers along Thayer Creek. The powerhouse would be a large structure, described as 68 feet long by 30 feet wide by 25 feet high. Construction period impacts for the building could include tree clearing and grading. Typical clearing limits for a project of this type extend twenty feet or more from the edge of grading to allow access for construction equipment and workers. If no grading is required for the structure, the clearing area would be about 70 feet by 90 feet, or approximately 0.15 acre. The switching yard would similarly require clearing and maintenance of a cleared area.

If possible, these project elements should be located where they can not be viewed from Thayer Creek. Materials, colors, and shapes for the structures would be selected to minimize contrast with the surrounding landscape. Clearing for construction would be minimized, and cleared areas restored with appropriate native vegetation.

These project elements described under the action alternatives would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

3.8.3.5 Access Roads and Transmission Cables

Access roads would provide service access to each of the facilities included in the proposed action. Under Alternative 2, access roads and transmission cables would extend from the power generation site to Kootznahoo Inlet. Under Alternative 2a access roads and transmission lines extend from the power generation site to the port facilities.

The visual impact of roads would depend greatly on the relationship of the road to topography and the viewer. Where forested landscapes are relatively level or gently rolling,

roads are not prominent visual features. Where the terrain is steeper, roads and their associated clearing can be much more prominent.

In forested areas, transmission line structures generally repeat the dominant vertical lines of the surrounding coniferous trees. The electrical lines themselves are not similar to other lines and shapes in the forest, and often have different reflective qualities, making them more visually prominent from foreground and middleground views. In the background, power poles and transmission lines are generally less prominent than their associated cleared areas. Clearing associated with power lines would create effects similar to those of proposed access roads. The visibility and effects of the access roads and transmission lines would vary in the different landscape units, and are discussed below.

Thayer Creek Landscape Unit

Effects in this landscape unit would be identical under Alternatives 2 and 2a. Access roads and transmission lines in this area would not be visible from Visual Priority Travel Routes and Use Areas. Because of topography and vegetation, they would also be screened from occasional visitors who might view them in the middleground or background. Where possible these features should be located where they are not visible from Thayer Creek. These project elements described under the action alternatives would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

Chatham Strait Shoreline Landscape Unit

Effects in this landscape unit would similar under Alternatives 2 and 2a, except at the proposed barge landing location. The location of the road and transmission line in this landscape unit should maintain a landscape buffer of minimum 100’ width from the shoreline. Assuming an appropriate buffer is maintained, the project elements in this landscape unit will not be visible from Visual Priority Travel Routes and Use Areas except at the proposed barge landing location, discussed above. Under Alternative 2 a short section of road may be visible in the foreground to boats near the shore. The power transmission line, however, would be further inland and would be buffered by existing vegetation. Under Alternative 2a, the powerline would extend to the shoreline at the barge landing location, and a structure at the shoreline would be required to make the transition from above-ground to underwater transmission cable. This structure would likely be visible in the foreground and middleground to small boats in Chatham Strait.

Under both alternatives, buffers should be maintained wherever possible between the road and transmission facilities and the shoreline of Chatham Strait. For Alternative 2a, the required shoreline structure should be designed to be as small as possible and blend with the surrounding landscape as much as possible, including in the choice of color, material, and shape.

These project elements described under the action alternatives would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

Chatham Strait Hillside Landscape Unit

Alternative 2a would not include any actions in this landscape unit, and views of the landscape would not change from their present condition.

Under Alternative 2 power poles may be visible in the middleground from some viewpoints within Visual Priority Travel Routes and Use Areas, but would generally be screened by vegetation and likely would not be distinguishable from surrounding forest. The alignment of the power line and road in this landscape unit should not be developed as a straight line up the hillside. The design of the transmission line in this landscape unit should include minor bends or jogs in the alignment to reduce visual impacts. Development of the transmission line as a straight corridor would create views from Chatham Strait to the ground surface, which should be avoided if possible.

Alternative 2a would have no effects in this landscape unit. With appropriate design Alternative 2 would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

Lakes Landscape Units

Alternative 2a would not include any actions in this landscape unit, and would have no effects.

Proposed elements included under Alternative 2 for this landscape unit would not be visible from Visual Priority Travel Routes and Use Areas. Two lakes in this landscape unit are adjacent to the proposed transmission line route. Lakes are visited for recreation or subsistence uses more frequently than the surrounding forest, and would be more likely to serve as viewing locations for the project elements. Where possible, the transmission lines should maintain a minimum 200 foot buffer from the lakes in this unit.

Alternative 2 would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

Kootznahoo Inlet Landscape Units

Alternative 2a would not include any actions in this landscape unit, and would have no effects.

Under Alternative 2, parts of the transmission corridor would be visible from Kootznahoo Inlet and parts of the community of Angoon. The rolling topography and mature vegetation on the hillside would likely screen portions of the transmission line and reduce its visual prominence. Also under this alternative, a structure would be located near the shoreline on the north side of Kootznahoo Inlet to make the transition from aboveground to submarine transmission line. This structure should be designed to blend with the surrounding landscape as much as possible. The shoreline in this area already has some developed structures, however, so the contrast between the power facility and the surrounding landscape will not be as great as for the location of the corresponding transition structure that would be built under Alternative 2a.

3.8.3.6 Staging Areas and Construction Camp

Staging areas and construction camp locations would be buffered from view by vegetation, and would likely only be visible to occasional recreational visitors. Assuming that these areas are restored following the completion of construction, visual effects would be minor and temporary under both action alternatives. The proposed actions would meet or exceed the modification visual quality objective as described in the standards and guidelines from all viewing distances.

3.8.3.7 Rock and Borrow Sites

Rock and borrow sites would likely be needed for the construction of the access road. Locations for these facilities have not been identified in the proposed action. In general, these facilities would not likely be visible from Visual Priority Travel Routes and Use Areas unless they are developed in the Chatham Straits Hillside Landscape Unit. The TUS land use designation includes guidelines for the siting, design, and restoration of rock and borrow sites.

3.8.4 Comparison of Effects of the Alternatives

Under the No Action alternative the forest would continue to develop under a natural regime of succession and disturbance. Some natural disturbances reduce the perceived visual quality of a landscape; however, the visual character of the landscape as an outcome of unimpaired natural processes is a desired characteristic of wilderness.

Many elements of the two action alternatives would not be visible from Visual Priority Travel Routes and Use Areas. Except for the common facilities located on the shoreline of Chatham Strait, the project elements related to the power generation facilities would be screened by topography and vegetation. Similarly, either alternative would have the opportunity to reduce visual impacts to viewers on or adjacent to Thayer Creek by appropriate siting and design of project elements. Thayer Creek is not a Visual Priority Travel Routes and Use Area.

Both alternatives would meet the standards and guidelines for visual resources for the TUS land use designation as described in the Forest Plan.

Alternative 2 would result in much more extensive modification to the landscape than Alternative 2a due to the required clearing for the transmission line and access road between the barge landing site and Kootznahoo Inlet. However, most of the transmission corridor would be screened from viewpoints along Visual Priority Travel Routes and Use Areas.

Alternative 2 would also carry a higher risk of additional visual impact due to the possible difficulty of constructing the transmission corridor and access road through the Chatham Strait Hillside landscape unit. Steep and broken terrain in this area could require larger than expected cut and fill slopes, along with associated clearing. If this occurs near the top of the slope it would be visible from Chatham Strait.

Alternative 2a would include less modification to the underlying landscape than Alternative 2 and would have correspondingly less visual impact. Alternative 2a would require 4.3 fewer miles of transmission lines and associated clearing through the most visible portions of the

project area than Alternative 2. This alternative would also avoid modification to the landscape in the Chatham Straits Hillside and Kootznahoo Inlet landscape units that would be visible from small boats. Although views from aircraft are specifically excluded from consideration as Visual Priority Travel Routes and Use Areas, there is a relatively high volume of floatplane traffic that views the project area, including regularly scheduled flights between Juneau and Angoon. The reduced length of transmission corridor and access road in Alternative 2a would also reduce the impact of the project for viewers in airplanes, where transmission facilities can not be screened effectively.

Alternative 2a would include a shoreline structure along Chatham Strait near the port facility that would be visible from nearby boats; this structure would not be included in Alternative 2.

3.8.5 Unavoidable Adverse Impacts

The project area is designated Wilderness, and currently does not include any visible signs of modification from the natural landscape. Viewers would perceive any visible modification to the project area that does not look like a natural disturbance or landscape pattern as an adverse effect. Although both action alternatives would meet the standards and guidelines for the Transportation and Utilities Systems (TUS) land use designation, they both include elements that would be visible and contrast with the surrounding landscape.

As recognized by the standards and guidelines for the TUS land use designation, major infrastructure projects generally contrast with the surrounding forestland, often leading to impacts on the scenery for sensitive viewers. Visitors to the project area who have an expectation of viewing wilderness would likely perceive the changes to the landscape negatively.

3.9 CULTURAL RESOURCES

36 CFR Part 800 regulations, which implement the National Historic Preservation Act (NHPA), as amended, require federal agencies to take into account the effects of their undertakings on historic properties, in consultation with other interested parties. Historic properties include any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (National Register). The information in this section was drawn from the archaeological survey report prepared for this project, which is on file at the Admiralty Island National Monument office.

3.9.1 Affected Environment

The following subsections describe the cultural prehistory and history of the project area, as well as the process by which area cultural resources were investigated and evaluated. Section 106 is the portion of the NHPA that requires federal agencies to consider the effects of their undertakings on historic resources. To complete the Section 106 review, agency staff conduct heritage resource surveys to identify any cultural resources or areas of traditional use within a project area that might be impacted by a proposed activity. Before beginning on-the-ground

archaeological surveys, cultural resource specialists review what is known about the prehistoric and historic use in the project area and evaluate any sites for significance. Avoidance of sites or protection of significant sites is considered prior to project implementation.

Information sources for the background review and literature search within the project area included selected works of Frederica de Laguna, Madonna Moss, Charles Mobley, and others working in the vicinity of Angoon and on Admiralty Island. These reports, books and articles document ongoing inventories and archaeological surveys relating to archaeological sites, in addition to ethnographic and historic overviews for the area. In addition, the Forest Service consulted the Angoon Community Association, Kootznoowoo, Inc., Central Council of Tlingit and Haida Indian Tribes, Sealaska Corporation, and the City of Angoon in July 2004 regarding potential cultural resource concerns associated with the proposed project.

The Forest Service archaeologist completed field reviews in 2004 and 2005 having surveyed approximately 65 acres of area identified as having a high sensitivity for the presence of cultural material. Project areas that fall within the high-sensitivity zone include the port facilities, portions of the road, the powerhouse location, and segments of the access roads that are in the vicinity of the powerhouse. The temporary barge landing and garage location, as well as the location where the submarine cable will transition from an overhead to a submarine cable, also within the high-sensitivity zone. These areas are below 100 feet in elevation, in the vicinity of an anadromous fish stream or coastline, or in the vicinity of a reported or documented archaeological site or site associated with an oral history.

The survey team identified six newly recorded sites, representing both prehistoric and historic use of the project area and continuous use of the landscape over time. Cultural resource specialists evaluated the sites for eligibility for inclusion on the National Register and to assess the effects of the proposed undertaking.

No historic lode or placer mining occurred within the area of potential effect. Field investigators identified and investigated one karst landform within the project area. This was a sinkhole approximately 130 feet in diameter and 30 feet deep. At its western edge, a karst limestone cave was located approximately 25 feet long and 6 feet high at its entrance. The cave floor was dry with a small stream percolating into gravel at its north end. No sign of human use was noted at the time of investigation, and no potential leads were identified.

3.9.1.1 Cultural Overview

The project area is in the traditional territory of the Angoon Tlingit, the *Xutsnoowú kwáan*, who occupied the shores of Chatham Straits on Admiralty Island from Point Marsden southward as far as Chapin Bay and on Chichagof and Baranof Island from Basket Bay to Gut Bay (Goldschmidt and Haas 1998). The Angoon Tlingit include the following clans:

Eagle/Wolf	Raven
Wooshkeetaan	Deisheetaan
Teikweidi	Aanxaakhittaan
Daklaweidi	

3.9.1.2 Historic and Prehistoric Sites in the Project Area

Review of literature and archival materials identified three previously documented sites in the vicinity of the project area. These are Turn Point Village, Thayer Creek Village, and Stillwater Garden Site. All three sites are outside the area of potential effect; therefore, Forest Service cultural resource specialists did not evaluate these sites for eligibility for inclusion on the National Register. All three sites are potentially eligible for inclusion, however, under Criterion D, based on their potential to yield information important to prehistory.

During field investigations in 2004 and 2005, field investigators identified six newly recorded sites and evaluated them for inclusion on the National Register. One site, Thayer Creek Cabin Remains, was determined not eligible because it did not meet any of the criteria for significance identified in 36 CFR 60.4. The other five sites are eligible for inclusion on the National Register. Three of the five sites, Stillwater Depressions, Stillwater Anchorage Collapsed Structure, and Rusty Traps Historic Site, were determined significant under Criterion D, for their potential to yield information important in prehistory or history. The other two sites, West Stillwater Anchorage Historic Cabin and Brightman SUA Residence, were determined significant under Criterion A, for their association with events that have made a significant contribution to the broad patterns of history.

3.9.2 Effects of Project Components

The three previously documented sites in the vicinity of the project area are spatially separated from the project footprint and would not be impacted by the proposed project. Turn Point Village is southwest of the project area, Thayer Creek Village is on the north side of the mouth of Thayer Creek, and Stillwater Garden Site is east of a small stream that borders the project area to the east.

Specialists assessed the potential for the proposed Angoon Hydroelectric Project to affect the five historic and prehistoric sites in the project area that are eligible for inclusion on the National Register. The project will be designed to avoid all known sites that are eligible for inclusion on the National Register. This would require integrating the design and engineering specifications with the archaeologist during all phases of project planning and during initial project implementation. Additional stipulations include the following:

- In the event that damage to the resource cannot be avoided, a plan to mitigate damage to the resource would be developed in consultation with other interested parties and the SHPO. A Memorandum of Agreement would be signed and carried out before project work proceeds.
- An archaeological monitor should be present during initial project implementation at the south end of the overhead transmission cable and associated road construction, as well as the area designated for the submarine cable interface with the overhead transmission cable.
- If during the course of the project implementation historic properties or any cultural material is noted, work would cease and the archaeologist and the Admiralty National Monument Ranger would be contacted immediately. If Native American remains

were encountered on lands within the project area, the Forest would follow Native American Graves Protection and Repatriation Act regulations set forth in 43 CFR 10.

The locations of the overhead transmission cable and substation at the southern terminus of the powerline have not been precisely located on the ground. The field investigations were designed to cover the approximate area identified as the vicinity of the project footprint. If the project footprint changes or its location shifts significantly to the east or west, additional archaeological survey will need to be completed to assess the effects of the project on historic properties. Avoidance of all the sites could be accomplished through coordination with archaeologists at the time of layout of the southern terminus of the overhead transmission cable. Such coordination would result in a determination of "no historic properties affected" for the proposed project (Table 3-9).

Table 3-8. Historic and Prehistoric Sites in the Angoon Hydroelectric Project Area, Determinations of Eligibility, and Determinations of Effect

Site Name	Site Type	NRHP Eligibility	Criterion[1/]	Potential Project Effects
Turn Point	Village	Not Evaluated	N/A	Outside area of potential effect
Thayer Creek	Village	Not Evaluated	N/A	Outside area of potential effect
Stillwater Garden	Garden	Not Evaluated	N/A	Outside area of potential effect
Thayer Creek Cabin Logs	Historic camp	Not Eligible	N/A	N/A
Stillwater Depressions	Prehistoric village	Eligible	D	No historic properties affected
Stillwater Anchorage Collapsed Structure and Shed	Historic cabin	Eligible	D	No historic properties affected
Rusty Traps Historic Site	Historic cabin	Eligible	D	No historic properties affected
West Stillwater Anchorage Cabin	Historic cabin	Eligible	A	No historic properties affected
Brightman Special Use Residence	Historic cabin	Eligible	A	No historic properties affected

Source: Gilliam et al. 2005

[1/] Criteria for inclusion on National Register of Historic Places, per 36 CFR 60.4: A - association with events that have made a significant contribution to the broad patterns of history; D - potential to yield information important to prehistory or history; N/A – Not Applicable..

3.9.3 Comparison of the Alternatives

None of the alternatives would be expected to impact any historic properties. Implementation of the Alternatives 2 and 2a would result in an elevated risk of impacts to undetected sites.

3.9.4 Unavoidable Adverse Impacts

Any ground-disturbing activity carries the risk of damage to buried or otherwise hidden historic properties. The mitigation measures that would be implemented as part of the

Alternatives 2 and 2a, including the presence of archaeological monitors and the development of plans to mitigate damage, would be expected to minimize the potential for negative effects.

3.10 SUBSISTENCE

This section discusses the subsistence resources of the Angoon Hydroelectric Project area, as well as the potential effects associated with the alternatives. Information in this section was drawn from the subsistence resource report for this project, which in turn was based on the detailed subsistence information and analyses in the Forest Plan FEIS (USDA Forest Service 1997b).

Subsistence is a broad term that applies to the use of many natural resources by rural Alaskans. ANILCA Section 810 requires that the Federal agencies with jurisdiction over public lands in Alaska analyze subsistence resources and uses and evaluate potential effects of management activities on these resources and uses. The analysis typically focuses on food-related resources that are most likely to be affected by habitat loss or alterations associated with land management activities. The analysis addresses three factors related to subsistence uses: (1) resource distribution and abundance, (2) access to resources, and (3) competition for the use of resources. The evaluation determines whether subsistence uses within the project area or portions thereof may be significantly restricted, as defined by the Alaska Land Use Council, by any of the proposed alternatives.

3.10.1 Affected Environment

The following paragraphs summarize the subsistence resources of the project area and characterize the subsistence use of the area by local residents. Additional information about the community of Angoon is presented in Section 3.11 (Socioeconomics). Section 3.4 describes fisheries resources in greater detail, and wildlife resources unrelated to subsistence are addressed in Sections 3.6 (Wildlife) and 3.7 (Threatened, Endangered, and Sensitive Species).

3.10.1.1 Subsistence Use of the Project Area

Subsistence hunting, fishing, and gathering activities are important to the residents of Angoon. In 1987, the per capita household subsistence harvest in Angoon was 242 edible pounds. More than 99 percent of Angoon's households harvested subsistence resources. Based on harvest data, deer are the most important subsistence resource for Angoon households, representing 30 percent of edible pounds harvested. Salmon species, primarily coho, Chinook, and sockeye, represent 29 percent of edible pounds harvested. Other species that are gathered from local waters include halibut, herring roe on kelp, Dungeness crab, clams, cockles, and chitons.

Angoon hunters travel an average of 13 miles to their most reliable deer hunting areas (USDA Forest Service 1997b). In a survey of local area hunters, George and Kookesh (1983) found that Angoon residents range throughout the western shore of Admiralty Island, from Hawk Inlet (42 miles from Angoon) to the north to Point Gardner in the south (32 miles from

Angoon). Angoon residents also cross Chatham Strait to hunt the eastern shores of Chichagof and Baranof Islands, but prefer to hunt Admiralty Island. Of nine sites identified as preferred hunting areas, the nearest to the project area was Parker Point, approximately 3 miles north of the Thayer Creek outlet (George and Kookesh 1983).

3.10.1.2 Subsistence Resources in the Project Area

ADF&G biologists conducted pellet count surveys in the Thayer Creek area in 1987, 1989, 1994, and 1998. Despite a slight downward trend, data from these surveys indicate healthy deer populations, particularly in comparison with other areas in Southeast Alaska (Rickards 2005c).

3.10.2 Effects of Project Components

The following subsections describe the effects on Sitka black-tailed deer that would be expected to result from project implementation. Effects on fisheries resources are described in Section 3.4. The proposed Angoon Hydroelectric Project would not be expected to significantly restrict any other subsistence uses within the project area.

3.10.2.1 Road and Transmission cable Corridors

Approximately 40 percent of the proposed transmission cable corridor would be constructed adjacent to the 1,000-foot beach fringe buffer. This would entail the removal of old-growth forest, converting it to shrub habitats of willow, alder, huckleberry, and forbs. The transmission cable corridor would be approximately 40 feet wide, however, tree removal would increase the likelihood of windthrow along the corridor. Loss of trees to windthrow would increase the effective width of any clearings.

The conversion of forested habitats to shrub habitats would reduce the capability of the affected area to support deer during winter (Hanley et al. 1989). Overstory removal would reduce snow interception; the resulting increased snow depths in cleared areas would hinder access to food resources. Increased snow depths would also affect deer movements between primary and extended winter range. These effects would be most notable in heavy snow years, resulting in an increase of energy expenditures for foraging deer. Lastly, overstory removal would reduce the thermal protection provided by forest stands. Despite the local effects to the transmission cable and road corridor, the deer population would be expected to remain stable because the area of the corridor is small relative to the project area.

3.10.2.2 Pipeline

Placement of a 42-inch diameter pipeline on the ground between the diversion dam and the power plant could create a barrier to deer movements in the project area. Based on information provided by ADF&G, however, an adult deer could be expected to leap a 42-inch barrier (personal communication, Matt Kirchoff, ADF&G, with Larry Rickards, USDA Forest Service, 2005). It is uncertain whether such a structure would pose a barrier to fawns. The pipeline would lay parallel to Thayer Creek on the slope break above the riparian area. It would not be an obstruction between the beach fringe and alpine areas. However, it may create a barrier between the uplands and riparian area.

3.10.3 Comparison of Effects of the Alternatives

Under the No Action alternative, deer habitat capability would not be reduced nor would there be any impediments to deer movement through project area. Effects on deer habitat would be the same in Alternative 2 and Alternative 2a in the Thayer Creek watershed. the transmission cable and road corridor in Alternative 2a is about 4 miles shorter than the transmission cable and road corridor in Alternative 2. Therefore, Alternative 2a would impede deer movements between primary and extended winter range less than Alternative 2.

3.10.4 Unavoidable Adverse Impacts

Impeding deer movement by the development of the transmission cable and road, and laying the pipeline is an unavoidable impact on Sitka black-tail deer. While individual deer, especially fawns, may be unable to negotiate the obstacles, the deer population overall would be able to circumvent them and maintain normal movement patterns.

3.11 WILDERNESS

The following paragraphs discuss the Wilderness character of the area surrounding the Angoon Hydroelectric Project area, and the potential effects associated with the alternatives. Congress through ANILCA exempted the project area from requirements of the Wilderness Act (ANILCA 506 (a)(3)(D)). This analysis focuses on the effects this project may have on wilderness resources outside of T.49S. R.67E. and T.50S. R.67E. Copper River Base and Meridian. The information in this section was drawn from the Wilderness resource report prepared for this project, which is on file at the Admiralty Island National Monument office.

3.11.1 Affected Environment

The proposed project is largely located within the Kootznoowoo Wilderness. A portion of the proposed access road and powerline route is on lands owned by Kootznoowoo, Inc., bordering Stillwater. The Wilderness Act of 1964 defines the primary conditions of Wilderness. The Forest Service uses four qualities to judge changes in Wilderness character over time, described below.

1. **Untrammeled**, or unhindered and free from modern human control, including places where natural forces operate without man's management and manipulation.

   No management actions taken in the project area have manipulated the vegetation, soils or watershed function. No animal species have been introduced to this project area, although red squirrels have established themselves throughout Admiralty Island from an introduction approximately 60 years ago. There is no management presence at Thayer Creek or along the proposed road corridor to Angoon, in contrast to the regular presence of rangers in Mitchell Bay. No permits are required to visit the project area. There are no designated campsites required for recreational camping, nor any Forest Closure Orders limiting access to forest lands.

2. **Natural**, where ecological systems are substantially free from the effects of modern civilization.

   No roads or trails have been constructed in the project area. Timber harvest has taken place in the past, but has been limited to hand logging of single trees or possibly of small stands. Botanical surveys have found five species of exotic plants along shorelines. Populations of fish and wildlife appear to be unaffected by habitat alteration, invasive species, or other human activities.

3. **Undeveloped**, or without permanent improvements or modern human occupation.

   Thayer Creek flows unimpeded from its source at Thayer Lake to its outlet at Chatham Strait. The stream meanders slowly through several miles of riparian habitat before descending precipitously through a narrow gorge just above the mouth. There is another small section of meander near the mouth on a relatively level bench bordering Chatham Strait. There are no human structures or facilities along the length of Thayer Creek, nor along the proposed road corridor linking the creek to Angoon. One undeveloped campsite is located on the bank of the creek near the mouth, but it contains little evidence of temporary human use. Other current evidence of human use includes three white metal cross memorials on the peninsula approximately 1.8 miles south of Thayer Creek. There are no current cabins or tent platforms under Forest Service SUA, and no known trespass structures.

4. **Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation**, this is the one quality that defines the human experience in Wilderness. It also includes the values of inspiration or of physical and mental challenge as defined in FSM 2320.3, Wilderness Management.

   The project area borders Chatham Strait and is a few miles from the community of Angoon. People use the area for subsistence deer hunting and fishing, largely along the shoreline. Recreational fishing, boating, and picnicking also occur along the shore, especially near the mouth of Thayer Creek. Industrial, recreational, and community boat traffic in Chatham Strait reduce opportunities for solitude along the shore. Opportunities for solitude farther inland are much higher because there is little on-shore use during most of the year. The Forest Plan designates most of the shoreline of west Admiralty Island, including the project area, in the “Primitive” class of the Recreation Opportunity Spectrum. The management standards for this class include encounters with two or fewer other groups per day and no other groups seen from campsites. Although access by water and aircraft is allowed under ANILCA exceptions to the Wilderness Act, use ashore involves walking and hiking off trail. There are no noticeable signs or interpretive facilities, nor any management presence.

Despite the proximity to the community of Angoon and history of subsistence use, the project area has a high degree of natural and undeveloped conditions, and it contains outstanding opportunities for solitude or primitive and unconfined experiences. The Wilderness character is very high, as is typical for most of the Kootznoowoo Wilderness.

3.11.2 Effects of Project Components

3.11.2.1 Project Construction

Under the Alternatives 2 and 2a, vegetation clearing and ground-disturbing activities would diminish the untrammeled quality of the project area. Such activities would include construction of the intake channel, pipeline and penstock corridor, powerhouse, port facilities, transmission cables, staging areas, and access roads. Natural qualities would similarly be diminished by the introduction of roads into the area, and by potential adverse effects on fish and wildlife habitat (see Sections 3.4 Fisheries, 3.5 Vegetation and Wetlands, and 3.6 Wildlife). The undeveloped quality of the project area would also be reduced by the construction of human structures such as the diversion dam, powerhouse, and port facilities. Opportunities for solitude would be dramatically reduced during project construction, as construction crews would be present in the project area on a daily basis for about 2 years.

3.11.2.2 Operation

Although some impacts associated with construction of the hydroelectric facility would be temporary, most structures and cleared areas would be permanent. As such, the presence of these project components would represent a permanent reduction in the untrammeled, natural, and undeveloped qualities of the project area. In addition, maintenance crews and vehicles would be required to pay frequent visits to the project area to ensure smooth operation of equipment and maintain cleared areas. Such visits would contribute to an ongoing reduction in opportunities for solitude.

3.11.3 Comparison of Effects of the Alternatives

Under the No Action alternative, no reduction in the Wilderness character of the project area would be expected. Signs of human activity (including vegetation management, structures or facilities, and interpretive signs) would remain scarce.

Implementation of Alternative 2 would result in the reduction in Wilderness qualities in the project area as described above. As noted in Chapter 1, ANILCA Section 506(a)(3)(D) specifically excludes the provisions of the 1964 Wilderness Act on Kootznoowoo's right to develop hydropower. Following construction, the intrusion of the developments on the Wilderness beyond the project area would be limited to noise associated with power generation and occasional vehicle travel associated with maintaining transmission cables, power plant, or dam. How far this noise travels would depend on weather conditions and terrain.

Alternative 2a would have the same effects as Alternative 2, except they wouldn't be as extensive since the transmission cable to Angoon would be submerged in Chatham Strait. Thus, modification of Wilderness attributes would be confined to the lower end of the Thayer Creek watershed and the area between the power plant and port facility. More area would be left as Wilderness under Alternative 2a than under Alternative 2.

It is unlikely the development of the project facilities and noise associated with them would negatively affect the untrammeled, natural, and undeveloped characteristics of the Kootznoowoo Wilderness beyond the townships authorized under ANILCA. Outstanding

opportunities for solitude would remain in the rest of the Kootznoowoo Wilderness beyond the project boundaries.

3.11.4 Unavoidable Adverse Impacts

The untrammeled, natural, and undeveloped characteristics of the project area, and outstanding opportunities for solitude would be lost in the project area. The dam on Thayer Creek would regulate stream flow on the lower end of the Creek. The design of the project facilities would reduce the visual effects but their presence would degrade the wilderness value of the project area. Noise generated by project facilities, and periodic maintenance of the facilities would continue through the life of the project.

Construction workers in the project area would limit the 'Outstanding Opportunities for Solitude' in the project area for two years while the facilities are being constructed. Following construction, people would be more frequent visitors to the area to perform the periodic maintenance and repair.

3.12 SOCIAL ECONOMICS

3.12.1 Affected Environment

3.12.1.1 Population

According to the latest population estimate available from the U.S. Census Bureau, the population in the city of Angoon was 487 people in 2004, down from 573 people in 2000, and 638 people in 1990 (U.S. Census Bureau 1990, 2000, 2004). This downward population trend is likely due to lack of high-paying jobs in Angoon (USDA Forest Service 2002b). More than 80 percent of the population is American Indian/Alaskan Native (U.S. Census 2000).

3.12.1.2 Economy

Commercial fishing is a major source of income in Angoon, and 59 residents hold commercial fishing permits (Welcome to Alaska 2006). A shellfish farm venture was recently funded by state and federal grants. The largest employer in Angoon is the Chatham School District. Logging on Prince of Wales Island provides occasional jobs. Subsistence remains an important part of the lifestyle. The most important resources are deer, salmon, bear, halibut, shellfish, geese, and berries. In a 2001 survey, Angoon residents ranked subsistence use 10 out of 10 in terms of importance to the community (USDA Forest Service 2002b).

The unemployment rate in 1999 was 12.95 percent, although 50 percent of all adults were not in the work force (Welcome to Alaska 2006). Per capita income in Angoon in 1999 was $11,357 and median household income was $29,861 (U.S. Census 2000). Almost 30 percent of the population (160 people), was living under the poverty level in 1999. According to the Mitchell Bay Landscape Assessment, Angoon shows potential signs of economic distress (USDA Forest Service 2002b).

A Cold Storage Fish Buying Station was recently constructed in Angoon. The community of Angoon identified this project, as well as the hydroelectric project and others listed below, during a 2001 town meeting on economic development (USDA Forest Service 2001):

- Health Clinic
- Hydroelectric Project
- Landfill Restoration
- Cold Storage Fish Buying Station
- Flood Protection
- Boat Launch Ramp
- Museum Renovation
- Multipurpose Community Service Building
- Airport
- Road to Hood Bay
- Bottled Water Facility

3.12.1.3 Public Services and Utilities

The one school in Angoon is attended by 125 students (Welcome to Alaska 2006). The Angoon Health Clinic provides health services, and Angoon EMS/Ambulance provides auxiliary health care.

Angoon has piped drinking water system, and more than 95 percent of the homes in the community have complete plumbing (Welcome to Alaska 2006). A secondary treatment plant processes sewage, which flows to an ocean outfall. The City collects refuse and hauls it to a landfill located approximately 2 miles from Angoon. Electricity is provided by Tlingit-Haida Regional Electrical Authority, which operates three diesel-fueled generators in Angoon. Electricity prices in Angoon are considered high and are expected to continue to increase due to the climbing cost of diesel.

Angoon is accessible only by float plane or boat (Welcome to Angoon 2006). Scheduled and charter float plane services are available from the state-owned seaplane base on Kootznahoo Inlet. Angoon has a deep draft dock, a small boat harbor, and state ferry terminal. The Alaska Marine Highway provides regular ferry service to Angoon. Freight arrives by barge and ferry. Streets in Angoon are graveled and narrow.

3.12.1.4 Community Cohesion

Translated from Tlingit, Angoon means "Town on the Portage" and is the only permanent community on Admiralty Island (Kootznoowoo 2006). Tlingít culture places a strong emphasis on family and kinship. Angoon is divided up into clans, and the predominant clan in Angoon is the Bear Clan (USDA Forest Service 2006). Within each clan are various houses. In Tlingít villages like Angoon, clan houses remain an important part of daily life, and are used to host meetings and celebrations. Angoon's strong indigenous heritage is evident in the painted fronts of the 16 clan houses (Welcome to Alaska 2006). In addition to the clan houses, Angoon has modern houses, school buildings, a general store, a lodge, and a bed and breakfast. There are no restaurants.

According to the U.S. Census, there were 228 housing units in Angoon in 2000 (U.S. Census 2000). Thirty-three of these units were vacant, and of these vacant housing units, 22 were used for seasonal, recreational, or occasional use. Of the occupied housing, 123 were owner-occupied and 72 were renter occupied.

Western culture has greatly influenced Angoon, and there is a concern about the loss of the Tlingít language and way of life (USDA Forest Service 2002b). Due to increasing contact with the western world, community leaders are looking for ways to maintain the Tlingít cultural identity. Angoon is a dry community; it is illegal to possess alcohol anywhere within the village limits.

3.12.1.5 Recreation

Tourists use the area for sport fishing and camping (USDA Forest Service 2002b). Three outfitters are authorized on National Forest in the area. Other outfitters work on private lands. In 1978, most of Admiralty Island was designated a National Monument.

3.12.2 Effects of Project Components

3.12.2.1 Construction

Additional employment and income may be created while the project is being constructed. Construction of the project may take 1 to 2 years, but an exact timeframe is not currently known. Residents and tourists of the area may see construction activities, but these activities would be short term. Short-term construction activities are not expected to adversely affect population levels, the economy, public services, utilities, community cohesion, or recreation.

3.12.2.2 Operation

Energy prices in Angoon are currently high and climbing. The project would help reduce the cost of electricity (HDR 2000).

An indirect effect of Alternatives 2 and 2a would be that some of the economic development projects identified by the community of Angoon would be more economically feasible, particularly those with high electricity demands, such as the bottled water facility. These economic development projects would in turn create jobs for the community and keep the population from declining further. During an Economic Initiatives town meeting in 2001, the community of Angoon identified the hydroelectric project as one of the top 11 priority economic development projects (USDA Forest Service 2002b).

Employment related to electricity production would not change from current levels.

3.12.3 Comparison of Effects of the Alternatives

Under the No Action alternative, electricity prices would continue to increase, potentially leading to further population decline. However, the No Action alternative would avoid visual, hydrological, fishery, and wildlife effects of the project facilities.

Alternatives 2 and 2a would provide more reliable and lower priced electricity to the community of Angoon, which may help to support its economy.

3.12.4 Unavoidable Adverse Impacts

The proposed project would not have any unavoidable adverse impacts on social economics in Angoon.

3.13 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

An irreversible commitment of resources refers to the loss of production or use of a resource due to a land use decision, that once execute, cannot be changed. An irretrievable commitment of resources applies to losses of production or use o renewable resources for a period of time.

Minor amounts of soil loss and displacement would result from any of the alternatives. Overall, there would be some soil loss due to erosion, and a slight increase in sediment production with any of the action alternatives. Road construction in Alternatives 2 and 2a would cause the greatest concentration of soil displacement and sediment movement. BMPs would be adequate to keep impacts within acceptable limits set forth in the Forest Plan.

Soil loss from roads would be irreversible.

Wilderness and scenic values in the project area, fish habitat in the bypass section of Thayer Creek, and some wildlife habitat would be irretrievable during the life of the hydroelectric facilities. If the project is abandoned, these uses would be restored though possibly not to the current level.

3.14 CUMULATIVE EFFECTS

This project is located in the Admiralty Island National Monument and Kootznoowoo Wilderness. Activities are limited to the project area. There are no known past, present, or reasonably foreseeable projects that would add to the impacts of this project. Therefore, no cumulative effects on any of the resources addressed above would occur under any alternative.

3.14.1 Cumulative Effects

The development of hydroelectric power in combination with other recent efforts to provide economic stability to Angoon, such as the Cold Storage Fish Buying Station and tourism-related businesses, would cumulatively benefit the economy of Angoon.

4. Lists

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