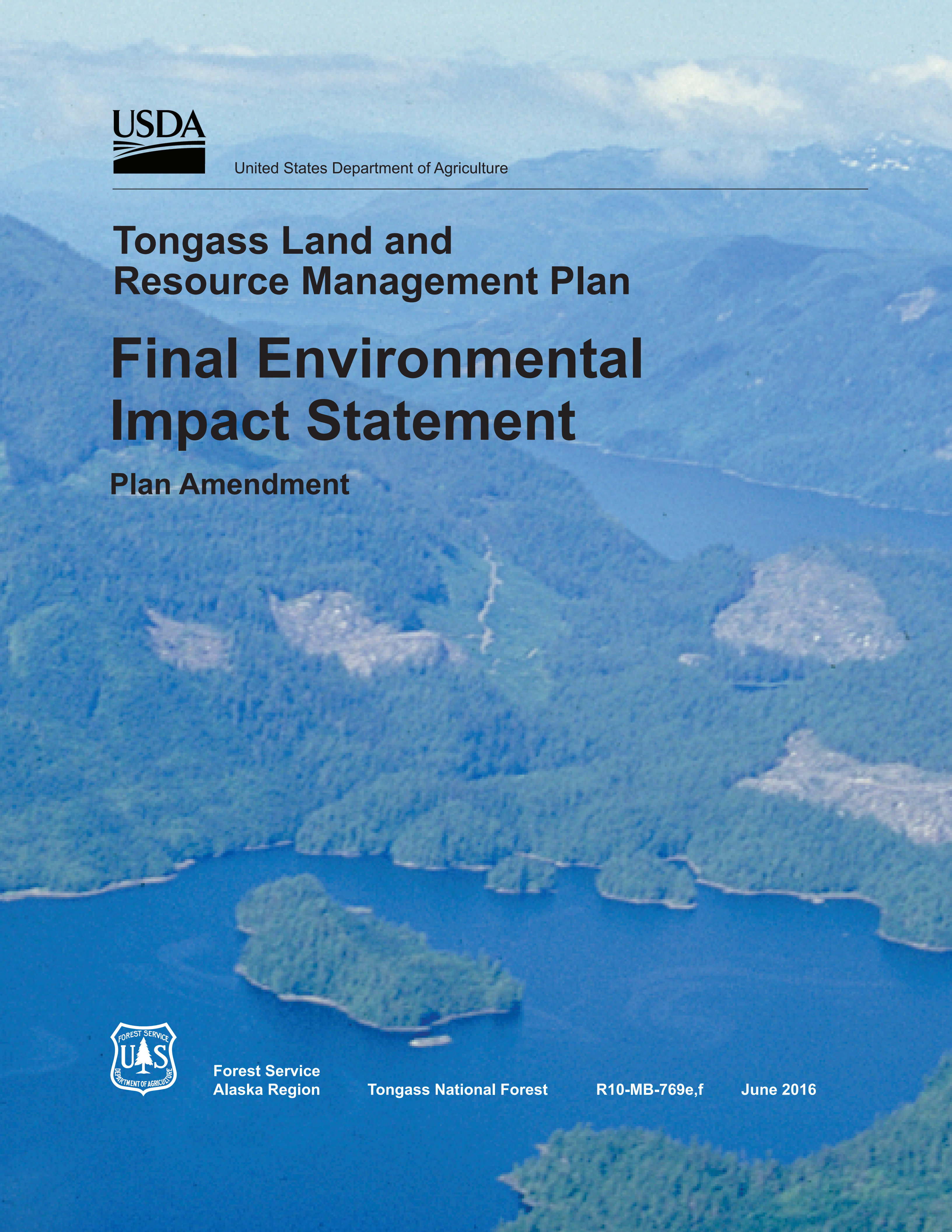


USDA

United States Department of Agriculture

Tongass Land and Resource Management Plan

Final Environmental Impact Statement

Plan Amendment

Forest Service
Alaska Region

Tongass National Forest

R10-MB-769e,f

June 2016

Tongass Land and Resource Management Plan Amendment

Final Environmental Impact Statement

June 2016

Lead Agency:	USDA Forest Service
Cooperating Agency:	US Fish and Wildlife Service
Responsible Official:	M. Earl Stewart, Forest Supervisor USDA Forest Service, Alaska Region, Tongass National Forest
For Further Information:	Visit the Forest Web site at: www.fs.fed.us/r10/tongass or Contact: Susan Howle Project Team Leader 648 Mission Street Ketchikan, AK 99901 (907) 228-6340

Abstract

Secretary's Memorandum 1044-009, Addressing Sustainable Forestry in Southeast Alaska (issued July 2, 2013), and the 5-Year Forest Plan Review (completed in September 2013) indicated that conditions on the land and demands of the public require the Tongass to modify the 2008 Forest Plan. In the Memorandum, the Secretary of Agriculture, Thomas Vilsack, asked the Forest Service to "Strongly consider whether to pursue an amendment to the Tongass Forest Plan. Such an amendment would evaluate which lands will be available for timber harvest, especially young growth timber stands, which lands should be excluded, and additional opportunities to promote and speed transition to young growth management..." and to "…continue to seek input from and work with stakeholders in the region towards this transition." The Tongass Advisory Committee (TAC) was established under the Federal Advisory Committee Act and was approved by the Secretary to "…provide advice to the Forest Service on how to expedite the transition to young growth management." The 5-Year Forest Plan Review also highlighted a need to make the development of renewable energy resources more permissible.

This Final Environmental Impact Statement (FEIS) responds to the Secretary's Memo and the 5-Year Forest Plan Review by analyzing five alternatives for amending the Plan, including the No-Action alternative. A separate document, called the Land and Resource Management Plan (Forest Plan), has been published with this FEIS to represent the Forest Plan under the preferred alternative (Alternative 5). Alternative 5 is based on the Tongass Advisory Committee's underlying principles, general approach, and recommendations. Appendix F displays a side-by-side comparison of the alternatives to show how they differ from the preferred alternative. Four key issues are identified: 1) transitioning to young-growth-based timber management in 10 to 15 years in an ecologically, socially, and economically sustainable manner; 2) promoting the development of renewable energy projects where it is compatible with National Forest purposes; 3) the effects of potential timber harvest activities in roadless areas; and 4) the effects of forest management on wildlife habitat and the Conservation Strategy. The five alternatives provide a range of options for addressing the issues. Direct, indirect, and cumulative effects of the alternatives are compared and disclosed in Chapters 2 and 3, based on inventory data and modeling.

Federal Recycling Program
Printed on Recycled Paper

CONTENTS

Contents

Contents

Contents

Contents

LIST OF TABLES

Contents

Contents

Contents

Contents

Contents

LIST OF FIGURES

Contents

ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ABC Islands	Admiralty, Baranof, and Chicagof Islands
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ADEC	Alaska Department of Environmental Conservation
ADED	Alaska Department of Economic Development
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation & Public Facilities
AEA	Alaska Energy Authority
AEL&P	Alaska Electric Light & Power
AF	Alluvial Fan
AFHA	Anadromous Fisheries Habitat Assessment
AKEPIC	Alaska Exotic Plants Information Clearinghouse
Alaska DCRA	Alaska Department of Community and Regional Affairs
AMHS	Alaska Marine Highway System
AMS	Analysis of the Management Situation
ANCSA	Alaska Native Claims Settlement Act of 1971
ANHP	Alaska Natural Heritage Program
ANILCA	Alaska National Interest Lands Conservation Act of 1980
AP&T	Alaska Power & Telephone
APLIC	Avian Power Line Interaction Committee
ASQ	allowable sale quantity
ATM	access and travel management
AVSP	Alaska Visitor Statistics Program
BBER	Bureau of Business and Economic Research
BCR	Bird Conservation Region
BE	biological evaluation
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	Best Management Practice
BP	before present
°C	degrees Celsius
CA	Census Area
CDP	Census Designated Places
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMAI	culmination of mean annual increment
CO	carbon monoxide
Corps	U.S. Army Corps of Engineers
CUA	Community Use Area
DBH	diameter at breast height
DCCED	Department of Commerce, Community, and Economic Development
DEIS	Draft Environmental Impact Statement

DEM	Digital Elevation Model
DOL	Department of Labor
DPS	distinct population segment
EA	environmental assessment
EFH	essential fish habitat
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act
ESA	Endangered Species Act
ESI	Existing Scenic Integrity
ESU	Evolutionarily Significant Unit
°F	degrees Fahrenheit
FACA	Federal Advisory Committee Act
FCRPA	Federal Cave Resources Protection Act
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FEIS	Final Enviromental Impact Statement
FIA FHM	Forest Inventory and Analysis-Forest Health Monitoring
FLPMA	Federal Land Policy and Management Act
FORPlan	Previous Forest Planning Model
Forest Plan	Tongass National Forest Land and Resource Management Plan
FP	Flood Plain
FPA	Federal Power Act
FRESH	Forest Resource Evaluation System for Habitat
FR	Federal Register
FRPL	free and reduced-price lunch
FSM	Forest Service Manual
FY	fiscal year
GCRP	(U.S.) Global Change Research Program
GIS	geographic information system
GMU	Game Management Unit
GSA	General Services Administration
HC	High Gradient Contained
HCA	Habitat Conservation Area
HSI	Habitat Suitability Index
IDT	Interdisciplinary Team
IFA	Inter-Island Ferry Authority
IPCC	Intergovernmental Panel on Climate Change
IPEC	Inside Passage Electric Cooperative
IRA	Inventoried Roadless Area
IRP	Integrated Resource Plan
km	kilometer
kW	kilowatt
kWh	kilowatt hour
LiDAR	Light Detection and Ranging

Contents

LSTA	Logging System and Transportation Analysis
LTF	log transfer facility
LTSP	Long-Term Soil Productivity
LTSY	long-term sustained yield
LUD	Land Use Designation
LWD	large woody debris
MAP	mean annual precipitation
MBTA	Migratory Bird Treaty Act
MBF	thousand board feet
MIS	Management Indicator Species
MM	Moderate Gradient Mixed Control
MMBF	million board feet
MMI	Mass Movement Index
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MVUM	Motor Vehicle Use Map
MW	megawatt
MWh	megawatt hour
NAAQS	National Ambient Air Quality Standards
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act of 1976
NFS	National Forest System
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	notice of availability
NOI	Notice of Intent
NPS	National Park Service
NRDC	Natural Resources Defense Council
NRIS	Natural Resource Information System
NSLP	National School Lunch Program
NTU	nephelometric turbidity unit
NVCS	National Vegetation Classification Standard
NVUM	National Visitor Use Monitoring
NWI	National Wetland Inventory
OGR	old-growth reserve
OHV	off-highway vehicle
P	Primitive
PCE	Power Cost Equalization
PDO	Pacific Decadal Oscillation
PEIS	Programmatic Environmental Imapct Statement
PM_{10}	particulate matter with a diameter of less than 10 microns in size
$PM_{2.5}$	particulate matter with a diameter of less than 2.5 microns in size
PNW	Pacific Northwest
POG	productive old growth

ppm	parts per million
PTSQ	projected timber sale quantity
PWSQ	projected wood sale quantity
R	Rural
RARE	Roadless Area Review and Evaluation
RAW	reasonable assurance of windfirmness
RM	Roaded Modified
RMA	Riparian Management Area
RN	Roaded Natural
RNA	Research Natural Area
Roadless Rule	Roadless Area Conservation Rule
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act - A Legacy for Users
SATP	Southeast Alaska Transportation Plan
SDEIS	Supplemental Draft Environmental Impact Statement
SDM	Size-Density Model
SEACC	Southeast Alaska Conservation Council
SEAPA	Southeast Alaska Power Agency
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SIO	Scenic Integrity Objective
SMS	Scenery Management System
SNAP	Scenarios Network for Alaska & Arctic Planning
SO_2	sulfer dioxide
SOC	Statement of Concern
SPM	Semi-Primitive Motorized
SPNM	Semi-Primitive Non-Motorized
SPTH	site potential tree height
SYL	sustained yield limit
T77	Tongass 77
TAC	Tongass Advisory Committee
TRUCS	Tongass Resource Use Cooperative Survey
TSC	Transportation Systems Corridor
TTRA	Tongass Timber Reform Act of 1990
TUS	Transportation and Utility System
TWYGS	Tongass-wide Young-Growth Studies
U	Urban
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VCU	Value Comparison Unit
VMS	Visual Management System
VPR	Visual Priority Route

WAA	Wildlife Analysis Area
WCF	Watershed Condition Framework
WRCC	Western Regional Climate Center

Executive Summary

Introduction

Forest land and resource management planning is a process for developing, amending, and revising land and resource management plans for each of the National Forests in the National Forest System (NFS). Forest plans are required by the National Forest Management Act of 1976 (NFMA) (16 United States Code [U.S.C.] parts 1600-1687). The 16.7-million-acre Tongass National Forest was the first forest to complete a Land and Resource Management Plan (Forest Plan) under the NFMA in 1979. That Forest Plan was amended in 1986 and 1991 and revised in 1997. A final Supplemental Environmental Impact Statement (SEIS) was completed in 2003, which further evaluated roadless areas for their wilderness potential. The Forest Plan was amended again in 2008 in response to a Ninth Circuit Court ruling and a 5-Year Plan Review completed in 2005. The revised Plan was amended 24 times between the 1997 revision and the 2008 amendment, primarily to adjust small old-growth habitat reserve boundaries and for electronic/communication site designations. Since the 2008 amendment, the plan has been amended to establish the Héen Latinee Experimental Forest, disestablish the Young Bay Experimental Forest, add communication sites to the list in Appendix E, modify small old-growth habitat reserves, and make minor corrections to the plan.

On July 2, 2013, Secretary of Agriculture, Thomas Vilsack, issued Memorandum 1044-009, *Addressing Sustainable Forestry in Southeast Alaska* (U.S. Department of Agriculture [USDA] 2013), which expressed the Secretary's intent to transition the Tongass National Forest to a young growth–based timber program in 10 to 15 years, more rapidly than considered in the 2008 Forest Plan. The Secretary asked that the Forest Service "[s]trongly consider whether to pursue an amendment to the Tongass Forest Plan. Such an amendment would evaluate which lands will be available for timber harvest, especially young growth timber stands, which lands should be excluded, and additional opportunities to promote and speed transition to young-growth management." Recognizing the importance of retaining expertise and infrastructure, the Secretary also stated that the Forest Service "will continue to offer a supply of old growth timber while increasing the supply of young growth to provide industry in Alaska the opportunity to develop new markets, learn new skills, and acquire new equipment." The Secretary also asked that a determination of whether to initiate an amendment be completed by September 30, 2013.

The Forest Service completed a Five-Year Review of the Forest Plan in September 2013. The results of the Five-Year Review and the Secretary's Memorandum led to the Tongass Forest Supervisor making a determination that "…conditions on the land and demands of the public require the Tongass to modify the 2008 Forest Plan" (USDA Forest Service 2013a). A Notice of Intent (NOI) to prepare an EIS was published in the Federal Register on May 27, 2014 (79 Federal Register [FR] 30074) initiating a 30-day scoping period. Among the comments from the Five-Year Review and from scoping were those that requested a transition to young-growth timber harvesting, ways to make renewable energy projects easier to implement, and a review of the 2001 Roadless Area Conservation Rule (Roadless Rule) inventoried roadless areas (IRAs). All comments were taken into consideration in identifying the scope of this Forest Plan amendment.

This Final Environmental Impact Statement (FEIS) is a programmatic analysis prepared by the Forest Service that describes and analyzes changes to the Forest Plan to accomplish the transition to young-growth management as provided in the Secretary's Memorandum. This FEIS evaluates which lands will be suitable for timber production, especially young-growth timber stands, and any changes or additions to management direction needed to promote and speed the transition to young-growth management while maintaining a viable timber industry in Southeast Alaska. This FEIS also describes and analyzes changes related to renewable energy development. The scope of the analysis is limited to these changes.

This FEIS analyzes in detail four action alternatives for amending the Plan, in addition to a No Action Alternative (Alternative 1). The analysis is published in two volumes. Volume 1 contains the FEIS, and Volume 2 contains the FEIS appendices. A complete Forest Plan Land Use Designation (LUD) map is provided for each of the alternatives in the Map Packet which accompanies the FEIS.

A separate document titled Tongass Land and Resource Management Plan (i.e., the Forest Plan) is published along with the FEIS and represents the selected alternative (Alternative 5). Chapter 2 and Appendix F in the FEIS describe how the other alternatives compare to Alternative 5. Instead of repeating all of the changes in management direction common to Alternatives 1-4 and Alternative 5, management direction of the alternatives is displayed in a side-by-side comparative format to demonstrate how and where direction differs from Alternative 5.

This FEIS describes and analyzes changes to the 2008 Forest Plan and tiers to and incorporates by reference the 1997 Tongass Land Management Plan Revision FEIS (1997 FEIS), the 2003 Final Supplemental EIS (SEIS) for Roadless Area Evaluation for Wilderness Recommendations (2003 FSEIS), and the 2008 Tongass Land and Resource Management Plan Amendment FEIS (2008 FEIS), and the 2008 Record of Decision (2008 ROD). Where appropriate, information in these documents that is relevant to analysis in this FEIS is cited and incorporated by reference.

Purpose and Need

The Forest Service determined that it is necessary to amend the 2008 Forest Plan. Amending the Forest Plan originates from the July 2013 memo from the Secretary of Agriculture directing the Tongass National Forest to transition its forest management program to be more ecologically, socially, and economically sustainable, while also being responsive to comments from the Five-Year Review of the Forest Plan. The purpose of this plan amendment is to:

- Review lands within the plan area to determine suitability for timber production, especially young-growth timber stands.
- Identify the projected timber sale quantity (PTSQ) and the sustained yield limit (i.e., the ecological yield of timber that can be removed annually on a sustained yield basis).

- Establish plan components (e.g., standards and guidelines) for young-growth forest management and renewable energy development to guide future project decision-making.
- Consolidate modifications made to the Forest Plan since its approval.

An amendment is necessary for responding to the July 2013 direction from USDA Secretary Tom Vilsack outlined in the Secretary's Memorandum 1044-009. The memorandum directs management of the Tongass National Forest to expedite the transition away from old-growth timber harvesting and towards a forest products industry that uses predominantly second-growth – or young-growth – forests. Secretary Vilsack's memorandum also directs that the transition must be implemented in a manner that preserves a viable timber industry that provides jobs and opportunities for Southeast Alaska residents. USDA's goal is to effectuate this transition, over the next 10 to 15 years, so that at the end of this period the vast majority of timber sold by the Tongass will be young growth. This timeframe will conserve old-growth forests while allowing the forest industry time to adapt. The 2008 Forest Plan provides for a transition to young growth over time, but there are challenges in establishing an economically viable young-growth forest management program due to the relatively young age of the available stands, market conditions, and other factors. Secretary Vilsack's direction requires Forest Plan amendments to guide future management of NFS lands and allocation of resources on the Tongass National Forest under the multiple-use and sustained yield mandate.

The need to amend the plan is further corroborated by the Five-Year Review of the Forest Plan, completed in 2013, which concluded that conditions on the land and demands of the public necessitate the Tongass National Forest to make changes to the Forest Plan. Concerns were consistently expressed during the Five-Year Review regarding the impact of rising fossil fuel prices and increasing climate change on the quality of life in Southeast Alaska. Changes to the Forest Plan are needed to make the development of renewable energy resources more permissible, including considering access and utility corridors to stimulate economic development in Southeast Alaska communities, and provide low-carbon energy alternatives, thereby displacing the use of fossil fuel.

Significant issues

The Forest Service used the scoping process to determine the scope of issues to be addressed and identify the significant issues related to a proposed action.

The Forest Service identified the following significant issues during scoping.

Issue 1 –Young Growth Transition

The Secretary of Agriculture asked the Forest Service to transition to a young-growth-based timber management program on the Tongass National Forest in 10 to 15 years, which is more rapid than planned. This transition is intended to support the Tongass managing its forest for an ecologically, socially, and economically sustainable forest management program and reduce old-growth harvest while still providing economic timber to support the local forest products industry.

The issue concerns financial efficiency, salability, and volume of future timber sales. It also relates to the potential local employment and revenues generated for communities in the local area. Young-growth stand growth rates, sustainable harvest rates, the amount of old-growth harvest needed during transition to sustain the timber industry, also known as "bridge timber," and the locations where young-growth harvest would take place are some of the factors to be considered.

Issue 2 – Renewable Energy

The development of renewable energy projects on the Tongass would help Southeast Alaska communities reduce fossil fuel dependence, stimulate economic development, and lower carbon emissions in the Region.

This issue relates to comments received during the Five-Year Review of the Forest Plan. The Forest Service should promote the development of renewable energy projects to help Southeast Alaska communities reduce fossil energy dependence, where it is compatible with National Forest purposes and to ensure that the planning, construction, and operation of projects protect and effectively use NFS lands and resources.

Issue 3 –Inventoried Roadless Areas

Timber harvest and road building that occurred in roadless areas before the 2001 Roadless Area Conservation Rule (Roadless Rule) was enacted and during the Tongass exemption period changed the values or features that often characterize inventoried roadless areas in some locations.

Issues and concerns received during scoping as well as during the Five-Year Review process expressed concerns about roadless areas on the Tongass; both in favor of protections afforded under the 2001 Roadless Rule as well as requesting that the forest plan be amended to address the significant changes brought about by its re-instatement on the Tongass.

Some people believe roadless areas on the Tongass should be allowed to evolve naturally through their own dynamic processes and should be afforded protection that ensures this will occur. Others believe that limiting road construction and reconstruction or other management actions in roadless areas might restrict the delivery of goods, services, and activities that these areas might otherwise provide.

Roadless areas are considered important because they support a diversity of aquatic and terrestrial habitats, species, and communities, and play an important role in helping to conserve native plant and animal communities and biological diversity. They also provide people with unique recreation opportunities.

During the Tongass exemption period and before the 2001 Roadless Rule was enacted, road construction, reconstruction, and the cutting, and sale of timber in some IRAs occurred. As a result, these activities in some IRAs may have altered the roadless characteristics.

Issue 4 – Wildlife Habitat and the Conservation Strategy

Old-growth timber harvest has changed the composition and spatial patterns of terrestrial wildlife habitats. How the resulting young-growth is managed may influence the future ecological integrity of the landscape at various scales. Changes made to suitable lands designated for development, and to plan components (e.g., standards and guidelines) may affect old-growth habitat for wildlife and the Tongass Old-growth Habitat Conservation Strategy and contributing elements to old-growth reserves (e.g., riparian, beach and estuary habitats).

The Tongass National Forest supports an important assemblage of wildlife many of which are associated with or at least partially dependent on old-growth forest including one of the largest populations of brown bears in the world, high densities of breeding bald eagles, the Alexander Archipelago wolf, species of high importance for subsistence (e.g., Sitka black-tailed deer), an extensive array of endemic mammals, and other species that are dependent on old-growth habitats (e.g., marten and goshawk). The Tongass Old-growth Habitat Conservation Strategy is considered important for the continued health of old-growth associated wildlife populations in Southeast Alaska.

Timber harvest, minerals and renewable energy development, and road development can have effects on the habitat and populations of many of these species and the diversity and integrity of Southeast Alaska ecosystems. Less than 10 percent of the productive old-growth habitat on the Tongass has been converted to young growth, the percentage is much higher for certain types of old growth, such as lowland and large-tree old growth. In addition, non-NFS old growth has generally been harvested at a much higher rate. Therefore, the consideration of harvest and road building on wildlife in Southeast Alaska are greater than the effects for the Tongass by itself.

Alternatives

Forest Plan

The current 2008 Forest Plan is associated with the No- Action alternative (Alternative 1). However, a number of changes to the Forest Plan text are being proposed. These changes are incorporated into a Forest Plan (Land and Resource Management Plan), which accompanies the EIS. The Forest Plan was developed based on the Preferred Alternative (Alternative 5).The individual alternative descriptions on the following pages identify the major changes in the Forest Plan.

Timber Demand

In past Forest Plan revisions and amendments, varying demand scenarios were used to develop alternatives, including scenarios that allowed for growth and expansion of the current industry. In this amendment, the purpose and need identifies the need to expedite the transition away from old-growth timber harvesting and towards a forest products industry that uses predominantly second-growth – or young-growth – forests. Therefore, examination of alternatives at levels above projected demand is not warranted because these would require expansion of old-growth harvest levels, at least during the next 10 to 15 years. However, over the longer term, expansion of the timber industry is an option as more and more young growth becomes economic to harvest.

Therefore, Alternatives 1 through 5 were designed to correspond with current demand projections and produce a projected timber sale quantity (PTSQ)[1] of about 46 MMBF per year during the next 15 years, with old growth making up a decreasing percentage of the total. Old-growth volume would continue to decrease until it reaches about 5 MMBF per year and it would remain at that level, to support limited small timber operators. As more young growth becomes economic to harvest, the PTSQ would be allowed to increase. In no case, would

[1] PTSQ is a new term defined in FSH 1909.12, Chapter 60. The term allowable sale quantity (ASQ) is not used with the 2012 planning rule.

the harvest level be allowed to exceed the sustained yield limit (SYL) (see Glossary and the *Timber* section of this EIS).

Even though Alternative 1 (no action) represents current management, it is modeled to follow the same volume production pattern. The July 2013 Secretary's memo identified a need to change direction in the 2008 Forest Plan (see Purpose and Need in Chapter 1) and without this amendment, the Tongass would be transitioning toward young-growth and away from old-growth harvest.

Provisions Common to all Alternatives

Under all alternatives, there is flexibility in terms of when young-growth stands may be harvested. Under Public Law 113-291, up to 15,000 acres of young growth may be harvested from 2016 through 2025, in stands less than 95 percent of CMAI. This CMAI flexibility may continue after 2025 (with annual maximums); however, the total acreage harvested at less than 95 percent of CMAI cannot exceed 50,000. In addition, young-growth sales under this provision may not be offered unless they represent non-deficit sales.[2] There is flexibility in NFMA to allow a continuation of harvesting at younger ages beyond 2025.

LUD Changes Common to the Action Alternatives

The LUD allocations for each alternative are described in the following alternative-specific descriptions. The LUDs for Alternative 1 (no action) are the same as the LUDs of the current Forest Plan. The LUDs of the action alternatives are different from Alternative 1 LUDs because of Old-growth Habitat LUD changes. Under Public Law 113-291, approximately 70,000 acres of NFS land were conveyed to Sealaska Corporation and an additional 152,000 acres were converted to LUD II. As a result of the land conveyance, old-growth reserves (OGRs) in 16 VCUs were affected. Beginning in February 2015, an interagency review team of biologists worked to develop a biologically preferred option for modifying these OGRs that meets Forest Plan Appendix K criteria and to document why other proposals are not recommended. In September 2015, the interagency review team produced a biologically preferred option (see Appendix E), which was incorporated into each of the action alternatives. Therefore, the Old-growth Habitat LUD acres vary between Alternative 1 and the action alternatives (Alternatives 2, 3, 4, and 5).

In addition, the Transportation and Utility Systems LUD would be removed under Alternatives 2, 3, 4, and 5. The LUD management prescription would be replaced by plan components under Alternatives 2, 3, 4, and 5 and would provide management direction for renewable energy and transportation systems corridors (see Chapter 5 in the proposed Forest Plan).

Alternative 1 (No Action)

The no action alternative represents current management direction (2008 Forest Plan) and includes the application of the Roadless Area Conservation Rule (2001 Roadless Rule) (36 CFR 294 Subpart B). As noted above, it also follows the direction provided in the July 2013 Secretary's memo, which identified a need to

[2]Any sale of trees pursuant to the authority granted under subparagraph (A) shall not—(iii) be advertised if the indicated rate is deficit (defined as the value of the timber is not sufficient to cover all logging and stumpage costs and provide a normal profit and risk allowance under the appraisal process of the Forest Service) when appraised using a residual value appraisal.

transition away from old-growth harvest. Under this alternative, timber harvest would follow the existing timber sale program adaptive management strategy (USDA Forest Service 2008c). A color map showing the phases in this strategy is provided along with the FEIS. Timber harvest is currently restricted to areas within Phase 1 of the strategy and timber harvest would have to reach 100 MMBF for two years before harvest could occur in Phase 2 areas. Timber management would be restricted to the development LUDs and would remain outside of inventoried roadless areas. No commercial harvest would be allowed in beach and estuary fringe or RMAs. All other 2008 Forest Plan management direction would be followed.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. However, beyond that, the minimum harvest age would return to 95 percent of CMAI except under exemptions provided by the NFMA.

Alternative 1 would result in the most old-growth harvest among the alternatives over both 25-year and 100-year periods. Table 2-2 summarizes the key elements of Alternative 1 and Table 2-3 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce about 8 MMBF of young growth and 38 MMBF of old growth per year during the first 10 years (Figure 2-1). From Year 10 through Year 25, it is projected to produce about 15 MMBF of young growth and 31 MMBF of old growth per year. At about Year 32, the young-growth harvest is expected to increase to about 41 MMBF and the old-growth harvest would decrease to 5 MMBF per year. The young-growth harvest is expected to continue to increase at a rapid rate after Year 32 and is expected to reach an upper limit of about 133 MMBF in about Year 38. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Alternative 2 (Proposed Action)

As in Alternative 1, this alternative would follow the existing timber sale program adaptive management strategy for old-growth harvest (USDA Forest Service 2008c) (see color map accompanying the FEIS); as a result, all old-growth harvest would come from Phase 1, at least during the first 15 years or so. After harvest volume exceeds 100 MMBF for two years, it is possible that limited old-growth harvest could occur in Phase 2 areas. Young-growth harvest could come from any phase of the strategy at any time. The portions of inventoried roadless areas (IRAs) that were roaded before the 2001 Roadless Rule and during the 2001 Roadless Rule exemption period for the Tongass would be available for young-growth and old-growth harvest. This would require rulemaking to modify 36 CFR 294.13(b)(4). If selected, no harvest could occur in IRAs until rulemaking is completed. No Roadless Area harvest outside of these roaded areas would be allowed.

Alternative 2 would differ substantially from Alternative 1 in terms of lands identified as suitable for young-growth timber production. Young-growth management would be allowed in both development and natural setting LUDs (except for Congressionally designated and administratively withdrawn areas, such as Wilderness, and islands less than 1,000 acres in size), in beach and estuary fringe, RMAs outside of Tongass Timber Reform Act (TTRA) buffers, and high-vulnerability karst.

Young-growth management may include clearcutting in all areas, except in RMAs and on high-vulnerability karst, where only commercial thinning (up to 33 percent basal area removal) would be allowed. After 15 years, clearcutting would no longer be allowed in the beach and estuary fringe and only commercial thinning would be allowed. In addition, in beach and estuary fringe, the intent is to maintain an approximate 1,000-ft wide protected corridor adjacent and inland of any even-aged harvest unit to function as an alternate, low elevation, natural habitat corridor.

Scenery standards for young-growth management would be relaxed. The SIOs would be designated as Very Low for all LUDs and distance zones.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. Scenery standards for renewable energy development would be relaxed to Very Low for all LUDs and distance zones.

Among the action alternatives, Alternative 2 would provide the largest amount of timber volume (old growth and young growth combined), including the largest amount of young-growth volume from lands suitable for timber production. It would result in the smallest amount of old growth timber volume over both 25-year and 100-year periods. Table 2-5 summarizes the key elements of Alternative 2 and Table 2-6 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1), emphasizing young growth and minimizing old growth. As such, it is expected to produce an average of about 22 MMBF of young growth and 24 MMBF of old growth per year during the first 10 years (Figure 2-3). From Years 11 through 15, Alternative 2 is projected to produce an average of 61 MMBF of young growth and 5 MMBF of old growth per year. Alternative 2 would likely reach a full transition harvest of 41 MMBF of young growth about Year 12. Young-growth harvest is expected to continue to increase at a rapid rate after Year 12 and is expected to reach an upper limit of about 120 MMBF in Year 17. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Alternative 3

Alternative 3 would allow old-growth harvest only in Phase 1 of the existing timber sale program adaptive management strategy (USDA Forest Service 2008c) (see color map accompanying this FEIS) but would allow young-growth harvest in all phases. This alternative would allow young-growth and old-growth harvest in 2001 Roadless Rule IRAs. If this alternative were selected, harvest in IRAs would be deferred until agency rulemaking modifies 36 CFR 294.13(b)(4) (2001).

Alternative 3 is similar to Alternative 2 in that it identifies lands as suitable for young-growth timber production in both development and natural setting LUDs (except for Congressionally designated areas such as Wilderness, administratively withdrawn areas, and islands less than 1,000 acres in size), as well as in beach and estuary fringe and high-vulnerability karst, but not in RMAs. Young-growth management may include clearcutting in all areas, except in beach and estuary fringe and on high-vulnerability karst, where only commercial thinning is allowed.

In addition, for young-growth harvest units larger than 20 acres in VCUs that have had concentrated past timber harvest, it is intended that 30 percent of the young growth stand acres should be left. This legacy provision would be described as a Management Approach in the Forest Plan.

Scenery standards for young growth management would be reduced by one level relative to the 2008 Forest Plan. SIOs would be reduced as follows: High would be reduced to Moderate, Moderate would be reduced to Low, and Low and Very Low would become Very Low.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. The SIO (scenery standard) for renewable energy development would Low for all LUDs and distance zones.

Alternative 3 would provide the second largest amount of timber volume (old growth and young growth combined). It would result in the second lowest harvest of old growth over both the 25-year and 100-year periods. Table 2-8 summarizes the key elements of Alternative 3 and Table 2-9 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce an average of about 20 MMBF of young growth and 26 MMBF of old growth per year during the first 10 years (Figure 2-5). From Year 11 through Year 15, it is projected to produce an average of 50 MMBF of young growth and about 5 MMBF of old growth per year. Alternative 3 would likely reach a full transition harvest of 41 MMBF of young growth at about Year 13. Young-growth harvest is expected to continue to increase at a rapid rate after Year 13 and is expected to reach an upper limit of about 117 MMBF in Year 17. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Alternative 4

Like Alternative 3, this alternative would allow old-growth harvest only in Phase 1 of the existing timber sale program adaptive management strategy (see color map accompanying this FEIS), but in contrast with Alternative 3, it would also limit young-growth harvest to only Phase 1. Similar to Alternative 1, this alternative includes the application of the 2001 Roadless Rule.

Alternative 4 would allow young-growth management only in the development LUDs. Harvest is allowed in beach and estuary fringe and on high-vulnerability karst, but only commercial thinning is allowed. No harvest is allowed in RMAs. Young growth management may include clearcutting in other areas.

In addition, for young-growth harvest units larger than 20 acres in VCUs that have had concentrated past timber harvest, it is intended that 30 percent of the young growth stand acres should be left. This legacy provision would be described as a Management Approach in the Forest Plan.

No change would occur in scenery standards relative to the 2008 Forest Plan.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. The SIO (scenery standard) for renewable energy development would Low for all LUDs and distance zones.

Alternative 4 would provide the smallest amount of timber volume (old growth and young growth combined) and the smallest amounts of young-growth volume. It would result in the second highest harvest of old growth during both the 25-year and 100-year periods. Table 2-11 summarizes the key elements of Alternative 4, and Table 2-12 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce an average of about 11 MMBF of young growth and 35 MMBF of old growth per year during the first 10 years (Figure 2-7). From Year 11 through Year 15, it is projected to produce an average of 26 MMBF of young growth and about 20 MMBF of old growth per year. Alternative 4 would likely reach a full transition harvest of 41 MMBF of young growth about Year 16. Young-growth harvest is expected to continue to increase at a rapid rate after Year 16 and is expected to reach an upper limit of 87 MMBF about Year 18. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Alternative 5 (Preferred Alternative)

Alternative 5 is the Preferred Alternative. This alternative is based on the recommendations from the Tongass Advisory Committee (TAC), a formally established Federal Advisory Committee (see Appendix B of the Forest Plan). The establishment of the TAC represents a turning point in Tongass management seeking new approaches, practices, and responses. The TAC offers a regionally focused, collaborative path toward an innovative opportunity for a viable young growth timber industry while honoring the suite of values – economic, ecological, social, and cultural – inherent in the Forest.

Like Alternatives 3 and 4, this alternative would allow old-growth harvest only within Phase 1 of the timber sale program adaptive management strategy (see color map accompanying this FEIS). As in Alternatives 1 and 4, the 2001 Roadless Rule would apply and no old-growth or young-growth harvest would occur in roadless areas. In addition, old-growth harvest is excluded from all

Tongass 77 (T77)[3] watersheds and TNC/Audubon Conservation Priority Areas (Albert and Schoen 2007). These old-growth harvest exclusion areas are shown on the large color map for Alternative 5 that accompanies this FEIS.

As in Alternatives 2, 3, and 4, Alternative 5 would allow young-growth harvest in all three phases of the timber sale program adaptive management strategy. It would allow young-growth management in development LUDs and in the Old-growth Habitat LUD including harvest in beach and estuary fringe and RMAs outside of TTRA buffers within these same LUDs. However, young-growth harvest in the Old-growth Habitat LUD, beach and estuary fringe, and RMAs outside of TTRA buffers would be allowed only during the first 15 years after Plan approval, and created openings for commercial harvest (up to 10 acres and a maximum removal of up to 35 percent of the acres of the original harvested stand) or commercial thinning would be allowed. In beach and estuary fringe, a 200-foot no-commercial harvest buffer adjacent to the shoreline would be required. Along lake shorelines, a 100-foot no-cut commercial harvest buffer would be established. Scenery standards (SIOs) for young growth management would be reduced to Very Low for all distance zones in the development LUDs only. This standard would also apply when young-growth and old-growth harvests are planned in the same Viewshed.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. The SIO (scenery standard) for renewable energy development would Low for all LUDs and distance zones.

Alternative 5 would provide the second smallest amount of timber volume (old growth and young growth combined) among the alternatives, but the second largest amount of old-growth volume among the action alternatives. Table 2-14 summarizes the key elements of Alternative 5 and Table 2-15 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce an average of about 12 MMBF of young growth and 34 MMBF of old growth per year during the first 10 years (Figure 2-9). From Year 11 through Year 15, it is projected to produce an average of 28 MMBF of young growth and about 18 MMBF of old growth per year. Alternative 5 would likely reach a full transition harvest of 41 MMBF of young growth about Year 16. Young-growth harvest is expected to continue to increase at a rapid rate after Year 16 and is expected to reach an upper limit of

[3] The Tongass 77 (T77) refers to value comparison units (VCUs), which approximate major watersheds located on National Forest System lands that Trout Unlimited, Alaska Program identified as priority salmon watersheds. As a result of the Sealaska Land Entitlement Finalization in the Carl Levin and Howard P. 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015 (Public Law 113-291), there was a net reduction in the T77 watersheds from 77 to 73. To provide clarity and consistency, the T77 nomenclature will continue to be used in this document when referring to these priority watersheds.

98 MMBF about Year 18. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Comparison of the Alternatives

This section briefly compares the environmental consequences of the five alternatives with respect to the significant issues described in Chapter 1. This comparison is based on the effects analyses presented in Chapter 3.

Issue 1 – Young-growth Transition

The purpose and need for this project is primarily based on a memorandum from the Secretary of Agriculture (see Chapter 1) that directs management of the Tongass National Forest to expedite the transition away from old-growth timber harvesting and towards a forest products industry that utilizes predominantly second-growth – or young-growth – forests. Secretary Vilsack's memorandum also guides that the transition should be implemented in a manner that preserves a viable timber industry that provides jobs and opportunities for Southeast Alaska residents. USDA's goal is to effectuate this transition, over the next 10 to 15 years, so that at the end of this period the vast majority of timber sold by the Tongass will be young growth. This timeframe will conserve old growth forests while allowing the forest industry time to adapt.

Because of the Secretary's memorandum, the existing condition emphasizes a transition to young growth and minimizes old-growth harvest, but does this within the constraints of the 2008 Forest Plan. Alternative 1 (no action) would result in full transition to a predominantly young-growth-based industry in about 32 years, well beyond the 15 year goal presented in the Secretary's memorandum. In contrast, all of the action alternatives would result in a full transition in about 12 to 16 years. Because these timeframes represent full transition, the period in which the "vast majority of timber sold by the Tongass will be young growth" is expected to be about 10 to 15 years for the action alternatives. Of the action alternatives, the fastest transition (12 years) would occur with Alternative 2 and the slowest transition (16 years) would occur with Alternatives 4 and 5.

All of the alternatives are expected to support from 184 to 231 annualized direct jobs during the first decade, depending on the portion of total harvest that is exported. Total estimated jobs are very similar across the alternatives, with the highest number of direct jobs supported by Alternative 2 and the lowest number of direct jobs supported by Alternative 1. In addition, each alternative is expected to meet the projected demand for Tongass timber. Therefore, each alternative is expected to meet the criterion of maintaining a viable industry. However, it is unclear how quickly industry will be able to "retool" mills and harvesting equipment and how markets will react to changing from old-growth to young-growth forest products; thus, this criterion is associated with a relatively high degree of uncertainty.

Under all alternatives, the harvest of old growth would diminish over time and the harvest of young growth would increase. Therefore, all of the alternatives would "conserve old-growth forests." The largest old-growth harvest in the first 25 years would be about 39,000 acres with Alternative 1. Each of the action alternatives would harvest less old growth, ranging from 15,000 acres with Alternative 2 to 24,000 acres with Alternative 5. The same pattern among the alternatives occurs with the 100-year harvest as well.

Issue 2 – Renewable Energy

Another important part of the purpose and need for this project is the purpose of establishing new direction in the Forest Plan so that renewable energy development is more permissible. There is a need to stimulate economic development in Southeast Alaska communities, and provide low-carbon energy alternatives, thereby displacing the use of fossil fuel. Under the 2008 Forest Plan, siting of energy projects is limited in certain LUDs, and it would remain that way under Alternative 1. Under each of the action alternatives (Alternatives 2, 3, 4, and 5), changes would be made to the Forest Plan that would result in improved flexibility in siting and development of renewable energy projects.

Issue 3 – Inventoried Roadless Areas

Under Alternatives 1, 4, and 5 IRAs are withdrawn from timber production and not suitable for timber production (FSH 1909.12, chapter 60, section 61.11). In Alternative 2, IRAs that were previously roaded would be available for road construction and timber harvest and in Alternative 3, all IRAs would be available for road construction and timber harvest. In both Alternatives 2 and 3, entry into IRAs would not be permitted without rulemaking or, in the case of Alternative 3, if the 2003 Tongass Exemption (68 FR 75136) is reinstated. Estimated acres of timber harvest in IRAs over 100 years would range from 0 acres for Alternatives 1, 4, and 5, to 11,000 acres for Alternative 2, to 29,000 acres for Alternative 3. The protection of roadless characteristics would be directly proportional to the projected acres of timber harvest with Alternatives 1, 4, and 5 providing the most protection, Alternative 2 providing the second most protection, and Alternative 3 providing the least protection.

Issue 4 – Wildlife Habitat and the Conservation Strategy

Relative to old-growth habitat conservation, Alternative 1 would have the highest harvest (1.3 percent of existing POG), followed by Alternative 4 (0.9 percent of existing POG), followed by Alternative 5 (0.8 percent of existing POG), followed by Alternatives 2 and 3 (0.7 percent of existing POG). The change in the percent of original POG remaining after 100 years would follow the same pattern. Currently, 92 percent of original POG is remaining; under all alternatives this percentage would drop by about 1 percent after 100 years. Alternative 1 would result in about 90 percent remaining and the action alternatives would each result in about 91 percent remaining. This same pattern would continue for the percent reduction in high-volume POG. The existing 86 percent of original high-volume POG remaining would be reduced to about 85 percent for all alternatives after 100 years. For large-tree POG, about 79 percent of the original acres exist. Alternative 1 would result in about 78 percent remaining after 100 years, while the action alternatives would maintain about 79 percent.

Young-growth harvest in the beach and estuary fringe would be lowest under Alternative 1 (no harvest). Under the action alternatives, no harvest of POG would occur, but impacts resulting from young growth harvest would be highest under Alternative 2, which would include the second highest amount of young-growth acres and would allow clearcutting. Under Alternatives 3 and 4, considerable young-growth acreage would be harvested, but using commercial thinning, which would result in less effects than clearcutting. Alternative 5 would have the lowest effect on beach and estuary fringe among the action alternatives because young-growth acreage would be lowest and only patch cutting (with created openings up to 10 acres and a maximum removal of up to 35 percent of the acres of the original harvested stand) or commercial thinning would be allowed and only during the first 15 years after Forest Plan approval with a one-time entry restriction.

For RMAs, the lowest effects would be associated with Alternatives 1, 3, and 4, which would permit no harvest in RMAs. Alternative 2 would have the greatest harvest impacts in RMAs because it would include the highest amount of acreage and would allow clearcutting during the first 15 years of Forest Plan approval and commercial thinning thereafter. Effects to RMAs would be lower under Alternative 5 due to a lower amount of acres harvested and only patch cutting or commercial thinning would be permitted and only during the first 15 years after Forest Plan approval with a one-time entry restriction.

In the Old-growth Habitat LUD, Alternatives 1 and 4 would allow no young-growth harvest. The greatest amount of young-growth harvest in the Old-growth Habitat LUD would occur under Alternative 2, followed by Alternatives 3 and 5. Effects would be greatest under Alternative 2 because it would allow clearcutting and have the largest harvest acreage, and less under Alternative 3 because only commercial thinning would be allowed, followed by Alternative 5 which would allow only patch cutting or thinning and only during the first 15 years after Forest Plan approval and with a one-time entry restriction.

Average total road density across the Forest (NFS lands only) under all alternatives would be approximately 0.23 mile per square mile after 100 years, an increase of 0.03 to 0.04 mile per square mile above existing levels. Approximately 83 percent of WAAs would have total road densities ranging between 0.0 and 0.7 mile per square mile under all alternatives. Total roads are conservatively defined to include open roads, closed roads, and decommissioned roads. Average open road density across the Forest (NFS lands only) would be approximately 0.09 mile per square mile, an increase of approximately 0.005 mile per square mile under all alternatives. Approximately 96 percent of WAAs would have open road densities ranging between 0.0 and 0.7 mile per square mile under all alternatives. Therefore, any potential increase in hunter access or risk of overharvest for wildlife species would be minor and localized, and would not be measurable at the forest-wide scale under any of the alternatives.

The transition to young-growth management would slow the long-term decrease in deer habitat capability due to the reduction in POG harvest. Based on Interagency Deer Habitat Capability model outputs, deer habitat capability under all of the alternatives would decline about 1 percent over 100 years. Forest-wide all alternatives would maintain about 99 percent of the existing deer habitat capability. Results based on the Forage Resource Evaluation System for Deer (or FRESH deer model) are very similar; Forest-wide, the existing level of habitat quality would be decline about 1 percent after 100 years under all alternatives.

Cumulative POG harvest on all landownerships would be greatest under Alternative 1, followed by Alternatives 4, 5, 3, and 2 (in that order). Cumulative effects would be least under the alternatives that propose the shortest young-growth transition time. After 100 years of Forest Plan implementation and non-NFS harvests, approximately 83 percent of the original (1954) total POG forest, about 76 percent of the original high-volume POG, and 63 to 64 percent of the original large-tree POG would be maintained on all landownerships under all of the alternatives.

Cumulative road densities (all land ownerships) would be similar among alternatives (about 0.45 mile per square mile), representing an increase of about 0.11 to 0.12 miles per square mile above current conditions. Open road densities for all land ownerships would increase from about 0.22 mile per square mile to about 0.24 mile per square mile after 100 years under all alternatives.

CHAPTER 1
PURPOSE AND NEED

Purpose and Need

Introduction

Forest land and resource management planning is a process for developing, amending, and revising land and resource management plans for each of the National Forests in the National Forest System (NFS). Forest plans are required by the National Forest Management Act of 1976 (NFMA) (16 United States Code [U.S.C.] parts 1600-1687). The 16.7-million-acre Tongass National Forest was the first forest to complete a Land and Resource Management Plan (Forest Plan) under the NFMA in 1979. That Forest Plan was amended in 1986 and 1991 and revised in 1997. A final Supplemental Environmental Impact Statement (SEIS) was completed in 2003, which further evaluated roadless areas for their wilderness potential. The Forest Plan was amended again in 2008 in response to a Ninth Circuit Court ruling and a 5-Year Plan Review completed in 2005. The revised Plan was amended 24 times between the 1997 revision and the 2008 amendment, primarily to adjust small old-growth habitat reserve boundaries and for electronic/communication site designations. Since the 2008 amendment, the plan has been amended to establish the Héen Latinee Experimental Forest, disestablish the Young Bay Experimental Forest, add communication sites to the list in Appendix E, modify small old-growth habitat reserves, and make minor corrections to the plan.

On July 2, 2013, Secretary of Agriculture, Thomas Vilsack, issued Memorandum 1044-009, *Addressing Sustainable Forestry in Southeast Alaska* (U.S. Department of Agriculture [USDA] 2013), which expressed the Secretary's intent to transition the Tongass National Forest to a young growth–based timber program in 10 to 15 years, more rapidly than considered in the 2008 Forest Plan. The Secretary asked that the Forest Service "[s]trongly consider whether to pursue an amendment to the Tongass Forest Plan. Such an amendment would evaluate which lands will be available for timber harvest, especially young growth timber stands, which lands should be excluded, and additional opportunities to promote and speed transition to young-growth management." Recognizing the importance of retaining expertise and infrastructure, the Secretary also stated that the Forest Service "will continue to offer a supply of old growth timber while increasing the supply of young growth to provide industry in Alaska the opportunity to develop new markets, learn new skills, and acquire new equipment." The Secretary also asked that a determination of whether to initiate an amendment be completed by September 30, 2013.

The Forest Service completed a Five-Year Review of the Forest Plan in September 2013. The results of the Five-Year Review and the Secretary's Memorandum led to the Tongass Forest Supervisor making a determination that "…conditions on the land and demands of the public require the Tongass to modify the 2008 Forest Plan" (USDA Forest Service 2013a). A Notice of Intent (NOI) to prepare an EIS was published in the Federal Register on May 27, 2014 (79 Federal Register [FR] 30074) initiating a 30-day scoping period. Among the comments from the Five-Year Review and from scoping were those that requested a transition to young-growth timber harvesting, ways to make renewable energy projects easier to implement, and a review of the 2001 Roadless Area Conservation Rule (Roadless Rule) inventoried roadless areas (IRAs). All comments were taken into consideration in identifying the scope of this Forest Plan amendment.

This Final Environmental Impact Statement (FEIS) is a programmatic analysis prepared by the Forest Service that describes and analyzes changes to the Forest Plan to accomplish the transition to young-growth management as provided in the Secretary's Memorandum. This FEIS evaluates which lands will be suitable for timber production, especially young-growth timber stands, and any changes or additions to management direction needed to promote and speed the transition to young-growth management while maintaining a viable timber industry in Southeast Alaska. This FEIS also describes and analyzes changes related to renewable energy development. The scope of the analysis is limited to these changes.

This FEIS analyzes in detail four action alternatives for amending the Plan, in addition to a No Action Alternative (Alternative 1). The analysis is published in two volumes. Volume 1 contains the FEIS, and Volume 2 contains the FEIS appendices. A complete Forest Plan Land Use Designation (LUD) map is provided for each of the alternatives in the Map Packet which accompanies the FEIS.

A separate document titled Tongass Land and Resource Management Plan (i.e., the Forest Plan) is published along with the FEIS and represents the selected alternative (Alternative 5). Chapter 2 and Appendix F in the FEIS describe how the other alternatives compare to Alternative 5. Instead of repeating all of the changes in management direction common to Alternatives 1-4 and Alternative 5, management direction of the alternatives is displayed in a side-by-side comparative format to demonstrate how and where direction differs from Alternative 5.

This FEIS describes and analyzes changes to the 2008 Forest Plan and tiers to and incorporates by reference the 1997 Tongass Land Management Plan Revision FEIS (1997 FEIS), the 2003 Final Supplemental EIS (SEIS) for Roadless Area Evaluation for Wilderness Recommendations (2003 FSEIS), and the 2008 Tongass Land and Resource Management Plan Amendment FEIS (2008 FEIS), and the 2008 Record of Decision (2008 ROD). Where appropriate, information in these documents that is relevant to analysis in this FEIS is cited and incorporated by reference.

Forest Planning History on the Tongass National Forest

The NFMA, enacted in 1976, requires each national forest to develop a land and resource management plan and revise its plan every 10 to 15 years. The Tongass became the first National Forest to complete a Forest Plan under NFMA in April 1979. The Alaska National Interest Lands Conservation Act (ANILCA) was signed into law December 2, 1980 (Public Law 96-187) and provided varying degrees of protection to over 157,000,000 acres of public lands in Alaska, including NFS lands. The 1979 Forest Plan was amended in 1986, reflecting changes mandated by ANILCA. The Forest Plan revision process began in 1987 and a Draft Environmental Impact Statement (DEIS) was published in June 1990. On November 28, 1990, the Tongass Timber Reform Act (TTRA) (Public Law 101-626) was enacted. The TTRA amended ANILCA to protect certain lands in the Tongass National Forest in perpetuity, to modify certain long-term timber contracts, to provide for protection of riparian habitat, and for other purposes. The 1979 Forest Plan was amended in February 1991 to incorporate the TTRA changes. The Forest Plan revision process continued with a Supplement to the DEIS published in September 1991, which incorporated all changes required by TTRA and evaluated new alternatives. Following completion of the June 1990 DEIS, TTRA designated five new wilderness areas and incorporated additional acres into an existing wilderness area. Therefore, the Forest Service did not reconsider roadless areas for potential wilderness recommendation. The Forest Service prepared an FEIS in the fall of 1992, but did not publish an associated ROD. The Regional Forester found there was new information that should be collected to respond to the 1982 National Forest Planning Regulations (36 Code of Federal Regulations [CFR] 219.19 (1982)). That process led to the 1997 FEIS and the Forest Plan Revision ROD (1997 ROD).

The 1997 Forest Plan was the subject of 33 appeals by organizations and individuals. In 1999, the Under Secretary of Agriculture affirmed the Regional Forester's decision regarding all 33 appeals, based on the 1997 Tongass Forest Plan Revision FEIS and planning record. The Under Secretary issued a new ROD (1999 ROD) for the 1997 Tongass Land Management Plan Revision.

Two lawsuits challenged the 1997 and 1999 RODs in the U.S. District Court for the District of Alaska. The Alaska Forest Association and some Southeast Alaska communities challenged many aspects of the 1997 Plan and the process by which the 1999 ROD was issued. The Sierra Club and other conservation groups challenged the lack of wilderness area consideration and potential recommendations in the 1997 Plan Revision FEIS and ROD. The Court issued a single opinion for both cases in March 2001.

In the Alaska Forest Association case *(Alaska Forest Association v. United States Department of Agriculture* No. J99-0013 CV [JKS] [D. Alaska]), the U.S. District Court upheld the 1997 ROD against all challenges, but held that the 1999 ROD was not properly adopted. The Court vacated the 1999 ROD and enjoined the Forest Service from implementation. The Court further directed the Forest Service to prepare a SEIS addressing the changes from the 1997 Tongass Forest Plan. Because of the extensive public involvement and scientific review in the 1997 ROD, and its thorough policy and legal review of the administrative appeal process and by the District Court, the Forest Service did not propose changes to the 1997 ROD similar to those enjoined by the District Court.

In the Sierra Club challenge of the 1997 Tongass Forest Plan Revision FEIS (*Sierra Club v. Lyons*, No. J00-0009 CV [JKS] [D. Alaska]), the Ninth Circuit Court found the 1997 Tongass Forest Plan should have considered making wilderness recommendations in the FEIS. The Court ordered the Forest Service to prepare a SEIS evaluating wilderness recommendations for roadless areas on the Tongass and provide the relative contribution to the National Wilderness Preservation System in its Analysis of the Management Situation. The Forest Service issued a Final SEIS and ROD for Roadless Area Evaluation for Wilderness Recommendations in February 2003, and no new wilderness areas were recommended in the ROD.

The Natural Resources Defense Council (NRDC) filed a lawsuit (referred to as NRDC I) in the U.S. District Court of Alaska in December 2003 challenging the 1997 Forest Plan and six timber sales. In January 2004, the NRDC filed a separate lawsuit on a seventh timber sale (referred to as NRDC II) and another lawsuit challenging an eighth sale in March 2004 (referred to as NRDC III). The District Court upheld the 1997 Forest Plan ROD and related National

Environmental Policy Act (NEPA) documents on all claims in September 2004. NRDC appealed this ruling to the Ninth Circuit Court of Appeals. The Ninth Circuit Court issued a ruling on NRDC I and NRDC II in August 2005 *(Natural Resources Defense Council, et al., v. United States Forest Service, et al., 421 F.3d 797 [9th Cir.2005]))*. The Court found inadequacies primarily relating to the NEPA process for the 1997 Forest Plan. These inadequacies dealt with the timber demand estimates, the range of alternatives related to timber demand, and the cumulative effects analysis related to activities on non-NFS lands. While this process was taking place, the Forest completed a Five-Year Review of the Forest Plan. This review identified a number of items that could lead to adjustments to the Plan.

The 2008 Forest Plan was the subject of 15 appeals by organizations and individuals; however, one of those appeals was subsequently dismissed because its content did not meet the requirements of appeals (36 CFR 217.9). In August 2008, the Chief of the Forest Service affirmed the Regional Forester's decision regarding all appeals.

On May 24, 2011, the Alaska District Court vacated the Tongass exemption[1] and reinstated the 2001 Roadless Rule on the Tongass National Forest (*Organized Village of Kake, et al. v. USDA, et al.*). As a result, the Tongass National Forest was subject to the provisions of the 2001 Roadless Rule. The State of Alaska subsequently appealed the District Court's decision and the Ninth Circuit Court of Appeals reversed the district court's decision and remanded the case to the lower court for further consideration. On July 29, 2015, the Ninth Circuit Court of Appeals issued its en banc decision in *Organized Village of Kake v. U.S. Dept. of Agriculture, 11-35517,* upholding the Alaska District Court's reinstatement of the Roadless Rule. Thus, the Tongass has been subject to the Roadless Rule since 2011 and remains so today.

The 2012 planning rule for land management planning for the National Forest System was published in the Federal Register on April 9, 2012 (77 FR 21162), and it became effective on May 9, 2012. It was developed through the most collaborative rulemaking effort in Agency history to ensure an adaptive land management planning process that is inclusive, efficient, collaborative and science-based to promote healthy, resilient, diverse and productive National Forests and Grasslands. In January 2015, the Forest Service published the final planning directives, the key set of agency guidance documents that direct implementation of the 2012 planning rule.

This proposed plan amendment was developed under the provisions in the 2012 Rule and changes made to the 2008 Forest Plan are presented in Chapter 5 of the proposed Forest Plan. Only those changes that were made to the 2008 Forest Plan are described and analyzed in this FEIS.

Factors That Led to the Need for Change

Since approval of the Forest Plan in January 2008, management of the Tongass National Forest has been very challenging due to a number of factors, including administrative and judicial proceedings. Many of these factors were highlighted as concerns in the Five-Year Review of the Forest Plan (36 CFR 219.10(g)

[1] The Roadless Rule was promulgated by the Department of Agriculture in 2001, limiting road construction and timber harvest in Inventoried Roadless Areas. In 2003, the Department exempted the Tongass from the rule (68 FR 75136).

(1982)) that was conducted in 2013 (USDA Forest Service 2013h). Based on the Five-Year Review of the 2008 Forest Plan and challenges in carrying out projects since 2008, the Tongass Forest Supervisor determined that conditions on the land and demands of the public require the Tongass to change the 2008 Forest Plan (USDA 2013i). He also determined that stakeholder input would be used for making changes to forest management on the Tongass. This section provides the context for the factors that led to a need for change.

Roadless area conservation

In January 2001, USDA published the Roadless Area Conservation Rule (36 CFR 294 Subpart B), which generally prohibits cutting trees and building roads in inventoried roadless areas on NFS lands. Since its adoption in 2001, the Roadless Rule has been the subject of litigation concerning how it is to be applied to the Tongass. Stakeholders with an interest in these lands, such as utility companies, timber and mining interests, and local communities, have raised questions about how the Roadless Rule will affect permits, contracts and other special uses involving access, road construction and road maintenance in inventoried roadless areas within Alaska's National Forests. The State of Alaska in 2001 filed a complaint in the United States District Court, District of Alaska, challenging the application of the Roadless Rule to the Chugach and Tongass National Forests. The Forest Service and the State of Alaska reached a settlement in 2003, and the Forest Service then published a rule temporarily exempting the Tongass National Forest from the Roadless Rule (68 FR 75136). In May 2011, the Alaska District Court vacated the Tongass exemption and reinstated the 2001 Roadless Rule on the Tongass National Forest (*Organized Village of Kake, et al. v. USDA, et al.*). After additional judicial proceedings, the Ninth Circuit Court issued an en banc decision in *Organized Village of Kake v. U.S. Dept. of Agriculture, 11-35517*, upholding the Alaska District Court's reinstatement of the Roadless Rule. In another court case, the State of Alaska has challenged the Roadless Rule in the U.S. District Court for the District of Columbia. Briefing in that case is currently being adjudicated. Thus, the Tongass has been subject to the Roadless Rule since 2011 and remains so today.

Litigation

Timber harvesting is one of the many uses of the Tongass, and the timber resource is managed to produce sawtimber and other wood products on lands identified as suitable for timber production on an even-flow, long-term sustained yield basis and in an economically efficient manner. Harvest of old-growth trees has become increasingly controversial. Since 2008, litigation filed on individual Tongass timber sales is hindering the ability of the Forest to accomplish the objective of providing a reliable Federal timber supply. The decline in timber sale volume between 2008 and 2012 is based on a variety of factors including demand, economic conditions, harvest costs, policy changes and litigation. Annual harvest volumes averaged 36 MMBF between 2002 and 2014 (USDA Forest Service 2015a).

Collaboration

The Forest Service prepared the 2008 Tongass Forest Plan Amendment and the associated EIS in response to the Ninth Circuit court's decision (*Natural Resources Defense Council, et al. v. United States*, Case No. 04-35868) and in response to the Five-Year Review of the 1997 Forest Plan that was completed in early 2005, which recommended several updates to the Plan. In the fall of 2006, while work was underway on the 2008 Tongass Forest Plan Amendment, The

Nature Conservancy formed the Tongass Futures Roundtable in an effort to bring stakeholders together to find practical solutions for industry, the Forest Service, communities, and conservation. The Roundtable brought together a diverse group of people and organizations long active in Tongass policy matters with the ultimate goal of developing consensus recommendations regarding where timber harvest should be allowed on the Tongass, and where timber harvest should be prohibited. The Roundtable also supported more diversified and sustainable local economies in communities across Southeast Alaska, including efforts to reduce the high energy costs that impede economic diversification by promoting development of renewable energy in communities that currently depend on diesel generators to provide electrical power. Although the Roundtable dissolved in 2011, several important relationships were established that laid the groundwork for the "Transition Framework" discussed below. Building on the efforts of the Roundtable, including supporting more diversified and sustainable economies in the communities of Southeast Alaska, representatives of the Forest Service, USDA Rural Development, and the Economic Development Administration conducted a series of listening sessions in the fall of 2009 in all 32 communities in Southeast Alaska to solicit ways to stimulate job creation and economic diversification throughout the region.

The 2008 Forest Plan decision acknowledged the "…expected increase in young-growth management over the next few planning cycles…and the increasing public interest in this conversion, which will ultimately reduce the need for old-growth timber resources and the associated need for development in roadless areas" (USDA 2008a). In 2010, the Forest Service, in partnership with other agencies within the USDA, announced a "Transition Framework" for Southeast Alaska (Alexander et al. 2010). The Transition Framework was developed as a strategy for developing economic opportunities in renewable energy, forest restoration, fisheries and mariculture, tourism and recreation, and subsistence. The goal of the Transition Framework is to conserve the Tongass National Forest while providing economic opportunity and stability to Southeast Alaska communities. The high cost of energy was soon identified as a major barrier to sustainable economic development in the region. As the Transition Framework continued to progress in 2011, the USDA agencies, working with the Juneau Economic Development Council, collaborated with over 120 business and community leaders to develop economic diversification initiatives through the creation of business clusters that, by 2013, included clusters for Ocean Products, Visitor Products, Renewable Energy, Mining Services and Supply, and Research and Development, as well as the Working Forest Group to address timber management issues.

2012 Planning Rule

While these collaborative efforts were underway in Southeast Alaska, the USDA was also pursuing similar approaches for planning across the National Forest System. These efforts resulted in publishing the 2012 planning rule for land management planning on April 9, 2012 (77 FR 21162). The 2012 Planning Rule was developed through the most collaborative rulemaking effort in Agency history to ensure an adaptive land management planning process that is inclusive and science-based to promote healthy, National Forests and Grasslands. In addition, the Secretary of Agriculture established an advisory committee under the Federal Advisory Committee Act (FACA) to provide recommendations on how to carry out the Planning Rule.

Five-Year Review of the 2008 Forest Plan

In 2013, the Tongass conducted a Five-Year Review of the 2008 Forest Plan to provide the Forest Supervisor with insight into views about the Forest Plan and projects carried out under the plan to assist in determining whether any actions are needed to change the plan. As part of this review, the results from and data evaluated in the Monitoring and Evaluation Reports (2008 to 2012) was considered. The Tongass staff engaged internal and external stakeholders and the public to obtain feedback on how the plan is working since 2008 (i.e., what is working well, what is not working, what is not addressed in the plan, whether changes are needed), and held public meetings in seven communities in Southeast Alaska (USDA Forest Service, 2013h). There were 152,182 comments submitted by individual citizens, Federal and state agencies, tribal governments, local governments, businesses, special interest groups, and non-governmental organizations. The comment period generated 3,104 coded comments, which were grouped into 24 Statement of Concern (SOC) Topics. The five SOC Topics with the most comments received were: 1) Tongass National Forest Management issues (644); 2) Timber (323); 3) Land Use Designations (285); 4) Socio-economics (281); and 5) Energy (239).

Secretary of Agriculture Memorandum 1044-009

It was in the context of sustained collaborative efforts to promote more sustainable economic diversification and a more sustainable timber management program on the Tongass National Forest that the Secretary of Agriculture issued Memorandum 1044-009, Addressing Sustainable Forestry in Southeast Alaska, on July 2, 2013. The memorandum focused on speeding the transition to management of second-growth (previously harvested) forests. In addition to speeding the transition to management of second-growth, the memorandum references the increased support USDA had provided over the previous three years under the Transition Framework to support “alternative economic development opportunities for communities across the region in the recreation, tourism, fishing and renewable energy sectors,” and directs such collaborative efforts to continue “to help strengthen and diversify local economies.”

An outgrowth of the Transition Framework, the Secretary’s memorandum directs management of the Tongass National Forest to “expedite the transition away from old-growth timber harvesting and towards a forest products industry that uses predominantly second-growth – or young-growth – forests.” It also affirmed that “this transition to a more ecologically, socially, and economically sustainable forest management is a high priority for USDA, the Forest Service, and the Tongass National Forest.” The memorandum directs the transition to be carried out in a manner that preserves a viable timber industry that provides jobs and opportunities for Southeast Alaska residents, with the goal of carrying out the transition over the next 10 to 15 years, so that at the end of this period the vast majority of timber sold by the Tongass will be young growth. It also directed the Forest Service to continue working with Congress to provide some flexibility with regard to culmination of mean annual increment (CMAI) requirements, which is essential to permit the development of economically viable young growth projects within the timeframe set as a goal for the transition. The Secretary’s memorandum also announced that USDA would establish an advisory committee under the FACA to provide recommendations to the Forest Service on ways to expedite the young-growth transition. In February 2014, this committee was designated as the Tongass Advisory Committee (TAC).

Congressional Action

In December 2014, Congress passed legislation – Carl Levin and Howard P. "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015 – that authorizes the Secretary of Agriculture to allow the harvest of trees before the culmination of mean annual increment of growth to facilitate the transition from timber harvest of old growth stands.

Change Determination

After completion of the Five-Year Review of the 2008 Forest Plan, the Tongass Forest Supervisor concluded that conditions on the land and demands of the public had changed and therefore the Tongass National Forest should make changes to the Forest Plan (USDA 2013). Concerns were consistently expressed during the Five-Year Review about the impact of high fossil fuel prices; the adverse effect of high energy costs on economic diversification and sustainable economic development; and increasing climate change on the quality of life in Southeast Alaska. Concerns were also expressed that the 2008 Plan's direction regarding transportation and utility systems (TUS), including the TUS overlay LUD, were overly complex, confusing, and difficult to implement, creating an impediment to development of hydropower, other types of renewable energy, and transmission lines needed to connect communities to sources of electric power. Based on this review, the Forest Supervisor determined to propose changes to the Forest Plan to make the development of renewable energy resources more permissible – including allowing greater project-level consideration of transportation and utility corridors and removing the TUS LUD – to stimulate renewable energy development in Southeast Alaska communities, provide low-carbon energy alternatives, and reduce the use of fossil fuels.

Purpose and Need

Purpose

The Forest Service determined that it is necessary to amend the 2008 Forest Plan. Amending the Forest Plan originates from the July 2013 memo from the Secretary of Agriculture directing the Tongass National Forest to transition its forest management program to be more ecologically, socially, and economically sustainable, while also being responsive to comments from the Five-Year Review of the Forest Plan. The purpose of this plan amendment is to:

- Review lands within the plan area to determine suitability for timber production, especially young-growth timber stands.
- Identify the projected timber sale quantity (PTSQ) and the sustained yield limit (i.e., the ecological yield of timber that can be removed annually on a sustained yield basis).
- Establish plan components (e.g., standards and guidelines) for young-growth forest management and renewable energy development to guide future project decision-making.
- Consolidate modifications made to the Forest Plan since its approval.

Need

An amendment is necessary for responding to the July 2013 direction from USDA Secretary Tom Vilsack outlined in the Secretary's Memorandum 1044-

009. The memorandum directs management of the Tongass National Forest to expedite the transition away from old-growth timber harvesting and towards a forest products industry that uses predominantly second-growth – or young-growth – forests. Secretary Vilsack's memorandum also directs that the transition must be implemented in a manner that preserves a viable timber industry that provides jobs and opportunities for Southeast Alaska residents. USDA's goal is to effectuate this transition, over the next 10 to 15 years, so that at the end of this period the vast majority of timber sold by the Tongass will be young growth. This timeframe will conserve old-growth forests while allowing the forest industry time to adapt. The 2008 Forest Plan provides for a transition to young growth over time, but there are challenges in establishing an economically viable young-growth forest management program due to the relatively young age of the available stands, market conditions, and other factors. Secretary Vilsack's direction requires Forest Plan amendments to guide future management of NFS lands and allocation of resources on the Tongass National Forest under the multiple-use and sustained yield mandate.

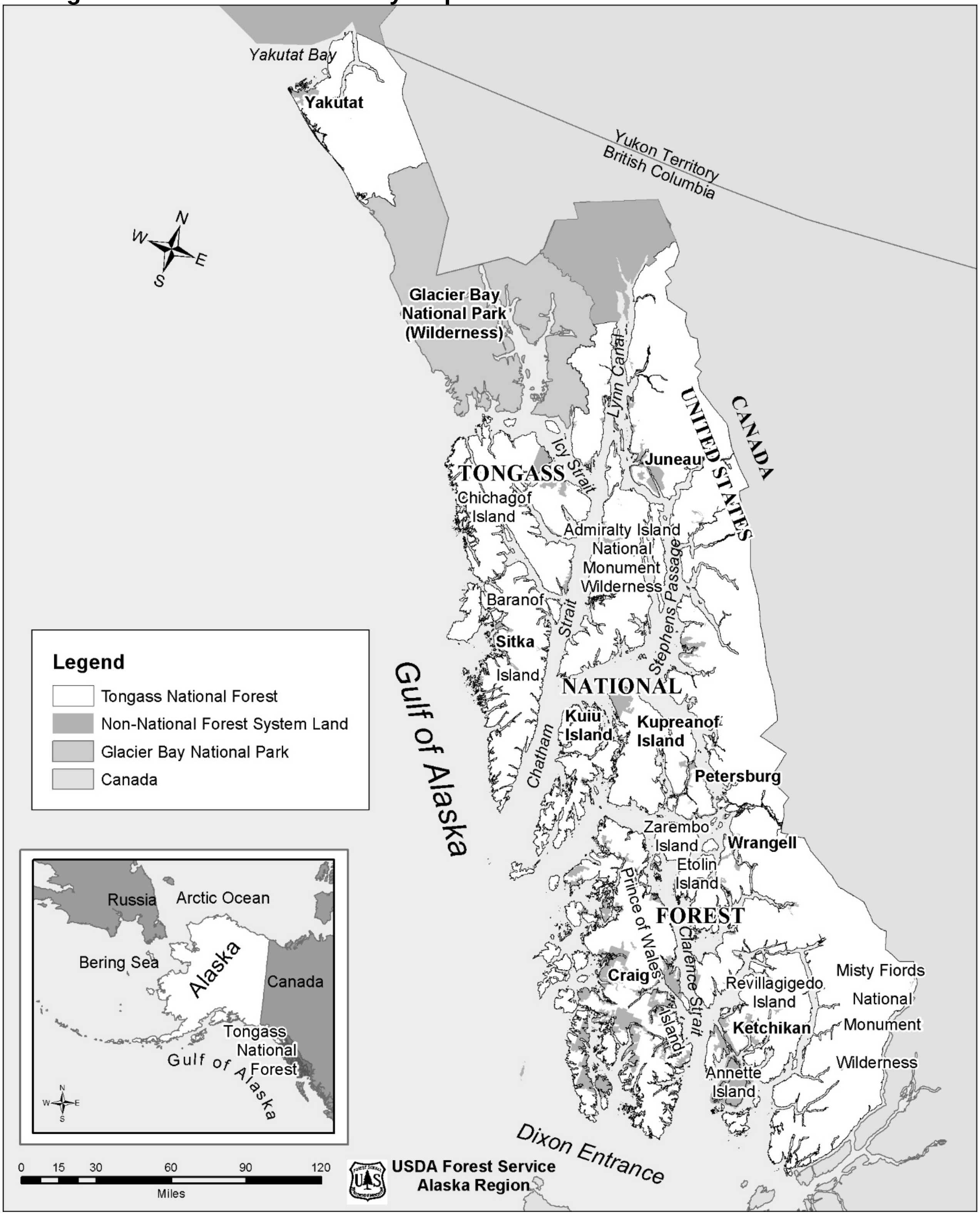
The need to amend the plan is further corroborated by the Five-Year Review of the Forest Plan, completed in 2013, which concluded that conditions on the land and demands of the public necessitate the Tongass National Forest to make changes to the Forest Plan. Concerns were consistently expressed during the Five-Year Review regarding the impact of rising fossil fuel prices and increasing climate change on the quality of life in Southeast Alaska. Changes to the Forest Plan are needed to make the development of renewable energy resources more permissible, including considering access and utility corridors to stimulate economic development in Southeast Alaska communities, and provide low-carbon energy alternatives, thereby displacing the use of fossil fuel.

Forest Location and Description

The 16.7-million-acre Tongass National Forest (Tongass or Forest) occupies about 7 percent of the area of Alaska. The Tongass is located in the southeastern portion of the state (the area commonly called the panhandle of Alaska or Southeast Alaska) and extends from Dixon Entrance in the south to Yakutat Bay in the north, and is bordered on the east by Canada and on the west by the Gulf of Alaska. The Tongass extends approximately 500 miles north to south and approximately 120 miles east to west at its widest point. Figure 1-1 is a vicinity map of the Forest.

The Tongass includes a narrow mainland strip of steep, rugged mountains and icefields and more than 1,000 offshore islands known as the Alexander Archipelago. Together, the islands and mainland have nearly 11,000 miles of meandering shoreline, with numerous bays and coves. A system of seaways separates the many islands and provides a protected waterway called the Inside Passage. Federal lands comprise about 95 percent of Southeast Alaska, with about 80 percent in the Tongass National Forest and most of the rest in Glacier Bay National Park and Preserve. The remaining land is held in state, Native corporations, and other private ownerships.

Figure 1-1.
Tongass National Forest Vicinity Map



Most of the area of the Tongass is undeveloped. Approximately 74,000 people inhabit Southeast Alaska, primarily in 32 communities located on islands or mainland coastal areas. Only eight of the communities have populations greater than 1,000 persons. Most of these communities are surrounded by, or adjacent to, NFS land. Only three communities are connected to other parts of the mainland by road: Haines and Skagway in the north and Hyder in the southeast.

In December 2014, the President signed into law the Carl Levin and Howard P. 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015 (Public Law 113-291). Title XXX, subtitle A, sec. 3002 of this law contains provisions to convey nearly 70,000 acres of NFS land in the Tongass to Sealaska, a regional Native corporation; change the land allocation of over 150,000 acres to "conservation areas" or LUD II; and allow for the harvest of trees prior to the culmination of mean annual increment of growth to facilitate the transition away from commercial timber harvest of old-growth stands among other provisions.

Public Issues

The economies of Southeast Alaska's communities rely on the Tongass National Forest to provide natural resources for uses such as fishing, timber harvesting, recreation, tourism, mining, and subsistence. Maintaining the abundant natural resources of the Forest, while providing opportunities for their use, is a major concern of Southeast Alaska residents.

Ranger District offices on the Tongass National Forest are located in Yakutat, Juneau, Hoonah, Sitka, Petersburg, Wrangell, Thorne Bay, Craig, and Ketchikan. There are also two National Monuments; Admiralty Island is managed by a Monument Ranger who shares an office in Juneau with the Juneau District Ranger and Misty Fiords managed by the Ketchikan District Ranger in Ketchikan (Figure 1-1).

Public Participation

As explained in the *Factors That Led to the Need for Change* section above, the Tongass has been encouraging meaningful public input and involvement in development of the Forest Plan. After completion of the Five-Year Review of the 2008 Forest Plan in 2013, the Tongass Forest Supervisor determined that conditions on the land and demands of the public had changed and therefore the Tongass National Forest should make changes to the Forest Plan (USDA Forest Service 2013h).

In February 2014, the USDA established the charter for a Federal Advisory Committee under the Federal Advisory Committee Act (FACA) to advise the Secretary and Chief on transitioning the Tongass to young-growth forest management. This committee, known as the TAC, included members representing federally recognized Indian Tribes, Alaska Native corporations, conservation organizations, timber industry, state and local governments, and other interests.

An NOI to prepare an environmental impact statement was published in the Federal Register on May 27, 2014 (79 FR 30074) initiating a 30-day public scoping period. The Forest Service requested public comments concerning the scope of the analysis until June 26, 2014. The Forest Service received approximately 124,000 letters and of these, 250 letters were unique. Comments and information from a wide variety of commenters including Forest Service personnel, public, other federal, state and local agencies, and non-governmental organizations were considered.

Identification of issues helps define or predict the resources or uses that could be most affected by the management of NFS lands. These issues are used as a basis to formulate management alternatives or to measure differences between alternatives.

Public involvement activities that have taken place since May 2014 include the following:

- An NOI to prepare an EIS was published in the Federal Register on May 27, 2014 (79 FR 30074) initiating a 30-day public scoping period. The Forest Service requested public comments concerning the scope of the analysis until June 26, 2014. The Forest Service received approximately 124,000 letters and of these, 250 letters were unique. Comments and information from a wide variety of commenters including Forest Service personnel, public, other federal, state and local agencies, and non-governmental organizations were considered. These comments are included in the Planning Record.
- The responsible official encouraged federal and state agencies and local governments to participate in the forest planning effort as cooperating agencies. On September 9, 2014, the Forest Service invited the U.S. Fish and Wildlife Service (USFWS), Environmental Protection Agency, State of Alaska, and all federally recognized Indian Tribes in Southeast Alaska. Of those invited, the USFWS accepted cooperating status with respect to the Forest Plan Amendment and entered into a Memorandum of Understanding (MOU) with the Forest Service in February 2015.
- A Forest Plan Amendment Web site was developed in September 2014 and has been maintained to inform and engage the public since then. It is updated as new information is developed or published and provides a mechanism for public input. This site can be accessed at: http://www.fs.usda.gov/goto/R10/Tongass/PlanAmend
- The responsible official encouraged participation from youth. Since December 2014, members from the plan amendment interdisciplinary team (IDT) have been engaging a youth advisory council comprised of high school students from the Ketchikan High School. The Forest Service wanted to expose young people to natural resource management on the Tongass, as well as engaging them in the public involvement process so their voices can be heard. The youth advisory council provided written comments on the Proposed Forest Plan and DEIS.
- On November 13, 2015, the responsible official provided to the Alaska Native Tribes and Alaska Native Corporations the opportunity to consult on a Government-to-Government and Government-to-Corporation level and inviting them provide input on the Proposed Forest Plan and associated DEIS and they were provided document access prior to the publication of the notice of availability (NOA) of the DEIS in the Federal Register on November 20, 2015 (80 FR 72719). Consultation has been conducted throughout the planning process, and is ongoing.
- In January and February 2015, public open house were held in Juneau, Sitka, and Ketchikan to engage the public in the planning process and share information about the progress being made on the Proposed Forest Plan and DEIS. All of the open house materials were posted on the Forest Plan Amendment Web site.

- In May of 2015, the TAC provided the Secretary with a comprehensive package of draft recommendations for the Forest Plan Amendment. The plan amendment IDT incorporated the draft recommendations that were applicable to amending the Forest Plan. These recommendations provided specific constraints related to transitioning the Tongass to young-growth forest management.
- On November 20, 2015, an NOA of the DEIS was published in the Federal Register (80 FR 72719), which started the 90-day public comment period.
- After reviewing the DEIS and Proposed Forest Plan, the TAC provided its final recommendations to the Secretary for the Forest Plan Amendment in December 2015.
- In January and February 2016, the Forest Service hosted nine public open house meetings, each followed by a subsistence hearing. These public open house meetings were held in the following Southeast Alaska communities: Klawock, Ketchikan, Wrangell, Petersburg, Juneau, Sitka, Hoonah, Yakutat, and Kake. Participants had the opportunity to review the contents of the Proposed Forest Plan, including the five alternatives analyzed in the DEIS. Forest Service staff provided an overview, listened to public concerns, and was available to answer questions. The public was also invited to submit written comments during the open house. Although an ANILCA Section 810 evaluation and determination was not required for approval of a Forest Plan amendment (see Subsistence section in Chapter 3 of FEIS), subsistence hearings were held after each open house meeting, which gave the public an opportunity to provide oral testimony regarding concerns about the Proposed Forest Plan Amendment on subsistence uses.
- More than 165,000 comments were received during the DEIS comment period. These comments are summarized and addressed in Appendix H, DEIS Comments and Responses. All comments received during the DEIS comment period are included in the Planning Record.

Significant Issues

The Forest Service used the scoping process to determine the scope of issues to be addressed and identify the significant issues related to a proposed action. When identifying issues to be analyzed in the environmental analysis, it is helpful to ask, "Is there disagreement about the best way to use a resource, or resolve an unwanted resource condition, or potentially significant effects of a proposed action or alternative?" If the answer is yes, the Forest Service may benefit from subjecting the issue to analysis. This is called a significant issue. Entire resources cannot be issues by themselves, but concerns over how a resource may be affected by the proposal can be issues.

Significant issues are those related to significant or potentially significant effects and are defined as those directly or indirectly caused by implementing the proposed action or alternative. These issues drive the range of alternatives and effects analysis.

The Four Significant Issues

The Forest Service identified the following significant issues during scoping.

Issue 1 –Young Growth Transition

The Secretary of Agriculture asked the Forest Service to transition to a young-growth-based timber management program on the Tongass National Forest in 10 to 15 years, which is more rapid than planned. This transition is intended to support the Tongass managing its forest for an ecologically, socially, and economically sustainable forest management program and reduce old-growth harvest while still providing economic timber to support the local forest products industry.

The issue concerns financial efficiency, salability, and volume of future timber sales. It also relates to the potential local employment and revenues generated for communities in the local area. Young-growth stand growth rates, sustainable harvest rates, the amount of old-growth harvest needed during transition to sustain the timber industry, also known as "bridge timber," and the locations where young-growth harvest would take place are some of the factors to be considered.

Issue 2 – Renewable Energy

The development of renewable energy projects on the Tongass would help Southeast Alaska communities reduce fossil fuel dependence, stimulate economic development, and lower carbon emissions in the Region.

This issue relates to comments received during the Five-Year Review of the Forest Plan. The Forest Service should promote the development of renewable energy projects to help Southeast Alaska communities reduce fossil energy dependence, where it is compatible with National Forest purposes and to ensure that the planning, construction, and operation of projects protect and effectively use NFS lands and resources.

Issue 3 –Inventoried Roadless Areas

Timber harvest and road building that occurred in roadless areas before the 2001 Roadless Area Conservation Rule (Roadless Rule) was enacted and during the Tongass exemption period changed the values or features that often characterize inventoried roadless areas in some locations.

Issues and concerns received during scoping as well as during the Five-Year Review process expressed concerns about roadless areas on the Tongass; both in favor of protections afforded under the 2001 Roadless Rule as well as requesting that the forest plan be amended to address the significant changes brought about by its re-instatement on the Tongass.

Some people believe roadless areas on the Tongass should be allowed to evolve naturally through their own dynamic processes and should be afforded protection that ensures this will occur. Others believe that limiting road construction and reconstruction or other management actions in roadless areas might restrict the delivery of goods, services, and activities that these areas might otherwise provide.

Roadless areas are considered important because they support a diversity of aquatic and terrestrial habitats, species, and communities, and play an important role in helping to conserve native plant and animal communities and biological diversity. They also provide people with unique recreation opportunities.

During the Tongass exemption period and before the 2001 Roadless Rule was enacted, road construction, reconstruction, and the cutting, and sale of timber in some IRAs occurred. As a result, these activities in some IRAs may have altered the roadless characteristics.

Issue 4 – Wildlife Habitat and the Conservation Strategy

Old-growth timber harvest has changed the composition and spatial patterns of terrestrial wildlife habitats. How the resulting young-growth is managed may influence the future ecological integrity of the landscape at various scales. Changes made to suitable lands designated for development, and to plan components (e.g., standards and guidelines) may affect old-growth habitat for wildlife and the Tongass Old-growth Habitat Conservation Strategy and contributing elements to old-growth reserves (e.g., riparian, beach and estuary habitats).

The Tongass National Forest supports an important assemblage of wildlife many of which are associated with or at least partially dependent on old-growth forest including one of the largest populations of brown bears in the world, high densities of breeding bald eagles, the Alexander Archipelago wolf, species of high importance for subsistence (e.g., Sitka black-tailed deer), an extensive array of endemic mammals, and other species that are dependent on old-growth habitats (e.g., marten and goshawk). The Tongass Old-growth Habitat Conservation Strategy is considered important for the continued health of old-growth associated wildlife populations in Southeast Alaska.

Timber harvest, minerals and renewable energy development, and road development can have effects on the habitat and populations of many of these species and the diversity and integrity of Southeast Alaska ecosystems. Less than 10 percent of the productive old-growth habitat on the Tongass has been converted to young growth, the percentage is much higher for certain types of old growth, such as lowland and large-tree old growth. In addition, non-NFS old growth has generally been harvested at a much higher rate. Therefore, the consideration of harvest and road building on wildlife in Southeast Alaska are greater than the effects for the Tongass by itself.

Changes between the Draft EIS and Final EIS

A number of updates and changes were made in the FEIS and Forest Plan in response to new information and to comments received on the DEIS and Proposed Forest Plan. The main areas of change to the EIS are described below. Changes to the Forest Plan are described in the next section.

1. Refinements were made to base Geographic Information System (GIS) coverages such as ownership, streams, cover type, roads, and LUDs to reflect updates due to changes in the existing condition and refinement of inventory data (e.g., updated young-growth inventory).

2. Because of refinements made to the base GIS coverages, the acreages and mileages associated with the existing condition and the alternatives changed, in many cases, and were updated throughout the document. Input data for the Woodstock model was also updated based on GIS refinements. Sometimes analysis methods were also refined, which resulted in changes to the quantification of effects.

3. The method of calculating suitable forest land was refined, including the model for calculating the riparian management area.

4. Alternative 5 was revised to add a 100-foot buffer around anadromous lakes in order to provide similar protection afforded by the Tongass Timber Reform Act.
5. Alternative descriptions in Chapter 2 were revised to call out additional differences between the alternatives, including the anadromous lake buffer and The Nature Conservancy/Audubon conservation priority areas, and Tongass 77 watersheds under Alternative 5.
6. Cost assumptions used in the Woodstock model were updated and additional cost factors were included as inputs. The model was rerun for each alternative. The FEIS was updated to reflect the revised model outputs.
7. Expanded discussion and analysis and incorporation of additional scientific references and studies were included in many sections of the FEIS.
8. FEIS Appendix B was updated and additional information on modeling and analysis techniques was added.
9. FEIS Appendix D was updated and additional analysis and information was incorporated.
10. FEIS Appendix H was added to provide information on the Alaska Limited Timber Export Policy.
11. FEIS Appendix I was developed, which summarizes the comments received on the DEIS and the Forest Service responses to these comments. Copies of the letters received from agencies and elected officials, including tribal governments, are also included.

Changes between Proposed Forest Plan and Forest Plan

Chapter 1 – Introduction

Purpose

Content was edited to correct clerical errors.

Relationship to Other Documents

Content was edited to correct clerical errors. A footnote was also added to clarify the definition for plan content.

Plan Organization

Plan content regarding the plan monitoring program was updated.

Forest Plan Management Direction

Content was edited to correct clerical errors.

Priority of Direction

Additional content was added to clarify that the direction in Chapter 5 assumes all laws, regulations, and policy pertaining to management of National Forest resources will be followed.

Forest Location and Description

Content was edited to correct clerical errors.

Chapter 2 – Goals and Objectives

Introduction

Content was edited to correct clerical errors.

Forest Desired Conditions

The following was removed from the fifth desired condition: "…considered threatened or endangered in the lower 48 states…" This statement was removed because it does not add any meaning, and the USFWS found wolves to not be warranted for listing under the endangered species act. Other edits to desired conditions included removing the underlining.

Ecosystem Services

No content was edited in this appendix.

Forest-wide Multiple Use Goals and Objectives

Clarifications were made regarding references to Forest-wide goals or objectives in Chapter 5. The goal or objective codes were included.

Clarifications were made to Transportation goals to ensure that access to Southeast Alaska communities is primarily achieved through Federal Highway Administration highways and roads in easements to the State of Alaska. The Forest Service will consider adding access points to facilitate implementation the State of Alaska's Southeast Transportation Plan (SATP) to tie the objective to the transportation plan.

Chapter 3 – Management Prescriptions

Land Use Designations

Land Use Designation Allocations were updated due to the refinements that were made to base GIS coverages in the FEIS.

Some wording that was deleted in the Proposed Forest Plan was restored. In the Proposed Forest Plan, some LUD Standards and Guidelines that repeated Forest Service Directive System wording (Forest Service Handbook [FSH] or Manual [FSM]) or repeated existing direction was deleted because it was not necessary. FSH 1909.12, chapter 20, section 22.1, paragraph 2f states that plan components should not should not repeat existing direction from laws, regulations, or directives. However, public comments expressed concerns about the "breadth" or expansiveness of these changes, giving the appearance of a broad-based amendment. (See FEIS Appendix H, Purpose and Need, Planning Rule sections.) Although these changes are administrative, for clarity's sake, the changes have been restored to the original language in the following LUDs: Wilderness, Research Natural Area, Municipal Watershed, Old-growth Habitat, Remote Recreation, Land Use Designation II, Wild River, Experimental Forest, Modified Landscape, Timber Production, and Minerals Overlay.

Tables that cross-reference, by resource, the Forest-wide Standards and Guidelines (Chapter 4) were edited based on the restored original language in Chapter 4 (explained below), as well as internally identified corrections that were needed in the section and subsection columns. The titles of the tables that cross-reference, by resource, the plan components (Chapter 5), were edited to reflect the title of Chapter 5 (i.e., plan content). Chapter 5 identifies "direction" for young-growth, renewable energy, and transportation systems corridors, and this word was added for clarity when cross referencing.

Chapter 4 – Standards and Guidelines

The corrections that were made to remove Forest-wide Standards and Guidelines that referenced directives (FSH or FSM), or repeated existing direction have been restored to original language for reasons as described above for Chapter 3 - Management Prescriptions. Although these changes are administrative, for clarity's sake, the changes have been restored to the original language in the following resource sections: Air, Fish, Lands, Plants, Recreation and Tourism, Soil and Water, Subsistence, Timber, Trails, Transportation, and Wildlife.

Chapter 5 – Plan Content Developed Under the 2012 Planning Rule

Introduction

Content was edited for clarity. A footnote was also added to clarify the definition for plan content. Under the Plan Components section, the definition for a standard was added for clarity.

Changes Made in the 2008 Forest Plan

This section was removed from Chapter 5 and placed in Chapter 1 of the FEIS.

Young Growth Direction

Several clarifications were made to the young-growth plan components based on final TAC recommendations (Forest Plan Appendix B), response to public comments (FEIS Appendix I), as well as internally identified clarifications. The management approach for young growth regarding the internal scientific review on young-growth timber projects that intersect with high value fish watersheds was updated based on final TAC recommendations (Forest Plan Appendix B, and public comments (see Appendix H, Specific Comments). The Scenery standard S-YG-SCENE-02 was removed based on IDT discussions with the TAC in December 2015, and the removal of this recommendation in their final recommendations. (Consult Forest Plan Appendix B.) The management approach for wildlife regarding young-growth harvest in the Old-Growth Habitat LUD to determine if Appendix K criteria could be met, was clarified in response to internal comments.

Renewable Energy Direction

Several clarifications were made to the renewable energy plan components based on public comments (FEIS Appendix H, Fish, Transportation and Utility System LUD , Renewable Energy), as well as internally identified clarifications. A management approach for renewable energy was added based on public comments that expressed concerns that renewable energy plan components may take priority over environmental protective measures. The fish standard S-RE-FISH-01 was clarified in response to public comments that expressed concerns about potential impacts of renewable energy development on fish.

Transportation Systems Corridors Direction

Clarifications were made to the transportation systems corridors plan components in response to public comments (FEIS Appendix H, Purpose and Need, Planning Rule, Road Density, Transportation and Utility System LUD , Specific Comments), as well as internally identified clarifications. In the introduction to this section, the following sentences was added for clarification and to be similar to what was stated in the renewable energy direction: Timber cut incidental to transportation systems corridors should be managed according to FSH 2409.18, chapter 80, section 84, Timber Settlement. This also helped to clarify management approach for timber. Lands standard S-TSC-LAND-02 was added in response to public comments (FEIS Appendix H, Transportation and Utility System LUD , Specific Comments), and this was also an internally identified oversight/correction, and was added to be similar to renewable energy standard S-RE-TRAN-01. Soil and Water standard S-TSC-SW-01 was changed to guideline G-TSC-SW-01 based on an internally identified correction. As a standard, this constraint would have required measuring percent of vegetation cover required to maintain soil cover. More flexibility is desired when implementing this as a guideline.

Forest-wide Plan Components

Forest Desired Conditions (Chapter 2)

The following sentence was removed from desired condition DC-04 based on an internally identified clarification: “Other management activities should not conflict with transportation operations.” Although the intent of this sentence was written to ensure that if a transportation systems corridor was likely, the Forest Service should not authorize other activities that would conflict, it was interpreted as if nothing should get in the way of a road. For this reason it was removed.

Forest-wide Multiple-use Goals and Objectives (Chapter 2)

Clarifications were made to timber objective O-TIM-01 in response to public comments (FEIS Appendix H, Purpose and Need, Specific Comments), as well as internally identified clarifications. Timber objective O-TIM-02 was rewritten in response to public comments (FEIS Appendix H, Specific Comments).

Forest-wide Standards and Guidelines (Chapter 4)

Beach and Estuary Fringe (BEACH)

The forest-wide standard S-BEACH-01 was clarified in response to public comment (FEIS Appendix H, Specific Comments), as well as internally identified clarifications.

Timber (TIM)

A forest-wide timber standard S-TIM-01 was added based on an internally identified comment. A plan for a national forest that intends to sell timber must identify the sustained yield limit (SYL) as directed by FSH 1909.12, chapter 60, section 64.31.

Chapter 6 – Implementation

Content in this chapter was edited to remove references to Appendix J and to the Tongass Strategic Plan (*Strategy for Management and Priority Setting – FY 2013 thru FY 2017*). This was an oversight in the Proposed Forest Plan. The Tongass National Forest has not updated its strategic plan. Therefore, language was added stating that the Forest Plan was consistent with several of the goals and objectives in the USDA Forest Service Strategic Plan: FY 2015-2020. The Decision Document section was removed because it repeated requirements of the following documents: 36 CFR 219.14 and FSH 1909.12, chapter 20, section 21.4. Both of these documents may change over time. It would be better for employees to check the CFR and Agency directives rather than refer to the plan content that may become out-of-date.

Chapter 7 – Glossary

This chapter was updated to remove glossary terms that had "strike throughs" in the Proposed Forest Plan. Some terms were further clarified. Additional terms were added for clarity.

Appendices

Appendix A –Timber Resource Land Suitability

Table A-1 was updated based on GIS refinements. Content was also updated based on final TAC recommendations (Forest Plan Appendix B) and in response to public comments (FEIS Appendix I, Specific Comments). Two tables were added to represent the following: 1) Estimated Vegetation Management Practices (Annual Average per Decade), and 2) Average volume outputs for the 1st and 2nd decades for Tongass National Forest planned timber sale program.

Appendix B – Tongass Advisory Committee Recommendations

Content in this appendix was replaced in its entirety by the TAC Final Recommendations (December 2015) as reflected in the Forest Plan.

Appendix C – Watershed Analysis

Content in this appendix was edited to correct clerical errors.

Appendix D – Riparian Management Area Standards and Guidelines

Content in this appendix was edited to correct clerical errors.

Appendix E – Communication Sites

Content in this appendix was edited to correct clerical errors.

Appendix F – Visual Priority Routes and Use Areas

Content in this appendix was edited to correct clerical errors.

Appendix G – Log Transfer Facility Guidelines

No content was edited in this appendix.

Appendix H – Karst and Cave Resources

No content was edited in this appendix.

Appendix I – ROS Class Standards and Guidelines

Content in this appendix was edited to correct clerical errors.

Appendix J – Special Land Designations or Classifications

Content in this appendix was edited to correct clerical errors. The Red River Research Natural Area was added as this was an oversight in the Proposed Forest Plan.

Appendix K – Old-growth Habitat Reserve Modification Procedures

No changes were made to this appendix.

Appendix L – Special Interest Areas and Experimental Forests

This appendix is now Appendix J. Additionally, the contents in this appendix were updated to reflect changes made to special interest areas and experimental forests. Land descriptions previously found in Chapter 3 were moved to this appendix to consolidate similar content and eliminate redundancy.

Organization of the Document

Organization of EIS and Associated Documents

This FEIS is organized into several chapters (Volume I) and a number of appendices (Volume II). Chapter 1, “Purpose and Need,” describes the reasons for proposing and completing a plan amendment. Chapter 2, “Alternatives,” describes the process used to develop alternatives, discusses alternatives not considered in detail, and describes the alternatives considered in detail. Finally, a comparison of these alternatives based on the key elements of the alternatives, and the significant issues is presented.

The discussions of the “Affected Environment” and the “Environmental Consequences” are combined in Chapter 3, “Environment and Effects.” This is done so the environmental consequences (effects or impacts) of the alternatives on forest resources, and the background information needed to understand these consequences, are discussed together for each resource. The focus is on effects that are related to the significant issues. Chapter 3 also includes a brief description of the physical, biological and socioeconomic settings of the Tongass National Forest.

The FEIS also includes a list of preparers; a list of agencies, organizations, and persons receiving copies of the document; a bibliography; a glossary; and an index (Chapters 4 through 8). A complete Forest Plan suitability map is provided for each of the alternatives in the Map Packet that accompanies the FEIS hard copy and CD.

Appendices to the FEIS are contained in a separate volume (FEIS Volume II). They provide more background on planning actions, certain resources and analyses, modeling and analysis techniques, and past and reasonably foreseeable projects.

In addition to the FEIS, a separate document, called the Tongass Land and Resource Management Plan (Forest Plan), has been published with this FEIS, to represent the Forest Plan under the Preferred Alternative (Alternative 5).

Additional information, maps, and published documents for the Tongass Forest Plan Amendment are contained in the Planning Record. Key documents and records are also available on the Forest Plan Amendment Web site (http://www.fs.usda.gov/goto/R10/Tongass/PlanAmend). These can also be accessed through the main Tongass Web site (www.fs.fed.us/r10/tongass). The complete Planning Record is on file at the Supervisor's Office in Ketchikan, Alaska.

CHAPTER 2
ALTERNATIVES

Alternatives

Introduction

This chapter describes and compares the alternatives considered for amending the 2008 Tongass Land and Resource Management Plan (Forest Plan). The Forest Service developed five alternatives for detailed analysis, including the no action and proposed action alternatives, in response to the significant issues. Alternatives are presented in comparative form, sharply defining the differences between each alternative and providing a basis for the rationale for eventual selection of an alternative in a decision. Chapter 2 is divided into four parts:

1. A discussion of how alternatives were developed and what constitutes an alternative;
2. A discussion of alternatives considered but eliminated from detailed study;
3. A full description of the alternatives that are considered in detail; and
4. A comparison of the alternatives considered in detail.

Color maps showing Land Use Designations (LUDs) and lands suitable for timber production are included in the *Map Folder* of the CD version of the Final Environmental Impact Statement (FEIS) and in the *Map Packet* accompanying the hard copy version. These maps are also available on the Tongass Planning Web site at www.fs.usda.gov/main/tongass/landmanagement/planning.

Alternative Development Process

What a Forest Plan Includes

Land management planning may be compared to city, county, or borough zoning. Just as areas in a community are zoned as commercial (allowing business uses), industrial (allowing factories), or residential (allowing only homes, schools, etc.), a National Forest is zoned to allow, or not allow, various uses and activities. Land management (forest plan) zoning is done through the use of land use designations (LUDs) that are applied only to National Forest System (NFS) lands on that NFS unit.

Land Use Designations specify ways of managing an area of land and the resources it contains. LUDs may emphasize certain resources (such as remote recreation or old-growth wildlife habitat) or combinations of resources (such as providing for scenic quality in combination with timber harvesting). Each LUD has a detailed *management prescription*, which includes the following elements of Forest Plan management direction: Land Use Designation Standards and Guidelines, Forest-wide Standards and Guidelines, and Plan Components[1].

Each management prescription specifies what is to be considered for site-specific project proposals, and under what conditions. Management prescriptions apply to NFS lands.

LUDs are assigned, or allocated, to specified areas of land. Under any one alternative, a given area of land will generally have only one LUD assigned to it. However, the Minerals LUD is an overlapping land allocation and can apply to a

[1] Plan components are desired conditions, goals, objectives, suitability of lands, standards, and guidelines as defined in the 2012 Planning Rule.

given piece of ground when and if a minerals Plan of Operation is approved on that piece of ground. In some other cases, two LUDs may apply to the same area, such as a Wild River LUD within a Wilderness LUD. In these cases, the more restrictive management prescription always applies. Some LUDs, such as Wilderness and LUD II, are congressionally designated and represent permanent allocations.

Forest resource use opportunities, such as timber harvesting or recreation, can be made available in different amounts. What lands to make available for timber harvest or how much of a particular kind of recreation opportunity to provide are questions that land management planning must also address. It is not always possible to provide all resource use opportunities in the amounts desired by everyone. The National Forest Management Act mandates the Forest Service to provide for multiple use and the sustained yield of the products and services obtained from the Forest.

The alternatives themselves are designed around a framework that establishes how much emphasis is placed on each of the significant issues or other issues. The FEIS alternatives are directly related to the issues described in Chapter 1. How alternatives were developed to address the issues is discussed below. The *Comparison of Alternatives* section at the end of this chapter also discusses ways in which the alternatives address the issues.

How Alternatives are Described

Each alternative for this FEIS is presented in the same format. This includes the following components:

- **Framework and Expected Outputs.** The basis for alternative design and outputs that are expected in the future under each alternative.
- **Land Use Designations.** The acreages allocated to each Land Use Designation.
- **Management Prescriptions.** Changes to the Forest Plan management direction.
- **Selected Outputs and Measures.** A summary of predicted outputs and measures associated with each alternative.

Land Use Designations

The alternatives are developed using the LUD allocations defined in the 2008 Tongass Forest Plan as the base. This base represents the current Tongass Forest Plan based on decisions made in the 2008 Record of Decision (ROD) and subsequent Forest Plan Amendments made for projects since 2008, as well as land adjustments in the National Defense Authorization Act for Fiscal Year 2015.[2]

The LUD allocations of the 2008 Tongass Forest Plan define the no action alternative (Alternative 1). The LUD allocations for the action alternatives are similar to the no action, but incorporate some adjustments. The management prescriptions for each specific LUD under the Alternative 1 are the same as under the 2008 Forest Plan (see Chapter 3 of the current Forest Plan, USDA Forest Service 2008a).

How the 2012 Planning Rule applies

The proposed plan amendment adds provisions to and modifies provisions of the 2008 Forest Plan. As explained in Chapter 6 of the amended plan, the 2012

[2] Public law No. 113-291, December 19, 2014, 128 Stat. 3729, section 3720(e)(4).

Planning Rule requirements for project consistency with plan components apply only to additions and modifications (36 Code of Federal Regulations [CFR] 219.15(d)).

This proposed amendment has met the applicable procedural requirements of the 2012 Planning Rule. That is, the amendment meets section 219.2(b)(3), to consider the best scientific information (219.3), to provide opportunities for public participation and give public notice (219.4, 219.16), to set out direction in the form of plan components (219.7(e)), to amend plans in accordance with a specific process (219.13), to include specific information in a decision document (219.14), to state whether or not projects authorized at the time of amendment may continue without change (219.15), and to provide an objection opportunity (parts 219.50-219.62).

The responsible official has determined that for this amendment only a part of the substantive provisions of 36 CFR 219.11 apply. The proposed plan amendment:

1. Identifies specific young-growth stands as suitable for timber production using the provisions of 36 CFR 219.11(a). Such stands include young growth in the beach and estuary fringe, riparian management areas, and in the Old-Growth Habitat LUD.
2. Includes plan components specific to guide young-growth harvest for timber production and other multiple-use purposes using the provision of 36 CFR 219.11(b).
3. Includes plan components specific to guide young-growth harvest for purposes other than timber production including improving or maintaining fish and wildlife habitat using the provision of 36 CFR 219.11(c).
4. Includes plan components specific to guide young-growth harvest to constrain timber harvest consistent with protection of soils, watershed, fish, wildlife, and scenic resources using the provisions of 36 CFR 219.11(d). The plan amendment does not change the plan direction for old-growth timber harvest.
5. Includes a standard for young-growth harvest before the culmination of mean annual increment to recognize the acreage limitation of subsection (e)(4)(B) of Public Law 113–291, Sec. 3002, subsection (e)(4)(A).

Some people may question this determination of limiting the substantial applicable requirements to section 219.11. However, the responsible official has the discretion to determine whether and how to amend the plan. The responsible official also has discretion to determine the specific changes to propose and approve. The rule provides that "[p]lan amendments may be broad or narrow, depending on the need for change," and that "[t]he responsible official has the discretion to determine whether and how to amend the plan" (36 CFR 219.13(a)). The rule reinforces the principle by providing that the rule "does not compel a change to any existing plan" (36 CFR 219.17 (c)).

Note that the first paragraph of 36 CFR 219.11 states that a plan must meet timber-related requirements "while meeting the requirements of §§ 219.8 through 219.10," and it has been argued that an amendment applying either of these sections would require a transformation of a plan to meet all the substantive requirements of the rule. Clearly, this phrase is intended for new or revised plans; otherwise, a simple, narrow proposal to change a plan developed under the 1982 rule would be impossible.

Future Project Consistency with the Amended Plan

Project consistency with the amended plan is complex. Plan direction that is unchanged by this amendment must be consistent in a different way than new plan direction added by this amendment.

Plan direction in the 2008 Forest Plan (e.g., standards and guidelines) was developed under the 1982 Planning Rule (47 Federal Register [FR] 43026). The 1982 Planning Rule did not provide specific criteria to evaluate consistency of projects or activities with the plan. Forest Service policy was that consistency could only be determined with respect to standards and guidelines, or just standards because an individual project alone could almost never achieve objectives and desired conditions (77 FR 21241, April 9, 2012)

The 2008 Forest Plan defines a guideline as "a preferred or advisable course of action or level of attainment designed to promote achievement of goals and objectives." Standards are mandatory and guidelines are discretionary in the 2008 Forest Plan.

The 2012 Planning Rule includes specific requirements for plan components (36 CFR 219 parts 219.8–219.11) and definitions for plan components are rigid. The 2012 Planning Rule defines a guideline as a constraint on project and activity decision-making that allows for departure from its terms, so long as the purpose of the guideline is met. Under the 2012 Planning Rule, standards and guidelines are both mandatory constraints and projects and activities must be consistent with the applicable standards and guidelines. The 2012 Planning Rule also includes consistency provisions at 36 CFR 219.15(d) that apply only to plan components developed under the 2012 Planning Rule. Therefore, any substantial changes to plan direction must be consistent with the 2012 Planning Rule.

To avoid confusion, most changes to plan direction are based on the 2012 Planning Rule and are written as plan components and are found in Chapter 5 of the Forest Plan. The plan direction in the 2008 Forest Plan that is not changed, for example Wilderness standards and guidelines, will retain standards (*mandatory*) and guidelines (*optional*) as defined by the 1982 Planning Rule.

Alternative Development

The proposed action (Alternative 2) was developed to maximize or emphasize the percentage of the volume coming from young growth as early as possible, while minimizing any potential effects on the old-growth conservation strategy and other resources, and to make the development of renewable energy resources more permissible in the plan area (see Chapter 1 Purpose and Need). Alternatives to the proposed action were developed in response to the significant issues (see Chapter 1, Issues). Ten alternatives were considered as part of the alternative development process. These include alternatives recommended in scoping comments, other comments, and developed internally by the plan amendment interdisciplinary team (IDT). Of these, five alternatives were eliminated from detailed study and are discussed in the following section (*Alternatives Eliminated from Detailed Study*). Five alternatives (including the proposed action) are considered in detail in this FEIS. They are designed to provide a range of reasonable ways to address the Purpose and Need.

Basic tools used in the development of the alternatives include recent timber demand projections (Pacific Northwest Research Station 2016), Tongass GIS databases, and the existing inventory of roadless lands (based on the 2001 Roadless Rule). Maintaining the integrity of the old-growth conservation strategy was also a major consideration in alternative development. Alternative proposals from other agencies or non-governmental organizations were considered along with alternatives developed internally by the plan amendment IDT.

Alternatives Eliminated from Detailed Study

Develop an Amendment using the 1982 Planning Rule Provisions

The 2012 Planning Rule gave the discretion to the Agency to initiate a plan amendment using the 1982 Planning Rule provisions for 3 years after May 9, 2012 (36 CFR 219.17(b)(2)). The Forest Service decided to use the 2012 Planning Rule provisions to amend the Forest Plan since that will best segue into the next revision of the plan. Since the scope of this amendment is narrow, it is less complicated to address and compare alternatives in a plan amendment under one set of regulations. Having one or more alternatives that used the 1982 Planning Rule provisions would make comparing these alternatives to the alternatives under the 2012 Planning Rule provisions more difficult since the definitions of plan components and their intent have changed from the 1982 Planning Rule. Most notably how standards and guidelines are defined and used (see discussion above in Future Project Consistency with the Amended Plan section). Therefore, any alternative that proposed using the 1982 Planning Rule provisions was removed from detailed consideration. Alternative 1 (no action) represents current management which follows the 1982 Planning Rule provisions in their entirety.

Alaska Mental Health Trust Land Exchange

Comments suggested that the proposed Alaska Mental Health Trust Land Exchange be included as an action common to all alternatives in the plan amendment. In determining whether the proposed land exchange fits within the scope of the EIS, the Forest Service considered three types of actions: connected, similar, and cumulative actions (40 CFR 1508.25).

The proposed land exchange is not a connected action (i.e., an action that is “closely related” to the proposal and alternatives, and provides a basis for evaluating their environmental consequences together). Connected actions automatically trigger other actions, they cannot or will not proceed unless other actions have been taken previously or simultaneously, or they are interdependent parts of a larger action and depend on the larger action for their justification.

The proposed land exchange is not similar to the action being proposed in this plan amendment. For these reasons, the proposed Alaska Mental Health Trust Land Exchange is not analyzed in detail in an alternative.

In terms of being a cumulative action, when viewed with the proposed actions for the plan amendment, the proposed Alaska Mental Health Trust Land Exchange is considered a reasonably foreseeable action and, therefore, is discussed and considered in this EIS.

State of Alaska Alternative

The State of Alaska proposed an alternative which was modeled and analyzed intensively before removing it from detailed consideration. Similar to Alternative 1 (no action), no commercial harvest would be allowed in non-development LUDs, Beach and Estuary Fringe, Riparian Management Areas (RMAs), or high-vulnerability karst. In addition, this alternative would follow the timber sale program adaptive management strategy.

This alternative differs from Alternative 1 in that the Timber Production, Modified Landscape, and Scenic Viewshed LUDs would be consolidated into a single LUD and labeled "Development LUD." Additionally, timber harvest and road construction would be allowed in 2001 Roadless Rule inventoried roadless areas.

Forest Plan direction for scenery (scenic integrity objectives [SIOs]) would not be established for areas within the Development LUD so that harvest could occur without specific constraints (e.g., standards and guidelines) to minimize scenery effects. However, this alternative would include a mitigating factor for scenery and wildlife. The factor limits the amount of area in a large watershed that can be young-growth forest; the total acreage in even-aged stands younger than 150 years would be limited to one-third of the total acreage of forest land within each Value Comparison Unit (VCU). The elimination of the requirement to harvest no earlier than at 95 percent of culmination of mean annual increment (CMAI) (see Alternative 1 description) would not be incorporated into this alternative.

This alternative was modeled using Woodstock (Walters 1993), a forest management linear programming modeling system that accommodates binary search and Monte Carlo simulation, in order to determine how quickly this alternative could transition to a harvest level dominated by young growth (see Appendix B). Modeling results indicated that transitioning to a point where about 41 million board feet (MMBF) of young growth and 5 MMBF of old growth could be harvested each year would require just over 30 years. The amount of young-growth timber on lands suitable for timber production in this alternative would be slightly less than in Alternative 1. Removal of the scenery standards would increase young-growth harvest in the early years. Not eliminating the CMAI requirement would decrease young-growth harvest, relative to Alternative 1, which would allow elimination of the CMAI requirement.

This alternative does not meet the purpose and need because it would not transition in 10 or 15 years and, in fact, would not increase the transition speed, relative to Alternative 1. Therefore, this alternative was not carried forward for detailed analysis in the EIS.

Immediate End to Old-growth Logging

Several scoping comments suggested an alternative that transitions away from old-growth management and into young-growth management immediately. Such an abrupt change would result in substantial adverse effects on the timber industry of Southeast Alaska for two reasons:

1. the abrupt change would make it difficult or impossible for mills to quickly re-tool so they could process young growth; and
2. the availability of economically viable young growth is currently limited and, as a result, the Forest Service would likely offer substantially less timber volume than the projected demand (Table 2-1).

Therefore, this alternative was eliminated from detailed analysis because it does not meet the purpose and need. Specifically, ending old-growth logging immediately would not meet the need for maintaining a viable timber industry that provides jobs and opportunities for Southeast Alaska residents.

Transition to Limited Young-Growth Logging in Five Years

Some comments requested a 5-year transition. In a detailed proposal, a constraint was added that the total initial volume would be 35 MMBF per year and the old-growth portion of that would steadily decrease over five years to a final volume of 3.5 MMBF or less per year. The goal is to increase young-growth volume during this 5-year period to maintain the total volume at 35 MMBF per year. Total volume is not to exceed 35 MMBF per year after the transition and is expected to be made up of 31.5 MMBF of young growth and 3.5 MMBF of old growth. This alternative was modeled using Woodstock (Walters 1993), a forest management linear programming modeling system that accommodates binary search and Monte Carlo simulation, and extensively analyzed (Appendix B).

To obtain this volume, the alternative would allow old-growth harvest only in Timber Sale Program Adaptive Management Strategy Phase I lands of the 2008 Forest Plan and outside of inventoried roadless areas. Similarly, young-growth harvest would also be allowed only in Phase I lands and only in Development LUDs outside of inventoried roadless areas; no harvest would be permitted in Beach and Estuary Fringe, RMAs, or in any lands identified as low, medium, or high vulnerability karst. This alternative would allow harvest of stands at ages younger than 95 percent of CMAI. In order to obtain sufficient young-growth volume to transition in five years, this alternative harvests stands as young as 55 years of age. As a result, a large number of trees in these stands produce only one log per tree, resulting in higher logging costs and smaller wood producing less revenue. This alternative also prioritizes the young-growth stands that may be harvested to achieve sufficient volume to maintain 35 MMBF per year.

This alternative does not meet the purpose and need for these reasons:

- The phase-down of old growth would result in too rapid of a transition to allow the timber industry time to retool. The purpose and need for this amendment, which relies on the Secretary's July 2013 memo, identifies a 10- to 15-year period for industry to adapt.
- Further, this alternative would not allow the Forest Service sufficient time to offer enough economic old-growth and young-growth volume during the next 10 or more years to maintain the current timber industry (Table 2-1), even if it could adapt that rapidly.
- This alternative is the most restrictive of the alternatives considered in terms of which young-growth stands may be harvested, and even without these restrictions, there is insufficient economic young-growth volume available to produce 31.5 MMBF per year by the end of Year 5.
- Harvesting 55-year-old trees does not appear to be practical or economic in Southeast Alaska. The market for large volumes of young-growth logs has not yet been demonstrated and this is especially true for small logs from 55-year-old stands.
- Recent experience and modeling indicates that the majority of trees in 55-year-old stands will produce only one log per tree. This results in higher logging costs and substantially lower revenues per acre (smaller diameter logs and fewer logs per acre).
- Stands producing only one log per tree, would result in much higher levels of slash (due to the fact that there would be many logs left behind that are almost long enough, but not quite). These slash levels may produce dense slash on

the forest floor with negative effects on regeneration, wildlife movement and forage, and/or recreation and scenery.

- Based on current demand projections, a total of 35 MMBF is insufficient to maintain the current industry (Table 2-1).

Therefore, this alternative was eliminated from detailed analysis because it does not meet the purpose and need.

In an attempt to modify this alternative so that it would be economic and meet the purpose and need, the interdisciplinary team changed its volume requirements to be the same as the alternatives analyzed in detail (i.e., 46 MMBF per year total volume, emphasizing young growth as much as possible, with old growth declining to a maximum of 5 MMBF per year). In addition, the minimum stand ages for harvest were changed to 65 years for high site and 75 years for lower site stands.

After modeling, it was observed that the volumes produced by this modified alternative were similar to the volumes produced by Alternative 4 (see Alternatives Considered in Detail section). Alternative 4 is very similar to this modified alternative in terms of its framework; the primary difference is that Alternative 4 allows commercial thinning in the Beach and Estuary Fringe. This small difference was judged to be insufficient to justify inclusion of an additional alternative so the alternative was eliminated from detailed evaluation.

Alternatives Considered in Detail

Table 2-1 displays the projected timber harvest under a baseline and three additional demand scenarios developed for the Tongass National Forest by Daniels et al. (2016). Under these demand scenarios the harvest projection would be 42 MMBF in 2016 and would increase under all scenarios to maximums ranging from 46 to 76 by 2030. The scenarios are described in detail in the Economic and Social Environment section of this EIS (see Tables 3.22-8 to 3.22-10 and Figures 3.22-7 and 3.22-8 and associated text).

Table 2-1
Projected Timber Harvest on the Tongass under the Baseline Model and Scenarios 1, 2, and 3 (MMBF)

Year	Baseline	Scenario One	Scenario Two	Scenario Three
2015	40.9	40.9	40.9	40.8
2016	41.6	41.6	41.6	41.6
2017	42.3	42.3	43.4	42.5
2018	43.1	43.1	46.3	43.3
2019	43.8	43.8	49.2	44.1
2020	44.5	44.5	52.1	45.0
2021	45.3	45.3	55.1	45.8
2022	46.0	46.0	58.0	46.7
2023	46.7	46.7	60.9	47.5
2024	47.5	47.5	63.8	48.4
2025	48.2	44.0	63.0	45.0
2026	48.9	44.5	65.7	45.6
2027	49.7	45.0	68.4	46.2
2028	50.4	45.5	71.0	46.8
2029	51.1	45.9	73.7	47.4
2030	51.9	46.4	76.4	47.9

In past Forest Plan revisions and amendments, varying demand scenarios were used to develop alternatives, including scenarios that allowed for growth and expansion of the current industry. In this amendment, the purpose and need identifies the need to expedite the transition away from old-growth timber harvesting and towards a forest products industry that uses predominantly second-growth – or young-growth – forests. Therefore, examination of alternatives at levels above projected demand is not warranted because these would require expansion of old-growth harvest levels, at least during the next 10 to 15 years. However, over the longer term, expansion of the timber industry is an option as more and more young growth becomes economic to harvest.

Therefore, Alternatives 1 through 5 were designed to correspond with current demand projections and produce a projected timber sale quantity (PTSQ)[3] of about 46 MMBF per year during the next 15 years, with old growth making up a decreasing percentage of the total. Old-growth volume would continue to decrease until it reaches about 5 MMBF per year and it would remain at that level, to support limited small timber operators. As more young growth becomes economic to harvest, the PTSQ would be allowed to increase. In no case, would the harvest level be allowed to exceed the sustained yield limit (SYL) (see Glossary and the *Timber* section of this EIS).

Even though Alternative 1 (no action) represents current management, it is modeled to follow the same volume production pattern. The July 2013 Secretary's memo identified a need to change direction in the 2008 Forest Plan (see Purpose and Need in Chapter 1) and without this amendment, the Tongass would be transitioning toward young-growth and away from old-growth harvest.

Provisions Common to all Alternatives

Under all alternatives, there is flexibility in terms of when young-growth stands may be harvested. Under Public Law 113-291, up to 15,000 acres of young growth may be harvested from 2016 through 2025, in stands less than 95 percent of CMAI. This CMAI flexibility may continue after 2025 (with annual maximums); however, the total acreage harvested at less than 95 percent of CMAI cannot exceed 50,000. In addition, young-growth sales under this provision may not be offered unless they represent non-deficit sales.[4] There is flexibility in NFMA to allow a continuation of harvesting at younger ages beyond 2025.

LUD Changes Common to the Action Alternatives

The LUD allocations for each alternative are described in the following alternative-specific descriptions. The LUDs for Alternative 1 (no action) are the same as the LUDs of the current Forest Plan. The LUDs of the action alternatives are different from Alternative 1 LUDs because of Old-growth Habitat LUD changes. Under Public Law 113-291, approximately 70,000 acres of NFS land were conveyed to Sealaska Corporation and an additional 152,000 acres were converted to LUD II. As a result of the land conveyance, old-growth reserves (OGRs) in 16 VCUs were affected. Beginning in February 2015, an interagency review team of biologists worked to develop a biologically preferred option for modifying these OGRs that meets Forest Plan Appendix K criteria and to document why other proposals are not recommended. In September 2015, the interagency review team produced a biologically preferred option (see Appendix E), which was incorporated into each of

---

[3] PTSQ is a new term defined in FSH 1909.12, Chapter 60. The term allowable sale quantity (ASQ) is not used with the 2012 planning rule.

[4]Any sale of trees pursuant to the authority granted under subparagraph (A) shall not— (iii) be advertised if the indicated rate is deficit (defined as the value of the timber is not sufficient to cover all logging and stumpage costs and provide a normal profit and risk allowance under the appraisal process of the Forest Service) when appraised using a residual value appraisal.

the action alternatives. Therefore, the Old-growth Habitat LUD acres vary between Alternative 1 and the action alternatives (Alternatives 2, 3, 4, and 5).

In addition, the Transportation and Utility Systems LUD would be removed under Alternatives 2, 3, 4, and 5. The LUD management prescription would be replaced by plan components under Alternatives 2, 3, 4, and 5 and would provide management direction for renewable energy and transportation systems corridors (see Chapter 5 in the proposed Forest Plan).

Forest Plan Direction Common to the Action Alternatives

Under Alternatives 2, 3, 4, and 5, Forest Plan direction in Chapter 5 that is common is presented in Appendix F and includes:

Young-growth Direction

(Desired Conditions) DC-YG-01, DC-YG-02, DC-YG-03, DC-YG-05; DC-YG-KC-01, DC-YG-RIP-01, DC-YG-SW-01

(Suitability of Lands) SUIT-YG-BEACH-01

(Objectives) O-YG-01, O-YG-02, O-YG-03

(Goals) GL-YG-02, GL-YG-03, GL-YG-04, GL-YG-05

(Standards) S-YG-FAC-01, S-YG-LAND-01, S-YG-REC-01, S-YG-SW-01

Management Approaches for Karst and Cave Resources, Recreation and Tourism, Soil and Water, and Timber

Renewable Energy Direction

All plan direction, except S-RE-SCENE-01 would not apply to Alternative 2. Under Alternative 2, the following standard would be applied:

S-RE-SCENE-01: Apply the forest-wide standards and guidelines of the Very Low Scenic Integrity Objective (SIO) to renewable energy sites.

All Management Approaches - Renewable Energy, Scenery, and Wildlife

Transportation Systems Corridors Direction

All plan direction.

All Management Approaches - Fish, Forest Health, Recreation and Tourism, Scenery, Timber, and Wildlife

Forest-wide Direction

All plan direction.

Alternative 1 (No Action)

Framework and Expected Outputs

The no action alternative represents current management direction (2008 Forest Plan) and includes the application of the Roadless Area Conservation Rule (2001 Roadless Rule) (36 CFR 294 Subpart B). As noted above, it also follows the direction provided in the July 2013 Secretary's memo, which identified a need to transition away from old-growth harvest. Under this alternative, timber harvest would follow the existing timber sale program adaptive management strategy (USDA Forest Service 2008c). A color map showing the phases in this strategy is provided along with the FEIS. Timber harvest is currently restricted to areas within Phase 1 of the strategy and timber harvest would have to reach 100 MMBF for two years before harvest could occur in Phase 2 areas. Timber management would be restricted to the development LUDs and would remain outside of inventoried roadless areas. No commercial harvest would be allowed in beach and estuary fringe or RMAs. All other 2008 Forest Plan management direction would be followed.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. However, beyond that, the minimum harvest age would return to 95 percent of CMAI except under exemptions provided by the NFMA.

Alternative 1 would result in the most old-growth harvest among the alternatives over both 25-year and 100-year periods. Table 2-2 summarizes the key elements of Alternative 1 and Table 2-3 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce about 8 MMBF of young growth and 38 MMBF of old growth per year during the first 10 years (Figure 2-1). From Year 10 through Year 25, it is projected to produce about 15 MMBF of young growth and 31 MMBF of old growth per year. At about Year 32, the young-growth harvest is expected to increase to about 41 MMBF and the old-growth harvest would decrease to 5 MMBF per year. The young-growth harvest is expected to continue to increase at a rapid rate after Year 32 and is expected to reach an upper limit of about 133 MMBF in about Year 38. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Over 80 percent of the Forest would remain in a natural state including inventoried roadless areas. Old-growth conditions would prevail on lands within these roadless areas. Old-growth harvest would continue at a declining rate, compared with current conditions, while young growth harvest would increase as young-growth stands mature and become increasingly economic. A predictable and sustainable supply of forest products would contribute to a limited integrated timber industry in Southeast Alaska for the foreseeable future. A mixture of old growth, recently harvested areas, and various ages of young growth occurs within roaded areas. Recreation, tourism, and subsistence opportunities emphasize natural setting types, although roaded opportunities expand slightly from current conditions due to construction of additional roads outside of inventoried roadless areas.

Table 2-2
Key Elements of Alternative 1

Old-growth Harvest

- Follows 2008 Forest Plan Timber Sale Program Adaptive Management Strategy for Phases 1, 2, and 3
- No harvest allowed in Inventoried Roadless Areas

Young-growth Harvest

- Allows harvest in Development LUDs, including Clearcutting
- Allows no harvest in Natural Setting LUDs
- Allows no harvest in Inventoried Roadless Areas
- Allows no commercial harvest in Beach and Estuary Fringe or in RMAs
- There is flexibility to harvest 50,000 acres at a younger age than 95% of CMAI per Public Law 113-291
- Scenery standards (SIOs) would not be modified for young growth

LUD Changes

- None

Other New Plan Direction (Forest Plan Chapter 5)

- None

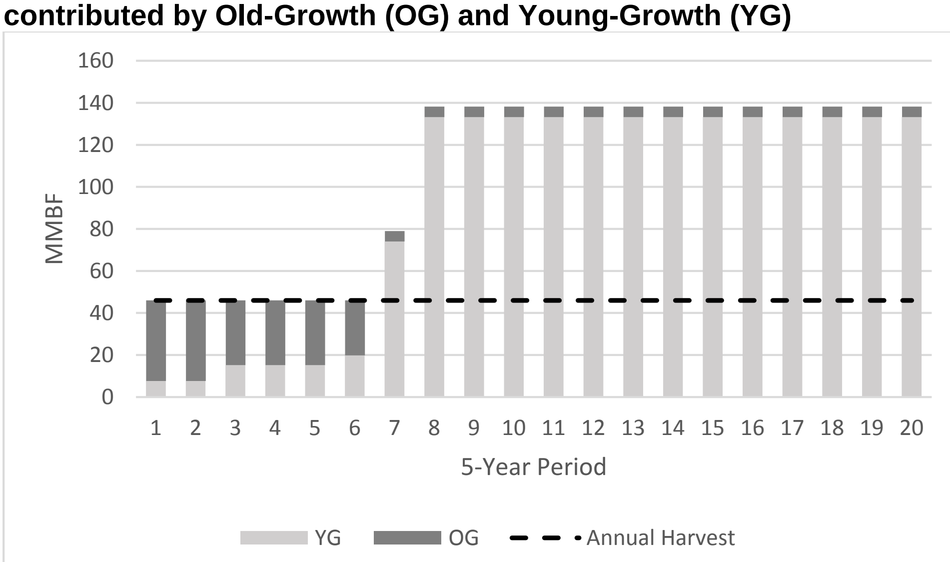
Land Use Designations

If Alternative 1 is selected, the LUD allocation acres and the suitable acres shown in Table 2-3 would result. Figure 2-2 shows the distribution of LUDs across the Tongass under Alternative 1 according to four LUD groups (see Table 2-3 for definitions of the LUD groups). Color maps showing LUDs, the Timber Sale Program Adaptive Management Strategy, and lands suitable for timber production under Alternative 1 are included in the *Map Folder* of the CD version of the FEIS and in the *Map Packet* accompanying the FEIS hard copy.

Management Prescriptions

Under Alternative 1, the management prescriptions identified in the 2008 Forest Plan would continue to be in effect. These represent the 2008 Land and Resource Management Plan (USDA Forest Service 2008a).

Figure 2-1
Projected Timber Sale Quantity (average annual harvest) over 100 Years in 5-Year Periods under Alternative 1 showing Volume (MMBF) contributed by Old-Growth (OG) and Young-Growth (YG)



Selected Outputs

Table 2-4 displays selected outputs and other measures associated with this alternative.

Table 2-3
Land Use Designation, Suitable, and Projected Harvest Acres for Alternative 1[1]

Land Use Designation Group	Acres Allocated
Wilderness LUD Group[2]	5,922,131
Natural Setting LUD Group – No YG Harvest [3]	7,464,989
Natural Setting LUD Group – With YG Harvest [4]	0
Development LUD Group[5]	3,367,736
Total National Forest System lands	16,755,685[6]
Suitable Acres	**Acres Allocated**
Suitable Acres-Old Growth	329,615
Suitable Acres-Young Growth	263,904
Projected Harvest	**Acres Allocated**
Projected Harvest Acres during first 25 Years	
Old Growth	38,527
Young Growth	9,669
Projected Harvest Acres during first 100 Years	
Old Growth	62,851
Young Growth	209,882

1 When more than one LUD is applied to the same area, such as a Special Interest Area within Wilderness, only the acreage of the more restrictive LUD is included. The acreage for the Minerals LUD would be 249,570; these acres are not included in the table because the Minerals LUD is an overlay. No acreages have been calculated for the Transportation and Utility Systems LUD because it is a series of corridors with undefined width and imprecise locations. Totals may not exactly equal the sum of individual entries due to rounding.

2 Includes Wilderness and National Monument LUDs.

3 Includes all Natural Setting LUDs: LUD II, Research Natural Area, Municipal Watershed, Wild, Scenic, and Recreational River, Old Growth Habitat, Special Interest Area, Remote Recreation, and Semi-Remote Recreation LUDs.

4 No LUDs meet these criteria.

5 Includes Timber Production, Modified Landscape and Scenic Viewshed LUDs. Experimental Forest is also included, even though lands are not suitable for timber production.

6 Includes 829 acres of unlabeled GIS slivers.

Figure 2-2
Wilderness, Natural Setting (with and without Young-growth Harvest), and Development LUDs on the Tongass National Forest under Alternative 1

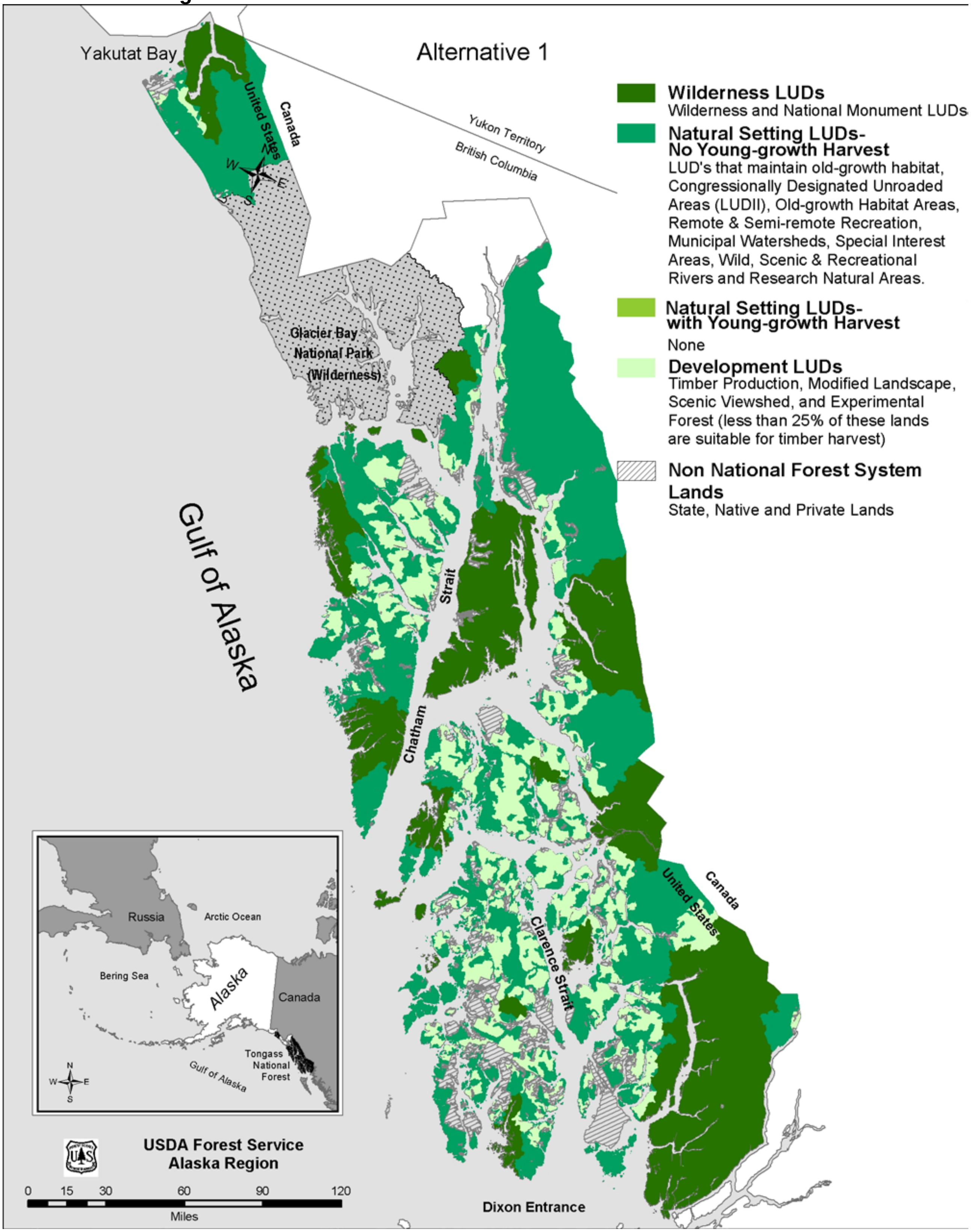


Table 2-4
Selected Outputs and Measures Associated with Alternative 1[1]

Resource/Category	Output/Measure
Percent in Wilderness LUD Group	35%
Percent in Natural Setting LUD Group with No YG Harvest	45%
Percent in Natural Setting LUD Group with YG Harvest	0%
Percent in Development LUD Group	20%
Estimated Harvest Area (acres) after 100 years in Inventoried Roadless Areas – Old growth and Young Growth combined	0
Percent of Existing Productive Old Growth Harvested after 100 years	1.3%
Percent of Original (1954) Productive Old Growth remaining after 100 Years (92% in 2016)	90%
Estimated Forest Land Suitable for Timber Production–Old Growth (acres)	328,615
Estimated Forest Land Suitable for Timber Production–Young Growth (acres)	263,904
Long-term Projected Timber Sale Quantity (PTSQ)[2] in MMBF	138
Estimated Years until maximum PTSQ is achieved	38
Estimated Years until full transition is achieved (i.e., 41 MMBF of Young Growth is harvested)	32
Maximum New Road Construction after 25 Years/100 Years (miles)	281/944
Maximum Road Construction on Decommissioned Road Grades after 25 Years/100 Years (miles)	64/428
Maximum New Road Reconstruction after 25 Years/100 Years (miles)	160/887

[1] Totals may not add exactly due to rounding.
[2] PTSQ volumes expressed as annual averages volumes.

Alternative 2 (Proposed Action)

Framework and Expected Outputs

As in Alternative 1, this alternative would follow the existing timber sale program adaptive management strategy for old-growth harvest (USDA Forest Service 2008c) (see color map accompanying the FEIS); as a result, all old-growth harvest would come from Phase 1, at least during the first 15 years or so. After harvest volume exceeds 100 MMBF for two years, it is possible that limited old-growth harvest could occur in Phase 2 areas. Young-growth harvest could come from any phase of the strategy at any time. The portions of inventoried roadless areas (IRAs) that were roaded before the 2001 Roadless Rule and during the 2001 Roadless Rule exemption period for the Tongass would be available for young-growth and old-growth harvest. This would require rulemaking to modify 36 CFR 294.13(b)(4). If selected, no harvest could occur in IRAs until rulemaking is completed. No Roadless Area harvest outside of these roaded areas would be allowed.

Alternative 2 would differ substantially from Alternative 1 in terms of lands identified as suitable for young-growth timber production. Young-growth management would be allowed in both development and natural setting LUDs (except for Congressionally designated and administratively withdrawn areas, such as Wilderness, and islands less than 1,000 acres in size), in beach and estuary fringe, RMAs outside of Tongass Timber Reform Act (TTRA) buffers, and high-vulnerability karst.

Young-growth management may include clearcutting in all areas, except in RMAs and on high-vulnerability karst, where only commercial thinning (up to 33 percent basal area removal) would be allowed. After 15 years, clearcutting would no longer be allowed in the beach and estuary fringe and only commercial thinning would be allowed. In addition, in beach and estuary fringe, the intent is to maintain an approximate 1,000-ft wide protected corridor adjacent and inland of any even-aged harvest unit to function as an alternate, low elevation, natural habitat corridor.

Scenery standards for young-growth management would be relaxed. The SIOs would be designated as Very Low for all LUDs and distance zones.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. Scenery standards for renewable energy development would be relaxed to Very Low for all LUDs and distance zones.

Among the action alternatives, Alternative 2 would provide the largest amount of timber volume (old growth and young growth combined), including the largest amount of young-growth volume from lands suitable for timber production. It would result in the smallest amount of old growth timber volume over both 25-year and 100-year periods. Table 2-5 summarizes the key elements of Alternative 2 and Table 2-6 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

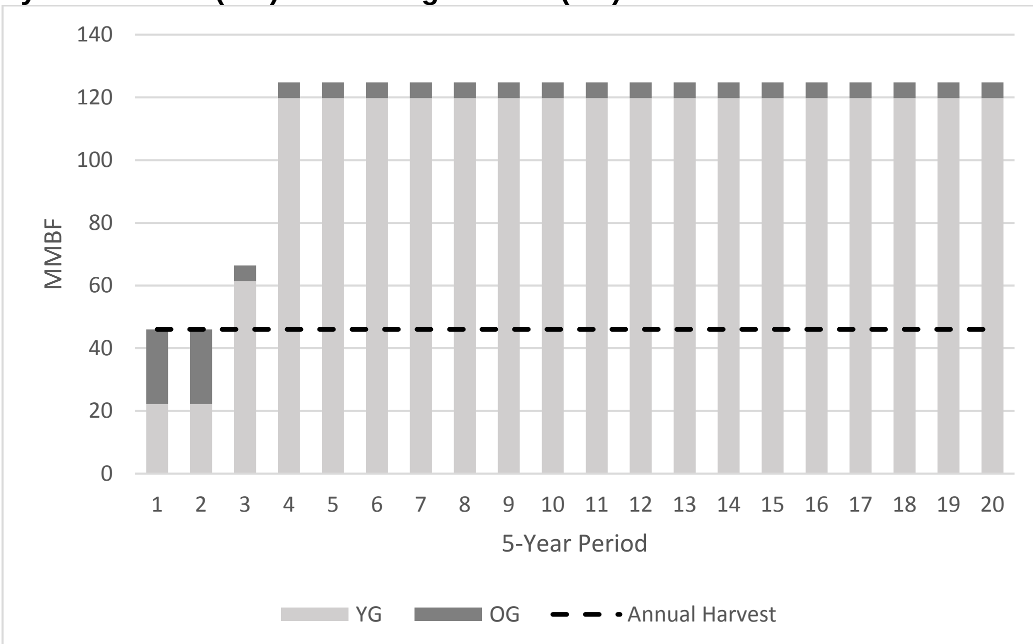
This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1), emphasizing young growth and minimizing old growth. As such, it is expected to produce an average of about 22 MMBF of young growth and 24 MMBF of old growth per year during the first 10 years (Figure 2-3). From Years 11 through 15, Alternative 2 is projected to produce an average of 61 MMBF of young growth and 5 MMBF of old growth per year. Alternative 2 would likely reach a full transition harvest of 41 MMBF of young growth about Year 12. Young-growth harvest is expected to continue to increase at a rapid rate after Year 12 and is expected to reach an upper limit of about 120 MMBF in Year 17. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Over 80 percent of the Forest would remain in a natural state. The portions of the IRAs that were roaded before the 2001 Roadless Rule and during the 2001 Roadless Rule exemption period for the Tongass would be available for harvest after rulemaking. Old-growth conditions would prevail on forest lands within IRAs that have not been roaded. Following the transition period, the young-growth based timber industry would have the potential for substantial growth as more young-growth stands become economic to harvest. Young growth may be harvested by clearcutting and other prescriptions in natural setting LUDs and beach and estuary fringe, but only commercial thinning (33 percent basal area removal) would occur in RMAs outside of TTRA buffers. A small old-growth based industry would continue after transition with an annual volume of about 5 MMBF being offered through the small and micro sale programs. A mixture of old growth, recently harvested areas, and various ages of young growth would occur within the roaded IRAs. Recreation, tourism, and subsistence opportunities would continue to emphasize natural setting types, although some additional roaded opportunities would be developed. Scenery impacts would occur in some visually sensitive areas because scenery standards for young growth harvest would be Very Low.

Land Use Designations

If Alternative 2 is selected, the LUD allocation acres and the suitable acres shown in Table 2-6 would result. Figure 2-4 shows the distribution of LUDs across the Tongass under Alternative 2 according to four LUD groups (see Table 2-6 for definitions of the LUD groups). Color maps showing both LUDs and lands suitable for timber production for Alternative 2 are included in the *Map Folder* of the CD version of the FEIS and in the *Map Packet* accompanying the FEIS hard copy.

Figure 2-3
Projected Timber Sale Quantity (average annual harvest) over 100 Years in 5-Year Periods under Alternative 2 showing Volume (MMBF) contributed by Old-Growth (OG) and Young-Growth (YG)



Management Prescriptions

The proposed Forest Plan that accompanies this EIS represents the Forest Plan if Alternative 5 (Preferred Alternative) were to be selected. Many of the changes reflected in the Forest Plan are consistent with Alternative 2, but some are not. The similarities and differences among the alternatives, with respect to the Forest Plan, are detailed in Appendix F to this EIS.

Selected Outputs

Table 2-7 displays selected outputs and other measures associated with this alternative.

Table 2-5
Key Elements of Alternative 2

Old-growth Harvest

- Allows harvest only within Phase 1 of the 2008 Timber Sale Program Adaptive Management Strategy.
- The portions of IRAs that were previously roaded would be available for harvest after rulemaking.

Young-growth Harvest

- Allows harvest in Development LUDs, including clearcutting, and entry into all phases of the Timber Sale Program Adaptive Management Strategy without regard to harvest volumes.
- Allows harvest in natural setting LUDs, except for Congressionally designated and administratively withdrawn areas and islands smaller than 1,000 acres.
- The portions of IRAs that were previously roaded would be available for harvest after rulemaking.
- Commercial harvest is allowed in beach and estuary fringe, in high-vulnerability karst, and in RMAs outside of TTRA buffers (details below).
- Clearcutting is allowed on all lands suitable for timber production (including natural setting LUDs), except RMAs and high-vulnerability karst where only commercial thinning is allowed. The maximum removal in RMAs outside of TTRA buffers is 33 percent (basal area). Clearcutting in beach and estuary fringe is not allowed after 15 years.
- In beach and estuary fringe, the intent is to maintain an approximate 1,000-ft wide protected corridor adjacent and inland of any even-aged harvest unit.
- There is flexibility to harvest at a younger age than 95 percent of CMAI throughout the life of the Plan.
- Scenery standards would be relaxed to Very Low SIO for young-growth harvest

LUD Changes

- Old-growth Habitat LUDs are modified to correspond with the biologically preferred option in areas where they were adversely affected by land conveyances and other changes resulting from Public Law 113-291.
- The Transportation and Utility Systems LUD is removed.

New Plan Direction (Forest Plan Chapter 5)

- Young-growth plan components added to Forest Plan.
- Renewable Energy plan components added to Forest Plan (including relaxation of SIO to Very Low for renewable energy development).
- Transportation Systems Corridors plan components added to Forest Plan.
- Forest-wide plan direction added to Forest Plan.

Table 2-6
Land Use Designation, Suitable, and Projected Harvest Acres for Alternative 2[1]

Land Use Designation Group	Acres Allocated
Wilderness LUD Group[2]	5,922,131
Natural Setting LUD Group – No YG Harvest[3]	1,005,922
Natural Setting LUD Group – With YG Harvest[4]	6,467,437
Development LUD Group[5]	3,359,367
Total National Forest System lands	16,755,685[6]
Suitable Acres	**Acres Allocated**
Suitable Acres-Old Growth	349,380
Suitable Acres-Young Growth	374,714
Projected Harvest	**Acres Allocated**
Projected Harvest Acres after 25 Years	
Old Growth	15,027
Young Growth	63,787
Projected Harvest Acres after 100 Years	
Old Growth	32,609
Young Growth	335,344

1 When more than one LUD is applied to the same area, such as a Special Interest Area within Wilderness, only the acreage of the more restrictive LUD is included. The acreage for the Minerals LUD would be 249,570; these acres are not included in the table because the Minerals LUD is an overlay. No acreages have been calculated for Renewable Energy and Transportation Systems Corridors because the projects are an undefined width and imprecise locations and not all renewable energy sites are known. Totals may not exactly equal the sum of individual entries due to rounding.

2 Includes Wilderness and National Monument LUDs.

3 Includes the following Natural Setting LUDs: LUD II, Research Natural Area, Enacted Municipal Watershed, and Wild River

4 Includes the following Natural Setting LUDs: Scenic, and Recreational River, Old Growth Habitat, Special Interest Area, Remote Recreation, and Semi-Remote Recreation LUDs.

5 Includes Timber Production, Modified Landscape, and Scenic Viewshed LUDs. Experimental Forest is also included, even though it is technically not a Development LUD.

6 Includes 829 acres of unlabeled GIS slivers.

Figure 2-4
Wilderness, Natural Setting (with and without Young-growth Harvest), and Development LUDs on the Tongass National Forest under Alternative 2

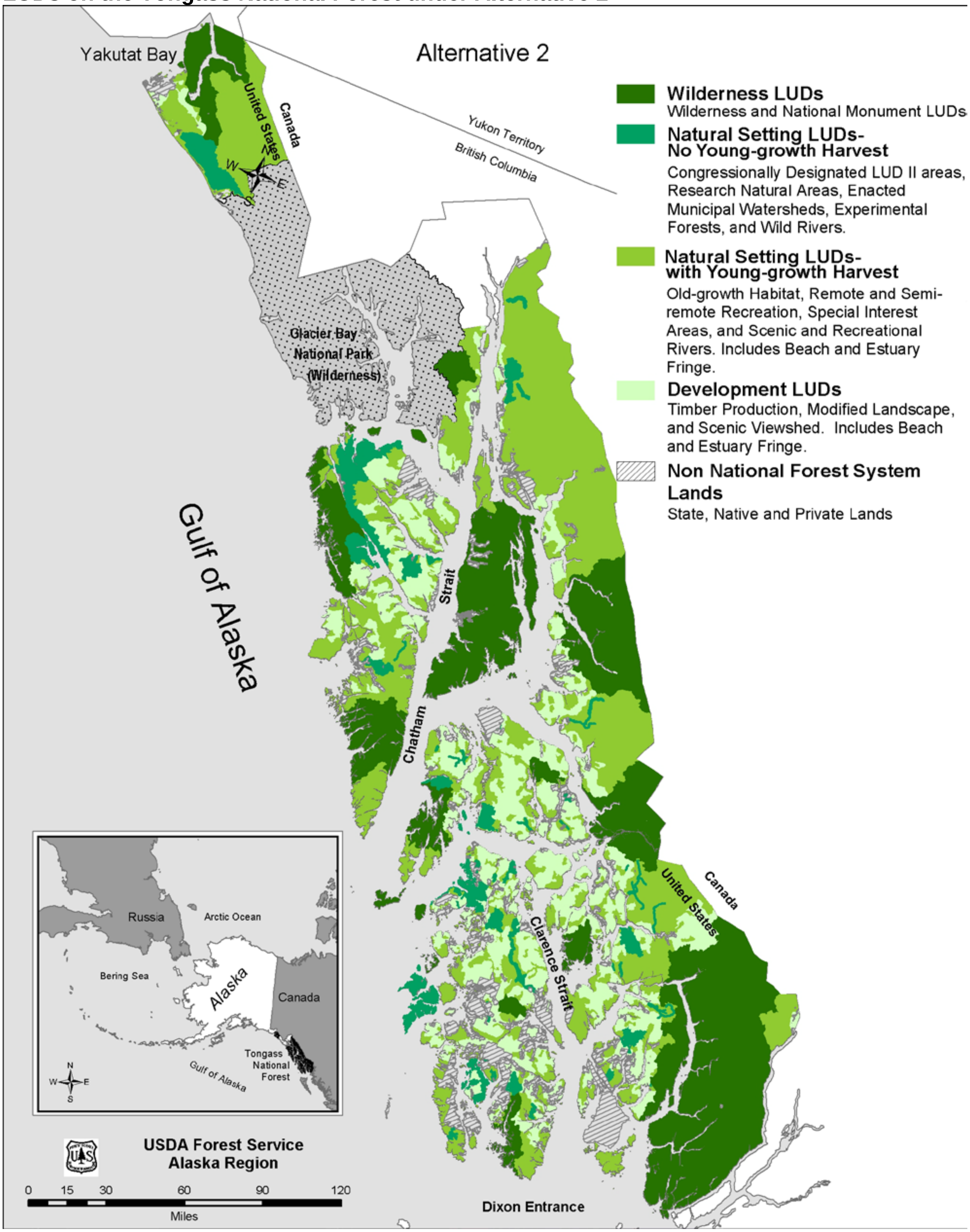


Table 2-7
Selected Outputs and Measures Associated with Alternative 2[1]

Resource/Category	Output/Measure
Percent in Wilderness LUD Group	35%
Percent in Natural Setting LUD Group with No YG Harvest	6%
Percent in Natural Setting LUD Group with YG Harvest	39%
Percent in Development LUD Group	20%
Estimated Harvest Area (acres) after 100 years in Inventoried Roadless Areas – Old growth and Young Growth combined	11,289
Percent of Productive Old Growth Harvested after 100 years	0.7%
Percent of Original Productive Old Growth remaining after 100 Years (92% in 2016)	91%
Estimated Forest Land Suitable for Timber Production–Old Growth (acres)	349,380
Estimated Forest Land Suitable for Timber Production–Young Growth (acres)	374,714
Long-term Projected Timber Sale Quantity (PTSQ) [2] in MMBF	125
Estimated Years until maximum PTSQ is achieved	17
Estimated Years until full transition is achieved (i.e., 41 MMBF of Young Growth is harvested)	12
Maximum New Road Construction after 25 Years/100 Years (miles)	260/1,056
Maximum Road Construction on Decommissioned Road Grades after 25 Years/100 Years (miles)	125/600
Maximum New Road Reconstruction after 25 Years/100 Years (miles)	256/1,191

[1] Totals may not add exactly due to rounding.
[2] PTSQ volumes expressed as annual averages and include sawlog plus utility.

Alternative 3

Framework and Expected Outcomes

Alternative 3 would allow old-growth harvest only in Phase 1 of the existing timber sale program adaptive management strategy (USDA Forest Service 2008c) (see color map accompanying this FEIS) but would allow young-growth harvest in all phases. This alternative would allow young-growth and old-growth harvest in 2001 Roadless Rule IRAs. If this alternative were selected, harvest in IRAs would be deferred until agency rulemaking modifies 36 CFR 294.13(b)(4) (2001).

Alternative 3 is similar to Alternative 2 in that it identifies lands as suitable for young-growth timber production in both development and natural setting LUDs (except for Congressionally designated areas such as Wilderness, administratively withdrawn areas, and islands less than 1,000 acres in size), as well as in beach and estuary fringe and high-vulnerability karst, but not in RMAs. Young-growth management may include clearcutting in all areas, except in beach and estuary fringe and on high-vulnerability karst, where only commercial thinning is allowed.

In addition, for young-growth harvest units larger than 20 acres in VCUs that have had concentrated past timber harvest, it is intended that 30 percent of the young growth stand acres should be left. This legacy provision would be described as a Management Approach in the Forest Plan.

Scenery standards for young growth management would be reduced by one level relative to the 2008 Forest Plan. SIOs would be reduced as follows: High would be reduced to Moderate, Moderate would be reduced to Low, and Low and Very Low would become Very Low.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. The SIO (scenery standard) for renewable energy development would Low for all LUDs and distance zones.

Alternative 3 would provide the second largest amount of timber volume (old growth and young growth combined). It would result in the second lowest harvest of old growth over both the 25-year and 100-year periods. Table 2-8 summarizes the key elements of Alternative 3 and Table 2-9 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

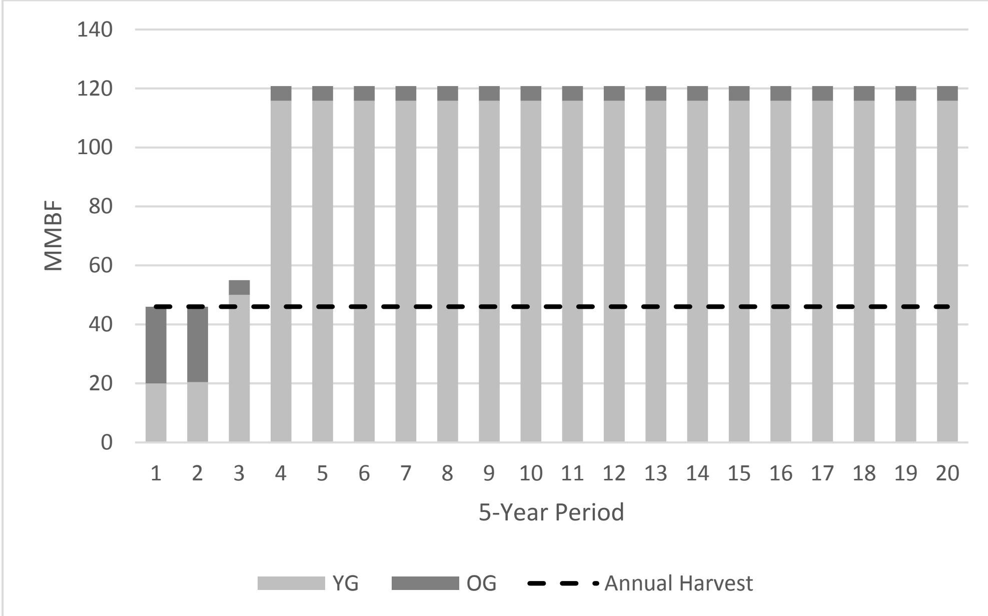
This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce an average of about 20 MMBF of young growth and 26 MMBF of old growth per year during the first 10 years (Figure 2-5). From Year 11 through Year 15, it is projected to produce an average of 50 MMBF of young growth and about 5 MMBF of old growth per year. Alternative 3 would likely reach a full transition harvest of 41 MMBF of young growth at about Year 13. Young-growth harvest is expected to continue to increase at a rapid rate after Year 13 and is expected to reach an upper limit of about 117 MMBF in Year 17. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Over 80 percent of the Forest would remain in a natural state. Old-growth conditions would prevail on forest lands within the IRAs. Young-growth harvest would be increasingly emphasized during a transition period and the existing timber industry maintained and given the opportunity to transition to a dominantly young-growth based industry over the next 10 to 15 years. Following the transition period, the young-growth based timber industry would have the potential for substantial growth as more young-growth stands become economic to harvest. Young growth would be harvested by clearcutting and other prescriptions in natural setting LUDs, but only commercial thinning would occur in beach and estuary fringe. A small old-growth based industry would continue after transition with an annual volume of about 5 MMBF being offered through the small and micro sale programs. A mixture of old growth, recently harvested areas, and various ages of young growth would occur within roaded areas. Recreation, tourism, and subsistence opportunities would continue to emphasize natural setting types, although some additional roaded opportunities would be developed. Limited scenery impacts would occur in some visually sensitive areas because scenery standards for young growth harvest would be reduced by one level compared with the current Forest Plan.

Land Use Designations

If Alternative 3 is selected, the LUD allocation acres and the suitable acres shown in Table 2-9 would result. Figure 2-6 shows the distribution of LUDs across the Tongass under Alternative 3 according to four LUD groups (see Table 2-9 for definitions of the LUD groups). Color maps showing both LUDs and lands suitable for timber production for Alternative 3 are included in the *Map Folder* of the CD version of the FEIS and in the *Map Packet* accompanying the FEIS hard copy.

Figure 2-5
Projected Timber Sale Quantity (average annual harvest) over 100 Years in 5-Year Periods under Alternative 3 showing Volume (MMBF) contributed by Old Growth (OG) and Young Growth (YG)



Management Prescriptions

The Forest Plan that accompanies this EIS represents the Forest Plan if Alternative 5 (Preferred Alternative) were to be selected. Many of the changes reflected in the proposed Forest Plan are consistent with Alternative 3, but some are not. The similarities and differences among the alternatives, with respect to the Forest Plan, are detailed in Appendix F to this EIS.

Selected Outputs

Table 2-10 displays selected outputs and other measures associated with this alternative.

Table 2-8
Key Elements of Alternative 3

Old-growth Harvest

- Allows harvest only within Phase 1 of the 2008 Timber Sale Program Adaptive Management Strategy.
- Inventoried Roadless Areas (IRAs) would be available for harvest after rulemaking.

Young-growth Harvest

- Allows harvest in Development LUDs, including clearcutting, and entry into all phases of the Timber Sale Program Adaptive Management Strategy without regard to harvest volumes.
- Allows harvest in natural setting LUDs, except for congressionally designated and administratively withdrawn areas and islands smaller than 1,000 acres.
- IRAs would be available for harvest after rulemaking.
- Commercial harvest is allowed in beach and estuary fringe but not in RMAs.
- Clearcutting is allowed in all areas except beach and estuary fringe and high-vulnerability karst, where only Commercial Thinning is allowed.
- Management Approach to provide legacy in young-growth harvest units larger than 20 acres in certain VCUs.
- There is flexibility to harvest at a younger age than 95 percent of CMAI throughout the life of the Plan.
- Scenery standards for young growth management would be relaxed; SIOs would be reduced by one level relative to the 2008 Forest Plan (i.e., High is reduced to Moderate, Moderate is reduced to Low, and Low and Very Low become Very Low).

LUD Changes

- Old-growth Habitat LUDs are modified to correspond with the biologically preferred option in areas where they were adversely affected by land conveyances and other changes resulting from Public Law 113-291.
- The Transportation and Utility Systems LUD is removed.

New Plan Direction (Forest Plan Chapter 5)

- Young-growth plan components added to Forest Plan.
- Renewable Energy plan components added to Forest.
- Transportation Systems Corridors plan components added to Forest Plan.
- Forest-wide plan direction added to Forest Plan.

Table 2-9
Land Use Designation, Suitable, and Projected Harvest Acres for Alternative 3[1]

Land Use Designation Group	Acres Allocated
Wilderness LUD Group[2]	5,922,131
Natural Setting LUD Group – No YG Harvest [3]	1,005,922
Natural Setting LUD Group – With YG Harvest [4]	6,467,437
Development LUD Group[5]	3,359,367
Total National Forest System lands	16,755,685[6]
Suitable Acres	**Acres Allocated**
Suitable Acres-Old Growth	516,566
Suitable Acres-Young Growth	349,872
Projected Harvest	**Acres Allocated**
Projected Harvest Acres after 25 Years	
Old Growth	16,599
Young Growth	53,734
Projected Harvest Acres after 100 Years	
Old Growth	35,568
Young Growth	313,216

1 When more than one LUD is applied to the same area, such as a Special Interest Area within Wilderness, only the acreage of the more restrictive LUD is included. The acreage for the Minerals LUD would be 249,570; these acres are not included in the table because the Minerals LUD is an overlay. No acreages have been calculated for Renewable Energy and Transportation Systems because transportation projects are a series of corridors with undefined width and imprecise locations and not all renewable energy sites are known. Totals may not exactly equal the sum of individual entries due to rounding.

2 Includes Wilderness and National Monument LUDs.

3 Includes the following Natural Setting LUDs: LUD II, Research Natural Area, Enacted Municipal Watershed, and Wild River

4 Includes the following Natural Setting LUDs: Scenic, and Recreational River, Old Growth Habitat, Special Interest Area, Remote Recreation, and Semi-Remote Recreation LUDs.

5 Includes Timber Production, Modified Landscape, and Scenic Viewshed LUDs. Experimental Forest is also included, even though it is technically not a Development LUD.

6 Includes 829 acres of unlabeled GIS slivers.

Figure 2-6
Wilderness, Natural Setting (with and without Young-Growth Harvest), and Development LUDs on the Tongass National Forest under Alternative 3

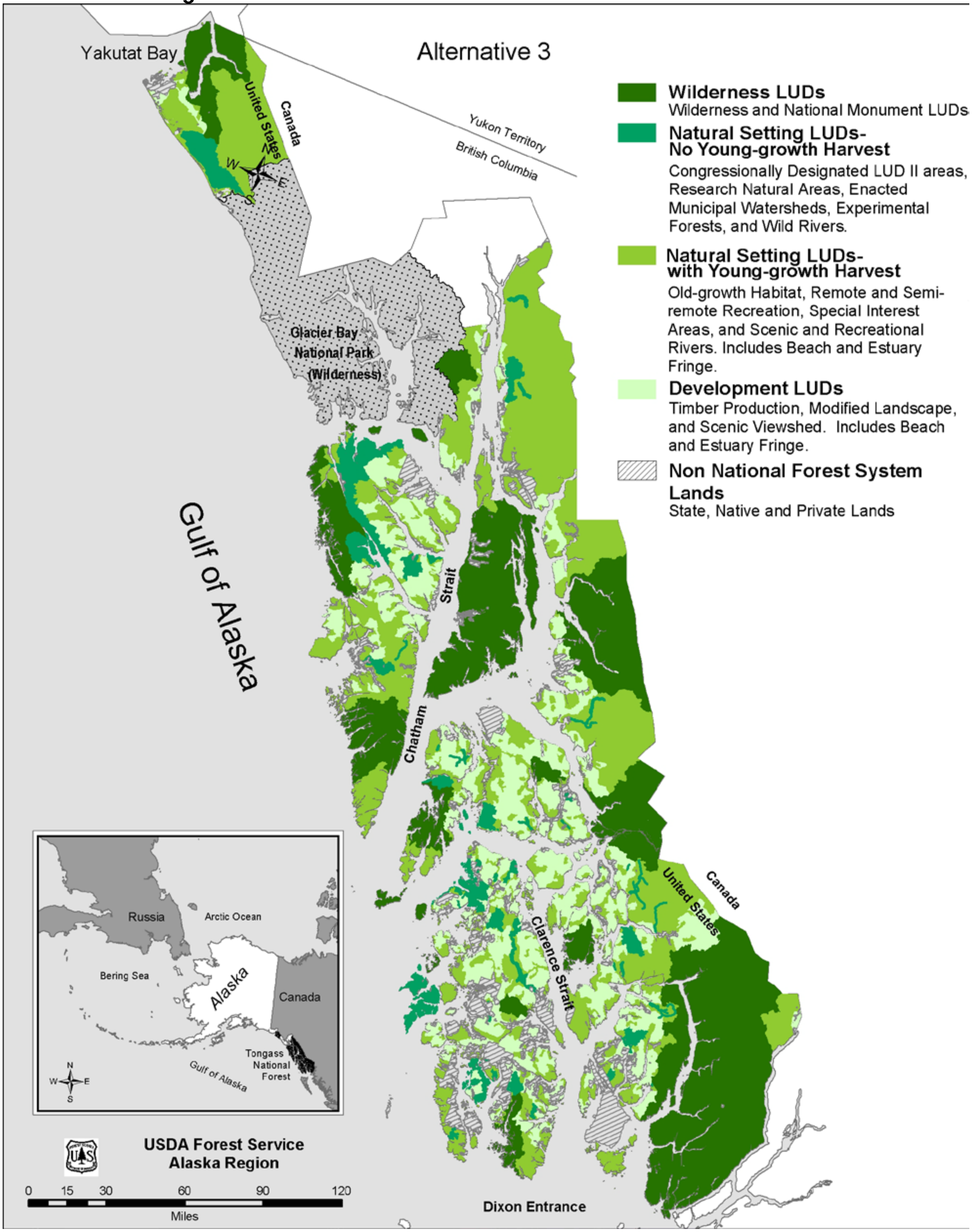


Table 2-10
Selected Outputs and Measures Associated with Alternative 3[1]

Resource/Category	Output/Measure
Percent in Wilderness LUD Group	35%
Percent in Natural Setting LUD Group with No YG Harvest	6%
Percent in Natural Setting LUD Group with YG Harvest	39%
Percent in Development LUD Group	20%
Estimated Harvest Area (acres) after 100 years in Inventoried Roadless Areas – Old growth and Young Growth combined	28,847
Percent of Existing Productive Old Growth Harvested after 100 years	0.7%
Percent of Original Productive Old Growth remaining after 100 Years (92% in 2016)	91%
Estimated Forest Land Suitable for Timber Production–Old Growth (acres)	516,566
Estimated Forest Land Suitable for Timber Production–Young Growth (acres)	349,872
Long-term Projected Timber Sale Quantity (PTSQ)[2] in MMBF	121
Estimated Years until maximum PTSQ is achieved	17
Estimated Years until full transition is achieved (i.e., 41 MMBF of Young Growth is harvested)	13
Maximum New Road Construction after 25 Years/100 Years (miles)	245/1,020
Maximum Road Construction on Decommissioned Road Grades after 25 Years/100 Years (miles)	110/566
Maximum New Road Reconstruction after 25 Years/100 Years (miles)	229/1,129

[1] Totals may not add exactly due to rounding.
[2] PTSQ volumes expressed as annual averages volumes.

Alternative 4

Framework and Expected Outcomes

Like Alternative 3, this alternative would allow old-growth harvest only in Phase 1 of the existing timber sale program adaptive management strategy (see color map accompanying this FEIS), but in contrast with Alternative 3, it would also limit young-growth harvest to only Phase 1. Similar to Alternative 1, this alternative includes the application of the 2001 Roadless Rule.

Alternative 4 would allow young-growth management only in the development LUDs. Harvest is allowed in beach and estuary fringe and on high-vulnerability karst, but only commercial thinning is allowed. No harvest is allowed in RMAs. Young growth management may include clearcutting in other areas.

In addition, for young-growth harvest units larger than 20 acres in VCUs that have had concentrated past timber harvest, it is intended that 30 percent of the young growth stand acres should be left. This legacy provision would be described as a Management Approach in the Forest Plan.

No change would occur in scenery standards relative to the 2008 Forest Plan.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. The SIO (scenery standard) for renewable energy development would Low for all LUDs and distance zones.

Alternative 4 would provide the smallest amount of timber volume (old growth and young growth combined) and the smallest amounts of young-growth volume. It would result in the second highest harvest of old growth during both the 25-year and 100-year periods. Table 2-11 summarizes the key elements of Alternative 4, and Table 2-12 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

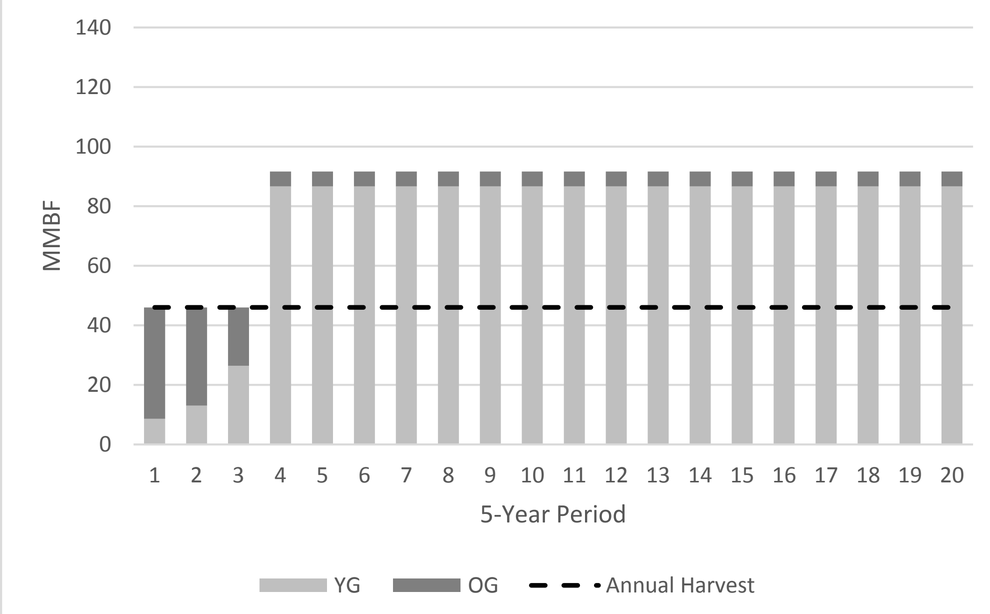
This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce an average of about 11 MMBF of young growth and 35 MMBF of old growth per year during the first 10 years (Figure 2-7). From Year 11 through Year 15, it is projected to produce an average of 26 MMBF of young growth and about 20 MMBF of old growth per year. Alternative 4 would likely reach a full transition harvest of 41 MMBF of young growth about Year 16. Young-growth harvest is expected to continue to increase at a rapid rate after Year 16 and is expected to reach an upper limit of 87 MMBF about Year 18. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

Over 80 percent of the Forest would remain in a natural state, including the 2001 Roadless Rule IRAs. Old-growth conditions would prevail on forest lands within the IRAs. Young-growth harvest would be increasingly emphasized during a transition period as the existing timber industry is maintained and given the opportunity to transition to a predominantly young-growth based industry over the next 10 to 15 years. Following the transition period, the young-growth based timber industry would have the potential for substantial growth as more young-growth stands become economic to harvest. Young growth would be harvested only by commercial thinning in beach and estuary fringe and on high-vulnerability karst. A small old-growth based industry would continue after transition with an annual volume of about 5 MMBF being offered through the small and micro sale programs. A mixture of old growth, recently harvested areas, and various ages of young growth would occur within IRAs. Recreation, tourism, and subsistence opportunities would continue to emphasize natural setting types, although some additional roaded opportunities would be developed. Effects on scenery would be similar to those permitted by the current Forest Plan.

Land Use Designations

If Alternative 4 is selected, the LUD allocation acres and the suitable acres shown in Table 2-12 would result. Figure 2-8 shows the distribution of LUDs across the Tongass under Alternative 4 according to four LUD groups (see Table 2-12 for definitions of the LUD groups). Color maps showing both LUDs and lands suitable for timber production for Alternative 4 are included in the *Map Folder* of the CD version of the FEIS and in the *Map Packet* accompanying the FEIS hard copy.

Figure 2-7
Projected Timber Sale Quantity (average annual harvest) over 100 Years in 5-Year Periods under Alternative 4 showing Volume (MMBF) contributed by Old Growth (OG) and Young Growth (YG)



Management Prescriptions

The Forest Plan that accompanies this FEIS represents the Forest Plan if Alternative 5 (Preferred Alternative) were to be selected. Many of the changes reflected in the proposed Forest Plan are consistent with Alternative 4, but some are not. The similarities and differences among the alternatives, with respect to the Forest Plan, are detailed in Appendix F to this FEIS.

Selected Outputs

Table 2-13 displays selected outputs and other measures associated with this alternative.

Table 2-11
Key Elements of Alternative 4

Old-growth Harvest

- Allows harvest only within Phase 1 of the 2008 Timber Sale Program Adaptive Management Strategy.
- No harvest is allowed in IRAs.

Young-growth Harvest

- Allows harvest in development LUDs, including clearcutting, but allows entry only in Phase 1 of the Timber Sale Program Adaptive Management Strategy.
- Allows no harvest in natural setting LUDs.
- Allows no harvest in IRAs.
- Commercial harvest is allowed in beach and estuary fringe and in high-vulnerability karst within development LUDs, but no harvest is allowed in RMAs.
- Clearcutting is not allowed in beach and estuary fringe and high-vulnerability karst; only commercial thinning is allowed.
- Management Approach to provide legacy in young-growth harvest units larger than 20 acres in certain VCUs.
- There is flexibility to harvest before 95 percent of CMAI throughout the life of the Plan.
- No changes would occur in scenery standards relative to the 2008 Forest Plan.

LUD Changes

- Old-Growth Habitat LUDs are modified to correspond with the biologically preferred option in areas where they were adversely affected by land conveyances and other changes resulting from Public Law 113-291.
- The Transportation and Utility Systems LUD is removed.

New Plan Direction (Forest Plan Chapter 5)

- Young-growth plan components added to Forest Plan.
- Renewable Energy plan components added to Forest Plan.
- Transportation Systems Corridors plan components added to Forest Plan.
- Forest-wide plan direction added to Forest Plan.

Table 2-12
Land Use Designation, Suitable, and Projected Harvest Acres for Alternative 4[1]

Land Use Designation Group	Acres Allocated
Wilderness LUD Group[2]	5,922,131
Natural Setting LUD Group – No YG Harvest[3]	7,473,359
Natural Setting LUD Group – With YG Harvest[4]	0
Development LUD Group[5]	3,359,367
Total National Forest System lands	16,755,685[6]
Suitable Acres	**Acres Allocated**
Suitable Acres-Old Growth	269,135
Suitable Acres-Young Growth	263,710
Projected Harvest	**Acres Allocated**
Projected Harvest Acres after 25 Years	
Old Growth	23,255
Young Growth	40,760
Projected Harvest Acres after 100 Years	
Old Growth	42,597
Young Growth	234,885

[1] When more than one LUD is applied to the same area, such as a Special Interest Area within Wilderness, only the acreage of the more restrictive LUD is included. The acreage for the Minerals LUD would be 249,570; these acres are not included in the table because the Minerals LUD is an overlay. No acreages have been calculated for Renewable Energy and Transportation Systems Corridors because the transportation projects are a series of corridors with undefined width and imprecise locations and not all renewable energy site locations are known. Totals may not exactly equal the sum of individual entries due to rounding.

[2] Includes Wilderness and National Monument LUDs.

[3] Includes all Natural Setting LUDs: LUD II, Research Natural Area, Municipal Watershed, Wild, Scenic, and Recreational River, Old Growth Habitat, Special Interest Area, Remote Recreation, and Semi-Remote Recreation LUDs.

[4] Includes no LUDs that are suitable for YG harvest.

[5] Includes Timber Production, Modified Landscape, and Scenic Viewshed LUDs. Experimental Forest is also included, even though it is technically not a Development LUD.

[6] Includes 829 acres of unlabeled GIS slivers.

Figure 2-8
Wilderness, Natural Setting (with and without Young Growth Harvest), and Development LUDs on the Tongass National Forest under Alternative 4

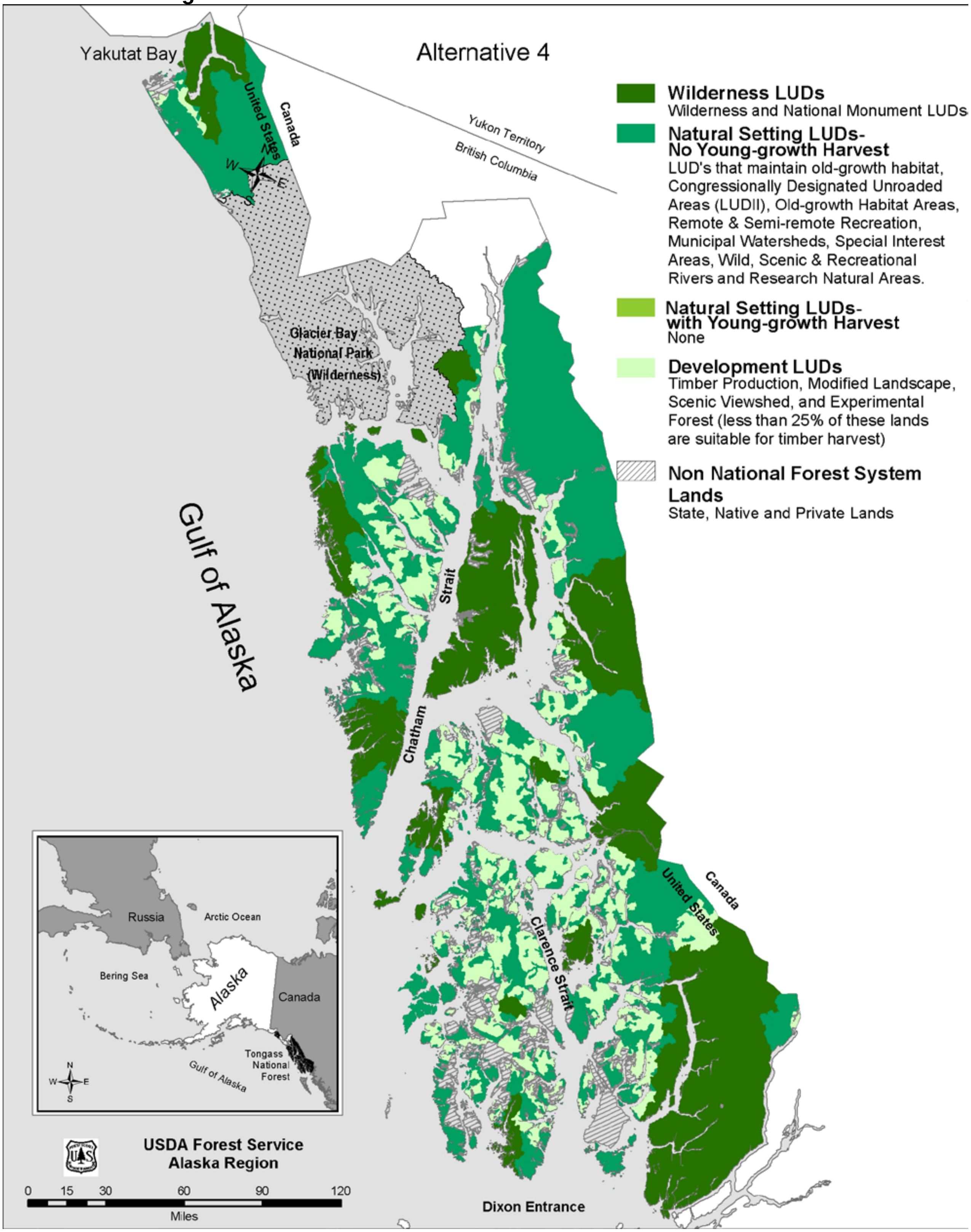


Table 2-13
Selected Outputs and Measures Associated with Alternative 4[1]

Resource/Category	Output/Measure
Percent in Wilderness LUD Group	35%
Percent in Natural Setting LUD Group with No YG Harvest	45%
Percent in Natural Setting LUD Group with YG Harvest	0%
Percent in Development LUD Group	20%
Estimated Harvest Area (acres) after 100 years in Inventoried Roadless Areas – Old growth and Young Growth combined	0
Percent of Existing Productive Old Growth Harvested after 100 years	0.9%
Percent of Original Productive Old Growth remaining after 100 Years (92% in 2016)	91%
Estimated Forest Land Suitable for Timber Production–Old Growth (acres)	269,135
Estimated Forest Land Suitable for Timber Production–Young Growth (acres)	263,710
Long-term Projected Timber Sale Quantity (PTSQ) [3] in MMBF	92
Estimated Years until maximum PTSQ is achieved	18
Estimated Years until full transition is achieved (i.e., 41 MMBF of Young Growth is harvested)	16
Maximum New Road Construction after 25 Years/100 Years (miles)	257/871
Maximum Road Construction on Decommissioned Road Grades after 25 Years/100 Years (miles)	97/445
Maximum New Road Reconstruction after 25 Years/100 Years (miles)	209/900

[1] Totals may not add exactly due to rounding.
[2] PTSQ volumes expressed as annual averages volumes.

Alternative 5 (Preferred Alternative)

Framework and Expected Outcomes

Alternative 5 is the Preferred Alternative. This alternative is based on the recommendations from the Tongass Advisory Committee (TAC), a formally established Federal Advisory Committee (see Appendix B of the Forest Plan). The establishment of the TAC represents a turning point in Tongass management seeking new approaches, practices, and responses. The TAC offers a regionally focused, collaborative path toward an innovative opportunity for a viable young growth timber industry while honoring the suite of values – economic, ecological, social, and cultural – inherent in the Forest.

Like Alternatives 3 and 4, this alternative would allow old-growth harvest only within Phase 1 of the timber sale program adaptive management strategy (see color map accompanying this FEIS). As in Alternatives 1 and 4, the 2001 Roadless Rule would apply and no old-growth or young-growth harvest would occur in roadless areas. In addition, old-growth harvest is excluded from all Tongass 77 (T77)[5] watersheds and TNC/Audubon Conservation Priority Areas (Albert and Schoen 2007). These old-growth harvest exclusion areas are shown on the large color map for Alternative 5 that accompanies this FEIS.

As in Alternatives 2, 3, and 4, Alternative 5 would allow young-growth harvest in all three phases of the timber sale program adaptive management strategy. It would allow young-growth management in development LUDs and in the Old-growth

[5] The Tongass 77 (T77) refers to value comparison units (VCUs), which approximate major watersheds located on National Forest System lands that Trout Unlimited, Alaska Program identified as priority salmon watersheds. As a result of the Sealaska Land Entitlement Finalization in the Carl Levin and Howard P. 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015 (Public Law 113-291), there was a net reduction in the T77 watersheds from 77 to 73. To provide clarity and consistency, the T77 nomenclature will continue to be used in this document when referring to these priority watersheds.

Habitat LUD including harvest in beach and estuary fringe and RMAs outside of TTRA buffers within these same LUDs. However, young-growth harvest in the Old-growth Habitat LUD, beach and estuary fringe, and RMAs outside of TTRA buffers would be allowed only during the first 15 years after Plan approval, and created openings for commercial harvest (up to 10 acres and a maximum removal of up to 35 percent of the acres of the original harvested stand) or commercial thinning would be allowed. In beach and estuary fringe, a 200-foot no-commercial harvest buffer adjacent to the shoreline would be required. Along lake shorelines, a 100-foot no-cut commercial harvest buffer would be established. Scenery standards (SIOs) for young growth management would be reduced to Very Low for all distance zones in the development LUDs only. This standard would also apply when young-growth and old-growth harvests are planned in the same Viewshed.

As noted previously, due to Public Law 113-291, CMAI requirements for determining the youngest age for harvest would be eliminated on up to 50,000 acres of young-growth. Beyond that, the minimum harvest age would continue to be flexible under exceptions allowed by NFMA.

The Forest Plan would include new management direction that improves flexibility in renewable energy development under this alternative. The SIO (scenery standard) for renewable energy development would Low for all LUDs and distance zones.

Alternative 5 would provide the second smallest amount of timber volume (old growth and young growth combined) among the alternatives, but the second largest amount of old-growth volume among the action alternatives. Table 2-14 summarizes the key elements of Alternative 5 and Table 2-15 summarizes the LUD acres, mapped suitable acres, and projected harvest acres under this alternative for young growth and old growth.

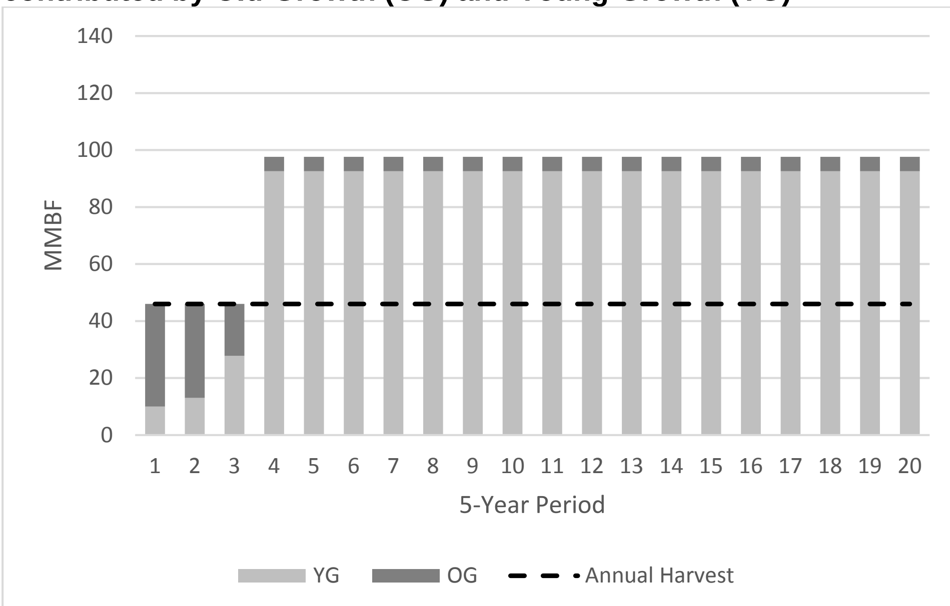
This alternative would harvest timber at a rate of 46 MMBF per year (equivalent to the harvest needed to meet the projected timber demand, see Table 2-1). It would emphasize young growth and minimize old growth while maintaining 46 MMBF per year. As such, it is expected to produce an average of about 12 MMBF of young growth and 34 MMBF of old growth per year during the first 10 years (Figure 2-9). From Year 11 through Year 15, it is projected to produce an average of 28 MMBF of young growth and about 18 MMBF of old growth per year. Alternative 5 would likely reach a full transition harvest of 41 MMBF of young growth about Year 16. Young-growth harvest is expected to continue to increase at a rapid rate after Year 16 and is expected to reach an upper limit of 98 MMBF about Year 18. The old-growth harvest rate would be held at 5 MMBF per year to support small and micro sales.

The majority (over 80 percent) of the Forest would remain in a natural state including IRAs. Old-growth conditions would prevail on forest lands within the IRAs. Young-growth harvest would be increasingly emphasized during a transition period and the existing timber industry is maintained and given the opportunity to transition to a dominantly young-growth based industry over the next 10 to 15 years. Following the transition period, the young-growth based timber industry has the potential for growth as more young-growth stands become economic to harvest. Young growth is harvested only by patch cutting or commercial thinning in non-development LUDs, beach and estuary fringe, and RMAs outside of TTRA buffers. An old-growth based industry would continue after transition with an annual volume of about 5 MMBF being offered through the small and micro sale programs. A mixture of old growth, recently harvested areas, and various ages of young growth would occur within roaded areas. Recreation, tourism, and subsistence opportunities would continue to emphasize natural setting types, although some additional roaded opportunities would be developed. Scenery impacts would occur in some visually sensitive areas because scenery standards for young growth harvest would be very low.

Land Use Designations

If Alternative 5 is selected, the LUD allocation acres and the suitable acres shown in Table 2-11 would result. Figure 2-10 shows the distribution of LUDs across the Tongass under Alternative 5 according to four LUD groups (see Table 2-15 for definitions of the LUD groups). Color maps showing both LUDs and lands suitable for timber production for Alternative 5 are included in the *Map Folder* of the CD version of the FEIS and in the *Map Packet* accompanying the FEIS hard copy.

Figure 2-9
Projected Timber Sale Quantity (average annual harvest) over 100 Years in 5-Year Periods under Alternative 5 showing Volume (MMBF) contributed by Old-Growth (OG) and Young-Growth (YG)



Management Prescriptions

Under Alternative 5, the management prescriptions identified in the Forest Plan (accompanying this FEIS) would be adopted. A track changes version of is available online. Clarifications and deletions to the 2008 Forest Plan are shown in Chapters 1, 2, 3, and 4 and additions to the Forest Plan are provided in Chapter 5. The similarities and differences among the alternatives, with respect to the Forest Plan, are detailed in Appendix F to this FEIS.

Selected Outputs

Table 2-16 displays selected outputs and other measures associated with this alternative.

Table 2-14
Key Elements of Alternative 5

Old-growth Harvest

- Allows harvest only within Phase 1 of the 2008 Timber Sale Program Adaptive Management Strategy.
- No harvest is allowed in IRAs.
- No harvest is allowed within the T77 watersheds or the TNC/Audubon conservation priority watersheds.

Young-growth Harvest

- Allows harvest in Development LUDs, including clearcutting, and entry into all phases of the Timber Sale Program Adaptive Management Strategy without regard to harvest levels.
- Allows harvest in Old Growth Habitat LUDs, but not in other natural setting LUDs or on islands less than 1,000 acres
- No harvest is allowed in IRAs.
- Commercial harvest is allowed in beach and estuary fringe outside of a 200-foot buffer and in RMAs outside of TTRA buffers.
- A 100-ft. no-cut buffer is established around all lakes.
- In Old Growth Habitat LUDs, Beach Fringe (outside of the 200-foot buffer) and in RMAs outside of TTRA buffers, clearcutting is not allowed, but patch cuts (≤10-acre openings and a maximum of 35% removal) is allowed, along with commercial thinning. Harvest is allowed in these land categories only during the first 15 years after plan approval.
- There is flexibility to harvest at a younger age than 95 percent of CMAI throughout the life of the Plan.
- The scenery standards (SIOs) would be reduced to Very Low in development LUDs only.

LUD Changes

- Old Growth Habitat LUDs are modified to correspond with the biologically preferred option in areas where they were negatively affected by land conveyances and other changes resulting from Public Law 113-291.
- The Transportation and Utility Systems LUD is removed.

New Plan Direction (Chapter 5)

- Young-growth plan components added to Forest Plan.
- Renewable Energy plan components added to Forest Plan.
- Transportation Systems Corridors plan components added to Forest Plan.
- Forest-wide plan direction added to Forest Plan.

Table 2-15
Land Use Designation, Suitable, and Projected Harvest Acres for Alternative 5[1]

Land Use Designation Group	Acres Allocated
Wilderness LUD Group[2]	5,922,131
Natural Setting LUD Group – No YG Harvest [3]	6,270,909
Natural Setting LUD Group – With YG Harvest [4]	1,202,450
Development LUD Group [5]	3,359,367
Total National Forest System lands	16,755,685[6]
Suitable Acres	**Acres Allocated**
Suitable Acres-Old Growth	229,060
Suitable Acres-Young Growth	338,973
Projected Harvest	**Acres Allocated**
Projected Harvest Acres after 25 Years	
Old Growth	23,813
Young Growth	43,316
Projected Harvest Acres after 100 Years	
Old Growth	42,479
Young Growth	284,144

[1] When more than one LUD is applied to the same area, such as a Special Interest Area within Wilderness, only the acreage of the more restrictive LUD is included. The acreage for the Minerals LUD would be 249,570; these acres are not included in the table because the Minerals LUD is an overlay. No acreages have been calculated for Renewable Energy and Transportation Systems Corridors because the transportation projects are a series of corridors with undefined width and imprecise locations and not all renewable energy site locations are known. Totals may not exactly equal the sum of individual entries due to rounding.

[2] Includes Wilderness and National Monument LUDs.

[3] Includes all Natural Setting LUDs except Old Growth Habitat: LUD II, Research Natural Area, Municipal Watershed, Wild, Scenic, and Recreational River, Special Interest Area, Remote Recreation, and Semi-Remote Recreation LUDs.

[4] Includes Old Growth Habitat LUD.

[5] Includes Timber Production, Modified Landscape, and Scenic Viewshed LUDs. Experimental Forest is also included, even though it is technically not a Development LUD.

[6] Includes 829 acres of unlabeled GIS slivers.

Figure 2-10
Wilderness, Natural Setting (with and without Young Growth Harvest), and Development LUDs on the Tongass National Forest under Alternative 5

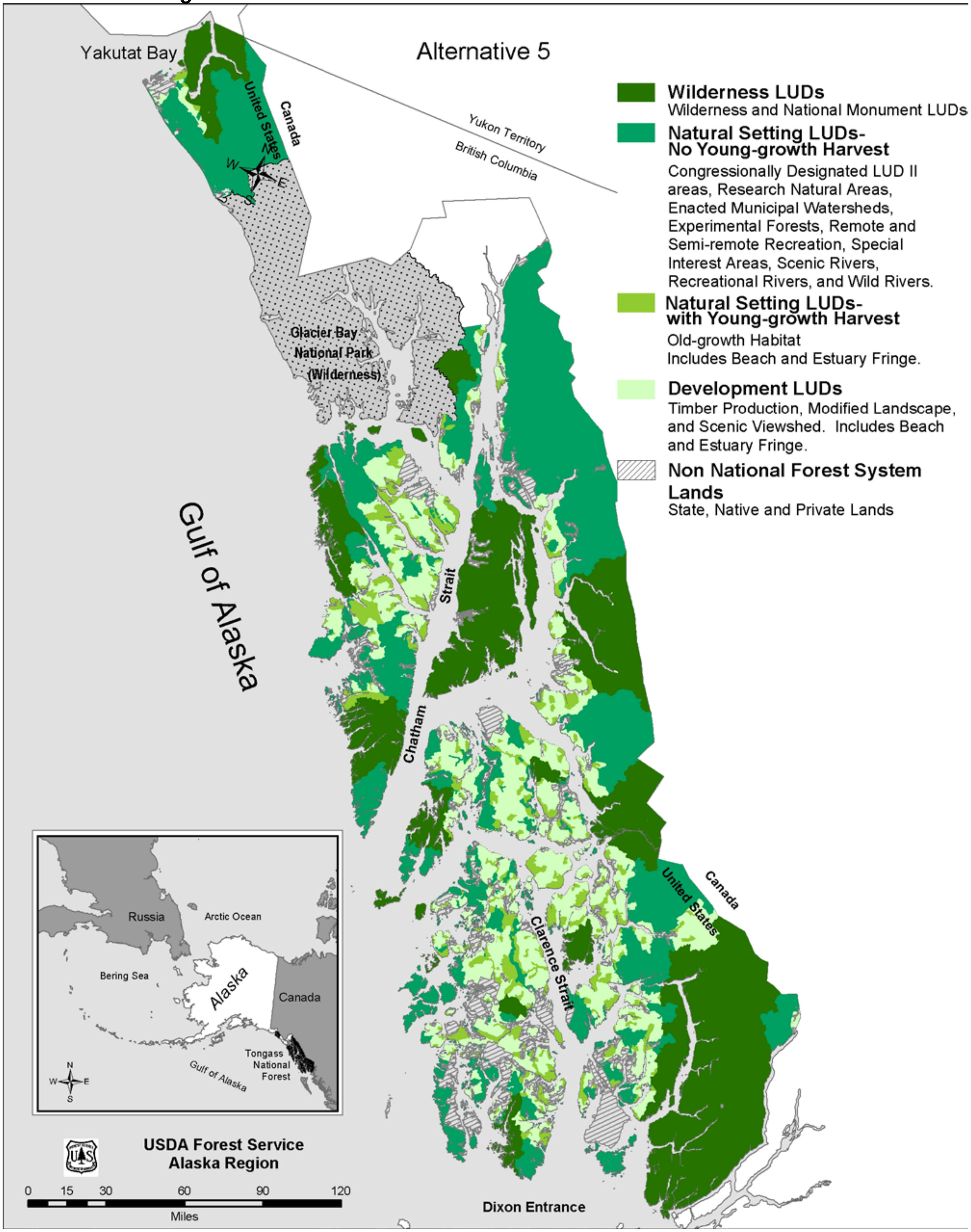


Table 2-16
Selected Outputs and Measures Associated with Alternative 5[1]

Resource/Category	Output/Measure
Percent in Wilderness LUD Group	35%
Percent in Natural Setting LUD Group with No YG Harvest	37%
Percent in Natural Setting LUD Group with YG Harvest	7%
Percent in Development LUD Group	20%
Estimated Harvest Area (acres) after 100 years in Inventoried Roadless Areas – Old growth and Young Growth combined	0
Percent of Existing Productive Old Growth Harvested after 100 years	0.8%
Percent of Original Productive Old Growth remaining after 100 Years (92% in 2015)	91%
Estimated Forest Land Suitable for Timber Production-Old Growth (acres)	229,060
Estimated Forest Land Suitable for Timber Production-Young Growth (acres)	338,973
Long-term Projected Timber Sale Quantity (PTSQ)[2] in MMBF	98
Estimated Years until maximum PTSQ is achieved	18
Estimated Years until full transition is achieved (i.e., 41 MMBF of Young Growth is harvested)	16
Maximum New Road Construction after 25 Years/100 Years (miles)	267/994
Maximum Road Construction on Decommissioned Road Grades after 25 Years/100 Years (miles)	102/527
Maximum New Road Reconstruction after 25 Years/100 Years (miles)	219/1,058

[1] Totals may not add exactly due to rounding.
[2] PTSQ volumes expressed as annual averages volumes.

Comparison of the Alternatives

This section briefly compares the environmental consequences of the five alternatives with respect to the significant issues described in Chapter 1. This comparison is based on the effects analyses presented in Chapter 3.

The following subsections provide the issue statement for each of the significant issues described in Chapter 1, and the units of measure used to analyze their effects. Hereafter the term "issues" is synonymous with "significant issues." Following these subsections, the alternatives are compared with respect to each issue. Important comparison tables are also presented. Table 2-17 (at the end of this section) compares each alternative in terms of the key elements that define the alternatives. Table 2-18 compares each alternative in terms of the quantitative and qualitative measures associated with each alternative. This table allows the reader to compare the effects of the alternatives on all issues simultaneously, so that a cumulative picture of the net effects can be obtained.

Issue 1 – Young-growth Transition

Issue Statement: The Secretary of Agriculture directed the Forest Service to transition to a young-growth-based timber management program on the Tongass National Forest in 10 to 15 years, which is more rapid than planned for in the 2008 Forest Plan. This transition is intended to support the Tongass managing its forest for an ecologically, socially, and economically sustainable forest management program and reduce old-growth harvest while providing economic timber to support the local forest products industry during the transition.

Units of Measure

- Lands suitable for timber production
- Acres of harvest of young growth vs. old growth over time

- Time required to fully transition to young-growth harvest
- Financial efficiency (discounted net revenue)
- Number of annualized direct jobs supported

Comparison

The purpose and need for this project is primarily based on a memorandum from the Secretary of Agriculture (see Chapter 1) that directs management of the Tongass National Forest to expedite the transition away from old-growth timber harvesting and towards a forest products industry that utilizes predominantly second-growth – or young-growth – forests. Secretary Vilsack's memorandum also guides that the transition should be implemented in a manner that preserves a viable timber industry that provides jobs and opportunities for Southeast Alaska residents. USDA's goal is to effectuate this transition, over the next 10 to 15 years, so that at the end of this period the vast majority of timber sold by the Tongass will be young growth. This timeframe will conserve old growth forests while allowing the forest industry time to adapt.

Because of the Secretary's memorandum, the existing condition emphasizes a transition to young growth and minimizes old-growth harvest, but does this within the constraints of the 2008 Forest Plan. Alternative 1 (no action) would result in full transition to a predominantly young-growth-based industry in about 32 years, well beyond the 15 year goal presented in the Secretary's memorandum. In contrast, all of the action alternatives would result in a full transition in about 12 to 16 years. Because these timeframes represent full transition, the period in which the "vast majority of timber sold by the Tongass will be young growth" is expected to be about 10 to 15 years for the action alternatives. Of the action alternatives, the fastest transition (12 years) would occur with Alternative 2 and the slowest transition (16 years) would occur with Alternatives 4 and 5.

All of the alternatives are expected to support from 184 to 231 annualized direct jobs during the first decade, depending on the portion of total harvest that is exported. Total estimated jobs are very similar across the alternatives, with the highest number of direct jobs supported by Alternative 2 and the lowest number of direct jobs supported by Alternative 1. In addition, each alternative is expected to meet the projected demand for Tongass timber. Therefore, each alternative is expected to meet the criterion of maintaining a viable industry. However, it is unclear how quickly industry will be able to "retool" mills and harvesting equipment and how markets will react to changing from old-growth to young-growth forest products; thus, this criterion is associated with a relatively high degree of uncertainty.

Under all alternatives, the harvest of old growth would diminish over time and the harvest of young growth would increase. Therefore, all of the alternatives would "conserve old-growth forests." The largest old-growth harvest in the first 25 years would be about 39,000 acres with Alternative 1. Each of the action alternatives would harvest less old growth, ranging from 15,000 acres with Alternative 2 to 24,000 acres with Alternative 5. The same pattern among the alternatives occurs with the 100-year harvest as well.

Issue 2 – Renewable Energy

Issue Statement: The development of renewable energy projects on the Tongass would help Southeast Alaska communities reduce fossil fuel dependence, stimulate economic development, and lower carbon emissions in the Region.

Units of Measure

- Improved flexibility in siting and development of renewable energy projects

Comparison

Another important part of the purpose and need for this project is the purpose of establishing new direction in the Forest Plan so that renewable energy development is more permissible. There is a need to stimulate economic development in Southeast Alaska communities, and provide low-carbon energy alternatives, thereby displacing the use of fossil fuel. Under the 2008 Forest Plan, siting of energy projects is limited in certain LUDs, and it would remain that way under Alternative 1. Under each of the action alternatives (Alternatives 2, 3, 4, and 5), changes would be made to the Forest Plan that would result in improved flexibility in siting and development of renewable energy projects.

Issue 3 – Inventoried Roadless Areas

Issue Statement: Timber harvest and road building that occurred in inventoried roadless areas (IRAs) before the 2001 Roadless Area Conservation Rule (2001 Roadless Rule) was enacted and during the 2003 Tongass Exemption (68 FR 75136) changed the values or features that often characterize IRAs in some locations. In addition, whether or not the Tongass would manage the Forest under the 2003 Tongass Exemption or not is the subject of ongoing litigation. Currently, the Tongass does not enter roadless areas for commercial timber harvest or road construction. However, in the future, this could change.

Units of Measure

- Acres of lands suitable for timber production within IRAs under each alternative
- Roadless characteristics protected under each alternative

Comparison

Under Alternatives 1, 4, and 5 IRAs are withdrawn from timber production and not suitable for timber production (FSH 1909.12, chapter 60, section 61.11). In Alternative 2, IRAs that were previously roaded would be available for road construction and timber harvest and in Alternative 3, all IRAs would be available for road construction and timber harvest. In both Alternatives 2 and 3, entry into IRAs would not be permitted without rulemaking or, in the case of Alternative 3, if the 2003 Tongass Exemption (68 FR 75136) is reinstated. Estimated acres of timber harvest in IRAs over 100 years would range from 0 acres for Alternatives 1, 4, and 5, to 11,000 acres for Alternative 2, to 29,000 acres for Alternative 3. The protection of roadless characteristics would be directly proportional to the projected acres of timber harvest with Alternatives 1, 4, and 5 providing the most protection, Alternative 2 providing the second most protection, and Alternative 3 providing the least protection.

Issue 4 – Wildlife Habitat and the Conservation Strategy

Issue Statement: Old-growth timber harvest has changed the composition and spatial patterns of terrestrial wildlife habitats. How the resulting young-growth is managed may influence the future ecological integrity of the landscape at various scales. Changes made to suitable lands designated for development, and to plan components (e.g., standards and guidelines) may affect old-growth habitat for wildlife and the Tongass old-growth conservation strategy and contributing elements to old-growth reserves (e.g., riparian, beach and estuary habitats).

Units of Measure

- Acres of productive old growth (POG) protected under each alternative

- Acres of high-volume POG protected under each alternative
- Acres of large-tree POG protected under each alternative
- Acres of young-growth harvest in beach and estuary fringe by alternative
- Acres of young-growth harvest in Riparian Management Areas (RMAs) by alternative
- Acres of young-growth harvest in the Old-growth Habitat LUD and other natural setting LUDs by alternative
- Average total and open road densities and percentage of Wildlife Analysis Areas (WAAs) in road density categories on NFS and all lands
- Indicators of habitat capability using habitat models
- Cumulative harvest and road development on all Southeast Alaska lands

Comparison

Relative to old-growth habitat conservation, Alternative 1 would have the highest harvest (1.3 percent of existing POG), followed by Alternative 4 (0.9 percent of existing POG), followed by Alternative 5 (0.8 percent of existing POG), followed by Alternatives 2 and 3 (0.7 percent of existing POG). The change in the percent of original POG remaining after 100 years would follow the same pattern. Currently, 92 percent of original POG is remaining; under all alternatives this percentage would drop by about 1 percent after 100 years. Alternative 1 would result in about 90 percent remaining and the action alternatives would each result in about 91 percent remaining. This same pattern would continue for the percent reduction in high-volume POG. The existing 86 percent of original high-volume POG remaining would be reduced to about 85 percent for all alternatives after 100 years. For large-tree POG, about 79 percent of the original acres exist. Alternative 1 would result in about 78 percent remaining after 100 years, while the action alternatives would maintain about 79 percent.

Young-growth harvest in the beach and estuary fringe would be lowest under Alternative 1 (no harvest). Under the action alternatives, no harvest of POG would occur, but impacts resulting from young growth harvest would be highest under Alternative 2, which would include the second highest amount of young-growth acres and would allow clearcutting. Under Alternatives 3 and 4, considerable young-growth acreage would be harvested, but using commercial thinning, which would result in less effects than clearcutting. Alternative 5 would have the lowest effect on beach and estuary fringe among the action alternatives because young-growth acreage would be lowest and only patch cutting (with created openings up to 10 acres and a maximum removal of up to 35 percent of the acres of the original harvested stand) or commercial thinning would be allowed and only during the first 15 years after Forest Plan approval with a one-time entry restriction.

For RMAs, the lowest effects would be associated with Alternatives 1, 3, and 4, which would permit no harvest in RMAs. Alternative 2 would have the greatest harvest impacts in RMAs because it would include the highest amount of acreage and would allow clearcutting during the first 15 years of Forest Plan approval and commercial thinning thereafter. Effects to RMAs would be lower under Alternative 5 due to a lower amount of acres harvested and only patch cutting or commercial thinning would be permitted and only during the first 15 years after Forest Plan approval with a one-time entry restriction.

In the Old-growth Habitat LUD, Alternatives 1 and 4 would allow no young-growth harvest. The greatest amount of young-growth harvest in the Old-growth Habitat

LUD would occur under Alternative 2, followed by Alternatives 3 and 5. Effects would be greatest under Alternative 2 because it would allow clearcutting and have the largest harvest acreage, and less under Alternative 3 because only commercial thinning would be allowed, followed by Alternative 5 which would allow only patch cutting or thinning and only during the first 15 years after Forest Plan approval and with a one-time entry restriction.

Average total road density across the Forest (NFS lands only) under all alternatives would be approximately 0.23 mile per square mile after 100 years, an increase of 0.03 to 0.04 mile per square mile above existing levels. Approximately 83 percent of WAAs would have total road densities ranging between 0.0 and 0.7 mile per square mile under all alternatives. Total roads are conservatively defined to include open roads, closed roads, and decommissioned roads. Average open road density across the Forest (NFS lands only) would be approximately 0.09 mile per square mile, an increase of approximately 0.005 mile per square mile under all alternatives. Approximately 96 percent of WAAs would have open road densities ranging between 0.0 and 0.7 mile per square mile under all alternatives. Therefore, any potential increase in hunter access or risk of overharvest for wildlife species would be minor and localized, and would not be measurable at the forest-wide scale under any of the alternatives.

The transition to young-growth management would slow the long-term decrease in deer habitat capability due to the reduction in POG harvest. Based on Interagency Deer Habitat Capability model outputs, deer habitat capability under all of the alternatives would decline about 1 percent over 100 years. Forest-wide all alternatives would maintain about 99 percent of the existing deer habitat capability. Results based on the Forage Resource Evaluation System for Deer (or FRESH deer model) are very similar; Forest-wide, the existing level of habitat quality would be decline about 1 percent after 100 years under all alternatives.

Cumulative POG harvest on all landownerships would be greatest under Alternative 1, followed by Alternatives 4, 5, 3, and 2 (in that order). Cumulative effects would be least under the alternatives that propose the shortest young-growth transition time. After 100 years of Forest Plan implementation and non-NFS harvests, approximately 83 percent of the original (1954) total POG forest, about 76 percent of the original high-volume POG, and 63 to 64 percent of the original large-tree POG would be maintained on all landownerships under all of the alternatives.

Cumulative road densities (all land ownerships) would be similar among alternatives (about 0.45 mile per square mile), representing an increase of about 0.11 to 0.12 miles per square mile above current conditions. Open road densities for all land ownerships would increase from about 0.22 mile per square mile to about 0.24 mile per square mile after 100 years under all alternatives.

Table 2-17
Comparison of Key Elements of the Alternatives

Element	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Timber Sale Program Adaptive Management Strategy Phases (see large color map)	2008 Forest Plan	2008 Forest Plan, except can enter Phases 2 and 3 for YG without limitation[1]	2008 Forest Plan, except Phase 1 only for OG; can enter Phases 2 and 3 for YG without limitation	2008 Forest Plan, except Phase 1 only for YG and OG	2008 Forest Plan, except Phase 1 only for OG; can enter Phases 2 and 3 for YG without limitation
Harvest in Roadless[2]	No entry	Roadless entry permitted in previously roaded IRAs after rulemaking	Roadless entry permitted (all IRAs with suitable lands) after rulemaking	No entry	No entry
Harvest in T77 Watersheds and TNC-Audubon Conservation Priority Areas	Harvest permitted	Harvest permitted	Harvest permitted	Harvest permitted	No OG Harvest permitted
Young-growth Harvest in Natural Setting LUDs	No entry	Clearcutting	Clearcutting	No entry	Old Growth Habitat LUD only; Created openings (<10 acres and <35% of stand) or thinning; no harvest after 15 years
Young-growth Harvest in Beach and Estuary Fringe	No entry	Clearcutting in Beach Fringe for first 15 years; only Commercial. Thinning thereafter	Commercial Thinning only	Commercial Thinning only	Created openings (<10 acres and <35% of stand) or thinning; no harvest after 15 years
Young-growth Harvest in Riparian Management Areas	No entry	Commercial Thinning only outside of TTRA; 33% maximum stand removal	No entry	No entry	Created openings (<10 acres and <35% of stand) or thinning, outside of TTRA; no harvest after 15 years; additional 100-ft buffer on lakes
Young-growth Harvest on High Vulnerability Karst	No entry	Commercial Thinning only	Commercial Thinning only	Commercial Thinning only	No entry
Beach and Estuary Fringe Buffer		Maintain 1,000-ft protected corridor inland of even-age harvest units			Maintain a 200-ft no-cut buffer adjacent to shoreline
Young-growth Legacy			For young-growth harvest units >20 ac leave 30% as legacy	For young-growth harvest units >20 ac leave 30% as legacy	
CMAI	Flexible for first 50,000 acres of young-growth harvest	Flexible for life of plan	Flexible for life of plan	Flexible for life of plan	Flexible for life of plan
Scenery Standards for Young-Growth	2008 Forest Plan	SIOs relaxed to Very Low	SIOs relaxed by one level from 2008 Forest Plan	2008 Forest Plan	SIOs relaxed to Very Low for YG in Development LUDs only
Scenery Standards for Renewable Energy	2008 Forest Plan (SIOs = Low for hydro)	SIOs relaxed to Very Low	SIOs = Low for all renewable energy projects	SIOs = Low for all renewable energy projects	SIOs = Low for all renewable energy projects
LUD Change	No change	Old-growth Habitat LUD modified	Old-growth Habitat LUD modified	Old -growth Habitat LUD modified	Old-growth Habitat LUD modified
Estimated Time to Full Transition	32 years	12 years	13 years	16 years	16 years
Renewable Energy Development	No change	New management direction that is more permissive	New management direction that is more permissive	New management direction that is more permissive	New management direction that is more permissive
Other	No change	New plan direction	New plan direction	New plan direction	New plan direction

YG = Young Growth, OG = Old Growth, CMAI = culmination of mean annual increment

[1] Under the 2008 Forest Plan, the scheduled timber sale program was generally confined to Phase 1 until such time as the level of timber harvest reached at least 100 MMBF for two consecutive years.

[2] Timber harvest is currently inconsistent with the 2001 Roadless Rule. Proposed timber harvest in IRAs could not occur until the Roadless Rule is changed as a result of new rulemaking, or the 2003 Tongass Exemption (68 FR 75136) is reinstated.

Table 2-18
Comparison of Alternatives

Resource/Category	Unit of Measure	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Key Issue 1 – Young-Growth Transition						
Land suitable for timber production	Acres of OG	328,615	349,380	516,566	269,135	229,060
	Acres of YG	263,904	374,714	349,872	263,710	338,973
Harvest after 25 years	Acres of OG	38,527	15,027	16,599	23,255	23,813
	Acres of YG	9,669	63,787	53,734	40,760	43,316
Harvest after 100 years	Acres of OG	62,851	32,609	35,568	42,597	42,479
	Acres of YG	209,882	335,344	313,216	234,885	284,144
Approximate Years to full transition (YG harvest = 41 MMBF)	years	32	12	13	16	16
Total discounted net revenue after 15 years	$ millions	$64	$12	$21	$48	$46
Total discounted net revenue after 25 years	$ millions	$101	($20)	($3)	$41	$42
Total discounted net revenue after 100 years	$ millions	$205	$24	$37	$84	$81
Number of annualized direct jobs supported (first decade)	# jobs	184-217	196-231	194-229	187-220	187-221
Key Issue 2— Renewable Energy						
More permissive in siting Renewable Energy projects	Yes/No	No	Yes	Yes	Yes	Yes
Key Issue 3 – Roadless Areas1						
Projected harvest in inventoried roadless areas after 100 years	Acres of OG	0	2,171	17,037	0	0
	Acres of YG	0	9,104	11,809	0	0
Roadless characteristics protected	Qualitative degree of protection	Most	Second most	Least	Most	Most
Key Issue 4 – Wildlife Habitat and the Conservation Strategy						
Percent of existing POG harvested after 100 years	Percent POG	1.3	0.7	0.7	0.9	0.8
Percent of original POG remaining after 100 years (92% in 2015)	Percent POG	90	91	91	91	91
Percent of original high volume POG remaining after 100 years (84% in 2015)	Percent POG	85	85	85	85	85
Percent of original large-tree POG remaining after 100 years (82% in 2015)	Percent POG	78	79	79	79	79
YG Harvest in Beach and Estuary Fringe after 100 years (all prescriptions)	Acres of YG	0	21,871	30,769	11,114	3,903
YG Harvest in Riparian Management Areas after 100 years (all prescriptions)	Acres of YG	0	26,030	0	0	1,089

Table 2-18 (continued)
Comparison of Alternatives

Resource/Category	Unit of Measure	Alternative 1	2	3	4	5
YG Harvest in Old Growth Habitat LUD after 100 years (all prescriptions)	Acres	0	31,640	26,186	0	1,811
Average road density on NFS lands after 100 years (0.195 miles/square mile in 2016)	Miles/Sq. Mile	0.231	0.235	0.233	0.228	0.232
Average road density on All lands within Tongass boundary after 100 years (0.334 mile/sq.mi.in 2016)	Miles/Sq. Mile	0.450	0.454	0.453	0.448	0.452
Average open road density on NFS lands after 100 years (0.089 miles/square mile in 2016)	Miles/Sq. Mile	0.094	0.095	0.095	0.094	0.094
Average open road density on All lands within Tongass boundary after 100 years (0.218 miles/sq. mile in 2016)	Miles/Sq. Mile	0.238	0.239	0.239	0.238	0.239
Percent of WAAs with road density on NFS lands <0.7 miles/sq. mile (85.3% in 2016)	Percent	82.7	82.7	82.7	83.8	82.8
Percent of WAAs with road density on All lands <0.7 miles/sq. mile (78.6% in 2016)	Percent	72.3	72.3	72.3	72.8	72.3
Species-Specific Effects						
Goshawks – Harvest of high-volume POG forest after 100 years	Acres	27,466	14,020	13,716	18,249	17,815
Marten – Harvest of deep snow winter habitat (high-volume POG forest <800 feet elevation) after 100 years	Acres	16,116	8,120	6,297	9,929	9,844
Wolf – Percent of 191 WAAs with model-generated habitat capability of at least 18 deer per square mile after 100 years (NFS Lands)	Percent	34	34	34	34	34
Brown Bear and Black Bear – YG harvest in beach and estuary fringe and RMAs after 100 years	Acres	0	47,901	30,769	11,114	4,993
Endemic Mammals – Harvest of POG forest after 100 years	Acres	62,851	32,609	35,568	42,597	42,479
Deer habitat capability on All Lands after 100 years in Terms of Percent of Original (1954) Habitat Capability (78% currently)	Percent	77	78	78	78	78

YG = Young Growth, OG = Old Growth, POG = Productive Old Growth, WAA= wildlife analysis area

1 Timber harvest is currently inconsistent with the 2001 Roadless Rule. Proposed timber harvest in IRAs could not occur until the Roadless Rule is changed as a result of new rulemaking, or the Tongass Exemption (68 FR 75136) is reinstated.

CHAPTER 3
ENVIRONMENT AND EFFECTS

Environment and Effects

Introduction

This chapter combines the affected environment and environmental consequences discussions required by the National Environmental Policy Act (NEPA) implementing regulations (40 Code of Federal Regulations [CFR] 1500-1508). The discussions are combined so that the environmental consequences (effects) of the alternatives on forest resources and the background information needed to understand these consequences are discussed together for each resource. Each resource is first described by its current condition, uses, supply, and demand, or expected use, along with an explanation of how each resource is measured and evaluated. The descriptions are limited to providing the background information necessary for understanding how the Environmental Impact Statement (EIS) alternatives may affect the resource. Methodology and scientific accuracy is discussed for most resources.

Many of the relationships established and discussed in the 1997 Tongass Land and Resource Management Plan (Forest Plan) Revision Final EIS (FEIS), the 2003 Supplemental EIS (SEIS), and the 2008 Forest Plan Amendment EIS are still valid and, therefore, are incorporated by reference in this EIS. However, this EIS updates some of this information to better reflect current conditions and focuses on the potential effects most relevant to the potential changes that could occur from this proposed amendment to the 2008 (current) Tongass Forest Plan.

Analyzing Effects

Following each resource description is a discussion of the potential effects (environmental consequences) to the resource associated with implementation of each EIS alternative. All significant or potentially significant effects, including direct, indirect, and cumulative effects, are disclosed. Effects are quantified, where possible, although qualitative discussions are also included. The means by which any identified potential adverse effects will be reduced or mitigated are also described.

Environmental consequences are the effects of implementing an alternative on the physical, biological, social, and economic environment. Direct environmental effects are defined as those occurring at the same time and place as the initial cause or action. Indirect effects are those that occur later in time, or are spatially removed from the activity but would be significant in the foreseeable future. Cumulative effects result from the incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions.

Cumulative effects can result from individually minor, but collectively significant, actions taking place over a period of time.

Potential adverse environmental effects that cannot be avoided are discussed. Unavoidable adverse effects are those resulting from managing the land for one resource at the expense of the use or condition of other resources. Many adverse effects can be reduced or mitigated by limiting the extent or duration of effects. The 2008 Tongass Forest Plan is designed to mitigate potential adverse effects on forest resources and uses, especially through its mix of management prescriptions and Forest-wide standards and guidelines. Mitigation measures within standards and guidelines are specified for project activities to be implemented under the 2008 Tongass Forest Plan.

Short-term uses, and their effects, are those that occur annually or within the first 10 years of Forest Plan implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services for 50 years and beyond. Long-term and cumulative effects may be projected out 100 years or more, as needed, to fully analyze the potential consequences for particular resources.

Irreversible and irretrievable resource commitments are typically not made at the programmatic level of a Forest Plan. Irreversible commitments are decisions affecting nonrenewable resources, such as soils, minerals, plant and animal species, and heritage resources. Such commitments of resources are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or the resource has been destroyed or removed. While the application of Land Use Designations (LUDs) allowing land-altering activities can indicate the potential for such commitments, the actual commitment to develop, use, or affect nonrenewable resources is made at the project level. The gradual decline in old-growth habitat may be considered an irreversible commitment.

Irretrievable commitments represent opportunities foregone for the period during which resource use or production cannot be realized. These decisions are reversible, but the production opportunities foregone are irretrievable. An example of such commitments is the allocation of LUDs that do not allow timber harvest to areas containing suitable and accessible forest land. For the time over which such allocations are made, the opportunity to obtain timber from those areas is foregone, thus irretrievable. Irreversible and irretrievable commitments are not identified, as such, in the discussions.

For estimating the effects of alternatives at the programmatic Forest Plan level, the assumption is made that the kinds of resource management activities allowed under the Plan will in fact occur to the extent necessary to achieve the goals and objectives of each alternative. The actual location, design, and extent of such activities are, however, not known at this time because that is a project-by-project decision. In many cases, the discussions refer to the potential for effects to occur, realizing that in many cases these are only estimates.

The effects analysis is useful in comparing and evaluating alternatives, but should not be applied per se to any specific location within the Forest. Land management plans are tools for further agency planning and guide future management activities. The land management plan is a strategic plan that establishes a long-term management framework for the Tongass National Forest. Within that framework, specific projects and activities will be proposed, approved, and implemented depending on specific conditions, budgets, needs, proposals, and circumstances at that time. The plan can only speculate about the projects that may be proposed and budgeted and the events that may occur that will force changes in the projects and the effects of these projects. Thus, the effects presented here are comparative in nature. Specific effects that can be meaningfully measured and evaluated generally occur at the project and activity stage.

An effort was made throughout the current Tongass Forest Plan amendment process to obtain and use the best available information to evaluate and compare the effects of alternatives. NEPA implementing regulations (40 CFR 1502.22) state that when "there is incomplete or unavailable information, the agency shall always make clear that such information is lacking." This was done where appropriate. The NEPA requirement goes on to say that if the incomplete information "is essential to a reasoned choice among alternatives" then considerations, such as the cost of obtaining it, apply. The 1997 Tongass Forest Plan Revision FEIS, the 2003 SEIS, the 2008 Forest Plan Amendment EIS, and this EIS, along with their planning records, will provide the Forest Supervisor with the "essential" information needed to make a reasoned choice among alternatives.

Cumulative Effects

Cumulative effects result from the incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. For this analysis, the area considered for cumulative effects varies according to the resource being assessed. Cumulative effects are discussed in detail for each resource in this chapter. Appendix C discusses the projects considered and records which projects were considered for each resource.

For most aquatic or watershed-related resources, the area within the proclaimed Forest boundary (approximately 17.9 million acres, including 1.2 million acres of non-National Forest System [NFS] lands) was used and analyses were generally conducted at the watershed scale (sixth-level hydrologic unit).

For wildlife and other terrestrial resources, all of Southeast Alaska from Yakutat Bay southeast to the southeastern end of Alaska (approximately 21.6 million acres, including 4.8 million acres of non-NFS lands) will be used as the study area, although some analyses will be based on the area within the Forest boundary, depending on the availability and quality of available information. The Southeast Alaska area includes all of Glacier Bay National Park and the State, Bureau of Land Management, and other lands in the vicinity of Haines and Skagway. Often, Wildlife Analysis Areas (WAAs) will be used to summarize information within these study areas. In addition, biogeographic provinces will be used to summarize cumulative effects information for wildlife and other terrestrial resources.

For social and economic, recreation, and related human uses, all of Southeast Alaska and beyond will be given consideration for cumulative effects, especially regarding economic, market, and other factors.

Existing conditions reflect the extensive changes brought about by long-term human occupancy and use of the forest and represent the present-day condition resulting from past and present actions. Direct and indirect effects include the short- and long-term effects that would result from each of the alternatives considered in this EIS. Cumulative effects may result when the direct and indirect effects associated with the alternatives are added to the effects associated with other past, present, or reasonably foreseeable actions.

Cumulative effects analyses are presented in the effects sections for each resource.

Analysis of long-term cumulative effects extends at least 25 years into the future and to 100 years in many cases. This period is well beyond the proposed period for transitioning to a harvest that is dominated by young growth and covers the period within which the next Forest Plan revision will have taken place.

Generally, for the physical and biological resources, the actions considered in assessing cumulative effects will include the following:

- Past, present, and future timber harvest and road construction on NFS lands; including precommercial thinning;
- Past, present, and future timber harvest on private, state, and Native corporation lands within the National Forest boundary.
- Reasonably foreseeable land adjustments including the proposed Alaska Mental Health Trust land exchange, remaining land conveyances due to the Alaska Statehood Act, and acquisition of the Cube Cove tracts on Admiralty Island by the Forest Service;
- Existing mining at Greens Creek Mine on Admiralty Island, Kensington Gold Mine north of Juneau, and other existing sites, as well as possible future sites, including the Bokan Mountain and Niblack sites on the southern end of Prince of Wales Island;
- Existing and proposed mining projects in Canada within watersheds that drain to Southeast Alaska waters (e.g., Kerr-Sulphurets-Mitchell mine in the Unuk River watershed, Red Chris mine in the Stikine Watershed, and the Tulsequah Chief mine in the Taku Watershed);
- Electrical intertie and other utility line construction, including the Kake to Petersburg Transmission Intertie project;
- Regional transportation development as defined by the State Transportation Plan and Forest Service Alaska Region Long-Range Transportation Plan, road paving on Prince of Wales Island, the closing of roads, and construction of the Angoon Airport;
- Kake Access Project;
- Development of fishing and other lodges;
- Human settlements – expansion of cities like Juneau and Ketchikan – as well as recreational cabin development and land auctions by the State;
- Past, present, and future recreation sites and trails development on NFS lands or removal from NFS lands;
- Potential geothermal development at Bell Island;
- Existing and future hydroelectric developments (e.g., Angoon Hydroelectric, Sweetheart Lake, Soule River, Swan Lake expansion, Crooked Creek/Jim's Lake, and Tenakee Springs/Indian River);
- Climate change and yellow-cedar decline;
- The tourism (mostly cruise ship) industry will continue to grow at a rate of about (+/-) 5 percent per year; and

- Watershed restoration projects across the Tongass. Watersheds were selected based on watershed condition rating completed in 2011, following the national Watershed Condition Framework guidance.

A complete list of past, present, and reasonably foreseeable projects considered, and which resources have overlapping effects, is provided in Appendix C, Cumulative Effects.

Geographic Information System Database and Quantification for this EIS

The Forest Service has developed an extensive computerized geographic information system (GIS) database that is continually improved and is used for Forest Plan–level and project-level analyses. This system makes it possible to conduct spatial analysis of alternatives and effects, and to rapidly display resource information in map format. The GIS is a very large database, containing information on many of the resources of the Forest. Much of the data consist of map "layers," each representing a particular resource or attribute (such as forest type, soil type, or recreation places). Numerical data can also be stored, displayed, and analyzed. Computer technology and capability continues to improve and the Forest GIS program, especially at the project level, reflects such growth. Additional information, as well as improved information, is now available for many resource areas. This EIS takes advantage of the new technology capability and information.

The baseline numbers used to describe the existing condition do not always match the numbers in the 2008 Forest Plan Amendment EIS. This is primarily because of ongoing management of the Tongass National Forest. Examples include changes in land ownership, changes in resource conditions resulting from timber harvest and road construction, and forest plan amendments. In addition, the use of newer computer mapping and measurement techniques that are more accurate than earlier methods also affects the numbers. In general, the relative differences between previous documents and the baseline numbers used in this EIS are small, and do not affect the analysis relationships among these documents.

It should be noted that in some cases where the acreages are measured that depend on overlaying of multiple coverages, the acreage measurements for individual categories sometimes need to be adjusted to account for the fact that coverages do not always line up exactly in places where they should (e.g., along property boundaries, saltwater shorelines, lake edges). Very slight misalignment of the coverages can result in polygon slivers between the coverages, which can produce acreage differences initially. These differences can amount to tens or hundreds of acres or more, especially because we are dealing with such a large area (i.e., 17 million acres). However, on a percentage basis, these slivers and the adjustments that are necessary are insignificant.

It should also be noted that the figures presented are generally rounded to the nearest whole acre, whole mile, or whole percent. No attempt has been made to adjust the numbers to force the sums of rounded numbers to equal the expected totals. Therefore, the sum of rounded individual numbers will often be one digit higher or lower than the expected sum. The sums that are presented are the sums of the unrounded numbers.

Land Use Designation Groupings

For many resources, the effects and the differences in effects among the alternatives are best identified through the LUD allocations. While each LUD has a different management emphasis, many are similar in the kinds of effects they would potentially create. Based on this and in order to simplify the identification of effects, the LUDs have been grouped into four categories: Wilderness, Natural Setting, Moderate Development, and Intensive Development. For some analyses, the LUDs are grouped into two categories: Wilderness and Natural Setting LUDs make up the non-development LUDs and Moderate and Intensive Development LUDs make up the development LUD category. Note that the Minerals LUD is an overlay LUD and is managed according to the underlying LUD until such time that a Plan of Operations is approved. Therefore, acreages in this EIS generally reflect the underlying LUD acreages. Under each of the Action Alternatives, the Transportation and Utility System overlay LUD would be removed. Table 3-1 displays these LUD groupings.

Table 3-1
Land Use Designation Groupings Used to Discuss Effects

LUD Group	Land Use Designation
Non-development LUDs	
Wilderness LUD Group	Wilderness Wilderness National Monument Nonwilderness National Monument
Natural Setting LUDs	LUD II Remote Recreation Semi-Remote Recreation Old-Growth Habitat Municipal Watershed Research Natural Area[1] Special Interest Area[1] Wild River[1] Scenic River Recreational River
Development LUDs	
Moderate Development	Experimental Forest Scenic Viewshed Modified Landscape
Intensive Development	Timber Production
Overlay LUDs[2]	
	Minerals Transportation and Utility Systems[3] (Alternative 1 only)

[1] These three LUDs function as overlay LUDs (see footnote 2) when they occur within Wilderness, Wilderness National Monument, or LUD II areas.
[2] The Minerals and Transportation and Utility Systems (TUS) LUDs are overlay LUDs. Areas allocated to these LUDs are managed according to the underlying LUD until such time that mineral or transportation or utility development is approved, if at all. Generally, acreages in this EIS do not include the Minerals or TUS LUDs, but rather the underlying LUD.
[3] The TUS LUD would be eliminated under Alternatives 2, 3, 4, and 5.

Land Divisions

The land area of the Tongass National Forest has been divided in several different ways to describe the different resources and how they are affected by the alternatives. These divisions vary by resource because the relationship of each resource to geographic conditions and zones also varies. Several of these divisions are described briefly here.

Watershed

The 6th-level Hydrologic Unit Code polygons were used for watershed/fisheries effects. These come from the national Watershed Boundary Dataset – see the *Water* section.

Geographic Provinces

These are seven large land areas that are distinguished by differences in ecological processes. They are defined by a combination of climatic and geographic features. Geographic provinces are used in the evaluation of Research Natural Areas and Wild and Scenic Rivers. See the *Research Natural Areas* section of the 1997 Forest Plan Revision FEIS for a description of each province.

Biogeographic Provinces

Biogeographic provinces are areas within which certain kinds of plants and animals tend to occur together. They are defined by a combination of similarity in species, patterns of distribution of species, and natural characteristics or barriers. Twenty-one biogeographic provinces occur on the Tongass. They are used in the *Biodiversity* and *Wildlife* sections.

Ecological Sections and Subsections

Ecological sections and subsections are two classification levels within a hierarchical system for subdividing ecosystems according to the National Hierarchical Framework of Ecological Units (see the *Biodiversity* section of this chapter).

The framework consists of eight nested mapping levels that serve a variety of purposes. Within the hierarchy, ecological sections characterize medium to large ecosystems (on the order of 1,000 square miles) and ecological subsections characterize mid-sized ecosystems (10 to 1,000 square miles). Fourteen ecological sections and 73 ecological subsections occur on the Tongass.

Value Comparison Units

Value Comparison Units (VCU) are distinct geographic areas, roughly analogous to watersheds, each encompassing a drainage basin containing one or more large stream systems. The boundaries usually follow watershed divides. VCUs were used for the 1979 Tongass Forest Plan to compare the relative values of various resources by location and have been modified to account for changes in allocation for Wilderness and LUD II. The Forest currently has about 945 VCUs averaging 18,000 acres in size.

Wildlife Analysis Areas

WAAs are land divisions used by the Alaska Department of Fish and Game. Approximately 190 WAAs apply to the Tongass National Forest; they average slightly less than 90,000 acres in size. In general, WAA boundaries correspond with VCU boundaries and they typically include three to eight VCUs (averaging just under five). They are used in the *Subsistence* and *Wildlife* sections.

General Forest Description

A brief description of the physical, biological, and socioeconomic settings of the Tongass National Forest is presented in this section. Chapter 1 and the alternative maps include a vicinity map.

Physical Setting

The mainland and many of the islands of Southeast Alaska are mountainous, often rising abruptly from sea level to several thousand feet. Elevations of forested areas extend up to approximately 3,000 feet in the southern sections of the Tongass National Forest and up to 2,500 feet farther north. The mountain valleys provide reservoirs for huge ice fields and glaciers, located primarily on the mainland.

More than one million years ago, all but the highest mountain peaks and some outer coastal areas in Southeast Alaska were covered by ice. The great erosional powers of these vast expanses of ice molded and shaped the landscape as the glaciers moved downhill under their own weight, carving the bedrock below them. When the ice receded and uncovered the land, the more resistant mineral-rich rocks remained, revealing a network of islands dissected by numerous streams, U-shaped valleys, and fiords. By about 13,500 years ago most of southeast Alaska was ice free. This modification by glaciers gives Southeast Alaska's landscape its character.

The configuration of the coastline, the warm Japanese ocean current, and the high coastal mountains provide the factors necessary to produce abundant rainfall. The annual precipitation of Southeast Alaska averages more than 100 inches throughout. Precipitation is highest in the southern areas and decreases as one moves north. At higher elevations, more than 200 inches of snow may fall annually, perpetuating the existing ice fields and glaciers. Storms and moderate to heavy precipitation occur year-round, but most commonly from September through November. The abundant moisture feeds numerous streams, rivers, and lakes that dot the landscape.

Southeast Alaska has a maritime climate, resulting from the moderating influence of the Pacific Ocean. In the summer, this provides a cooling influence, while in winter, temperatures are warmer than would be expected for these latitudes. Normal temperatures range from mid-40 degrees Fahrenheit (°F) to mid-60°F in the summer, and from the high teens to the low-40s in the winter. During the warmer months, temperatures are highest inland and lowest along the coasts, while in the colder months, the reverse is true.

Biological Setting

The coastal forest of Southeast Alaska is part of the cool, temperate rain forest that extends along the Pacific coast from Northern California to Cook Inlet in Alaska. Most of the Forest is composed of old-growth conifers, primarily western hemlock and Sitka spruce, with a scattering of mountain hemlock, western redcedar (in the south), and Alaska yellow-cedar. Red alder is common along streams, beach fringes, and on soils recently disturbed by management activities and landslides. Black cottonwood grows on the floodplains of major rivers and recently deglaciated areas.

Blueberry, huckleberry, Sitka alder, Devil's club, and salal are common shrubs in the Forest. The Forest floor is composed of plants, such as deerheart, dogwood, single delight, and skunk cabbage. Because of the high rainfall and resulting high humidity, mosses grow in great profusion on the ground, on fallen logs, on the lower branches of trees, and in forest openings.

Grass-sedge meadows usually lie at low elevations, often along the coast. Stands of willows border many of the stream channels. Muskeg (bog plant) communities, dominated by sphagnum mosses and sedges, occur throughout the Forest.

The alpine zone usually lies above 2,500 to 3,000 feet. It occupies the area above the coastal forest and is separated from the Forest by a subalpine or transition zone. Resident plants have adapted to snowpack and wind abrasion by evolving low-growth forms. Low, mat-forming vegetation covers most of the area, with cushion-like plants occupying crevices on exposed rock outcrops and talus slopes.

The forests, shorelines, streams, and rivers of Southeast Alaska provide habitat for over 300 species of birds and mammals, including game and non-game animals, such as brown and black bear, Sitka black-tailed deer, moose, wolf, mountain goat, beaver, otter, and marten. The coastline provides ideal habitat for a large population of bald eagles, and wetlands provide nesting habitat for many waterfowl. Large tracts of intact ecosystems help preserve biodiversity.

The Forest is a productive landscape that sustains robust fish stocks for subsistence, personal use, commercial, and sport fisheries. Maintaining the habitat diversity and connections among watersheds is essential to the continued productivity of the Forest's salmon fisheries.

A highly productive marine environment includes an abundance of marine mammals, halibut, herring, and hundreds of shellfish. Both resident and anadromous fish are found within and adjacent to the Forest.

Socioeconomic Setting

There are dozens of communities, including many long-standing Native villages, that exist within the Forest boundary. These communities use and depend on forest resources. As a consequence, management decisions and actions of the Tongass National Forest have a great deal of influence on those communities. A multitude of resources and activities produced from the Forest fuel the economies, livelihoods, and way of life for the people who live there. The abundant resources of the forests and waters have provided food, shelter, and livelihood for its peoples for thousands of years. The first inhabitants of the area, the Tlingit, Haida, and Tsimshian, adapted well to the coastal environment and developed a rich culture. The numerous waterways allowed for mobility, which aided in expanding trade and gathering food. Their cultural identities and traditional way of life are rooted in and tied to the land and waters of Southeast Alaska. Alaska Natives have continuously inhabited the Forest for more than 10,000 years and today are dependent on subsistence hunting and fishing and utilization of all Tongass resources to sustain their bodies as well as their traditions, cultures, and livelihoods.

In the 1700s, Russian exploration began in Alaska. The fur trade, primarily sea otter pelts, was the main force driving colonization. When most of the sea otter populations were depleted, the fur industry declined and Russia lost interest in its North American colony. Alaska was sold to the United States in 1867.

Colonization continued under U.S. ownership, and new industries developed. In the late 1800s, commercial fish canning became an important part of the economy of Southeast Alaska. During that same period, the discovery of gold brought thousands of miners to the area, and many were followed by their families. The most important of the early gold discoveries occurred in Juneau. In the early 1900s, the Depression brought a decline in mining employment, and the impact of World War II resulted in the closures of the last remaining mines.

The timber resource was used by the earliest inhabitants in a variety of ways, including making buildings, canoes, totem poles, and carvings. The Russians harvested timber for building ships and structures. In the earlier part of the century, small timber mills operated in a few communities. During the 1950s, two pulp mills were developed in Ketchikan and Sitka, and the timber industry became a major economic component of Southeast Alaska's economy.

In the 1950s, Alaska focused its attention on statehood, and on January 3, 1959, became the 49th state of the United States. This resulted in an increase in government employment and, coupled with the growth of the timber industry, a gradual shift towards a more diversified economy.

More than 74,000 people live in the towns, communities, and villages of Southeast Alaska. Most of the region's population is concentrated in a few communities, the largest being Juneau, Ketchikan, Sitka, and Petersburg. Services, state and local government, and retail trade were the largest economic sectors by employment in Southeast Alaska in 2013, accounting for 26, 23, and 11 percent of total employment, respectively. Employment in natural resource-based industries remains important in many of the region's communities. Tourism, which has increased in recent years, provides another important source of regional employment and income. Many rural communities continue to depend primarily on fishing, timber production, and subsistence uses.

Organization of Chapter 3

The remainder of Chapter 3 is divided into three broad parts:

- Physical and Biological Environment
- Human Uses and Land Management
- Economic and Social Environment

The resources that make up the physical and biological environment are described first and the effects of the alternatives are analyzed. This part sets the stage for the next part—the evaluation of human uses and land management. Finally, both of these parts set the stage for the final part—the economic and social environment. The focus is on significant effects, with the analysis centered on the key issues related to the Forest Plan amendment.

Physical and Biological Environment

Climate and Air

Affected Environment

Climate

The Tongass National Forest occupies an archipelago and a narrow strip of the mainland between the Pacific Ocean and the crest of the coastal mountains. The configuration of the coastline, the warm Japanese ocean current, and the high coastal mountains combine to produce a cool, wet environment. According to climate summaries and narratives developed by the Western Regional Climate Center (WRCC 2008), precipitation at sea level in Southeast Alaska ranges from 30 inches per year at Skagway to 220 inches per year at Little Port Walter. Precipitation increases with elevation. It is estimated that the average annual precipitation may be as high as 400 inches on the mountains of southern Baranof Island and about 260 inches over the Juneau Icefield. Southeast Alaska has complete cloud cover approximately 85 percent of the year. Snowfall varies according to elevation and distance inland from the coast. October is generally the wettest month. May through July are, on average, the drier months. The Pacific maritime influence holds the daily and seasonal temperatures within a narrow range. Temperatures average 28 degrees Fahrenheit (°F) in the winter and 52°F in the summer (USDA Forest Service 2013b). During the warmer months, temperatures are highest inland and lowest along the coasts, while in the colder months, the reverse is true. Storms and moderate to heavy precipitation occur year-round, but occurs most commonly from September through November. The abundant moisture supports an extensive temperate rain forest and feeds numerous streams, rivers, and lakes, which in turn provide valuable fish habitat.

Climate Change

Southeast Alaska experiences considerable year-to-year and decade-to-decade variability in its weather, associated with large-scale shifts in ocean temperatures, salinity levels, and ice conditions. In fact, there is an inherent level of climate variability in the Pacific Northwest (which includes Southeast Alaska) associated with Pacific Decadal Oscillation (PDO), or the shift between two different circulation patterns that occurs every 20 to 30 years in the northern portion of the Pacific Ocean; as well as other multi-year sea-surface temperature anomalies. Shifts in the location of cold and warm water in the Pacific Ocean alter the path of the jet stream, and thus result in cyclical changes in weather patterns typified by “warm” and “cold” phases (Mantua et al. 1997).

Southeast Alaska’s climate has shown a strong warming trend since the middle of the 19th century (i.e., the end of the Little Ice Age), as has much of the Northern Hemisphere (Parson et al. 2001). A portion of this change in Southeast Alaska’s average temperature is likely the result of the natural changes in the earth's climate, which are caused in part by "wobbles" in the earth's rotation around the sun resulting in changes to earth's position within its elliptical path (i.e., the precession of equinoxes) as well as the PDO discussed above. However, recently (in geological terms) humans have contributed to the acceleration of natural climate change on a global level through multiple activities such as the burning of fossil fuels, which have released greenhouse gases into the environment, as well as reducing natural carbon sinks (Intergovernmental Panel on Climate Change [IPCC] 2014; USDA Forest Service 2015a). The potential impacts of accelerated climate change on the ecosystems of Southeast Alaska may include acidification of ocean waters; increasing the temperatures of ocean and streams; altering water input sources; changing precipitation rates and patterns; increasing the rate of glacier retreat; increasing storm intensities; altering ecosystem composition and structure; altering species distributions; and altering fire regimes (Wolken et al. 2011; Shanley et al. 2015; EcoAdapt 2014).

The impacts of climate change have been, and will likely continue to be, more pronounced in the most northern and southern regions of the globe. Alaska, which is located farther north than any other U.S. territory or state, has experienced an increase in annual temperatures at twice the rate of rest of U.S. (Haufler et al. 2010; Chapin et al. 2014). Alaska's annual average temperatures have increased by 3.4°F over the last 50 years, with an increase of 6.3°F in average winter temperatures (Haufler et al. 2010; Chapin et al 2014; U.S. Environmental Protection Agency [EPA] 2014a). The average number of snow-free days has also increased in Alaska by about 10 days (Chapin et al. 2014).

The observed changes to the climate in Southeast Alaska have resulted in modifications to ecosystem processes and ecosystem services on the Tongass National Forest. For example, the warmer summers have led to longer growing seasons for trees and other vegetation, while warmer winters have resulted in more insect outbreaks, plant diseases, and population declines for some plant species.[1] The warming trend has also reduced snowpack in low-elevation areas, which may be contributing to ongoing yellow-cedar decline.[2] Drier summers may have also contributed to the number and duration of low stream-flow episodes, which can have adverse effects on salmon while warming of some watersheds may increase productivity for some fish populations (EcoAdapt 2014). The increase in the amount of precipitation falling as rain instead of snow since the 1970s has reduced the frequency of low- and moderate-elevation avalanches, which has allowed mountain hemlock to colonize some alpine areas (EcoAdapt 2014; Shanley and Albert 2014). Furthermore, although Alaska has not yet experienced the same extensive rate of establishment by invasive plant species that has historically occurred in rest of the U.S., the current and predicted milder winter temperatures and the longer growing season in Southeast Alaska have created opportunities for the spread and establishment of invasive plant species within this region (Bauder and Heys 2004; McKee 2006; Wolken et al. 2011).

The ongoing changes to Alaska's climate, as well as to the temperate forests in this region, can have global consequences. For example, recent data show that the melting of glaciers and ice sheets in Alaska has contributed more to the global increase in sea levels over the past 50 years than any other glaciated

---

[1] In 2014, Alaska Region Forest Health Protection surveyed 4.5 million acres of the Tongass National Forest and mapped 51,000 acres of insect and disease damage. The most widespread damage type was recorded for yellow-cedar (which had a decline of about 19,600 acres), followed by 12,000 acres of spruce defoliation. Seventeen other infestation/damages were mapped, most notably cottonwood defoliation, hemlock sawfly, and general conifer defoliation (Heutte, pers. comm. 2015).

[2] Almost 585,000 acres of yellow-cedar decline have been mapped in Alaska through aerial detection surveys since the surveys began in the late 1980s, with extensive mortality occurring in a wide band from the Ketchikan area to western Chichagof and Baranof Islands (USDA Forest Service 2015b).

region that has been measured, with the exception of the Greenland and Antarctic ice sheets (Wolken et al. 2011; Chapin et al. 2014). The coastal-temperate forests in Southeast Alaska comprise approximately 10 percent of Alaska's total forests and 19 percent of the world's coastal-temperate forests (Wolken et al. 2011). Although these coastal forest types are confined to a relatively small footprint globally (covering less than 0.5 percent of the earth's total forested area), they play a critical role in the delivery of dissolved organic carbon to coastal oceans (Wolken et al. 2011). In addition, these forests currently sequester and store large quantities of carbon (DellaSala 2014; DellaSala 2016; Law 2014). As a result, Southeast Alaska plays an important role in the global climate and carbon cycle.

Climate Models

There are several models that examine the potential future climate conditions and/or trends in Alaska's climate. The most reliable models suggest warmer, wetter conditions for Alaska. They generally state that rainfall may increase and snowfall may decrease at lower elevations in Southeast Alaska over the next 50 to 100 years (Bonsal and Prowse 2006; SNAP 2013). The Scenarios Network for Alaska & Arctic Planning (SNAP) recently developed a model for climate projections in Southeast Alaska (SNAP 2013 as cited in EcoAdapt 2014). SNAP's projections suggest that mean winter temperatures in Southeast Alaska may increase by an additional 1.8 to 6.3°F (or 1 to 3.5 degrees Celsius) by the year 2050 (SNAP 2013 as cited in EcoAdapt 2014). Their model also suggests that precipitation levels may increase in all seasons, with winter precipitation potentially increasing by 5 to 15 percent by 2050. The effects that this would have on local conditions would vary; with the increased precipitation potentially resulting in increased snow occurring at higher elevations where temperatures remain below freezing. Lower elevations could experience a shift from snow to rain and a decrease in snowpack as the lower elevations warm and the number of days with below freezing temperatures decrease (SNAP 2013 as cited in EcoAdapt 2014).

Carbon Sequestration

Carbon, primarily in the form of carbon dioxide, is one of the major greenhouse gases being released into the atmosphere through both natural and anthropogenic (i.e., human-driven) influences (McPherson and Simpson 1999; IPCC 2014). This atmospheric carbon, as well as other gases (e.g., methane, nitrous oxide, and water molecules), traps the sun's heat, thereby creating a natural "greenhouse effect" that makes life on earth possible (McPherson and Simpson 1999). The amount of carbon dioxide in the atmosphere is regulated by complex interactions between the atmosphere, terrestrial environment, marine environment, and geologic processes. Recent changes to the global carbon cycle, driven in large part by human activities, have been cited as one of the leading causes for global climate change and the general warming trend that has been detected (IPCC 2014).

The Tongass National Forest stores more forest carbon than any other national forest in the United States (Barrett 2014). As such, a critical ecosystem service sustained by this forest is carbon sequestration (i.e., the removal of carbon dioxide from the atmosphere and keeping that carbon inactive by storing it in live or dead biomass as well as organic soil matter). This makes the Tongass National Forest a critical component in the global carbon cycle (DellaSala 2014; DellaSala 2016; Law 2014).

Generally, the capacity of a forest system to sequester and store carbon depends on the location, age, and species composition of the forest (Birdsey et al. 1993; McKinley et al. 2011). In some forests found in warmer climates, the accumulation of carbon can decrease overtime as the carbon stored in soils and dead vegetative materials are released through the process of organic decay. However, the cool conditions on the Tongass National Forest slow down the rate of decomposition, which includes biomass breakdown/decay and carbon release. The dead or decaying plant matter is incorporated into the system's soil profile within the Tongass National Forest, where it accumulates and resides in various stages of decomposition for prolonged periods. As a result, mature forests within the Tongass National Forest generally store considerable amounts of carbon on the forest floor and in the soil profile. Smith et al. (2004) estimated that approximately 70 tons per acre of carbon are stored on the forest floor in the hemlock-Sitka spruce ecosystems found on the Tongass National Forest. Furthermore, some studies have indicated that trees can continue to accumulate carbon at increasing rates as they mature, thereby resulting in large amounts of carbon stored annually within mature trees (Stephenson et al. 2014). As a result, mature forests on the Tongass National Forest likely store considerably more carbon compared to younger forests in this area (within the individual trees themselves as well as within the organic soil layer found in mature forests).

Although the organic soils of the Tongass National Forest currently store considerable amounts of carbon, D'Amore and Lynn (2002) note that numerous studies have shown that carbon stored in soils may be released to the atmosphere in the form of carbon dioxide or methane, as the climate warms. Davidson and Janssens (2006) noted that many factors can affect the sensitivity of soil decomposition rates to increased temperatures (e.g., the relative mix of organic to mineral substrates, soil moisture levels, as well as other biotic and abiotic conditions) and that not all organic soil types would be equally sensitive to increased temperature; however, D'Amore has indicated that the organic layers in the soil profile of mineral soils as well as organic soils in general on the Tongass National Forest would likely experience increased decomposition rates if average temperatures were to increase (D'Amore et al. 2015; D'Amore 2016). As a result, the projected increases in average temperatures as a result of climate change could result in the release of portions of the carbon currently stored in the Tongass National Forest's soil layers. In addition, the clearing of forested areas during past and ongoing harvesting activities can increase this effect, by increasing the amount of solar energy that is allowed to reach the ground while the forest regenerates following a harvest. The projected increase in average temperatures and longer growing season could also increase the growth rates of fungi in temperate-forests (a taxa that aids in the decomposition of forest material) which would also increase the rate of carbon released to the atmosphere (e.g., currently stem-decay fungi consume approximately 31 percent of the volume of live trees; Wolken et al. 2011). Furthermore, dissolved carbon may be transported to streams and the ocean due to the increased precipitation predicted to occur over the next 50 to 100 years. Increased stream temperatures can also result in an increased rate of carbon released from aquatic systems.

Previous studies have been conducted to determine how much carbon is stored on the Tongass National Forest. Barrett (2014) examined the storage and flux of carbon in live trees, snags, and logs in the Tongass National Forest.[3] On the Tongass National Forest, growth and recruitment of live trees removed an estimated 760 pounds of carbon per acre per year from the atmosphere, but net change in live carbon mass was not significantly different from zero, with mortality and harvest estimated at 670 pounds of carbon per acre per year (Barrett 2014). Including its wilderness areas, aboveground live and snag carbon on the Tongass National Forest is estimated to be 601 (± 21) million tons on an estimated 9.7 million acres of forest.[4] Some 233 million tons of this carbon are on lands that are legally excluded from timber harvesting, such as formally designated wilderness areas (Barrett 2014). Total carbon densities on unmanaged forests were estimated as 72 tons per acre, which comprised 7 percent logs, 13 percent snags, and 80 percent live trees. Carbon densities on managed forests were estimated as 45 tons per acre, which comprised 38 percent logs, 8 percent snags, and 54 percent live trees (Barrett 2014). On a per-acre basis, the Western hemlock and Sitka spruce forest types were found to have the highest amount of carbon (Barrett 2014). Using the per-acre values by forest types, and extrapolating to include wilderness areas, provides a rough estimate of about 650 million tons in aboveground tree carbon on the Tongass National Forest, equivalent to 2.4 billion tons of carbon dioxide (CO_2; Barrett 2014). To put this in perspective, an estimated 83,500,000 billion metric tons of carbon are stored worldwide, primarily in the oceans and marine sediment, based on United Nations estimates. D'Amore and Edwards (no date) estimated that the carbon stored in the Tongass National Forest makes up about 8 percent of the carbon currently stored in the forests of the United States. Leighty et al. (2006) estimate that between 6.4 and 17.2 million metric tons (0.2 to 0.6 percent) of stored carbon has been lost on the Tongass National Forest since timber harvest began in the early part of the 20th century. For comparison, approximately 2,039 million metric tons of carbon was released to produce electric power in the United States in 2012 (U.S. Energy Information Administration [EIA] 2013). The total U.S. carbon emissions in 2012 (which includes the electric sector discussed above, as well as other sections such as industry, transportation, agriculture, and commercial/residential) were approximately 6,526 million metric tons (EPA 2014b).

Interest in enhancing ecosystem carbon sequestration and storage has intensified recently, as concerns about how to mitigate climate change have increased. The question of how active management of ecosystems may contribute to, or detract from, this mitigation effort is being explored, with varying results. A few studies have shown that the management of some forests with certain parameters being met (such as the addition of fertilizer) may result in heightened capacity for carbon sequestration and storage (Schroeder 1991; Binkley et al. 1997). A study in the eastern United States found that thinning a 50-year-old stand from below (i.e., removing the smallest trees) resulted in more stored carbon after 25 years than resulted from thinning stands from the middle or from above (Hoover and Stout 2007). A study conducted in the Pacific Northwest (Perez-Garcia et al. 2005) concluded that the use of wood in permanent structures resulted in "*significant atmospheric carbon reductions by displacing more fossil fuel-intensive products in housing construction*." However,

[3] A number of carbon pools and fluxes were not included in Barrett's report, including (1) carbon in non-forested lands, which includes alpine environments, wetlands, grasslands, and shrublands; (2) below-ground carbon, including roots, soils, and organic materials; (3) carbon in non-tree vegetation and litter within forest; (4) carbon in a few pools currently not measured by FIA, which includes stumps below 4.5 feet and dead saplings; and (5) carbon in forest lands in inaccessible wilderness.
[4] Note that this does not represent a complete accounting of stored carbon, as it does not take into consideration carbon stored in the soil, nor does it take into consideration the stored carbon present in the final products of the harvested timber.

Harmon et al. (1990) noted that even when timber is used for permanent construction purposes, 35 to 45 percent of the wood's biomass is lost to sawdust or scraps created during the processing; therefore, the final amount of carbon ultimately stored in permanent construction is much less than was originally harvested. Other studies, particularly two with application to Southeast Alaskan ecosystems (Harmon et al. 1990; Leighty et al. 2006), indicate that the Tongass National Forest would generate a net release of carbon to the atmosphere if active harvest of old growth is pursued (in other words, harvesting old growth instead of young growth could reduce the carbon sequestering ability of the forest).

As discussed above, timber harvesting and active forest management can affect a forest's ability to store and ultimately sequester carbon. DellaSala (2014, 2016) suggested that a logged forest would emit substantial amounts of carbon for at least the first 15 years following harvest, and that a young regenerating forest would remain a net carbon emitter for up to 50 years. Janisch and Harmon (2002) suggested that it can take more than 200 years following a timber harvest for forests to reach equilibrium (i.e., the point where carbon released from the initial harvest as well as ongoing decay of organic materials equals the amount of carbon that is absorbed into the system). The net effect of a timber harvest and active forest management action (i.e., amount of carbon released versus the amount stored) would depend on how the harvested timber was used (e.g., if it was used for durable timber products, paper, pulp, or biomass fuels[5]), what substitute materials are available for construction purposes (i.e., non-wood materials), the amount of carbon emitted during harvesting activities, the amount of carbon emitted via decomposition of on-site wood and organic soil matter losses, and the influence of the harvested wood on timber markets elsewhere (McKinley et al. 2011; Jonsson et al. 2012). If the emissions are less than the carbon stored in utilized wood, and if the system can rapidly replace losses from decomposition through tree growth, the activity may ultimately yield a net gain of stored carbon; otherwise, the activity would result in a net loss of stored carbon (which would have an adverse effect on carbon sequestering and potentially climate change rate). Although the amount of carbon that has been released on the Tongass National Forest since harvesting began has not been tracked or monitored, based on the understanding of carbon dynamics outlined in Barrett (2014), we can infer that the past harvests and management of the Forest has likely resulted in a net release of carbon to the atmosphere due in part to the practice of harvesting of old-growth timber on the Forest.

Air Quality

The air quality of Southeast Alaska and the Tongass National Forest is generally good. The prevalent airflow from the Pacific Ocean, the relatively small amount of industrial development in Southeast Alaska, the lack of large population centers, the absence of slash burning following harvest, and environmental regulations all contribute to maintaining clean air. Forest activities have historically had little direct effect on air quality on the Tongass (USDA Forest Service 1997a). However, cruise ship emissions in certain locations and trans-Pacific pollutants such as persistent semi-volatile organic pollutants and greenhouse gases are a growing concern.

The State of Alaska Department of Environmental Conservation (ADEC) under the Clean Air Act, via Title 1 and Title 5 of the EPA approved State Implementation Plan regulates air emission from stationary sources. ADEC

[5] If the harvested materials were all used for biomass fuels or other products that would be burned, this would result in a net release of substantial amounts of carbon to the environment (Holtsmark 2012; DellaSala and Koopman 2015). However, the Tongass Forest Plan does not specify how the harvested timber would be used, and the Forest is not managed for biomass fuels.

issues air permits to industrial sources that demonstrate compliance with the Alaska Ambient Air Quality Standards, which are identical to the National Ambient Air Quality Standards (NAAQS). The primary standards were developed to protect public human health and the secondary standards to protect public welfare. Six criteria pollutants are included in the NAAQS: sulfur dioxide (SO_2), carbon monoxide (CO), lead, ozone, nitrogen dioxide (NO_2), and particulate matter with a diameter of less than 10 microns in size (PM_{10}) and less than 2.5 microns in size ($PM_{2.5}$). The NAAQS are provided in Table 3.1-1.

Table 3.1-1
Criteria Pollutants, National Ambient Air Quality Standards

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS
SO_2 (ppb)	1-Hour [1]	75	NA
	3-Hour	NA	500
CO (ppm)	1-Hour [2]	35	NA
	8-Hour [2]	9	NA
NO_2 (ppb)	1-Hour [3]	100	NA
	Annual	53	53
Ozone (ppm)	8-Hour [4]	0.075	0.075
PM_{10} (µg/m^3)	24-Hour [5]	150	150
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35
	Annual [7]	12.0	15.0
Lead (µg/m^3)	3-Month [8]	0.15	0.15

µg/m^3 = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
[1] NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum 1-hour average concentration.
[2] NAAQS is not to be exceeded more than once per calendar year.
[3] NAAQS applies to the 3-year average of the annual (98th percentile) of the daily maximum 1-hour average concentration.
[4] NAAQS applies to the 3-year average of the annual 4th highest daily maximum 8-hour average concentration.
[5] Not to be exceeded more than once per year on average over 3 years.
[6] NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
[7] NAAQS applies to the 3-year average of annual concentrations.
[8] NAAQS applies to the maximum arithmetic 3-month mean.

Air quality and sources of air pollution on the Tongass are described in Air Quality Monitoring on the Tongass National Forest: Methods and Baselines Using Lichens (Geiser et al. 1994) and Air Quality Biomonitoring with Lichens-Tongass National Forest (Dillman et al. 2007). An aerosol sampler near Petersburg was installed in 2004 as part of the Interagency Monitoring of Protected Visual Environment (IMPROVE) program. This was the only IMPROVE site in Southeast Alaska, with the next nearest station in Tuxedni Wilderness near Anchorage. Data from the IMPROVE site were collected over a 5-year period to observe trends and to determine regional, state, and national significance. A review of the latest data available (years from 2007 through 2009) at the IMPROVE site shows that $PM_{2.5}$ levels relative to NAAQS were well below the applicable thresholds near Petersburg (IMPROVE 2015).

Visual inspections of cruise ship emissions by wilderness rangers in Tracy Arm occur during the summer tourist season as part of an agreement with the State using EPA-approved methods. Also, the Tongass National Forest worked with the National Park Service in the Southeast Alaska Network and Forest Service Air Resource Program in Region 6 to coordinate a Southeast Alaska cruise ship emissions monitoring effort using passive air samplers in remote locations, including Tracy Arm (Schirokauer et al. 2014).

Juneau Air Quality

Juneau's Mendenhall Valley is the only area in Southeast Alaska that is known to have exceeded the NAAQS. The EPA listed Juneau City and Borough as a non-attainment area for particulate matter less than or equal to 10 micrometers in 1990. The area is classified as Moderate for this component of air quality, with an average daily rating of 110 out of a maximum of 500. Monitoring data indicate that air quality in Juneau has met state and federal ambient air quality standards in recent years. No state or federal ambient air quality standards have been exceeded since 1997. The last time particulate matter standards were exceeded in Juneau was in 1994 (ADEC 2014a). The State, via their approved Mendenhall Valley attainment plan (59 FR 13884), established control measures to maintain PM_{10} levels and to strive to achieve attainment status (EPA 1994). Because no exceedances have been monitored recently, on May 9, 2013, the EPA granted the request by the State to redesignate the area from nonattainment to attainment for PM_{10}. Areas like Juneau, Alaska, that have been redesignated as attainment areas are classified by EPA as maintenance areas (EPA 2014c).

Lichen tissues were collected on Mt. Roberts in the downtown Juneau area at five different elevations as part of the Tongass lichen biomonitoring program and in collaboration with the State. The lichen tissues analyzed were elevated above threshold levels in all five plots in three or more elements including sulfur, nitrogen, and heavy metals. Lichens from the plot at 175 feet above sea level had the greatest number of elements above threshold (i.e., 12 pollutants), indicating that the sources are probably local and anthropogenic (Dillman et al. 2007).

Sources of Air Pollution

There are 36 stationary sources of air pollution in Southeast Alaska that require air quality control permits as of 2015. These include diesel power plants, asphalt plants, incinerators, mining facilities, and other facilities. Some of these sources operate intermittently (e.g., back-up power plants may operate during power failures or during peak demand periods, and asphalt plants may operate seasonally), and others may be operating at full capacity (e.g., Greens Creek mine).

Other sources of air pollution in Southeast Alaska include mobile sources (such as cars, trucks, boats, cruise ships, airplanes, and helicopters) and area sources (such as home furnaces, wood stoves, and open burning). Under certain weather conditions, wildfires in Canada can affect air quality and visibility (i.e., regional haze) in parts of Southeast Alaska, although no advisories were issued by ADEC in 2013 or 2014 for the Tongass.

Cruise ship traffic has greatly increased in Southeast Alaska over the last several years. There were 489 planned cruise ship visits in Juneau during 2015, with an annual average number of visits of 492 ships for the 2014 to 2015 seasons (CLAA 2014a, 2014b). Cruise ship emission monitoring in Juneau by ADEC indicates that ship emissions are well within federal and state standards.

Cruise ship traffic in Tracy Arm creates a particular concern for air quality in Wilderness. Tracy Arm received 200 cruise ship visits in 2009 (USDA Forest Service 2009a). Tracy Arm is less than a mile wide (on average) and is surrounded by high mountains. Cruise ship emissions may linger above the fjord for hours. The emissions are most heavily concentrated in upper Tracy Arm, where vessels stop near the South Sawyer Glacier for 1 to 4 hours (depending on ice conditions). Ship emissions often increase because of rapid changes in engine loading necessary for the ship to maneuver through ice and turn around.

The Forest Service has received an increased number of public complaints concerning air quality within the Tracy Arm. In an effort to better address the visibility concerns in the Wilderness resulting from cruise ship emissions, the Forest Service and ADEC have developed a Memorandum of Understanding to train Forest Service wilderness rangers to visually monitor cruise ship emissions with EPA-approved standards. ADEC annually reviews the visible emission observations and takes action on any that exceed the State Marine Vessel Emission standard (18 AAC 50.070) (ADEC 2014b).

Three lichen biomonitoring plots were established within Tracy Arm. All were revisited in 2011 and 2012; results indicate that levels were at or above thresholds for sulfur, nitrogen, potassium, manganese, and silicon.

Environmental Consequences

Direct and Indirect Effects

Air Quality

The expected direct effects on air quality from forest management activities would be temporary and limited in nature, resulting from dust and vehicular emissions from logging operations, administrative and harvest-related use of Forest roads, and facilities and equipment required to support energy development. None of the alternatives considered would include broadcast burning of slash following harvest, which is seldom if ever used on the Tongass National Forest.

Alternatives 2, 3, 5, 4, and 1 would result in progressively more potential total harvest, road construction/reconstruction, harvest-related vehicle use and/or helicopter use, and wood processing comparatively, which could subsequently result in progressively more potential emissions by alternative (including emissions of green-house gases). However, due to the short-lived nature of these activities coupled with dynamic weather patterns throughout Southeast Alaska (consistent wind and rain throughout the year), no significant adverse effects on air quality are anticipated from these activities under any of the alternatives considered.

Indirect effects on air quality can result from the use of trees harvested from the Tongass National Forest, such as in the operation of industrial processing sites and firewood burning, as well as emissions from private vehicles using Forest unpaved roads. These indirect effects on air quality can be aesthetically displeasing or have potential health risks to both humans and the Forest. EPA and ADEC have limited regulatory responsibility, under the Clean Air Act, for air quality related to these kind of sources. The enforcement of the applicable regulations by these agencies is anticipated to keep any potential adverse effects within the standards for air quality; therefore, no significant indirect effects from the uses of the Tongass National Forest should occur.

Climate Change / Carbon Sequestration

The Tongass National Forest plays an important role in amount of carbon that is stored globally as well as the global climatic condition (see the discussion above in the Affected Environment section). As a result, land management and other actions taken on the Tongass National Forest can affect climate change at a local, regional, and global scale. Although there is a substantial amount of recent literature about the effects of forest management on climate change and carbon storage, different authors have reached widely different conclusions about net sequestration rates/effects due to different assumptions made regarding pre- and post-harvest decay rates, the amount of energy that would be expended during the harvesting and transportation of timber, utilization rates and lifespan of wood products, future growth rates of young-growth stands, the substitution of wood for other products, and market leakage (e.g., Harmon et al. 1990; Birdsey et al. 1993; McKinley et al. 2011; Jonsson et al. 2012). Some of these factors may contribute to a net removal of carbon from the atmosphere, while other components can increase the carbon emission rate. Each of the harvesting alternatives would affect the amount of carbon that is stored in the forest; however, the amount/extent of this effect would depend on the time scale of consideration; how much of the wood is removed/harvested from the forest; how the wood is used; and how much carbon is released in cutting, yarding, transporting, and processing the wood as well as in soil carbon and woody debris decomposition (see discussion above, in the "Affected Environment" section). These factors and how they relate to the proposed alternatives are discussed in more detail below.

The harvesting of old-growth trees can reduce the carbon storage capacity of the forest and result in a net loss of carbon from the forest and into the atmosphere (Harmon et al. 1990; Leighty et al. 2006; also see the discussion in the Affected Environment section). The Tongass National Forest is unique within the National Forest System in regard to the substantial amount of old growth that is present outside of wilderness areas on the Forest. Also unique is the proportion of harvesting that has occurred in old-growth forest acres as opposed to young-growth acres during recent decades. Harvesting of old-growth creates an initial net release of CO_2 into the atmosphere relative to leaving stands unmanaged, and this release of carbon can continue for years as logs and snags left after harvest continue to decompose (Harmon et al. 1990). Some of the forest's carbon may be stored in the wood products that are produced following a harvest; however, the carbon in these products will transition back into the atmosphere over time as they degrade or are disposed of. For example, because harvest levels peaked in the 1970s, and much of the resulting wood products may now be in landfills, wood products from the Alaska Region are now believed to be a net emitter of carbon (Barrett 2014). In addition, approximately 35 to 45 percent of a tree's biomass is lost to sawdust or scraps during processing; therefore, the final amount of carbon ultimately stored in wood products would be less than was originally harvested (Harmon et al. 1990), likely resulting in a net release of stored carbon. In addition, some of the wood products could be burned as part of biomass energy production, which would rapidly release the stored carbon into the atmosphere (Holtsmark 2012; DellaSala and Koopman 2015).

Conclusions regarding carbon storage, carbon emissions, and ultimately sequestration can be strongly influenced by the temporal scale examined. For example, DellaSala (2014, 2016) suggested that a logged forest would emit substantial amounts of carbon for at least the first 15 years following harvest, and that a young regenerating forest would remain a net carbon emitter for up to 50 years. Janisch and Harmon (2002) suggested that it can take more than 200 years following a timber harvest for forests to reach equilibrium. Therefore, it appears that harvesting options proposed in the five alternatives considered would likely result in a net release of carbon in the short to medium timeframe (i.e., within the first 50 years following harvest), and could remain a net contributor to carbon emissions for more than 200 years.

The current land management plan for the Tongass National Forest focuses timber harvest primarily on old-growth forests (i.e., Alternative 1 would keep this practice as the primary management tool); and as discussed above, harvesting old-growth timber reduces the carbon storage and ultimately the carbon sequestration ability of forests in Southeast Alaska. Each of the Action Alternatives considered for the plan amendment (i.e., Alternatives 2 through 5) would involve some harvesting of old-growth forests over a period of time (see Chapter 2); however, these would be at levels lower than what is currently allowed under the 2008 Forest Plan. As a result, although each of the alternatives would result in a net release of carbon to the atmosphere, all action alternatives would result in a lower carbon emissions and potentially higher sequestration compared to the current plan (i.e., Alternative 1) due to the extent of old-growth forests that could be harvested under the No Action Alternative. Based on the 25-year projection, Alternatives 2 and 3 would have the lowest potential old-growth harvest compared to the other alternatives considered, while Alternative 1 would have the highest potential old-growth harvest and the lowest potential total harvest (i.e., the total harvest level that includes both old-growth and young-growth harvests in the calculation) compared to the other alternatives. Alternative 2 would have the highest potential total harvest. (see Table 3.13-7 in the *Timber* section).

The assessment provided above in this section employs a qualitative evaluation of carbon sequestration. A qualitative evaluation of the differences among alternatives provides the most certain and reliable illustration of potential differences between alternatives. A preliminary quantitative (i.e., numeric) assessment is feasible, but the quantitative results would include a large amount of error or uncertainty, such that the calculated differences between the alternatives would be difficult to discern. As outlined in McKinley et al. (2011) quantitative assessment of forest carbon must carefully address uncertainty; and portions of a quantitative analysis for this project with particularly high uncertainty include the following:

1. While the amended plan specifies limits in timber harvest from old-growth and young-growth forest, it is unknown when forests will be harvested or the extent of harvest that would occur at any particular time (i.e., at or below the specified limit), for any alternative. This leads to high uncertainty in estimating differences in carbon pools over time.
2. The differences among alternatives in regard to the transportation of wood (location transported or shipped to) cannot be accurately estimated at this time.
3. Similarly, differences among alternatives in the types of forest products that will be produced from trees harvested on the Tongass is unknown (e.g., product type influences the timing and amount of carbon stored).
4. Finally, there are differences related to market leakage (McKinley et al. 2011; Jonsson et al. 2012) associated with timber harvest.

All these factors have a very high level of uncertainty at the Forest Plan level. Consequently, the programmatic assessment cannot compare quantitatively (within reasonable accuracy) the carbon emission or sequestration differences among alternatives,[6] Because of the large uncertainties in a quantitative life-cycle assessments for this amendment, we adopt a qualitative approach and focus on acres harvested, miles of road built, etc., which provides a more

[6] In addition to examining only standing carbon stocks, carbon mitigation can also be assessed through life cycle analysis. A recent synthesis of findings about the mitigation effectiveness of alternate forest management and wood use options concluded: *In the long term, sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual yield of timber, fiber, or energy from the forest, will generate the largest sustained mitigation benefit* (IPCC 2007). In a multi-use context, we are not suggesting that all lands be managed to generate the largest sustained carbon mitigation benefit, but rather simply citing IPCC scientists that research is being conducted on additional approaches that may lead to other conclusions. For example, Vose et al. (2012) report that life cycle evaluations of management and wood use options suggest more intensive approaches to wood production, harvest, and use to maximize carbon mitigation (Vose et al 2012).

transparent, tractable evaluation of the relative differences between alternatives. As discussed above as part of the qualitative assessment, it is anticipated that each of the alternatives would result in a net increase in carbon emissions, and Alternative 1 is estimated to have the highest contribution to short-, mid-, and long-term carbon emissions.

All alternatives include standards and guidelines that protect soils, such as standards/guidelines related to harvesting on steep slopes, roads built across steep slopes, and on soil disturbing activities. These measures would help retain carbon stored as organic material in the soil. Also, unlike many areas of the country, broadcast burning to reduce slash is not practiced on the Tongass; therefore, much more of carbon stored on the forest floor and in the upper layers of soil is retained compared to sites that are broadcast burned.

Cumulative Effects

Air Quality

Cumulative effects on air quality include harvest-related emissions from state and private land, vehicle and maritime emissions, permitted uses such as community incinerators, industrial operations, cruise ship emissions, and electricity generation. Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

Most of the logs harvested on private land are expected to be exported; therefore, locally there would be little additional emissions due to processing and/or burning wood from state and private land locally. Because of the temporary and limited effects associated with timber harvest on National Forest System (NFS) lands, the alternatives are not expected to contribute significantly to cumulative effects on air quality. Air pollution from wood processing is likely to remain low, but could increase somewhat if more wood is burned to produce energy.

Emissions from vehicles, maritime activities, cruise ship operations, community incinerators and industrial operational emissions would continue to contribute to cumulative effects on air quality. There are no known substantial increases in these activities, and therefore, they are expected to continue to be a negligible source of air quality emissions.

Each of the action alternatives (i.e., Alternatives 2 through 5) would remove the windows[7] and avoidance language under the Transportation and Utility System (TUS) Land Use Designation (LUD) requirements and replace it with Renewable Energy Plan Components. Some areas would remain designated as TUS “avoidance”[8] areas under Alternative 1. See the Renewable Energy Section for more information on TUS windows and avoidance areas. There are preliminary

---

[7] A TUS “window” is an area potentially available for the location of transportation or utility corridors and sites. Windows represent areas of future opportunity where the applied management direction will not conflict with future designation of a TUS. A site-specific analysis is still required during project-level planning, to identify resource protection needs within these areas. Windows are designated through the allocation of lands to TUS windows in their standards and guidelines.

[8] A TUS "avoidance area" is an area where the establishment and use of transportation or utility corridors and sites is not desirable given the LUD emphasis. A search for "windows" should be exhausted before TUS facilities are considered in avoidance areas. When feasible, these areas should be avoided through site-specific analysis during project-level planning. Avoidance areas often include congressionally and administratively designated areas. Although special environmental or procedural considerations may be required for these areas, these special designations do not preclude consideration and use as a TUS. Avoidance areas are designated through the allocation of lands to LUDs specifically identified as TUS avoidance areas in their standards and guidelines. In cases where proposed or potential corridors are allocated to the TUS LUD that traverse other LUDs identified as TUS “avoidance areas,” treat the corridors within such LUDs the same as TUS “windows” (subject to applicable laws).

plans for renewable energy projects in the Tongass National Forest that include hydropower, geothermal power, and tidal power production plants (Tetra Tech 2015). Although these renewable energy projects could still be built under Alternative 1, the Action Alternatives would likely streamline the development and permitting process for these projects making it more likely that they would be built. Although the Action Alternatives could make it more likely that renewable energy projects would be built, the plan does not specify or support any particular renewable energy type.

If built, these new power sources would require implementation of additional transmission lines and access roads to link the new power produced to the grid. Implementation of these renewable energy projects could result in long-term reductions in both air pollution and carbon emissions, as many communities may no longer have to rely on diesel generators if these new power sources are developed in the region. Nevertheless, initial development of renewable energy projects would result in temporary localized air quality impacts relating to construction of the projects and their support facilities (transmission lines and roads). Operationally, air quality emissions from these projects would likely be negligible, consisting of maintenance activities and worker trips. At this time it is not possible to quantitatively assess impacts from these types of developments because there is little to no detail available regarding these potential projects. Nevertheless, each of these renewable energy projects would proceed through their own National Environmental Policy Act effort where quantitative impact analysis would be competed and a determination of compliance with air quality standards would be made.

Periodic forest fires in western Canada would continue to pose a potential adverse air quality effect, although the infrequent and transitory nature of these events prevents the analysis of quantitative impacts to the Tongass.

Climate Change / Carbon Sequestration

This section will address two issues: 1) the cumulative effects of the proposed amendments and other past, present, and reasonable foreseeable actions on climate change and carbon sequestration; and 2) the cumulative effects of climate change on the Forest Service's future management of the Tongass National Forest.

The extent and scope of cumulative effects on climate change and carbon sequestration depends on the amount and condition of total forest land harvested (worldwide, as well as locally within Southeast Alaska); the use to which harvested wood is put; the use of the land post-harvest; how the non-NFS lands are managed (including private and state-managed lands within the U.S., as well as forests in other countries); on the amount of carbon released during harvest, processing, and transporting wood products; decomposition rates of organic materials; factors such as the amount of new hydroelectric or other renewable energy power projects that are built (e.g., those that might replace diesel generated power); future community expansion and development; as well as emissions from ongoing and future activities in the region. The anticipated scope and magnitude of many of these factors (e.g., the increased anticipated decomposition rates in organic materials in Southeast Alaska as average temperatures increase; the potential for new hydroelectric or other renewable energy power projects to be developed in the region; and emissions from ongoing and future activities) are discussed and analyzed above. It is anticipated that communities in the region and worldwide will continue to increase in some areas and decrease in others depending on local population sizes, as well as site-specific socioeconomic and other anthropogenic factors (see the *Communities* section). It is uncertain how forested lands that are located outside of the U.S. would be managed by their respective governments or land-owners (and the Forest Service would have no jurisdiction over these foreign lands or entities), but it is likely that many of these areas will continue to be managed under their respective government's current forest management practices, as well as responding to global markets including the influences of the Tongass forest products on those markets leading to some level of market leakage (e.g., Jonsson et al. 2012). It is likely that most of the state and private commercial forest land in Southeast Alaska, except for state parks and some other state lands, would be managed for the production of forest products under any of the alternatives considered in this analysis. On Forest Service–managed lands, the maximum amount of suitable land on the Tongass that could be harvested would vary depending on the alternative selected (see the *Timber* section). Maximum levels of harvest would only occur if additional manufacturing facilities and markets are developed, as well as other factors such as funding and staff levels. If the products resulting from harvest are primarily lumber and other building materials, there is a potential that the carbon in these products would be stored for the life of the buildings, longer if the wood is recycled or placed in landfills. If the wood is used for paper products or fuel, carbon storage would be short term (Harmon et al. 1990). Any temporary storage of carbon in lumber products may be offset by carbon released during and after harvest, transportation, and processing.

Each of the alternatives would cumulatively add to the global effects of climate change by contributing to the net release of carbon to the atmosphere; however, the goal of the proposed amendment is to reduce the total old-growth harvest that could occur, and as a result, each of the Action Alternatives (i.e., Alternatives 2 through 5) would have lower cumulative effects to carbon emission levels compared to the 2008 Forest Plan (i.e., Alternative 1). Stated more directly, based on the extent of old-growth forest harvest, Alternative 1 would result in the lowest potential for carbon storage followed by Alternatives 4, 5, 2, and 3.

Climate change could impact the resources currently managed by the Forest Service as well as how the Forest Service manages the Tongass National Forest in the future. While there is general agreement among scientists that the climate of Southeast Alaska is warming, there is considerable uncertainty concerning the exact scope of the effects of climate change on the forests of Southeast Alaska and how best to deal with possible changes to the many resources managed on the Tongass.

Shanley et al. (2015) predicted that the increased temperatures and precipitation events estimated to occur in the region as a result of climate change would have the following effects to coastal temperate rainforests like those found in the Tongass National Forest: increased frequency of flooding and rain-on-snow events; an elevated snowline and reduced snowpack; changes in the timing and magnitude of stream flow, freshwater thermal regimes, and riverine nutrient exports; changing non-forested habitats; altitudinal and latitudinal expansion of lowland and subalpine forest types; shifts in suitable habitat boundaries for vegetation and wildlife communities; adverse effects on species with rare ecological niches or limited "dispersibility"; and shifts in anadromous salmon distribution and productivity (Shanley et al. 2015). Other effects on forests in the Tongass National Forest could include increased blowdown; increased tree mortality from insects and disease; increased fire frequency and severity; adverse effects on air quality; and changes to subsistence use and recreation.

If warmer winter weather results in higher insect populations and increased tree defoliation (as discussed above), there is a risk that increased dead material and warmer weather may spawn more fires than are normal for the area. However, as Berman et al. (1998) state, it is difficult to predict the magnitude of the area likely to be burned in a region without an historic fire record, but they estimate that most fires would be small and of low intensity, suggesting a scenario in which 5,000 acres might burn over a period of decades (an average of approximately 100 acres per year). Juday et al. (1998) and Shanley et al. (2015) suggest that the effects of fires on resources are likely to be low in this region, but that the effects of insects and disease may increase. For example, Shanley et al. (2015) stated "[a]ssuming that seasonality of precipitation does not change significantly, fire will remain unimportant as a disturbance agent, but higher [mean annual temperature] is anticipated to increase the incidence and severity of insect and disease in lowland forests."

Plant and animal species will respond to changing climates individually; and some species or individuals will be more sensitive and vulnerable than others (Millar et al. 2006). For example, forest losses (either from climate induced increases in insects, diseases, or fire) could harm wildlife habitat, which in turn could adversely affect subsistence resources; while conversely, Juday et al. (1998) suggested that warmer winters could result in sustained higher populations of Sitka black-tailed deer, one of the most important subsistence resources for residents of Southeast Alaska and a major prey species for wolves. Juday et al. (1998) also postulate that warmer, drier conditions could increase stream temperatures and cause seasonal low flows, both of which could adversely affect salmon (EcoAdapt 2014). Berman et al. (1998) estimated that a 25 percent decline in salmon stocks would result in a loss of $25 million a year (approximately $31 million in current dollars). However, Oswood et al. (1992) state that melting glaciers would result in more runoff entering streams. This could offset any decrease in summer flows due to reduced summer precipitation, at least in the short run. In time, glacial mass would be reduced and their contribution to stream flow would decrease (EcoAdapt 2014). Oswood et al. also believe that climate change would result in changes to the nutritional levels of leaf material entering streams, but could not predict whether this would have a positive or negative effect of fish. Some recent studies have postulated that watersheds currently fed by snow may transition to rain-fed systems, thereby altering water storage and flow dynamics that can affect salmon health (Wolken et al. 2011; Shanley and Albert 2014). The rate of decline and mortality of yellow-cedar in Southeast Alaska may be increased as a result of climate change (Hennon and Shaw 1997; Wolken et al. 2011; Hennon et al. 2016), as the snowpack in low-elevation areas may continue to be reduced as a result of the warming trend, resulting in greater exposure of yellow-cedar's fine roots to freezing, especially in the southern portion of the region (see the *Forest Health* section).

Warmer temperatures are expected to result in a loss of carbon stored in leaf litter and soil organic matter, due to increased soil respiration (Bachelet et al. 2005). The clearing of forested areas during harvesting or other development actions could increase this effect, by increasing the amount of solar energy that is allowed to reach the ground.

Shanley et al. (2015) hypothesized that climate change could also affect the quality of timber products that could be harvested from this region. For example, they state that "[a]ccelerated forest growth rates, if driven by [mean annual temperature] warming, may in turn increase the quantity but decrease the tight grain quality of forest products from second-growth forests, relative to those harvested from primarily forests during the 20th century." Furthermore, some studies have found reduced productivity of forests throughout Alaska as a result of recent changes to climatic conditions (Wolken et al. 2011).

All of these factors and anticipated effects related to climate change can have both local and global implications to communities as well as associated social costs (Larsen et al. 2007; IPCC 2014; EcoAdapt 2014). These include changes to subsistence and recreational resources, impacts to infrastructure and land-use, changes to transportation routes and options, and potential impacts to public health as a result of climate change.

The Forest Service will continue to work with local stakeholders and Pacific Northwest scientists to develop measures to alert the Forest Service to trends that may affect the health of the Forest and the species that depend on it, as well as measures that could be implemented to minimize or adapt to the effects of climate change on managed resources. One monitoring effort that the Forest Service currently uses to track changes in vegetation is the Forest Inventory and Analysis-Forest Health Monitoring (FIA FHM) program. Researchers have analyzed the existing FIA data from plots containing epiphytic lichen, and vascular plant data to develop air pollution and climate models (Root et al. 2014). Annual insect and disease surveys also provide information on how climate change may be affecting forests. Stream gauges, some of which provide long-term data on stream flow, are another tool used by the Forest Service to monitor the effects of climate change on the Tongass National Forest. The ongoing work of the Forest Service, local stakeholders, and Pacific Northwest scientists will aid in developing management tools to address ongoing changes to the environment and climate.

Geology, Karst, and Caves

Affected Environment

Geology

The Tongass National Forest is underlain by complex geology. Southeast Alaska is located near the boundaries between the Pacific and North American tectonic plates. During the past 170 million years, tectonic movements have brought massive crustal blocks from across the Pacific Ocean and lodged and welded them onto the edge of the North American plate. The resulting southeast-northwest trending rock belts, or accreted terranes, include a wide variety of geologic materials (Nowacki et al. 2001). As the Pacific and North American plates collided, the coastal mountains of Southeast Alaska were uplifted. More recently, fault movements have offset the accreted terranes, adding further geologic complexity to the region. This tectonic plate boundary forms part of the “Ring of Fire,” the area around the Pacific Ocean that is high in volcanic, mountain-building, and seismic activities. Evidence of relatively recent volcanic activity exists within the Tongass National Forest. The Mount Edgecumbe volcanic field volcanic activity began about 600,000 years ago. Mount Edgecumbe itself formed as a result of several explosive eruptions 12,000 to 14,000 years ago. The volcanic field last erupted between 5,000 and 6,000 years ago. On the southern Tongass are two other volcanic fields that have developed during the late Pleistocene. The Craig volcanic field consists of 18 known vents that range in age from 847,000 to 6,700 years before present. The Ketchikan volcanic field consists of 30 vents ranging in age from 400,000 to 8,100 years before present (BP). These features consist of cinder cones, lava flows, rhyolite domes, and obsidian flows, many of which erupted subglacially or marginal to ice.

Together, these tectonic, seismic, and volcanic forces have resulted in many different geologic formations in Southeast Alaska. Within the Tongass National Forest, generalized lithologies have been delineated and include granitics, noncarbonated sedimentary, carbonate sedimentary, metasedimentary, complex sedimentary and volcanics, volcanics, and mafics/ultramafics (Nowacki et al. 2001). During the past 12.5 million years, many of these lithologies have been affected by glaciers.

Within the Tongass National Forest, recurrent ice sheets formed and spilled from the St. Elias and Coast Mountains onto adjacent surfaces (Nowacki et al. 2001). Pushing seaward, these continental ice sheets combined with smaller alpine glaciers descended from isolated island peaks. Together, the ice sheets and glaciers reworked the topography of the land by rounding mountains, scouring bedrock, depositing glacial sediments, and carving U-shaped valleys and submarine trenches. In some areas, unconsolidated sediments were left, including glacial till (ice-contact deposits), glacial outwash, and glacial marine sediments. During the last glacial maximum, ice flowed all the way to the continental shelf. As glaciers retreated worldwide, the ice sheet receded first at coastal margins, then north and eastward along major channels and valleys into the mountains. Deglaciation was rapid and largely complete by 13,500 years ago.

The group of islands and fjords that currently make up the Tongass National Forest developed after the last major glacial retreat as seawater flooded the deeply incised valleys and trenches. Since deglaciation, coastlines have shifted dramatically due to tectonic events, worldwide sea level changes, and land rebound in the absence of the glaciers' massive weight. Elevated fossil-bearing marine beaches and deltas along the coastline indicate an uplift of the land relative to the sea since the last glacial maximum.

There are multiple sites with important vertebrate and invertebrate paleontological resources throughout the Tongass, including 220 million year-old sites on Gravina Island and the islands in Keku Strait (Baichtal 2006). Many important paleontological resources have been identified in caves on the Tongass National Forest. Paleontological resources are managed and protected on federal lands per Subtitle D of the Omnibus Public Land Management Act of 2009 (Public Law 111-11). The Forest Service recently issued new rules for paleontological resource preservation that became effective on May 18, 2015 (80 [74] Federal Register 21587-21638). The new rule addresses the management, collection, and curation of paleontological resources from National Forest System (NFS) lands including management using scientific principles and expertise, collecting of resources with and without a permit, curation, confidentiality of specific locality data, and penalties for illegal activities.

As a result of the geological processes in Southeast Alaska, the region's physiography is topographically complex. Broad physiographic areas in the Tongass National Forest include icefields, recently deglaciated areas, large mainland river systems, angular mountains, rounded mountains, hills, lowlands, and recent volcanic fields. These distinct areas reflect the geomorphic and glacial history of the land. Continental ice sheets flowed, scoured, and deposited materials, tectonics added blocks of distinct geology, and volcanism superimposed younger rocks.

Karst and Caves

The geology and climate of Southeast Alaska are particularly favorable for karst development. Karst is a comprehensive term that applies to the unique topography, surface and subsurface drainage systems, and landforms that develop by the action of water on soluble rock (primarily limestone and marble [carbonates] in Southeast Alaska). The dissolution of the rock results in the development of internal drainage, producing sinking streams (streams that sink into the stream bed or karst features), closed depressions, sinkholes, collapsed channels, and caves.

Because of fractures in the carbonates, high annual precipitation, and peatlands adjacent to the carbonate bedrock, karst has developed, to varying extents, within all carbonate blocks. The Tongass National Forest contains the largest known concentration of dissolution caves in Alaska. Approximately 431,030 acres of karst are on NFS lands.

In Southeast Alaska, the karst landscape can be characterized as an ecological unit found atop carbonate bedrock in which karst features and drainage systems have developed as a result of differential solution by surface and ground waters. These acidic waters are a direct product of abundant precipitation and passage of these waters through the organic-rich forest soil and adjacent peatlands. Recharge areas may be on carbonate or adjacent noncarbonate substrates. A few characteristics of this ecological unit include mature, well-developed spruce and hemlock forests along valley floors and lower slopes, increased productivity for plant and animal communities, extremely productive aquatic communities, well-developed subsurface drainage, and the underlying unique cave resources (Baichtal and Swanston 1996). The visible karst landscape also contains “epikarst,” or surface features, particularly in the alpine and sub-alpine zones. These include deep shafts and fissures, eroded rills, and spires or spikes of limestone.

Karst lands add a vertical, underground dimension to land use planning. Karst subsurface drainage networks generally operate independently of, and with more complexity than, the surface drainage systems above, and the watershed characteristics of the surface may have little or no relationship to the subsurface system. On karst lands, the many solution-widened fissures at the surface become entry points into the subsurface drainage system, where water and sediment from surface sources move vertically downward into the underground lateral systems. Sediment and water from disturbed lands or roads may enter this system at a single point and emerge unexpectedly at one or more distant springs, sometimes crossing surface watershed boundaries. Karst groundwater systems routinely transport water for several thousands of feet to receiving caves, springs, and surface streams.

Most Tongass National Forest caves pre-date the most recent glaciation, as evidenced by the presence of glacial clays, glacial sediments, wood, Pleistocene vertebrate remains, and possibly ancient ice. Speleothems (i.e., secondary mineral deposits such as stalactites, stalagmites, flowstone, and crystal growths) from El Capitan Cave, on Prince of Wales Island, have been radiometrically dated to between 107,000 and 115,000 years old, or during the last interglacial period. Speleothem dates from other caves in the Tongass National Forest range from 53,000 to 185,800 years old. The most recent glaciation modified a pre-existing karst landscape, collapsing some passages and systems, gouging into others, and filling some with sediments. The epikarst (surface karst), which is well developed in higher elevations, has been removed in places at lower elevations by glaciation. Where low-elevation epikarst is present, primarily on the outer coast of islands seaward of Prince of Wales Island, vegetation has been re-established and a forested epikarst created. With the development of forested epikarst and peatlands, and the entrance of associated acidic waters into underground tributaries, a system of enlarged caves and vertical shafts has developed.

There is a definite tie between the karst landscape and the productivity of the spruce and hemlock forests found there. Dense stands of very large diameter spruce and hemlock at lower elevations are characteristic of many karst landscapes. The major contributors are believed to be the nutrient rich soils, well-developed subsurface drainage, and dissected bedrock surface, which allows the tree roots to hold fast and become more windfirm. The old-growth forest on this low-elevation karst provides a well-structured, multi-layered canopy resulting in high-quality winter habitat for many wildlife species. The structure of the forest provides many forbs and shrubs, which provide forage. It is possible that this forage contains, at a minimum, higher calcium levels allowing for better bone, muscle, and antler development. The combination of quality forest structure and abundant nutritional browse make the karst landscape, in general, exceedingly important habitat.

Many wildlife species, including mammals, birds, and invertebrates, find the surface karst features and the stable environment and shelter provided within the caves to be valuable habitat (Baichtal and Swanston 1996). Cave systems provide critical summer and winter roosting and hibernating habitat for bats (Baichtal and Swanston 1996). Preliminary studies suggest that aquatic habitats associated with karst landscapes may be 8 to 10 times more productive than adjacent non-karst aquatic habitats (Baichtal and Swanston 1996). Karst aquatic habitats support a greater abundance, distribution, density, and variety of invertebrate species than non-carbonate habitats, have higher growth rates for smolts and resident fish, have less variable water temperatures and flow regimes, and contain unique habitat affecting species distribution, abundance, and adaptation.

The potential cultural and paleontological significance of the caves and karst landscape is high (Baichtal and Swanston 1996). The Pleistocene paleontology of the area is primarily known from cave and rock shelter deposits, which are often intimately related to archaeological sites. The cool, stable, non-acid environments in the caves result in exceptionally good preservation of bone and organic materials. To date, significant archaeological and paleontological materials have been discovered in over 30 caves and rock shelters within the Tongass National Forest. Evidence of human habitation, the oldest dating to about 9,700 years BP, has been discovered in several caves on Prince of Wales and nearby seaward islands. Eighteen black bears (*Ursus americanus*), one dating to approximately 39,000 years BP, and 13 brown bears (*Ursus arctos*), ranging in age from about 35,400 to 7,200 years BP and now extinct on Prince of Wales Island, have been found.

Cave invertebrate collections have yielded at least five troglobitic and 40 troglophilic invertebrate species. Many of these species, such as *Onychiurus* n.sp., *Tomocerus* n.sp., and *Stygobromus* n.sp., have only just been discovered. These species and their distribution may shed light on the extent of past glaciations and the timing of sea level fluctuation in the region.

Of the 431,030 acres of NFS karst lands, approximately 278,000 acres were originally productive old growth (POG). Based on geographic information system (GIS) queries, 82,240 of these POG acres (29 percent) have been harvested, leaving 152,800 acres of existing POG on NFS karst lands.

Aerial and on-the-ground observations are revealing the effects of past resource management on karst systems. Hydrologic evidence suggests that timber harvest alter the timing and intensity of surface flow, resulting in accelerated sediment and debris transport. Passages have flooded that had not flooded for centuries, and many cave entrances were infilled and/or blocked by logging slash, sediment, and debris, resulting in surface flows being rerouted into different passages. In the past, runoff generated from road surfaces commonly was diverted into karst features. It is not yet fully known what cumulative effects past timber harvest have had on the epikarst landscape. In some portions of the Tongass National Forest, 70 to 80 percent of the commercial forest land within specific karst blocks have been harvested. Overall, about 41 percent of original POG on karst lands below 800 feet in elevation have been harvested on the Tongass. In the North Central Prince of Wales Biogeographic Province (which includes most of Thorne Bay Ranger District and part of the Craig Ranger District), about 57 percent of the original POG on karst lands below 800 feet have been harvested.

The Land and Resource Management Plan (Forest Plan) includes standards and guidelines that provide for other land uses while taking into account the function and biological significance of the karst and cave resources within the landscape. The Forest manages karst lands using karst vulnerability mapping. This strategy assesses the susceptibility of the karst resources to any land use. Vulnerability mapping utilizes the fact that some parts of a karst landscape are more sensitive than others to planned land uses. The key elements of the strategy focus on the openness of the karst system and its ability to transport water, nutrients, soil and debris, and pollutants into the underlying hydrologic systems. The strategy strives to maintain the capability of the karst landscape to regenerate a forest after harvest, to maintain the quality of the waters issuing from the karst hydrologic systems, and to protect the many resource values within the underlying cave systems as per the requirements of the Federal Cave Resources Protection Act (FCRPA).

Multiple reviews of the karst management strategies have been conducted by two panels, independent reviewers, and internally as well. These reviews include the Karst and Cave Resource Significance Assessment, Ketchikan Area, Tongass National Forest, Alaska (Aley et al. 1993); the Application of a Karst Management Strategy: Two Case Studies from the Tongass National Forest, Southeastern Alaska; The Challenges of Implementation (Baichtal 1997); the Heceta Sawfly Salvage Sale, Soils, Karst, and Cave Resource Evaluation, Heceta Island, Southeastern Alaska (Baichtal and Landwehr 1997); the Karst Vulnerability Assessment Review, Heceta Island (Aley 1997); and the Karst Management Standards and Implementation Review, Final Report of the Karst Review Panel (Griffiths et al. 2002). These reviews, combined with implementation and effectiveness monitoring and resource specialist input, formed the basis for the changes to karst and cave management standards and guidelines adopted in 2008.

In 2008, the Tongass National Forest amended the 1997 Forest Plan and made substantial changes to the karst and cave management standards and guidelines. The 2008 Forest Plan also included additions to the geologic special interest areas to protect nearly 47,000 additional acres (57,164 acres total) of karst lands that are most vulnerable to disturbance from development. In 2014, the National Defense Authorization Act for Fiscal Year 2015 changed some of those Geologic Special Areas to Land Use Designation (LUD) II Geologic Conservation Areas. The land ownership of some of the Geologic Special Areas was transferred to the Sealaska Corporation. Currently, 69,825 acres (16 percent of the Tongass karst lands) are Geologic Special Interest Areas or LUD II Geologic Conservation Areas.

On the low to moderate vulnerability karst lands (defined in the Karst and Cave Resources Standards and Guidelines of Chapter 4 in the Forest Plan), where mineral or glacially derived soils fully or partially cover the epikarst, forest regeneration is exceptional. In these areas, even the complete loss of soil and litter from the surface of the limestone will not prohibit the re-establishment of a forest because the displaced surface materials are retained within the epikarst channels (Harding and Ford 1993). On highly vulnerable karst lands, the epikarst channels are too deep to allow conifer seedlings to establish themselves even if the displaced soil is retained. The bottom of the channels may also be open, directly transporting sediment and debris into the karst groundwater system. Highly vulnerable karst areas are generally found at higher elevations, have thin organic soils that are easily displaced, are on steeper slopes, or are in areas of intense karst development. Previous harvest in such areas has increased the percentage of bare rock, resulting in less-than-desirable forest regeneration. Recent implementation and effectiveness monitoring (USDA Forest Service 2013c) found that the Karst and Cave Standards and Guidelines outlined in the Forest Plan were being implemented to the fullest extent practicable. Through effectiveness monitoring, the karst and cave standards and guidelines outlined in the Forest Plan were shown to ensure a high level of protection for significant caves and karst resources overall. The karst resources standards and guidelines have been fully implemented in proposed and ongoing projects, such as the Big Thorne Timber Sale, Dargon Point Environmental Assessment, Logjam Timber Sale, Twelvemile Restoration Environmental Assessment, review of the Juneau Access Road Proposal, Phases 1 and 2 of the Forest Highway 43 construction from the Coffman Cove Junction to the Whale Pass Junction, and the Sunnahae Trail construction (USDA Forest Service 2012a, 2013c). Programs such as the small-sale program on Thorne Bay Ranger District allow the karst management specialist to work closely with the presale forester, purchaser, and sale administrator to ensure consideration of karst resource values.

Recent post-harvest monitoring has been limited because only a minor amount of harvest occurred on karst lands where mitigation had been prescribed. In the limited subsurface karst evaluations to document changes, no substantial changes as a result of management activities were documented (USDA Forest Service 2012a, 2013c).

Although most caves found to date on the Tongass are not suitable for recreation purposes because of frequent flooding, instability, or presence of fragile structures, the Forest Service is seeking opportunities for surface and subsurface public access and interpretation. Currently, free guided tours are provided by the Forest Service at El Capitan Cave during the summer where interpretive information is provided regarding karst geology and archeological discoveries.

Karst areas in Southeast Alaska are most comparable to those of karst lands found on Vancouver Island and the Queen Charlotte Islands of British Columbia (Canada), portions of Patagonia (Chile), Tasmania, and the west coast of the South Island of New Zealand. All of these areas have very steep surface slopes and subsurface hydraulic gradients, and very high levels of rainfall. These characteristics put them among the most dynamic karst terrains on earth, evolving and changing more rapidly and abruptly than karst in more moderate settings. The Karst Panel Report (Aley et al. 1993, as cited in USDA Forest Service 1997a) found the karst lands of the Tongass National Forest to be of national and international significance for a variety of reasons. The Karst Review Panel in the summer of 2002 confirmed these findings (Griffiths et al. 2002). Both of these panels consisted of world renowned karst experts with a breadth of karst resource backgrounds and a wide variety of international exposure to karst areas and management considerations. Not only is the level of karst development and the karst hydrology and mineralogy globally significant, the paleontological and archaeological discoveries have provided information on the prehistory of Southeastern Alaska and contributed to and challenged theories of the peopling of North America.

The natives and local inhabitants of Southeast Alaska have long known of the presence of caves. The existence of well-developed cave systems was first reported in 1975 and mapping of the caves began in 1987. The existence of vast areas in which karst had developed was fully recognized in 1990. Though noted by early foresters and geologists, the relationship between high site productivity and the presence of karst landscape became apparent at about this same time. With the passing of the FCRPA in 1988, the Forest struggled with methods to protect the many caves throughout the landscape. At first, protection focused on the large, significant karst features and cave entrances. Subsequent measures tended to look at entire karst hydrologic systems.

Currently, the Tongass inventory includes 611 caves (plus one state cave). Of these, 290 were identified in 1996 during the initial process of identifying significant cave resources. An additional 87 caves were added in 2003. The Tongass National Forest has received another 57 nominations that are pending.

The remaining 177 caves do not have nominations. Intense karst development has been identified on northern, central, and south-central Prince of Wales Island, Kosciusko Island, Dall Island, Heceta Island, Revillagigedo Island, Chichagof Island, and on the mainland southeast of Wrangell (Baichtal 2006).

Approaches to characterizing karst areas on the Tongass National Forest in recent years have included tracer dye studies to define karst watersheds and water quality parameters, physical monitoring of karst springs, and measurement of rainfall (USDA Forest Service 2013c). These efforts provided preliminary data on how karst groundwater systems and water chemistry relates to precipitation and runoff. These data will be used to establish baseline conditions, and will be compared with karst conditions monitored after implementation of management activities. In addition, Light Detection and Ranging (LiDAR) technology has been used in ongoing inventories of karst and cave resources.

Environmental Consequences

Direct and Indirect Effects

Geology

None of the alternatives modify standards and guidelines for geology. As per current direction, geologic inventories would be conducted to cover bedrock geology, surficial geology, stratigraphy, hydrogeology, geomorphic features, geological hazards, karst features, caves, and paleontology, including potential for geologic formations to yield fossil resources of scientific and other values. The continued focus on geologic resources results in protection of unique features and utilization of geological resources. Refer to the *Minerals* section for more information on potential effects related to mining and mineral resources.

Karst and Caves

Potential effects to karst systems and caves and associated drainages from timber harvest and road building include changes in hydrology, infiltration rates, sediment production, debris transport, pollutants, and introduction of organics that can lead to oxygen depletion. Issues and concerns related to karst lands primarily revolve around potential changes to groundwater flow in the underground system. Any management activity that causes sediment or organic debris to build up in the subsurface conduits decreases the capacity of these conduits and makes the formation of surface streams more likely. Similarly, any management activity that increases groundwater recharge may also affect the capacity of the conduits in the underground system and make formation of surface streams more likely. Changes in the presence of surface water can produce broad ecosystem changes both above and below ground. Groundwater recharge in karst lands occurs by either discrete or diffuse recharge. Discrete recharge refers to losing or sinking streams that enter the subsurface at specific insurgence points. Diffuse recharge refers to subsurface entry of water through the forest floor and the epikarst. Losing or sinking streams can rapidly deliver sediment into subsurface passageways.

Sediment transport into karst systems also produces concern. This concern is primarily attributed to the size of past harvest blocks and the rate at which the landscape was harvested prior to the early 1990s, when the extensiveness and significance of karst terrain on the Tongass National Forest became more fully recognized. The current standards and guidelines address these concerns to a high degree.

Potential effects on karst lands from planned timber harvesting, associated road construction, and quarry development may occur; however, with implementation of the current or proposed standards and guidelines (as modified through ongoing monitoring and adaptive management), and site-specific mitigation measures (designed and implemented at the project level), the Forest expects to mitigate the effects of any proposed activity. Site-specific mitigation measures include protection of the high vulnerability karst areas and features, partial cutting, reduced harvest unit size, use of logging systems that achieve at least partial suspension, reductions in rate of harvest, and other changes in logging practices.

The Karst Review Panel in the summer of 2002 found that implementation of the Karst and Cave Standards and Guidelines from the current Forest Plan had ensured a high level of protection for karst resources overall (Griffiths et al. 2002). The Panel noted high standards in both the philosophy of management and the way that specific management practices were formulated and applied. Implementation of specific policies and procedures was found to be very good and in general compliance with the stated goals and objectives of the karst program. The Panel also noted the extent to which high vulnerability karst had been protected since 1997. In addition, the Panel outlined the action required to more actively manage karst landscapes covered with second-growth stands and recommended a new procedure for assessing the autogenic (precipitation on carbonate rocks) recharge component of karst units.

Several elements of the Karst and Cave Standards and Guidelines were updated in 2008 to better assess karst landforms and vulnerability, as well as allow flexibility depending on the professional judgment of karst-trained specialists. The 2008 Record of Decision also designated several geologic Special Interest Areas. These Special Interest Areas included all identified high vulnerability karst lands that were not already protected within current non-development LUDs.

Much of the karst land within development LUDs has been designated as high vulnerability karst land and is protected or mitigated by standards and guidelines or included within geologic Special Interest Areas. It is estimated that 30 percent of the other karst lands will be determined to be high vulnerability karst with ground verification in the future.

Approximately 431,030 acres of karst underlies NFS lands inside the Tongass National Forest. Alternative 1 would result in the lowest estimated maximum future harvest on NFS karst lands at 49,807 acres, including POG and young growth on suitable karst lands (Table 3.2-1). Alternative 2 would result in the highest estimated maximum future harvest on karst lands at 67,933 acres. Karst inventories and vulnerability assessments would continue to be required before timber harvest could occur on suitable lands under all of the alternatives. Alternatives 2 and 3 have the greatest acres of harvest on karst lands because they allow young-growth harvest in the most LUDs that are not currently considered suitable for timber harvest and they allow commercial thinning on high vulnerability karst. Alternative 4 would also allow commercial thinning on high vulnerability karst, but is limited to the existing development LUDs.

Table 3.2-1
Estimated Maximum Future Tongass Harvest (acres) on Karst Lands under the Alternatives after 100 Years

	Old Growth	Young Growth by Vulnerability Class			
Alternative	All Karst Lands	High	Moderate	Low or Unmapped	Total Area
Alternative 1	5,631	0	2,136	41,320	49,087
Alternative 2	2,688	4,017	2,563	58,665	67,933
Alternative 3	2,118	3,880	2,502	57,302	65,802
Alternative 4	4,090	783	2,231	48,166	55,271
Alternative 5	4,639	0	2,389	52,422	59,451

The vast majority of harvest would occur on low vulnerability or unmapped karst lands. Low vulnerability karst lands are not sensitive to management activities due to the depth of overlying material (e.g., glacial till) and low hydrologic conductivity. There would be no change to management practices on these lands between any alternatives. Should these lands later be determined to be high vulnerability karst lands, the more restrictive management rules would apply.

Even-aged management on low vulnerability karst and limited clear-cutting in medium vulnerability karst has always been allowed, although more restrictive guidelines than normally employed on non-karst lands may be needed on medium vulnerability karst. Alternatives 1 through 4 would be managed in similar fashion so long as karst management objectives could be met. Under Alternative 5, created openings are limited to 10 acres with a maximum removal of 35 percent of the original stand. Project-specific karst evaluations would still be required and effects would be avoided or minimized through project and site specific management prescriptions, such as requiring partial suspension yarding or limiting the size of openings moderate changes to precipitation throughfall.

No additional harvest is anticipated in any areas mapped as high vulnerability karst under Alternatives 1 and 5. These areas are included in the existing Special Interest Areas, and are not suitable for harvest under these alternatives. Alternatives 2, 3, and 4 each allow for commercial thinning on high vulnerability karsts on a case-by-case basis when the karst management objectives can be met. While it is believed that these activities can be carefully planned and implemented to accomplish this, a shortage of monitoring on the effects to karst from second-growth management on the Tongass is recognized and there is some uncertainty. However, where commercial thinning is determined to be an appropriate treatment on high vulnerability karst lands, effects to karst will be addressed through project-specific prescriptions and analysis to ensure karst management objectives can be met.

The amount of new road construction on karst lands would also vary by alternative in relation to the acres of old growth harvested on karst lands. The estimated maximum amount of future old-growth harvest that could occur on NFS karst lands would vary by alternative, ranging from 2,118 acres under Alternative 3 to 5,631 acres under Alternative 1 (Table 3.2-1).

Cumulative Effects

There are approximately 549,522 acres (859 square miles) of karst lands within the boundaries of the Tongass National Forest. Some 431,030 acres (674 square miles) are on NFS lands. Past timber harvest has affected the epikarst landscape on the Tongass National Forest. In some portions of the Tongass, 70 to 80 percent of the commercial forest land within specific karst blocks has been harvested. It is estimated that about 29 percent (82,239 acres) of the karst lands on NFS lands have been harvested (based on the GIS database). In addition, several hundred miles of authorized and unauthorized roads have been constructed on karst lands. All alternatives would involve additional future harvests (Table 3.2-1) and associated road building and reconstruction on karst lands to varying degrees. Appendix C of this EIS provides a full list of all the projects considered in the cumulative effects analysis.

Baichtal and Swanston (1996) observed sediment deposits and waterline marks in underground systems that suggested that past timber harvesting had increased sediment and debris transport and flooding of underground passages, many of which had not previously flooded for centuries. These timber harvests were conducted prior to the Karst and Cave Resources Standards and Guidelines implemented in the 1997 Forest Plan. As a result, they had more significant effects on karst lands than current and future harvest activities. At that time, many cave entrances were filled or blocked by logging slash, sediment, and debris. Additional runoff generated from road surfaces commonly had been diverted into karst features. They also noted strong evidence of greatly increased surface runoff on karst landscapes and adjacent surfaces after timber harvest, which increased sediment, nutrient, and debris transport capability of associated drainage networks.

Based on information from Prince Wales Island, Baichtal and Swanston (1996) noted few tree regeneration problems in low-elevation stands on karst landscapes. As a consequence, most easily accessible, low-elevation karst areas on the island had been harvested. After the initial timber harvests, harvest activities concentrated on steeper, higher elevation karst landscapes characterized by shallower, excessively well-drained soils. Baichtal and Swanston (1996) suggested that trees were smaller and regeneration problems were greater at these steep, upper elevation sites. This condition possibly resulted from shallow soils with low nutrient availability, excessive drainage of surface and soil waters into subsurface karst systems, removal of much of the shallow soil because of inadequate log suspension, and continued desiccation of the soil once the protective forest canopy was removed. After timber removal, high rainfall rapidly transported fragile soils into the well-developed epikarst.

More recent monitoring of karst lands near harvested areas (USDA Forest Service 2012a, 2013c) have confirmed that current timber harvest practices have adjusted substantially to accommodate Karst and Cave Standards and Guidelines. For example, karst resource input was provided for timber sales projects throughout the Tongass.

Extensive landscape changes and ground disturbance have occurred and are likely to continue to occur on non-federal lands in Southeast Alaska. These include timber harvest and road construction, mining, recreation and tourism, growth of human settlements, transportation projects, and energy and transmission projects. Forest Service regulations requiring protection of karst resources do not apply to non-federal lands. Approximately 109,800 of the nearly 540,600 acres of karst lands within the Tongass National Forest boundary are on state or private lands.

Transfers of karst lands from NFS lands to other land managers or private owners could also occur under any of the alternatives through land exchanges or other types of land adjustments (such as the Alaska Mental Health Trust Land Exchange). This type of future action could increase the amount of karst lands in Southeast Alaska that are not in a protected LUD. Any exchange or other type of adjustment (outside of legally required conveyances) would require National Environmental Policy Act analysis, most likely an EIS, which would include public involvement and would disclose any adverse effects to karst and cave resources, as well as to other resources.

Soils

Affected Environment

Soils in Southeast Alaska develop in parent materials originating from a variety of geological or vegetative sources. Parent material is the inorganic or organic matter in which soils develop, and in the Tongass National Forest includes volcanic ash; glacial deposits; hillslope, stream, and uplifted marine sediments; rock; and deposits of decomposed plant materials. Soils are commonly divided on the basis of their parent material. Both mineral and organic soils occur extensively within the Tongass National Forest, where more than 100 different soils have been identified. Soils cover 84 percent of the inventoried land surface area of the Tongass; the remainder consists of ice, exposed bedrock, and bodies of water.

From a resource management perspective, soil productivity (i.e., a soil's ability to support vegetative growth) and the potential loss of soils or off-site effects from erosion and landslides are the principle concerns. The productivity of soils directly or indirectly affects the productivity of other forest resources. Tree growth, wildlife and fish habitat quality, and recreation uses and potentials depend in part on the quality of soils. In Southeast Alaska, soil productivity, in terms of tree growth, is high on well-drained soils (e.g., on steep slopes, in karst areas, and on floodplains) and decreases as latitude and elevation increase and as drainage becomes poorer.

Soil, or site, productivity is generally measured by the rate of biomass accumulation, and site index is commonly used to give a relative indication of this productivity. Site index is determined by the height of dominant trees at a specified age. The site index tables or curves available for use in Southeast Alaska were developed from trees in even-aged stands, not the uneven-aged or old-growth stands that predominate here; consequently, the resulting site index categories are more useful for comparison than as absolute numbers. Soil productivity also can be estimated from the characteristics of individual soil types. The principal characteristics are soil depth, drainage, acidity, and coarse fragment content. Over one-quarter of the total productive forest land mapped in the Tongass National Forest Soil Resource Inventory has been identified as the highest site index category (Category 4), which means that on average these sites will grow trees greater than 80 feet tall in 50 years (Table 3.3-1). Approximately 11 percent of the Tongass productive forest land falls into the lowest site index category (Category 1), which corresponds with trees less than 40 feet high in 50 years. Approximately one-quarter of the productive old growth (POG) and two-thirds of the harvested young growth have been mapped as Category 4 (Table 3.3-1).

Table 3.3-1
Estimated Percent of the Productive Forestland on the Tongass by Site Index Category

	Site Index Category					
	1	2	3	4		
Productive Forest Land Category	**Avg. Site Index = 0-40**	**Avg. Site Index = 41-60**	**Avg. Site Index = 61-80**	**Avg. Site Index > 80**	**Unmapped[1]**	**Total**
Productive Old Growth	12%	12%	23%	25%	28%	100%
Young Growth – Harvested	5%	6%	20%	64%	4%	100%
Young Growth – Natural	12%	14%	25%	34%	16%	100%
Total Productive Forest land	11%	12%	23%	28%	26%	100%

[1] Unmapped areas are mostly in Wilderness or National Monument.

Soil erosion in the form of gully, sheet, and rill erosion is a minor occurrence under natural, undisturbed conditions in Southeast Alaska, because the thick surface duff layers that cover the mineral soils protect them from surface erosion. Mineral soils can be disturbed and exposed either by natural causes, such as landslides and blowdown, or management activities, such as timber harvest and road and landing construction. Surface erosion can become active once the duff layer is removed and can remain active until revegetation occurs.

The Soil and Water Standards and Guidelines in the 2008 Forest Plan are important for minimizing potential detrimental soil disturbance. According to results of recent soil and water implementation and effectiveness monitoring (USDA Forest Service 2013b), the Tongass National Forest is implementing the standards and guidelines for soil disturbance successfully during timber sale activities and road and landing construction. The Tongass National Forest has collected over 50 miles of soil disturbance transect data following timber harvest. Data collected indicate that all timber harvest units, including cable, helicopter, and shovel yarding systems (restricted to slopes less than 30 percent gradient), are within the established Region 10 soil quality guideline of less than 15 percent soil disturbance that is considered potentially detrimental (Landwehr et al. 2012), as set forth in Forest Service Manual (FSM) 2554 (FSM R-10 2500-2006-1).

Soil quality monitoring with soil disturbance transects continues on the forest. Monitoring and evaluation reports are written annually in addition to periodic reports summarizing soil disturbance transect data and/or soil bulk density sampling data. The most pertinent of these reports are Landwehr and Nowacki (1999), Landwehr (2008a and 2014), and Landwehr et al. (2012). These reports are discussed further in the Environmental Consequences section.

The longevity of soil disturbance has been evaluated in young-growth stands in the Tongass National Forest by re-monitoring 15 year-old young-growth harvest units where relatively high levels of soil disturbance were documented following harvest (Landwehr 2008a). Results indicate that many small soil disturbances, less than about 25 square feet in area, are not identifiable after 15 years of recovery and likely not detrimental to woody plant growth even on relatively poor soils. Areas of detrimental soil disturbance are typically in coarse textured nutrient poor soils and lie in a landscape position where soil erosion or other factors have prevented natural recovery of the site (Landwehr 2008a).

Recent monitoring of soil conditions has also been completed in older young-growth stands (more than 50 years old) to evaluate soil disturbance over the long term (Landwehr et al. 2012). Results indicate that highly productive, relatively nutrient rich soils may tolerate more severe and extensive soil disturbance before exhibiting a reduction in desired vegetation or vegetation growth at the desired growth rates. Soil displacements smaller than 100 square feet in area were rarely identified in highly productive stands after 50 or more years of recovery. Detrimental soil conditions in 50+ year-old young-growth stands were primarily soil displacements and soil erosion. Soil displacements occurred primarily on tractor skid trails and spar tree yarding corridors. Soil erosion was identified on steeper slopes in the displaced areas as evidenced by the presence of small gullies and ephemeral streams; however, soil erosion was almost entirely arrested after 50 years of recovery. Areas of displaced soils greater than 100 square feet in area generally resulted in different vegetation communities and reduced growth rates compared with adjacent undisturbed sites (Landwehr et al. 2012).

Landslides, both naturally occurring and human-caused, dominate soil movement processes on steep forest lands in Southeast Alaska (Swanston 1969, 1974). Written over the course of more than 40 years, Swanston's many papers present excellent characterizations of landslides in Southeast Alaska. Landslides deliver eroded material to streams more quickly, and in greater quantity, than surface erosion. Landslides can seriously retard soil productivity for forest regeneration on slopes by removing the soil mantle down to bedrock or glacial till. It can take 50 to 100 years or more for soil layers to be rebuilt on exposed bedrock in these landslide areas. Debris deposited on lower slopes and valley bottoms may improve site productivity locally because of incorporation of organic nutrients and improved drainage. Regeneration at such sites is rapid.

A recent study (Johnson et al. 2007) compared the effects from 100 percent tree removal to partial cuts (25, 50, and 75 percent removals) on landslide potential. They focused on effects to soil saturation (groundwater levels) and found increasing soil saturation with increasing percent tree removal. Increased soil saturation likely correlates with increased potential for soil erosion through landsliding, although they did not model this possibility directly because of uncertainties in estimating loss of cohesion as a result of changes in root strength in partial cut.

The amount of soil saturation may be impacted by future climate change. Soil saturation impacts are predicted to be highly variable based on site-specific physical characteristics such as soil type, bedrock orientation, and gradient. At the broad scale, predicted changes in temperature and precipitation are not expected to measurably change existing soil saturation conditions (EcoAdapt 2014). The *Climate and Air* section includes discussion of soil carbon loss in a warming environment.

In the Tongass National Forest, several factors including soil depth, soil type, drainage characteristics, and landform type control soil stability on steep terrain. On steep forested slopes, the dominant failure type is debris avalanche, which is the failure of a finite mass of water-charged overburden material along a relatively planar surface. These landslides occur primarily at shallow depths (1 to 3 feet) in the soil overburden and may break apart and transform into debris flows, which are a mixture of water, soil, rock and organic debris that rapidly moves downslope. The texture of the soil overburden is characteristically gravelly silt or gravelly silty sand; less commonly the texture might be sandy gravel with little or no cohesion (Swanston 1997). Organic content may exceed 30 percent locally because of the downward migration of organic particles into the mineral soil zone, which substantially increases cohesion at some sites.

The Mass Failure Rating Classification developed by Alexander (1987) and refined by Swanston (1997), provides an indication of the relative frequency of mass failures when vegetation is cleared or the land is disturbed. In this system, soil map units in the Tongass National Forest are classified in the Mass Movement Index (MMI) from low to high or extreme risk (MMI 1 to MMI 4) of management induced landslides. The Mass Movement Index is based on slope gradient, parent material and soil properties, level of dissection, and evidence of prior landslides or snow avalanches (Swanston 1997). Slope is a primary factor in the MMI.

Almost half of the Tongass is made up of lands with slopes less than 35 percent (Table 3.3-2). Nearly one-third of the Tongass ranges in slope from 35 to 67 percent, and the remaining 19 percent exceeds 67 percent slope. Only 14 percent of productive old-growth lands and 5 percent of harvested young growth lands exceed 67 percent slope. In general, these steep slopes pose greater risks for soil erosion through landslides.

Table 3.3-2
Estimated Percent of the Tongass National Forest, POG, and Young Growth by Slope Category

		Percent Slope Category			
Forest Land	**Acres**	**0-35%**	**35-67%**	**>67%**	**Total**
Productive Old Growth	4,999,684	49%	37%	14%	**100%**
Young Growth – Harvested	421,616	69%	26%	5%	**100%**
Young Growth – Natural	83,126	83%	13%	4%	**100%**
Other Areas	11,242,029	49%	30%	22%	**100%**
Tongass National Forest	16,746,454	49%	32%	19%	**100%**

Swanston and Marion (1991) mapped landslides in the Tongass National Forest during the 21-year period, 1963 through 1983. They noted an occurrence rate of 118 landslides per 980 square kilometers (242,163 acres) in harvested or roaded areas over 21 years. Based on this count, an average of one landslide occurred per 2,052 acres of harvest over 21 years, or one landslide per 43,092 acres (on average) per year. They found that landslides were 3.5 times more likely on harvested areas. These landslide rates are generally supported by other landslide inventories and analyses that have been completed on the Tongass National Forest (Bishop and Stevens 1964; Landwehr 1994 and 1998).

Swanston and Marion (1991) showed that roughly 10 percent (118) of the landslides occurred in clearcut harvest areas or were directly associated with timber harvesting, whereas roughly 90 percent (1,277) occurred in unlogged areas. Landslides in unlogged areas appear to be larger and longer than those in logged areas.

A Forest-wide inventory to identify, delineate, and digitize all landslides as an independent layer in GIS was initiated in 2001. The first phase of the landslide inventory to map all landslides in development land use designations and other areas where soil mapping exists was completed in Fiscal Year 2012. Keeping this landslide inventory current is a challenge. To date, landslide frequency analyses and evaluation of landslide densities in managed stands versus unmanaged areas have not been completed on this dataset. Future planning efforts include a landslide frequency analysis based on slope class using an updated 5- to 10-meter digital elevation model with a projected delivery date of 2016 (USDA Forest Service 2013b).

Environmental Consequences

Direct and Indirect Effects

Forest management activities can cause soil erosion and subsequent loss of site productivity through the exposure of mineral soil, alteration of subsurface drainage, and the concentration of soil and rock material at unstable sites. Best Management Practices (BMPs) are used to minimize soil erosion from all management activities. BMP implementation and effectiveness is monitored on a subset of activities on the forest each year. Monitoring for the past 10 years indicates a high rate of BMP implementation and effectiveness (USDA Forest Service 2013b).

Soil Quality Monitoring over the past 25 years indicates that old-growth timber harvest activities (as currently practiced) are achieving the FSM-2554-R10-2006, (Region 10 soil quality standards). The transition to young-growth harvest may result in soil erosion and subsequent loss of site productivity to varying degrees. Due to the substantial amount of vegetative groundcover remaining on harvest units during and following timber harvest, surface erosion from these areas is usually relatively small (Martin and Kirtland 1995; Swanston 1969); however, detrimental soil conditions persist in the landscape in the form of temporary roads, landings, rock pits and some yarding disturbances may result in a loss of productivity, in terms of desired vegetation growth. Relatively nutrient rich soils, such as deep soils with limestone influence, appear to be more tolerant of moderate levels of soil disturbance without an obvious change in productivity. In contrast, heavy soil disturbance from harvest on coarse textured, nutrient poor soils developed in gravelly outwash, has been shown to result in reduced tree growth on those sites (Billings 1970; Harris et al. 1976; Landwehr 2008a; Landwehr et al. 2012).

Young-growth stands may have detrimental soil conditions remaining from the first timber harvest. Recent soil quality monitoring of young-growth stands (greater than 50 years old) was completed by Landwehr et al. (2012). Detrimental soil conditions in these stands were primarily soil displacements and soil erosion from tractor skid trails and spar tree yarding corridors. The monitoring also found that the duff layer thickness was reduced in harvested stands on limestone soils when compared with adjacent unharvested stands. On soils of mixed minerology the duff layers were not significantly different in harvested stands compared to unharvested stands. Regarding duff thickness, more work needs to be done, but Landwehr et al. (2012) suggests several possible reasons for reduced duff thickness, none of which equate to reduced productivity of the limestone sites. The existence of soil erosion was identified by the presence of small gullies and ephemeral streams; however, after 50-years of recovery erosion is almost entirely arrested (Landwehr et al. 2012).

Due to the possibility of detrimental soil conditions in existing young-growth stands, the Forest Plan requires an evaluation of detrimental soil condition prior to harvest. This management approach will help insure that soil conditions remain within Region 10 soil quality standards.

Due primarily to economics of harvest many young-growth timber harvests will be conducted using ground-based equipment. Shovel yarding has been used on the forest for more than 25 years. Landwehr (2014) summarized the history of ground-based equipment timber harvest on the forest and provided the most recent soil quality monitoring data for timber harvest with ground-based equipment, especially on slopes over 30 percent gradient. The report documents the increase in detrimental soil conditions with operations on steeper slopes. On slopes over 30 or 35 percent gradient the amount of detrimental soil conditions caused by ground-based equipment triples, but was still within Region 10 Soil quality standards. Landwehr (2014) recommends restricting equipment to slopes less than 30 to 35 percent gradient.

Alluvial soils are generally included in riparian management areas. Alternatives 2 through 5 allow limited commercial timber harvest in riparian management areas outside Tongass Timber Reform Act buffers as long as riparian management objectives (Appendix D of the Forest Plan) can be met. The need to minimize soil disturbance on alluvial soils, especially in areas of braided channels, has long been recognized (1977 Southeast Alaska Area Guide, Martin et al. 1995). Appendix D of the Forest Plan requires minimizing soil disturbance on fluvial channel process groups (alluvial fans floodplains and moderate gradient mixed control channels) to prevent the formation of new channels and to limit alder regeneration. Soil disturbance can be reduced considerably by the method of harvest and guidelines for equipment operations. For example, tractor logging, commonly used in the 1950s and 1960s, typically resulted in more than triple the amount of soil disturbance as cable yarding during the same time period. (Landwehr et al. 2012). Monitoring of more recent shovel yarding operations indicates that shovel yarding on slopes up to 30 percent gradient results in soil disturbance amounts similar to cable logging. On slopes over 30 to 35 percent gradient, soil disturbance from shovel yarding increases (Landwehr 2014).

The effects of timber harvest on site productivity are described in several papers in Slaughter and Gasborro (1988). Regeneration after clearcutting is excellent on all but a few sites in coastal Alaska, except in isolated areas with severe soil disturbance. Once established, growth rates of hemlock and spruce are relatively high (Farr and Ford, as cited in Slaughter and Gasborro 1988). New stands contain several thousand stems per acre, and crown closure begins to take place by age 15 to 20 years. Crown closure approaches 100 percent by 25 to 30 years of age and remains so for 100 years or more. Silen (in Slaughter and Gasborro 1988) also states that more than 90 percent of clearcut areas densely restock naturally in Southeast Alaska. Precommercial thinnings aid in achieving desired stocking levels and increased growth (Pawuk, in Slaughter and Gasborro 1988).

Klock (in Slaughter and Gasborro 1988) notes that soil compaction, most frequently by ground skidding operations, leads to reduced timber volume growth. In a world-wide review of literature related to areas of forest soil productivity decline, Powers et al. (1990) identified soil compaction and loss of soil organic matter as a two factors common to areas where forest soil productivity declined. Powers et al. (1990) observations led to the creation of the Long-Term Soil Productivity (LTSP) experiment, which is testing the effects of two levels of organic matter removal and soil compaction on soil productivity. The LTSP is a long-term, controlled, field scale experiment with installations throughout North America and several other countries.

Several soil compaction studies have been completed on the Tongass National Forest. The most recent studies have measured soil bulk density on skid trails created as part of the commercial thinning project (Landwehr and Silkworth 2011) and shovel trails used for stream restoration (Landwehr and Foss 2014). The shovel trails used for stream restoration experienced tens and in some cases hundreds of equipment passes to move wood from the roadside to the stream. The commercial thinning tractor skid trails moved cut logs to the roadside and most trails received tens and in some cases hundreds of passes of equipment. Both of these studies and studies before them (Landwehr and Foss 2006; Landwehr et al. 2012; Alexander 1990) found that soils at a few individual sample sites on equipment trails were compacted but overall the equipment trails were not compacted.

There are several reasons for the lack of detrimental soil compaction in Tongass soils. First, Tongass soils are generally coarse textured with clay contents typically less than 20 percent. Secondly, Tongass soils have high organic matter content and often have high coarse fragment content that resists compaction. Thirdly, Tongass forested soils are subject to rapid root growth by conifers in young-growth stands. The root growth tends to loosen soils. Trees in many old and young-growth stands are subject to strong winds which causes tree rocking or windthrow that loosens upper layers of soil. Finally, on the Tongass cull logs and slash are used to spread the weight of equipment out over a larger surface area, thus avoiding potential compaction (Landwehr and Foss 2014).

Blowdown, or windthrow, can increase along the edges of regeneration harvest units, and this may expose mineral soil. Blowdown increases the potential for soil erosion and may increase the potential for landslides.

According to a study by Kramer et al. (2001), watersheds in the Tongass National Forest that experience more intense soil mixing from windthrow have lower levels of strongly humified soil carbon pools (e.g., lower levels of reprecipitated acid) than areas that have not experienced windthrow. The disturbed watersheds include more organic matter in a partially decomposed particulate form, which translates to less acidic carbon forms, higher ion exchange capacity, higher soil pH, and lower bulk density in the soil (Kramer et al. 2004). The disturbed soils are more aerated, better drained, and have higher nutrient status. Conversely, Stephens et al. (1969) found a reduced site index in stands regenerated following windthrow. Stephens et al. (1969) identified shading of the soil surface caused by windthrown trees as the reason for lower site index in windthrown stands. Predicted climate trends have the potential to increase the frequency of windthrow events due to higher winds and saturated soils in extreme events (EcoAdapt 2014).

Soil productivity decreases from the construction of roads and landings because land is taken “out of production” (i.e., removed, covered over, or compacted). Erosion increases from the construction of roads and landings because of the destabilizing effect of cuts, fills, and drainage alterations, and the lack of protective vegetation cover on road and landing surfaces and other disturbed areas. Standards and guidelines, BMPs, including those identified in the Soil and Water Conservation Handbook (USDA Forest Service 2006a), and National (USDA Forest Service 2012b) and other relevant mitigation measures, are applied at the project level to minimize potential adverse effects. At the Forest Plan level, the overall difference in acres disturbed by roads is a good indication of how site-specific effects are likely to vary between alternatives. Refer to the *Water* and *Fish* sections for more detailed analyses of potential effects on water quality or fish habitat due to roads.

Table 3.3-3 displays the maximum cumulative acres, by alternative, to be covered by road surfaces after the first 25 and after 100 years of implementation of the Forest Plan (assuming none of the roads is completely obliterated). The cumulative acres of road surfaces after 25 years of implementation would be similar under Alternatives 2 through 5. The amount of road acreage under these alternatives would be less than expected under the 2008 Forest Plan (Alternative 1) due to the ability to utilize or reconstruct existing roads (i.e., open, closed, or decommissioned) for harvest of young growth, thereby reducing the amount of new road construction necessary. The cumulative acres of road surfaces after 25 years of implementation would be least under Alternative 3 and least under Alternative 4 after 100 years of Forest Plan implementation.

Table 3.3-3
Estimated Maximum Cumulative Acreage Covered by Road Surfaces on NFS Lands after the first 25 Years and after 100 Years by Alternative[1]

Alternative	Existing Condition	After 25 Years of Implementation	After 100 years of Implementation
1	15,278	16,121	18,109
2	15,278	16,057	18,445
3	15,278	16,013	18,338
4	15,278	16,049	17,892
5	15,278	16,079	18,259

[1] Acres covered by road surfaces are calculated based on an average of 3 acres per 1 mile of road.

Landings are considered part of the road network based on transportation handbook direction and are co-located, to the extent possible, with turnouts, borrow areas, and turnaround areas required for road construction and subsequent safe travel. Both Region 10 and National BMPs specifically consider landing location and design and re-use of existing landings while maintaining water quality protection. For young-growth management, many existing roads and landings would be reused if the roads and landings are compatible with management objectives and water quality protection (National Core BMP VEG-6).

Table 3.3-4 contains the estimated maximum road miles, by alternative, to be constructed, constructed over a decommissioned roadbed, and reconstructed over 25 years by alternative of implementation. The miles of road construction over 25 years of implementation is least under Alternative 3. Less road construction translates to less direct impacts on soil productivity and less indirect impacts from road associated soil erosion. The miles of road construction after 25 years of implementation is highest under the 2008 Forest Plan (Alternative 1).

Table 3.3-4
Estimated Maximum Road Miles to be Constructed or Reconstructed over 25 Years by Alternative

Alternative	Road Construction (Miles)	Road Construction over Decommissioned Roadbed (Miles)	Road Reconstruction (Miles)
1	281	64	160
2	260	125	256
3	245	110	229
4	257	97	209
5	267	102	219

Landslides may adversely affect soil quality. They also have the potential to affect aquatic habitats, both positively and negatively. Landslides have a positive effect by providing new sources of woody debris and gravel favorably altering elements of fish habitat. They negatively affect aquatic habitats by destroying viable fish eggs by smothering and bed load overturn, and by destroying habitat elements for fish (pools, riffles, log discharge, etc.).

As part of the effects analysis, the average landslide frequency from the Swanston and Marion (1991) study was applied to the estimated harvest levels likely under each alternative over the first 25 years of the Forest Plan implementation. However, the Forest Plan includes standards and guidelines and mitigation measures that were not in effect during the period of the landslide study (e.g., Riparian Standards and Guidelines, and BMPs). For the purposes of this comparison, a projected maximum harvest over 25 years is used because the landslide occurrences reported by Swanston and Marion (1991) reflect long-term averages. As previously stated, landslides typically are associated with storm events and large amounts of precipitation, which are highly variable from one year to another. For example, widespread landsliding in headwater tributaries following basin wide clear-cut logging on Prince of Wales Island was triggered by intense rainstorms in 1961 and 1993 (Gomi et al. 2004).

The data in Table 3.3-5 are used to compare the long-term landslide estimates that may result from the individual harvest levels under each alternative as a means to compare the relative level of effects under each alternative. All alternatives have a higher landslide potential (i.e., maximum increase in number of landslides over first 25 years) than under the 2008 Forest Plan (Alternative 1) because there are more total acres being harvested in order to transition to young-growth harvest. Alternatives 3, 4, and 5 would have slightly lower potential increase in the number of landslides than Alternatives 2. Alternative 2 has an estimated increase of 10 landslides over 25 years when compared to the 2008 Forest Plan (Alternative 1).

Table 3.3-5
Estimated Maximum Increase in Landslide Frequency over the First 25 Years of Forest Plan Implementation[1]

Alternative	Projected Maximum Acres of Harvest in First 25 Years[2]		Estimated Maximum Increase in Number of Landslides over First 25 Years
	Old Growth	Young Growth	
1	38,527	9,669	17
2	15,027	63,787	27
3	16,599	53,734	24
4	23,255	40,760	22
5	23,813	43,316	23

[1] This table uses the landslide frequency of one landslide per 2,052 acres in harvested and roaded areas cited in Swanston and Marion (1991) and one landslide per 7,100 acres for unharvested acres (based on their estimate of landslides being 3.5 times more prevalent in harvested vs. unharvested areas), in order to estimate the increase due to harvest and roading. It should be noted that Swanston and Marion (1991) measured landslide frequency based on large-scale clearcutting of large portions of watersheds that occurred between 1963 and 1983.
[2] Based on the acres of harvest scheduled by the Woodstock model over the first 25 years. These numbers assume that the maximum allowable acres would be harvested during this period, an unlikely scenario. Most likely, fewer acres would be harvested, particularly in the first decade. Any harvest would comply with the Forest Plan standards and guidelines, including buffers, unstable slope restrictions, smaller opening sizes, and BMPs.

The data in Table 3.3-5 assume that the rate of landsliding associated with young-growth timber harvest would be similar to the rate of landsliding associated with old-growth harvest. Areas of young-growth harvest would likely have different rates of landsliding than those following past old-growth harvests for two reasons:

1. The young-growth stands would have had 50 or more years of exposure to storm events and thus unstable areas may have already failed. If landslides have occurred in the young-growth stands, they can be useful for identifying potentially unstable areas to be avoided during the second entry.
2. Landslide rates in young-growth stands may increase due to climate change or other unforeseen changes in soils resulting from a second timber harvest entry in the young-growth stands.

These data limitations and uncertainties should be considered when evaluating the data presented in Table 3.3-5.

As of this writing, the Tongass National Forest has only harvested a few young-growth stands, and none of them on steep slopes. Thus, there is a paucity of monitoring data on the Tongass National Forest pertaining to slope stability following young-growth timber harvest. There are several recent landslide studies following young-growth harvest from British Columbia (Jakob 2000; Guthrie 2002) and the Pacific Northwest (Robinson et al. 1999; Stewart et al. 2013); however, due to the highly variable nature of landslides, regional differences, and other factors, those studies do not provide reliable future landslide rate estimates for the Tongass National Forest following young-growth timber harvest. As a result, the Swanston and Marion (1991) landslide rate estimates in Table 3.3-5 remain the best available estimates for future landslide rates on the Tongass National Forest.

Management induced landslides are considered detrimental soil conditions and are included in soil quality monitoring. The 1997 and 2008 Forest Plans required on-site slope stability analysis for timber harvest proposed on slopes over 72 percent gradient. Application of this standard has resulted in the avoidance of hundreds of acres of unstable areas and a limited amount of timber harvest on slopes over 72 percent. Long-term monitoring of slopes over 72 percent that have been harvested is proposed as part of the forest-wide landslide inventory effort.

As the forest transitions to young-growth management, harvest on slopes over 72 percent will likely become less of an issue. Approximately 5 percent of existing young-growth stands occur on slopes over 72 percent gradient. Since the original timber harvest, the young-growth stands on slopes over 72 percent have experienced numerous storm events. If the slope is unstable, a harvest-related landslide would likely have occurred after 50 or more years of storm events. However, the likelihood of a harvest-related landslide is not constant over time. The highest likelihood of landslides in harvested areas is thought to be 4 to 10 years after timber harvest (Sidle 1991 and 1992; Schmidt et al. 2001), with decreasing likelihood over time. This is because the stabilizing effect of root reinforcement is reduced during the period when the root systems of harvest trees are decaying and new root systems are emerging (Ziemer 1981).

Under all alternatives, there would be no change to the existing standards and guidelines for harvest on steep slopes except for the addition of a Management Approach for conducting slope stability assessments for steep slopes in young-growth stands, as described in Forest Plan Chapter 5. The slope stability analysis is still required for young-growth harvest on slopes over 72 percent but the on-site requirement is dropped unless a slope stability specialist deems it necessary based on remotely sensed data. This change presents a reasonable risk based on the above discussion and will reduce the slope stability specialist's workload in young-growth project planning.

There may be an increase in future landslide rates based on current climate projections. Although climate trends will likely vary within the Tongass National Forest, general trends project increased mean annual temperatures, reduced snowpack, earlier snowmelt, and increasing shift from snow to rain (Wolken et al. 2011). Climate trends may lead to more extreme precipitation events in some areas (NPS 2013) which will be more likely to occur as rain-on-snow events (Rennert et al. 2009). Since the majority of landslides occur over relatively short time periods during high intensity storm events, the predicted climate trends, in particular, more frequent rain-on-snow events, are likely to increase landslide rates over the next 50 to 100 years (EcoAdapt 2014). High flow scour and outburst floods associated with glacial recession are also likely to increase landslide rates and sediment delivery to glacial rivers (Moore et al. 2009).

In limited parts of the Tongass National Forest, soil degradation from steadily increasing off-highway vehicle (OHV) use has been documented (USDA Forest Service 2006). In November 2005, the Forest Service adopted a final rule for managing motor vehicle use, including OHV use, on national forests throughout the United States (36 Code of Federal Regulations 212 – Travel Management – Roads Rule). Avoiding routes that cross saturated soils with low-bearing strength would prevent most resource damage. Under the 2008 Forest Plan, access and travel management (ATM) plans have been developed for each District to designate a system of roads and trails for OHV use, and identify if any areas for cross country travel are appropriate and do not cause resource damage. Each District annually prepares an updated Motor Vehicle Use Map (MVUM). The MVUM displays National Forest System (NFS) routes (roads and trails) or areas designated as open to motorized travel. With limited exceptions, OHV use off of designated MVUM routes is prohibited to limit soil impacts such as rutting, soil compaction, and other resource damages. One exception is that some ATM plans allow travel outside of designated MVUM routes for the purposes of game retrieval, with a permit, if it can be done without causing resource damage. Recent soil quality monitoring by the Yakutat Ranger District identified soil disturbance and resource damage in limited areas associated with game retrieval. It was noted that there were adjacent route alternatives at the sites monitored with better drained soils and that user education could reduce the resource damage (USDA Forest Service 2014b).

A number of proposed renewable energy projects could be built in the future that may have impacts to soils. In June 2014, the Forest Service identified 25 proposed renewable energy projects in Southeast Alaska that are currently active (USDA Forest Service 2014c). Proposed projects are common to all alternatives and include hydropower, geothermal, biomass, and tidal energy development plans. Although many of these are still in the early conceptual planning stage and applications have not been submitted to the Forest Service, many of the proposed projects include transmission lines and in some cases, access roads on NFS lands. Alternatives 2, 3, 4, and 5 would address concerns related to renewable energy sites and utility lines through the addition of new forest-wide Renewable Energy and Transportation Systems corridors plan components standards and guidelines to the Forest Plan.

The environmental effects from proposed renewable energy projects are not known at this time; however, existing and proposed transmission line projects including the Swan Lake-Lake Tyee Intertie Project (completed in 2009) and the Kake to Petersburg Transmission Line Intertie Project (currently undergoing National Environmental Policy Act [NEPA] review) have evaluated soil impacts. In general, project development and maintenance could potentially result in impacts including soil displacement, soil erosion, and loss of soil porosity related to ground disturbance and the increased potential for landslides. Standards and guidelines, BMPs, and other relevant mitigation measures would be applied at the project level to minimize potential adverse effects. Steep slopes, as well as riparian and other sensitive areas should be delineated on project maps to ensure their recognition, proper consideration, and protection during the development of renewable energy projects. Access roads needed for transmission lines should utilize existing transportation corridors, where possible. The potential effects of each proposed project would be evaluated in future analysis during the NEPA permitting process.

Root-wads attached to tree boles are needed for stream restoration projects. Removing trees with the root-wad attached can cause severe soil displacements of the soil duff and topsoil. Beginning in 2009 the forest has had a need to harvest root-wads for stream restoration projects from a few acres each year.

Monitoring of the effects of root-wad removal on soil productivity is ongoing (Foss 2015). In addition, all regeneration harvests are monitored for adequate stocking of conifer species. To date all root-wad harvests that have resulted in a regeneration harvest have met minimum stocking guidelines, indicating that the sites have adequately regenerated. Growth of trees and natural soil recovery is being monitored with photo points (Foss 2015). Following the 2009 root-wad harvest of 6 acres, visual monitoring resulted in the development of guidelines for root-wad harvests (Landwehr 2009). The guidelines for root-wad harvest are used to minimize impacts to soils from root-wad harvest. The amount of root-wad harvest for stream restoration is the same under all alternatives.

Cumulative Effects

Cumulative effects to soils would include both the effects discussed above and other potential effects related to activities outside of NFS lands. Appendix C of this Environmental Impact Statement provides a full list and description of all the projects considered in the cumulative effects analysis including past, present, and reasonably foreseeable future actions. The total area within the Tongass National Forest boundary, including both NFS and non-NFS lands, is about 17.9 million acres. Of this area, non-NFS lands make up approximately 7 percent (1.2 million acres). If all of Southeast Alaska is included, the land area is about 21.6 million acres and non-NFS lands make up approximately 23 percent (4.9 million acres).

Management activities on non-NFS lands are not held to the Region 10 soil standards; however, BMPs are required under the Alaska Forest Resources and Practices Act, including detailed regulations related to providing notification prior to timber harvests and managing riparian areas. The state forester must protect riparian areas from the significant adverse effects of timber harvest activities on fish habitat and water quality. These measures are designed to avoid soil erosion and sedimentation near streams. Martin (1996) compared pre- and post-harvest basins on non-NFS lands and found short-term effectiveness of these BMPs. Martin (1997) evaluated BMP effectiveness, including those designed to reduce soil erosion to mitigate turbidity. The report determined BMPs minimized sediment delivery and effectively maintained turbidity at comparable non-harvest levels. Arians (2003) includes several studies that compared pre- and post-harvest basins and indicated that logging with the BMPs does not result in significant effects to soils that would result in stream sedimentation and damage to fish. Despite these BMPs, some landslides, soil erosion–related to duff removal, and losses in site productivity likely have occurred and will continue to occur on non-NFS lands. However, cumulatively, non-NFS lands represent only 7 percent of all of the soil resources in Southeast Alaska within the Tongass boundary. Potential impacts to the remaining 93 percent of soil resources would be mitigated through implementation of standards and guidelines and BMPs associated with each of the alternatives.

The 2013 monitoring (USDA Forest Service 2014a) found that overall soil and water BMPs were implemented and found to be effective in Tongass timber harvest and road construction activities. Based on monitoring results, no changes were recommended to Forest Plan standards and guidelines for attaining State of Alaska water quality standards. Furthermore, effects of harvest on soil resources would ultimately be considered at the project-specific levels, ensuring minimal adverse cumulative effects to soil resources.

As described earlier under the discussion of the potential direct and indirect effects to soils from roads and landings, at the Forest Plan level, the overall difference in roaded area is a good indication of how site-specific effects are likely to vary among alternatives. This approach also applies to cumulative effects. Standards and guidelines, BMPs, and other relevant mitigation measures are applied at the project level to minimize potential adverse effects.

Under all alternatives, the density of roads would be less than under the 2008 Forest Plan due to the ability to utilize existing roads (i.e., open, closed, or decommissioned) for harvest of young growth, reducing the amount of new road construction. Reductions in soil productivity losses and soil erosion would correlate with lower cumulative road densities.

Roads are more prevalent on non-NFS lands than on NFS lands. In addition to approximately 5,005 total road miles currently on NFS lands, an additional 3,691 miles currently exist on non-NFS lands within the Forest boundary, and most of these roads are associated with timber harvest activities. Projected future road density for existing conditions and under each alternative, for both NFS and non-NFS lands, are shown in Table 3.3-6. Estimated maximum road densities after 100 years of implementation are relatively high (up to 3.551 miles per square mile) on non-NFS lands, resulting in commitment of soil resources; however, cumulative future road densities on NFS lands are considerably lower, ranging from 0.195 miles per square mile under existing conditions to 0.235 miles per square mile under Alternative 2 (see the *Water* section for additional information).

Table 3.3-6
Estimated Maximum Road Density on NFS Lands and Non-NFS Lands after 100 Years under Existing Conditions and by Alternative

Alternative	NFS Lands Road Density (miles per square mile)	Non-NFS Lands within Forest Boundary Road Density (miles per square mile)
Existing	0.195	2.293
1	0.231	3.551
2	0.235	3.551
3	0.233	3.551
4	0.228	3.551
5	0.232	3.551

Other reasonably foreseeable future activities on NFS lands include mining, recreation and tourism, transportation, and renewable energy projects. Alternatives 2, 3, 4, and 5 would address concerns related to renewable energy sites and utility lines through the addition of new forest-wide Renewable Energy Sites and Utility Lines standards and guidelines to the Forest Plan. Overall, the cumulative effects of considered alternative actions combined with other non-NFS lands actions would increase the potential for cumulative effects to soil resources. Potential cumulative effects of harvest, roads and landings, and other actions would be evaluated on a project-specific basis ensuring that any adverse effects to soil resources would be reduced, moderated, mitigated, or eliminated.

Mitigation

Forest-wide standards and guidelines (see Forest Plan Chapters 4 and 5) are followed on site-specific projects to mitigate the effects of management activities. They are designed to minimize accelerated soil erosion and maintain long-term soil productivity. They include soil conservation practices and incorporate the applicable BMPs (see Soil and Water Handbook). Annual monitoring (described in FSM 2554) of BMP implementation and effectiveness helps ensure that water quality goals, and standards and guidelines, are met during project implementation (see Forest Plan, Chapter 6).

This page is intentionally left blank.

Water

Affected Environment

The Tongass National Forest can be characterized by its abundance of water. The maritime climate brings precipitation nearly year-round, with the heaviest amounts occurring from September through January. Coastal low-elevation rain forests thrive in this maritime climate. Thousands of miles of shoreline and hundreds of bays and inlets characterize the marine environment of the Tongass. An important consideration for all water-related issues is the effect that changes in water flow and quality have on important aquatic resources, especially fish.

The water environment of the Forest can be described in terms of climate, water quantity, water quality, watershed condition, and water use. There are over 900 sixth-level subwatersheds within the 26,000 square miles that make up the Tongass National Forest. Climate is described in the *Climate and Air* section, with applicable climate change information in the subsections below including cumulative effects. The water quantity, water quality, watershed condition, and water use are summarized in the subsections below. Wetlands are described in the *Wetlands* section. Fish and fish habitat are described in the *Fish* section.

Water Quantity

Streams and rivers on the Tongass produce a large volume of water per unit of land. Much of the flow originates or passes through thousands of small to large lakes. Both glacial and non-glacial river and stream systems occur on the Tongass, and runoff varies greatly between the two stream systems. Runoff from glacially fed streams usually starts in June in response to snow and ice melt, reaching peak flows in July and August. Runoff drops rapidly in October and low flows occur from December through April. Runoff from non-glacial streams tends to respond to high precipitation events; therefore, the highest flows tend to be in October and December and the lowest flows between January and March, and mid-May to August.

Many factors influence how timber harvest and clearing of forest for road construction may affect runoff, and most are site-specific. The combined effects of these activities with site-specific factors can influence the amount and timing of runoff. In studies conducted in the Pacific Northwest, factors, especially those relating to roads, affect runoff patterns; although site-specific conditions including hillslope gradient, topography, soil type, and rainfall all influence the level of effect (Coe 2004). In general, changes in streamflow following timber harvest and road building are commensurate with the proportion of watershed harvested (Harr 1986; Jones and Grant 1996; Jones 2000; Moore and Wondzell 2005; Grant et al. 2008). In studies on the effects of forest harvest activities on peak flows in the Pacific Northwest, a minimum cumulative harvest of 20 to 40 percent has been shown to result in a 10 percent change in peak flow (Grant et al. 2008). Overall, removal of forest cover increases water yield, though attempts to quantify this at the watershed level show highly variable and unpredictable results (Bosch and Hewlett 1982; Keppeler and Ziemer 1990; Keppeler and Lewis 2007; Grant et al. 2008).

On the Tongass, stream channels and lakes are categorized by class based on their fish production values. Although there are additional details (see the *Glossary* for full definitions), stream classes are generally defined as follows:

- Class I streams and lakes have anadromous or adfluvial fish or fish habitat: or, high-quality resident fish waters, or habitat above fish migration barriers known to provide reasonable enhancement opportunities for anadromous fish.
- Class II streams and lakes have resident fish or fish habitat and generally steep gradients (6 to 25 percent or higher) where no anadromous fish occur, and otherwise not meeting Class I criteria.
- Class III streams are perennial and intermittent streams that have no fish populations or fish habitat, but have sufficient flow or sediment and debris transport to directly influence downstream water quality or fish habitat capability.
- Class IV streams are intermittent, ephemeral, and small perennial channels with insufficient flow or sediment transport capability to directly influence downstream water quality or fish habitat capability. Class IV streams do not have characteristics of Class I, II, or III streams, and have a bankfull width of at least 0.3 meter (1 foot).

Field survey methods to determine stream class follow the Tongass National Forest fish stream identification and classification procedures (USDA Forest Service 2015o). In addition, the Tongass uses a stream channel classification system based on the Alaska Region Channel Type Classification System (Paustian et al. 1992; revised October 2010). Streams are categorized into channel types, which are grouped into nine process groups, or combinations of similar channel types based on major differences in landform, gradient, and channel shapes (see Appendix D in the Tongass National Forest Land and Resource Management Plan [Forest Plan] for a full description). These are used to assess watershed condition, fish habitat production capabilities, and sensitivity to management activities (see the *Fish* section for additional information).

Nearly 46,000 miles of streams have been mapped on National Forest System (NFS) lands (Table 3.4-1). Of those, approximately 63 percent are classified in the high gradient contained process group (Table 3.4-1). Additionally, some 4,300 Class I and II lakes equaling 144,000 acres are also present on NFS lands.

There are also streams that have not been mapped because they require ground surveys to locate. During the planning stages of a specific proposed timber management activity, detailed ground surveys following the Tongass National Forest procedures (USDA Forest Service 2015o) are performed to delineate all such streams within the directly affected proposed project area. Many of these are small low-flow, high-gradient Class III and IV headwater streams, but others may contain valuable aquatic habitat.

Table 3.4-1
Mapped Stream Miles by Process Group and Stream Class[1] for Each Ranger District Group[2] on NFS Lands

Stream Process Group	Class	Ranger Districts: Northern	Central	Southern	Total
Alluvial Fan (AF)	I	241	50	127	418
	II	597	93	127	817
	III	86	83	107	275
	IV	0	3	2	6
Estuarine (ES)	I	140	112	56	308
	II	1	0	1	2
	III	0	0	0	0
	IV	0	0	0	0
Flood Plain (FP)	I	2,081	624	976	3,681
	II	58	124	69	251
	III	1	11	11	22
	IV	1	0	0	1
Glacial Outwash (GO)[3]	I	388	237	247	873
	II	77	81	6	164
	III	57	48	9	114
	IV	0	1	0	1
High Gradient Contained (HC)	I	83	89	138	310
	II	3,035	840	2,133	6,007
	III	7,626	4,830	8,440	20,896
	IV	375	611	527	1,514
Low Gradient Contained (LC)	I	129	119	157	405
	II	12	26	14	52
	III	0	0	4	4
	IV	0	0	0	0
Moderate Gradient Contained (MC)	I	668	403	972	2,043
	II	351	198	215	765
	III	7	38	76	121
	IV	1	2	2	5
Moderate Gradient Mixed Control (MM)	I	777	806	1,122	2,705
	II	328	313	290	930
	III	7	20	48	76
	IV	5	15	22	42
Palustrine (PA)	I	1,341	414	552	2,307
	II	55	99	105	260
	III	4	8	30	43
	IV	3	7	11	22
Unverified Connectors (UC)[4]	I	72	21	25	118
	II	3	1	3	6
	III	12	1	4	16
	IV	0	5	21	26
Total	**I**	5,918	2,875	4,374	13,167
	II	4,516	1,776	2,962	9,255
	III	7,800	5,039	8,730	21,569
	IV	385	644	586	1,615
Grand Total[4]	**All Streams**	**18,620**	**10,333**	**16,653**	**45,606**

Table 3.4-1
Mapped Stream Miles by Process Group and Stream Class[1] for Each Ranger District Group[2] on NFS Lands

Stream Process Group	Class	Ranger Districts			Total
		Northern	Central	Southern	

[1] Miles are only those currently mapped and in the GIS database excluding lake miles and channels on all non-NFS lands. Additional unmapped streams are present, but have not been located through on-the-ground surveys, especially Class III and IV streams that are greatly underrepresented in the database. Numbers may not add up precisely because of rounding. See Paustian et al. 1992, as amended in 2010) for a description of the stream process groups and the glossary for a definition of stream classes.
[2] Northern Districts=Admiralty, Hoonah, Juneau, Sitka, and Yakutat; Central Districts=Petersburg and Wrangell; Southern Districts=Ketchikan-Misty Fiords, Thorne Bay, and Craig
[3] Includes all glacial outwash channel types.
[4] Includes unverified connector channels such as ice fields, connector streams, and intertidal channels not field surveyed.
Source: GIS database, March 2016

Water Quality

The State of Alaska sets water quality standards for chemical, physical, and biological parameters for waters on NFS lands. The Alaska Department of Environmental Conservation (ADEC) and the Forest Service have agreed that the Forest Service is the agency responsible for monitoring and protecting water quality on the NFS lands of Alaska for the purpose of meeting the Clean Water Act, as amended. Best management practices (BMPs), as described in the Soil and Water Conservation Handbook (USDA Forest Service 2006), the Alaska Nonpoint Source Pollution Control Strategy, and the Alaska Water Quality Standards (18 Alaska Administrative Code [AAC] 70) together form the “Forest Service Alaska Region Water Quality Management Plan,” as agreed to in the Memorandum of Agreement dated April 6, 1992 (ADEC and USDA Forest Service 1992). With implementation of this Plan, the State of Alaska recognizes that the Forest Service BMPs are the primary means to protect water quality from nonpoint sources of pollution. In 1997, the ADEC determined that the Forest Service BMPs meet or exceed the BMPs contained in the Alaska Forest Resources and Practices Act and Regulations (11 AAC 95) (Brown 1997). In 2012, the Forest Service issued National Core BMPs, which are also implemented in the Tongass National Forest.

In addition, the ADEC is responsible for providing a list to the U.S. Environmental Protection Agency (EPA) of the status of water quality within the state. The state makes a determination of which state waters (e.g., streams, rivers, bays) exceed state water quality standards and are limited by point and/or non-point sources of pollution, which may require additional controls to meet state water quality standards. Waters that fit this definition are put on a list as designated under Section 303(d) of the Clean Water Act, which is published by the state and sent to the EPA. State waters in this category are known as waters on the 303(d) list.

The most recent list for 2012 (ADEC 2013) includes Katlian River (on Baranof Island north of Sitka), listed as impaired for non-attainment of the sediment and turbidity standards due to past timber harvest activities, including road maintenance and riparian harvest. An assessment indicated that most sediment sources in the watershed are natural and there are limited opportunities for rehabilitation (USDA Forest Service and Sitka Tribe of Alaska 2003). Five streams along road system 3030 near Sweetwater Lake on Prince of Wales Island had been designated as 303(d) waters due to acid rock runoff conditions from the road construction. Recently, due to remediation actions, monitoring of these streams found they meet most water quality standards including improved biological resources and have been recommended by the ADEC for removal from 303(d) listed streams and placed as Category 2 streams, which are streams meeting most water quality standards. Marine waters listed near the Tongass National Forest include Hawk Inlet (Admiralty Island), Thorne Bay (Prince of Wales Island), and Ward Cove (Ketchikan). Some streams and log transfer facilities (LTF) that were listed as 303(d) in the past have been removed from this category due to improved water quality conditions. Currently, no LTF facility used by the Forest Service is 303(d) listed.

Stream Temperature

Stream temperatures are affected by solar radiation, evaporation, advection, conduction, and convection (Brown 1983; Adams and Sullivan 1989). Streams have a general tendency to warm as flow moves from upstream to downstream. Higher stream temperatures in the summer are generally the result of natural heating from solar radiation, increases in air temperatures, and decreases in streamflow (Zwieniecki and Newton 1999). Increased stream temperature results in reduced oxygen, but other factors such as decaying organic matter or abundance of salmon in a stream can also have large effects on dissolved oxygen concentrations (Pentec Environmental 1991; Spence et al. 1996; Welch et al. 1998).

Maintaining proper water temperature is critical for the health of aquatic ecosystems. Anadromous fish and other aquatic species are sensitive to water temperature with very low or high temperatures causing adverse conditions. Often in streams with salmon and trout, high water temperature is of greatest concern (see the *Fish* section for additional information). Timber harvest and road construction have the potential to reduce stream-side shade and raise water temperatures. Forest Plan standards and guidelines (see Chapter 4, Chapter 5, and Appendix D of the Forest Plan) minimize riparian harvest (see the subsection on Riparian Areas in the Watershed Condition section below) in order to maintain stream-side shade.

Removal of riparian vegetation can increase stream temperatures, but the magnitude of effects from timber harvest and road construction activities varies. Murphy and Milner (1997) reviewed studies in Southeast Alaska that did not include stream-side buffer practices and found a wide range of temperatures in streams, most with small increases that did not approach lethal levels. Other studies have found that total stream temperature change across a cleared area with no buffer may be greater in small, shallow streams than in large, deeper streams (Beschta et al. 1987; Moore et al. 2005).

In coastal British Columbia, daily maximum stream temperatures in the summer increased in streams with no buffer, while water temperature in streams with 10- and 30-meter (approximately 33 feet to 98 feet) buffers did not (Gomi et al. 2006). In the State of Washington one study of very small streams (most less than 1 meter [3 feet] wide) found stream temperatures increased following logging, with average maximum summer temperatures of about 0.7 to 1.5 degrees Celsius (°C) (33.3 to 34.7 degrees Fahrenheit [°F]) higher in harvested compared to unharvested buffers (Janisch et al. 2012). In contrast, studies in Oregon State forests with restrictive no harvest buffers found no measureable changes in stream temperature in harvested areas relative to control streams (Groom et al. 2011).

Hetrick et al. (1998) determined that stream temperature effects from vegetation removal were mitigated after flow through 150 meters (approximately 492 feet) of stream-side canopy cover; however, other studies (Poole et al. 2001; Moore and Wondzell 2005, Pollock et al. 2009) noted that while water temperature cooling occurred below previous timber harvest, once streams entered forested areas, the level of cooling and distance to return to unharvested temperature levels was variable. In addition, studies have found for smaller streams that return to pre-harvest temperatures following regrowth of riparian shade is often rapid, with the recovery of stream temperatures in less than 10 years (Moore et al. 2005; Quinn and Wright-Stow 2008).

In comparing stream temperatures in logged versus unlogged watersheds, Konopacky Environmental (1996) did not detect increases that could be characterized as differing significantly. An analysis of legacy stream temperature data collected on Prince of Wales Island in Southeast Alaska was completed in 2004 using data from 1997 to 2002 in harvested and unharvested watersheds (Walters and Prefontaine 2005). In this study, state water quality criteria for stream temperatures were exceeded during warm weather in both harvested and unharvested watersheds. In another study of water temperature in three Tongass National Forest drainages, two with no harvest and one with past harvest, all had exceedances of state water temperature criteria, with effects of past harvest practices on stream temperature not apparent (Tucker and Thompson 2010). Tucker and Thompson (2010) concluded drainage characteristics and local weather may have masked changes in stream temperature from upland and riparian harvest. High stream temperatures in Southeast Alaska are likely to occur under natural conditions during warm, rainless weather, and result in high stream temperatures during low stream flow periods regardless of extent of past riparian timber harvest or watershed harvest.

Factors other than riparian vegetation, such as landslides, debris flows, and overall basin size, may have substantial effects on the significance and magnitude of measured effects on stream temperatures (Ice et al. 2010). In the State of Washington, Janisch et al. (2011) conducted a study of very small streams (most less than 1 meter [3 feet] wide) and found that stream temperature changes varied and were poorly related to stream buffer size, with likely other stream morphological conditions (e.g. wetlands, substrate) having a greater effect on temperature changes than buffer characteristics. Although results from the various studies may vary, most studies suggest that elevated summer stream temperatures are affected more by other environmental conditions than past timber and riparian harvest.

Climate change has the potential to affect runoff and stream temperatures on the Tongass National Forest. Several modeled results presented in recent literature demonstrate that air temperatures and precipitation in Southeast Alaska and the Tongass National Forest will increase this century (EcoAdapt 2014; Shanley et al. 2015), although the degree to which changes occur vary substantially between areas across the Forest. In general, increases in air temperature are expected in the winter months with increases in precipitation expected in the fall and winter (EcoAdapt 2014). These warmer air temperatures would likely result in much of the precipitation occurring as rain instead of snow and contribute to the melting of glaciers, higher peak flows in the fall and winter in most streams other than glacial-fed streams, and lower summer flows primarily in snowmelt- and rain-dominated watersheds (Shanley and Albert 2014; Shanley et al. 2015). Regarding stream temperatures, the warmer air temperatures may result in increased stream temperatures, but the degree to which increases would occur depend greatly on factors such as glacial system, groundwater inputs, presence of lakes and ponds, and stream shading (EcoAdapt 2014). In addition, any potential increase in stream temperatures may be lessened by the potential increases in rainfall occurring in the summer and fall (EcoAdapt 2014).

Changes in any of the physical or chemical properties of water can directly affect water use by people, fish, and wildlife. Factors such as stream temperature and dissolved oxygen are not expected to change appreciably by alternative, even when effects from climate change are considered, and therefore only limited discussion is provided further in this section.

Sediment and Other Factors

Sediment is solid materials that were derived from the natural weathering of rock or from erosion of areas modified by man, such as roads and landings, agricultural lands, or urban areas. Sediments are carried and deposited by wind, water, and ice, and may be transported as either suspended load or bedload in streams. Suspended sediment is carried within the water column, while bedload material moves via rolling or bouncing along the bottom of the stream or riverbed. Suspended sediment causes water to have a turbid or murky appearance. Under natural conditions, the great majority of suspended load and bedload transport occurs during storm runoff events.

Landslides

Soil mass movements (landslides), streams cutting new channels, and bank erosion are the main natural processes creating sediment. Landslides cause large, but temporary, increases in suspended and bedload sediments. Stream and riverbed or bank erosion may contribute to sediment over long periods of time. Steep terrain and large amounts of rainfall make the soil sensitive to erosion if the organic material covering the soil is disturbed. High rainfall also makes soils sensitive to sediment production by road construction and timber harvest activities.

Stream substrates are replenished by natural process such as landslides (Meehan 1991; Reeves et al. 1995; Wing 2000). Sediments, including gravels, and large woody debris are deposited in stream headwater areas. During high-flow periods, some of that sediment and wood is transported through the stream system, although much wood may be stored in headwater channels.

Timber harvest has the potential to affect stream substrate composition through erosion and slumping of hill slopes following harvest, alternating stream buffer characteristics, road and landings construction, road drainage structures, level of use and maintenance of roads, number of stream crossings by roads, density of roads in the watershed, bank erosion where trees have been removed, and hydrology changes (Everest et al. 1987; Swanson et al. 1987; Furniss et al. 1991; Spence et al. 1996; Sweeney and Newbold 2014). On Prince of Wales Island, more than 300 landslides and debris flows were triggered by an October 1993 storm (Johnson et al. 2000). Eroded soil from these landslides was transported as sediment in nearby channels. Channel bedload sediment was 2 to 10 times greater and relatively finer compared with bedload transport in a channel that had last experienced a landslide and debris flow in 1961 (Gomi et al. 2004).

Swanston and Marion (1991) mapped landslides in the Tongass National Forest during the 21-year period, 1963 through 1983. The rate of landslides during this period was 3.5 times higher on harvested areas than on unharvested (see *Soils* section). Of the 1,277 landslides that occurred on unharvested areas, 37 affected Class I and II streams, while 7 of the 118 landslides on logged areas affected Class I and II streams. It is important to note that clearcut timber harvests conducted between 1963 and 1983 did not include the restrictions that were included in the 1997 Forest Plan. These past harvests often involved logging large portions of watersheds with very large clearcuts and almost no buffers, slope restrictions, or other form of restrictions. There have been multiple landslide inventories and analyses (Bishop and Stevens 1964; Landwehr 1994 and 1998) completed on the Tongass National Forest that have found similar overall landslide rates to the Swanston and Marion (1991) inventory and greater landslide densities in managed stands than in unmanaged areas. Future landslide potential, even in young-growth harvest areas, will be moderated by the Forest Plan requirement to determine slope stability of slopes over 72 percent. Slopes in those categories are considered of higher risk, and determinations of stability prior to initiating logging would occur for all future actions (see *Soils* section) and aid in reducing the risk of increased sediment to streams.

Roads

Road and related timber landings construction near streams, even where the road does not actually cross the stream, may contribute to increased sediment loads in streams, and poses a potential risk to overall watershed conditions (Reid and Dunn 1984; Furniss et al. 1991; Rashin et al. 1999; Gucinski et al. 2001; Luce and Wemple 2001; Gomi et al. 2005). Road location, or the distance between soil disturbance and a stream, as well as the presence of vegetation (riparian) buffers between roads and streams, affects the amount of sediment delivered to a stream through hill-slope runoff, road-runoff, landing runoff, or roadside ditches (MacDonald et al. 2001; Croke and Hairsine 2006; Rashin et al. 2006; Steel et al. 2007; McCune 2010). Knutson and Naef (1997) summarized literature on riparian function, and suggested a 300-foot maximum vegetative buffer was adequate to control sediment delivery to water bodies. McCune (2010) found that direct connection of flow and associated sediment from roads decreased linearly as distance increased, up to approximately 660 feet.

Maintenance of roads, landings, and roadside ditches, including grading and blading of the road surface and ditches and clearing of roadside and ditch vegetation, can increase sediment and turbidity in streams (Luce and Black 1999, 2001; Coe 2006). The increase in sediment delivered to streams by roads and roadside ditches is also related to the hydrologic connectivity, or the linkage between the sediment source areas and the channel network (Furniss et al. 2000). Although road improvement and maintenance has been shown to temporarily increase sediment and turbidity, regular maintenance can help reduce the adverse effects of roads and road deterioration on streams and salmonid habitats (Furniss et al. 1991). Road improvement and maintenance can also prevent severe erosion and increased sediment yields associated with drainage system failures which can minimize the degree of impact roads have on soil and water resources (Luce and Black 2001; Napper 2008).

Gomi et al. (2005) reviewed suspended sediment sources and transport in small forest streams in the Pacific Northwest region and concluded that vegetation clearing can increase fine sediment supply through soil disturbance and accelerated landslides. In addition, studies have found evidence that increased stream flows following vegetation clearing resulted in increased sediment recruitment from within-channel sources, such as through channel erosion (Grant and Hayes 2000 and Lewis et al. 2001 as cited in Gomi et al. 2005). Clearing large portions of forested land from a watershed has been found to increase peak flow response during rainstorms as a result of vegetation loss (Hewlett and Helvey 1970 as cited in Webster et al. 1992; Hudson 2001; Grant et. al. 2008; Tonina et al. 2008), with the increased peak flows intensifying sediment recruitment from within-channel sources (Webster et. al. 1992; Tonina et al. 2008; Grant and Hayes 2000 and Lewis et al. 2001 as cited in Gomi et al. 2005).

Generally, the effects of timber harvest on peak flows and resulting sediment recruitment and transport are, however, dependent upon multiple factors, including area of basin harvested, hydrologic regime, topography, soil conditions, road density, and harvest methods (Jones and Grant 1996; Hudson 2001; Gomi et. al. 2005; Karwan et al. 2007; Grant et al. 2008; Tonina et al. 2008). Specific to Southeast Alaska, statistical relationships between fine sediment and watershed disturbance were not found by Bryant et al. (2004) or Woodsmith et al. (2005). Ross (2013) found evidence of smaller median particle size in stream substrate in watersheds with historical timber harvest, which included historical timber practices of removing riparian trees down to the stream bank.

In Alaska, the ADEC has established numeric criteria for turbidity standards (ADEC 2006) to help evaluate the presence of suspended particulates. Turbidity criteria indicate values will not exceed 5 nephelometric turbidity units (NTUs) over natural conditions, when natural values are less than 50 NTUs. Turbidity in Alaska correlates with suspended sediment, although the exact relationship varies by region and stream type (Lloyd 1987; Lloyd et al. 1987) and has not been determined in Southeast Alaska.

In Southeast Alaska, suspended sediment loads in non-glacial streams in undisturbed watersheds are very low. Concentrations of suspended sediments range from less than 10 parts per million (ppm) in the winter to occasionally over 100 ppm in the fall during storm runoff periods (Schmiege et al. 1974). Suspended sediment in glacial streams is highly dependent on the volume of water flow from snow and ice melt. At high flows, concentrations may reach from 200 to more than 600 ppm; at low flows during winter, suspended sediment concentrations seldom exceed 20 ppm (Schmiege et al. 1974).

On the Forest, current road construction methods and culvert installation activities have been found to have little effect on stream turbidity. Turbidity data collected during culvert installation or road construction suggest few instances where the state criteria have been exceeded (USDA Forest Service 2004a). Of 12 replacement culvert installations monitored in 2004, 10 always met the turbidity criteria for drinking water and 11 of the sites met the criteria for fish propagation within 48 hours of the construction activity. Typically, water returned to less than 5 NTUs over background shortly after construction. In Upper Shaheen Creek in 2004, monitoring was conducted to determine effects of road construction (including a bridge) on meeting turbidity criteria (Thompson and Tucker 2005). The results from monitoring suggest some short-term exceedance of the 5 NTU criteria. Of 50 days of continuous monitoring (when upstream and downstream sites were both monitored), 11 days had some exceedance; of these, 9 were short term (less than 15 minute spikes in turbidity), while the remaining 2 exceedances were up to 30 minutes. Similar results were found in 2003, when 32 and 51 of 54 monitored culvert installations met drinking water, and fish production turbidity criteria, respectively (Monitoring Report summary for 2003).

Effects of timber management activities on turbidity levels in two small watersheds were examined over a 5-year period (2004-2008) on Prince of Wales Island (Tucker and Thompson 2010). The study evaluated turbidity levels in the two small adjacent watersheds with similar characteristic; however, one of the watersheds, Chanterelle, was unharvested and the other watershed, Scary, was harvested and roaded. Turbidity in both remained mostly low, similar, and below state water quality standards (5 NTUs) except during storm events that resulted in peak stream flows. While the highest turbidity value (902 NTUs) occurred in the managed watershed (Scary), statistical tests comparing values from 41 coincident peak storm events found no significant differences between peak turbidity in these two watersheds (median during peak events was 16.7 and 15.2 NTUs in Scary and Chanterelle, respectively). In this study, Tucker and

Thompson (2010) found that naturally occurring events (e.g., landslides, bank avulsion) may outweigh any potential turbidity increases resulting from management activities (e.g., harvest, roads) in these watersheds.

The Nakwasina River on Baranof Island, which had been listed as a 303d impaired stream on the state's list based on past timber practices effects on stream sediment and turbidity in 1998, was monitored for turbidity levels in 2008, with turbidity values compared to the Clear River, a nearby mostly unaffected stream (Tucker et al. 2009). Tucker et al. (2009) determined turbidity levels were low in both the Nakwasina River and Clear River, with higher values in the Clear River, but overall some increases occurred in both rivers during higher flows. Overall, long-term effects on increased turbidity values in the Nakwasina River due to past timber practices were not apparent.

Within Fubar Creek (now named Gandláay Háanaa) on Prince of Wales Island, turbidity was monitored due to historic landslides associated with timber management to determine if state standards for turbidity were being met and compare turbidity values to Rio Roberts, a nearby mostly unaffected stream (Tucker 2011). Tucker (2011) determined that frequency of exceedance of the 5 NTU state standard were similar for both Fubar Creek and Rio Roberts (less than 5 NTUs in Fubar Creek and Rio Roberts 96.3 and 97.0 percent, respectively). Although peak values were more often higher in Fubar Creek than Rio Roberts, the values were in the range of natural variability. Overall, long-term effects on increased turbidity values in Fubar Creek due to historic landslides associated with timber management were not apparent.

As noted above, changes in any of the physical or chemical properties of water can directly affect water use by people, fish, and wildlife. Sediment input to streams and turbidity are the two water quality factors most likely to be affected by the alternatives, and therefore are discussed further in this section.

Watershed Condition

In 2011, the Forest Service Watershed Condition Framework (WCF) established a nationally consistent approach for classifying watershed condition (USDA Forest Service 2011a). The approach is designed to foster integrated watershed assessments, target restoration in priority watersheds, enhance collaboration with partners, and improve outcome-based performance measures for documenting improved watershed condition. Twelve core indicators were evaluated to classify watershed condition across the Tongass National Forest in 2011, using available data from national forest lands. Components of these 12 indicators, based on selected metrics within each of the aquatic and terrestrial indicators, representative of the specific National Forest, are determined to be "Good - functioning properly", "Fair - functioning at risk", or "Poor - impaired function." The results of evaluating each of the 12 indicators are averaged by weighting (see USDA Forest Service 2011a for methods) to provide an overall watershed Condition Class rating: Class 1 "functioning properly," Class 2 "functioning at risk," or Class 3 "impaired function." Data from non-National Forest lands were not used; non-National Forest lands were assigned a subjective rating as same, better, or poorer condition using best available knowledge.

Most of the approximately 900 watersheds within the Tongass National Forest are in near natural condition (Condition Class 1). Sixty-eight watersheds were rated "at risk" for maintaining ecological functions and aquatic resources due to past management practices, while none are rated as Class 3. A detailed map showing the status and individual rating of each of the watersheds in the Tongass can be accessed at the Forest Service's Watershed Condition Class and Prioritization Information website (http://apps.fs.usda.gov/nfs/nrm/wcatt/WCFMapviewer/). Watershed health issues primarily result from historical timber harvest and road building that occurred between 1950 and 1990, prior to our current understanding of the importance of watershed resources and processes. Measures are now in place to protect and maintain watershed health, namely the riparian protections described in the Riparian Areas subsection below. In addition, the watershed condition ratings, along with use and aquatic value criteria, led to designation of Priority Watersheds for restoration focus (see the *Fish* section for restoration).

Of the 12 core indicators from the WCF (USDA Forest Service 2011a) used to assess watershed functional status condition relative to hydrologic and sediment regimes, the percent of road miles within 300 feet of waterbodies indicator is used to evaluate the potential for sediment to enter streams based on road location. Although this WCF indicator provides an approach to evaluate watershed function based on road miles near waterbodies, a bias in this indicator was identified in a recent policy primer (Rissien 2011). Specifically, the primer recommended that the percentage of waterbodies within 300 feet of a road, and not the percentage of road miles within 300 feet of waterbodies, should be used to evaluate watershed function. Using this criterion, the watershed would be considered "properly functioning" if less than 10 percent of the waterbodies' length in a watershed has roads, "functioning at risk" if between 10 and 25 percent, and "impaired functioning" if greater than 25 percent are within 300 feet of water bodies, relative to the effects of this factor on the hydrology and sediment regime. As shown in Table 3.4-2, about 89 percent of all watersheds would currently be considered "properly functioning" and less than 1 percent as having "impaired function." The results influence the overall rating of watershed conditions, but as stated above, these results are considered along with all other indicators to make the complete watershed function rating assessment.

Table 3.4-2
Percent of Subwatersheds on the Tongass National Forest with Waterbodies within 300 Feet of Roads

Percent of Waterbodies within 300 feet of Roads	Percent of Subwatersheds
0	64.8
>0 – 10	24.0
>10 - 25	10.6
>25	0.7

Numbers may not add up precisely because of rounding.

Riparian Areas

Riparian areas represent dynamic, complex, three-dimensional transition zones between terrestrial and aquatic ecosystems. In the Tongass National Forest, Riparian Management Areas (RMAs) are delineated according to stream process group. The RMAs encompass the stream, mandatory no-harvest zones required by the 1990 Tongass Timber Reform Act (TTRA), adjacent site-potential tree-height distances, landscape features such as floodplains, alluvial fans, and v-notches, and associated wetlands (Forest Plan, Appendix D, Paustian 2004). The RMAs are ecologically tailored to ensure the integrity of the stream channel, maintain supply of large wood, and protect other functions critical to soil, water, fish, and wildlife in Southeast Alaska (USDA Forest Service 2015c). Greatest protection is provided to riparian areas associated with alluvial soils and fish streams; fishless headwater streams are also protected as important conduits of clean water, large wood, stream substrate, and food for aquatic organisms.

Under the 2008 Forest Plan, timber harvest is prohibited in RMAs on Class I, II, and III streams, unless stream process group objectives can be met as documented by watershed analysis (Forest Plan Appendix C). Class IV streams do not have RMAs (or mandatory no-harvest buffers), but are protected by BMPs to minimize disturbance during timber harvest. Standards and guidelines considered to be important for protection of watersheds by the Alaska Anadromous Fish Habitat Assessment (USDA Forest Service 1995) have been incorporated into the RMAs, which were further bolstered by literature review for the 2008 Forest Plan (Landwehr 2006; Paustian et al. 2006). These ecologically based RMA buffers are likely an important component to mitigate potential effects of climate change on hydrologic regimes and fish (EcoAdapt 2014).

In addition, reasonable assurance of windfirmness (RAW) must be provided for buffers, which may or may not include additional buffer width depending on site conditions (Forest Plan Appendix D). For 14 consecutive years at 262 sites on the Tongass National Forest, windfirmness at riparian buffers was monitored (USDA Forest Service 2014d). Based on this monitoring, results have found average blowdown in buffers, which include standard buffers to slope break, to be 6.7 percent (median 0.8 percent). Blowdown is skewed in its distribution ranging from 0 to 85 percent, with 74 percent of the sites with less than 5 percent blowdown. This monitoring has found the rate of windthrow decreases over time; however, monitoring of windfirm buffers on second-growth harvest areas has not been occurring.

To date, approximately 57,929 acres of riparian forest (nearly 5 percent of the original 1,262,531 acres of riparian forest on the Tongass) have been harvested (see Table 3.4-3), including approximately 1,000 acres that are now within Wilderness and 1,800 acres that are now in legislated LUD II areas (USDA Forest Service 1997a). The 55,129 acres of harvest riparian forest outside of Wilderness and LUD II represents over 9 percent of the original 599,253 acres of riparian productive old growth (POG) outside Wilderness and LUD II (USDA Forest Service 1997a). Most of this harvest, almost 53,000 acres, took place between 1950 and 1991 and primarily occurred in riparian/wetland soil polygon areas (see Table 3.4-3). This is approximately 1,292 acres per year; however, following implementation of the 1990 TTRA, harvest in riparian areas has been much lower (approximately 201 acres per year). Since 2008, POG harvest in riparian areas has been limited to approximately 34 acres per year.

Table 3.4-3
Total Riparian Management Area (RMA), Productive Old Growth (POG) in RMA, and Past Harvested Areas in RMA by Stream Channel Process Group on NFS Lands

Stream Process Group	Riparian Management Area (Acres)			
	Total Existing	POG	Harvested Prior to 1991[1]	Harvested in 1991 to Present
Alluvial Fan (AF)	50,622	23,547	4,958	359
Estuarine (ES)	12,450	3,469	201	0
Flood Plain (FP)	199,299	111,707	9,620	328
Glacial Outwash (GO)[2]	52,890	7,937	698	7
High Gradient Contained (HC)	366,731	167,106	12,960	2,611
Low Gradient Contained (LC)	12,725	8,885	369	16
Moderate Gradient Contained (MC)	75,692	36,801	1,457	150
Moderate Gradient Mixed Control (MM)	118,433	70,394	6,910	501
Palustrine (PA)	63,093	12,955	1,298	60
Unverified Connectors (UC)[3]	25	2	7	1

Table 3.4-3 (continued)
Total Riparian Management Area (RMA), Productive Old Growth (POG) in RMA, and Past Harvested Areas in RMA by Stream Channel Process Group on NFS Lands

	Riparian Management Area (Acres)			
Stream Process Group	Total Existing	POG	Harvested Prior to 19911	Harvested in 1991 to Present
Lake[4]	63,480	18,593	233	19
Riparian/ Wetland Soil Polygons	247,092	77,466	14,191	974
Grand Total	**1,262,531**	**538,864**	**52,904**	**5,025**

[1] No TTRA or RMA buffer required during this period
[2] Includes all glacial outwash channel types.
[3] Includes unverified connector channels such as ice fields, connector streams, and intertidal channels not field surveyed.
[4] RMA buffer on lakes and ponds
Numbers may not add up precisely because of rounding.
Source: GIS database, March 2016

As previously noted, the TTRA dramatically reduced riparian harvest after 1990, and the 1997 Forest Plan further reduced riparian harvest. Since 1997, riparian harvest has been predominately limited to road construction clearing. The GIS-modeled RMA over-estimates riparian acres associated with some stream process groups that are determined not to be riparian at the project level; this results in over-reporting riparian harvest at the forest level. Although both the 1997 and 2008 Forest Plans provided a mechanism for adjusting RMA buffers to allow for commercial harvest in riparian areas (Appendix C in the 2008 Forest Plan), this process has been used sparingly.

Young growth riparian ecosystems vary widely, and previously harvested timber stands are now in various stages of secondary plant succession, depending on original plant associations, site quality, complex geomorphic conditions and site disturbance. With the exception of where the ground is highly disturbed, the species composition on these secondary successional riparian areas is very similar to the riparian vegetation prior to timber harvest, with Sitka spruce, red alder, and western hemlock dominating the tree canopy (USDA Forest Service 1997a). On the more disturbed sites, the vegetation is often similar to primary successional species, such as what occurs following deglaciation, with red alder the most common component. The Tongass Young Growth Management Strategy (USDA Forest Service 2014d) describes a range of typical stand conditions and management considerations.

Floodplains

Executive Order 11988 directs federal agencies to provide leadership and take action on federal lands to avoid, to the extent practicable, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains. The Forest's floodplains are typically found in broad, flat, alluvial U-shaped valleys, with high stream flows inundating the floodplain. These floodplains are forested, and usually support plant communities having an overstory of Sitka spruce or Sitka spruce and western hemlock. The shrub understory is variable and may include blueberry, skunk cabbage, devil's club, salmonberry, and alder. Supporting this vegetation are well-, moderately well-, or somewhat poorly drained, deep mineral soils with thin organic surface layers.

Prior to the 1990 TTRA, nearly 10,000 acres of the Flood Plain (FP) process group were harvested (see Table 3.4-3). Due to the common occurrence of high stream flows inundating the floodplain, areas where harvest occurs can result in channel movement and increased downstream transport of materials, and reduced supply of large trees to streams. The depletion of large old-growth trees from past harvest in RMA is a long-term impact that will continue to affect floodplain and stream function for hundreds of years. Currently, based on channel type characteristics, the FP process group makes up almost 9 percent of the nearly 46,000 linear miles of the streams mapped on the Forest and is typically protected through identification and designation of RMAs and associated Riparian Standards and Guidelines (see Chapters 4 and 5 and Appendix D of the Forest Plan).

Alluvial Fans

The Forest's alluvial fans are typically found in the transitional area between valley floodplains and steep mountain slopes. The alluvial fan channel typically changes course frequently resulting in multiple branches across the valley floor reflecting a fan-like landform. Because of characteristics of alluvial fans, the plant communities typically comprise Sitka spruce or Sitka spruce and western hemlock. The shrub understory is most commonly blueberry and devil's club.

Prior to the 1990 TTRA, nearly 5,000 acres of the Alluvial Fan (AF) process group were harvested (see Table 3.4-3). Approximately 11 percent of Tongass National Forest watersheds have had more than 10 percent of alluvial soil riparian areas clearcut, mostly between 1950 and 1990 (USDA Forest Service 2014d). Based on channel type characteristics, the AF process group makes up over 3 percent of the nearly 46,000 linear miles of the streams mapped on the Forest. Similar to the FP process group, these are typically protected through identification and designation of riparian management areas and associated Riparian Standards and Guidelines (see Chapters 4 and 5 and Appendix D of the Forest Plan).

Other

Although past harvest in FP and AF process group's represent some of the greatest concerns for any potential future harvest due to unique characteristics and frequent channel movement, past harvest in other process groups has occurred in equal or greater amounts prior to the 1990 TTRA. These include the High Gradient Contained (HC) and Moderate Gradient Mixed Control (MM) process groups, with nearly 13,000 and 7,000 acres harvested, respectively (see Table 3.4-3). Harvest within the HC process group has the potential to alter downstream transport of sediment and wood due to its generally steep and confined characteristics. Although the MM process group is typically located on the landscape in the middle to upper valley bottom, harvest associated with the HC or AF process groups that are adjacent to the MM process group has the potential to deposit additional materials. When combined with harvest in the MM process group, these additional materials could affect the process group's transport capacity.

Beach/Estuary Fringe

Currently, there are about 500 miles of beach/estuary fringe adjacent to past shoreline harvest areas, out of about 17,000 miles of shoreline in the Tongass National Forest. Beach/estuary fringe harvest may have an effect on sediment entry to the marine system and nearshore benthic disturbance (see *Fish* section for details of biologic effects). Young-growth area beach/estuary fringe harvest has the potential to affect the nearshore marine system from the timber removal methods that may be employed.

Water Use

Key water uses on the Forest include public water supply, recreation, growth and propagation of fish, and hydroelectric power generation. The Forest supplies public and private water systems across the Forest. The ADEC classifies public water systems into four categories that are based on the number of individuals served and frequency of water use (i.e., year round or seasonally). The four categories include Community Water System, Non-Transient Non Community Water System, Transient Non Community Water System, and Class C public water system. The Community Water System applies to those systems with greatest number of users that use water year round. This category would apply to larger communities in Southeast Alaska in the vicinity of the Tongass National Forest boundary. Community Water Systems include water supplies for Ketchikan, Petersburg, Sitka, Juneau, Wrangell, Kake, Klawock, Craig, and Hydaburg. The source watersheds for these systems are within the Forest Service Municipal Watershed Land Use Designation (LUD) (see the Forest Plan, Chapter 3, Municipal Watershed). Ketchikan, Sitka, and Petersburg are congressionally designated municipal watersheds, and the other six communities have non-congressionally designated municipal watersheds. All other non-private water users in the vicinity of the Tongass National Forest boundary are designated under the other three ADEC public water system categories. In addition, water is supplied from the Forest to fish hatcheries, industrial sites, and resorts.

Renewable Energy Development

Hydroelectric generation continues to be used in many places throughout the Forest to provide electricity for mining, sawmills, communities, and other uses. There are 24 hydropower installations in Southeast Alaska, about half of which are on Tongass National Forest Lands (USDA Forest Service 2010b). Some of these are major power facilities producing greater than 10 megawatts (MW) of energy for the communities of Juneau, Sitka, Ketchikan, Wrangell, and Petersburg. Some interties have been developed between facilities with additional installations and interties between installations being proposed. The *Renewable Energy* section supplies additional information on existing and planned hydroelectric projects.

Environmental Consequences

Direct and Indirect Effects

This section considers the effects of forest management activities on water quantity, water quality, watershed condition, including riparian beach fringe areas, water use, and cumulative effects. The effects of timber harvest and roads and related harvest landings on fish and fish habitat are discussed in the *Fish* section of this chapter. The effects on potential hydroelectric projects are discussed in the *Renewable Energy* section, and the effects of log transfer facilities on the marine environment are discussed in the *Fish* and *Transportation* section of this chapter.

Forest management activities affect water quantity and quality, as well as the timing of water flows through alteration of canopy cover, soil, and watershed conditions. Most watersheds are in a state of dynamic equilibrium where changes occur naturally because of changes in weather patterns. Because of the overriding influence of climate and watershed resiliency, changes in streamflow and sediment delivery resulting from management activities (e.g., timber harvest and road construction) are difficult to measure.

Water Quantity

As described in the Affected Environment subsection, changes in streamflow following timber harvest and road building are commensurate with the proportion of watershed harvested. Studies from coastal British Columbia suggest that even selective harvesting may result in statistically significant increases in peak flows (Hudson 2001). After harvest has occurred and the forest canopy begins to close, with forest canopy recovery assumed to occur in 30 years (Hicks et al. 1991; Jones 2000), pre-harvest streamflow conditions are also likely to recover.

Little has been quantified about the effects of timber harvest and roads on stream flows in Southeast Alaska watersheds. Of the limited studies, one study in Staney Creek on Prince of Wales Island concluded that timber harvest of 35 percent of basin area may have increased streamflow during dry periods (Bartos 1989). Additional analysis of these data suggests that the change could be due to climatic cycles, not timber harvest (USGS 2000). From analysis of accumulative water yields in Staney Creek and a control watershed (Old Toms), summer minimum stream flow patterns for Staney Creek did not show evidence that potential changes in forest canopy interception rates affected low flow regimes (USGS 2010). Furthermore, Staney Creek exhibited higher variability in minimum streamflow during pre-harvest periods compared to young-growth forest conditions. However, in the case of the Staney Creek investigation, it is likely that climate signals between modes of the Pacific Decadal Oscillation (PDO) have masked any discernable changes in discharge patterns resulting from timber harvest in the drainage. Overall, water yield appears to increase as a function of mean annual precipitation (MAP), but this effect may be short-lived since the revegetation responses will be quicker in areas of higher MAP (Bosch and Hewlett 1982).

In addition to the Bartos (1989) study on the effect of timber harvest on streamflow during dry periods, Bartos (1990) assessed how geologic zones in Southeast Alaska affected low flows after timber harvest. Bartos (1990) found in general that where watersheds were composed primarily of metamorphics, volcanics, and igneous rocks, lower flows are likely to occur because of timber harvest. In contrast, larger flows are likely to occur because of timber harvest where watersheds are composed of sedimentary rocks. In addition to these studies from Southeast Alaska, many studies from the Pacific Northwest have also indicated that in addition to timber harvest and roads affecting runoff timing and quantity of peak flows, other factors including precipitation, soil type and depth, lithology, road design, hillslope gradient, and topography, may play significant role in stream flows (Coe 2004).

Grant et al. (2008) evaluated numerous Pacific Northwest watershed studies to evaluate the effects of harvest practices on peak flow. In this study, Grant et al. (2008) found there to be an increase in peak flow with the portion of watershed harvested. The relationship was affected by the presence of roads and if watersheds were rain dominated, transient snow dominated, or snow dominated. Based on mean reported measurable change in peak flow, Grant et al. (2008) found that watersheds with both harvest and roads had measurable changes in peak flow at about 29 percent of watershed harvested in rain-dominated watersheds and 19 percent for transient snow watersheds. These results were consider conservative in their estimate as studies reporting no change in flow were not included in the analysis.

Besides factors such as soil type and depth, lithology, road design, hillslope gradient, and topography affecting water quantity, climate change has the potential to affect stream flows on the Tongass National Forest this century, although the degree to which changes occur vary substantially between areas across the Forest (EcoAdapt 2014, Shanley et al. 2015). In general, increases in precipitation are expected in the fall and winter, with much of the precipitation occurring as rain instead of snow (EcoAdapt 2014). These increases in precipitation occurring as rain would further contribute to the melting of glaciers, higher peak flows in the fall and winter in most streams other than glacial fed streams, and lower summer flows primarily in snowmelt- and rain-dominated watersheds (Shanley and Albert 2014; Shanley et al. 2015).

Projected effects on stream flow within watersheds Forest-wide can be generally assessed by the total acreage of timber harvest and road density. The Timber Harvest and Roads subsections below provide estimated timber harvest and road density on NFS lands under existing conditions and after 100 years of full implementation for each of the alternatives. In addition, the estimated timber harvest and road reconstruction miles in beach/estuary fringe and RMA after 100 years of full implementation for each of the alternatives are also provided.

Quantifying the total acreage of timber harvest and road density provides a general approach to assessing projected effects on water quantity. The potential effects of changes in stream flows within watersheds Forest-wide are expected to vary depending on the factors describe above, as well as the relative amount of timber harvest and roads and the applicable Forest-wide standards and guidelines (see Chapters 4 and 5 and Appendix D of the Forest Plan). The effects from changes in stream flows in a particular subwatershed can only be estimated during project planning, at which point the rate of entry into subwatersheds and locations of proposed roads and harvest units would be analyzed. The actual effects on stream flows can only be determined by site-specific monitoring.

Timber Harvest

As described above, timber harvest has the potential to change streamflow by altering processes that control the amount and timing of water delivered to streams. Generally, reduction of forest cover increases water yield, but the response to treatment is highly variable and unpredictable (Bosch and Hewlett 1982; Keppeler and Ziemer 1990; Keppeler and Lewis 2007; Grant et al. 2008). The direct removal of forest canopy affects rain interception (Prussian 2010), evapotranspiration, snow storage, snow melt, and soil moisture (Jones and Grant 1996; Hubbart et al. 2007). After harvest is completed, soil moisture and transpiration changes continue in response to uptake and use of water by remaining and regenerating vegetation. Climate cycles also influence streamflow and probably confound most studies on the relationship between timber harvest and streamflow, which have not occurred over long enough timeframes to account for climate shifts (USGS 2000; Neal et al. 2002).

The complex relationships between these processes, how they are altered by timber harvest, the role other factors play, and the net effects on streamflow have been studied extensively in the Pacific Northwest, with varying conclusions. Nonetheless, the total acreage of timber harvest between alternatives, combined with road density (see Roads subsection below), provides a general indication to assess projected effects on water quantity. Table 3.4-4 provides the estimated maximum acres of harvest by alternative after full implementation (i.e., 100 years) of the Forest Plan.

Table 3.4-4
Estimated Maximum Acres of Timber Harvest after 100 Years of Full Forest Plan Implementation[1]

Alternative	Maximum Likely Harvest (Acres) and Percent of Total				Total Maximum Harvest (Acres)
	Young Growth		Old Growth		
1	209,882	77%	62,851	23%	272,733
2	335,344	91%	32,609	9%	367,952
3	313,216	90%	35,568	10%	348,783
4	234,885	85%	42,597	16%	277,481
5	284,144	87%	42,479	13%	326,623

[1] Based on harvesting at the PTSQ level for 100 years.

As harvested forest areas mature, young growth is predicted to dominate harvest acreage over a 100-year period. Alternatives 2, 3, and 4 would have the highest proportion young-growth harvest with at least 85 percent, while Alternative 5 would be at least 87 percent and, Alternative 1 the lowest proportion with only 77 percent young-growth harvest. Projected acres of young-growth harvest would range from about 209,882 under Alternative 1 to 335,344 under Alternative 2 (see Table 3.4-4).

Included in the estimated maximum acres of timber harvest in Table 3.4-4, young-growth area beach/estuary fringe and RMA harvest have the potential to directly affect the nearshore marine system and stream channels through increased runoff associated with forest clearing. Table 3.4-5 quantifies the estimated amount of harvest by alternative within the beach/estuary fringe and RMA after 100 years of full implementation.

Table 3.4-5
Estimated Harvest (acres) of Young-Growth by All Harvest Methods (e.g., even aged, group selection, commercial thin) in Beach Fringe and Riparian Management Area (RMA) after 100 Years by Alternative[1]

Alternative	Beach/Estuary Fringe	RMA
1	0	0
2	21,871	26,030
3	30,769	0
4	11,114	0
5	3,903	1,089

[1] Alternative 2 allows clearcutting in Beach/Estuary for the first 15 years and then only commercial thinning. Only commercial thinning is allowed in RMA.
Alternatives 3 and 4 allow only commercial thinning in the Beach/Estuary Fringe.
Alternative 5 allows harvest openings up to 10 acres maximum and commercial thinning in both Beach/Estuary Fringe (with a 200 foot no cut beach buffer) and RMA.

Based on Tables 3.4-4 and 3.4-5, Alternative 2 would likely have the greatest effect on water quantity based solely on the acres of harvest across the Forest and within the beach/estuary fringe and RMA. Although Alternative 1 would have no harvest within the beach fringe or RMA, it has the largest amount of acreage within POG. Alternative 3 would be similar to Alternative 2, with the exception of no harvest within RMA (see Table 3.4-5). This would likely reduce the effects on water quantity and watershed condition (see Watershed Condition subsection below) of Alternative 3 relative to Alternative 2. Alternative 4 would have similar effects as Alternative 1, although with a greater extent in young growth, lesser in POG, and much greater in beach/estuary fringe. Alternative 5 would also have similar effects as Alternative 1, with the exceptions of lower harvest in POG and greater harvest in beach/estuary fringe and RMA. Relative to Alternative 4, Alternative 5 would have similar effects associated with harvest in POG and less effects in beach/estuary fringe, but slightly greater effects within RMA.

As previously described, the effects from changes in stream flows in a particular subwatershed can only be estimated during project planning, during which the rate of entry into subwatersheds and locations of proposed harvest units and roads would be analyzed. The actual effects on stream flows can only be determined by site-specific monitoring. The Watershed Condition subsection below provides further information related to RMA and beach/estuary fringe.

Roads

Compounding the difficulty of identifying streamflow responses to timber harvest is the influence of the road network. Roads can contribute towards increases in peak flow to streams (Grant et al. 2008). Increases in peak flows can result in stream channel erosion and bed scour (Tonina et al. 2008), affecting stream bed and bank stability, and adverse effects on fisheries resources (see the Fish section). Roads can potentially create areas of hillslope instability resulting in landslide generation, contribute fine sediment from surface erosion, and alter surface and subsurface water flow patterns. Some studies suggest that the influence of roads on the hydrologic cycle is just as significant as timber harvest, with the roads interacting positively with the vegetation removal to speed the delivery of water to channels during storm events (Jones and Grant 1996). Furthermore, mid-slope roads intercept subsurface flow paths, converting subsurface waters to surface waters (McGee 2000; Coe 2004), which can further contribute to increased peak flows (Jones and Grant 1996; Wemple and Jones 2003). In addition, road ditches integrate with and extend the stream network, thereby increasing transport efficiency to streams (Montgomery 1994; Wemple et al. 1996).

Removal of forested wetland acres for timber harvest and roads can result in increased soil moisture due to reduced evapotranspiration (Cox et al. 2013), as is expected to occur when forest canopy is removed. Replacement of wetland area with road surface can disrupt flow paths, decrease storage capacity, and increase sedimentation. Based on research regarding the effect of road construction impacts on adjacent wetlands in Southeast Alaska, effects to wetland hydrology and vegetation adjacent to roads are expected to be limited to a few meters of the road (Glaser 1999; Kahklen and Moll 1999; McGee 2000). Although timber harvest and roads on the Tongass National Forest may increase soil moisture, disrupt flow paths, decrease storage capacity, and increase sedimentation, these effects would likely only be measurable in those subwatersheds exceeding road density thresholds identified by the WCF.

The WCF concluded as part of their assessment that watersheds with fewer roads generally have healthier overall resources (USDA Forest Service 2011a). Specifically, the Forest Service (2011a) noted the following: 1) a watershed with road density of less than 1 mile per square mile would be considered “good” or “properly functioning,” 2) watersheds with road density of 1 to 2.4 miles per square mile were “fair’ or “functioning at risk,” and 3) watersheds with road density greater than 2.4 miles per square mile were rated as “poor” or “impaired function.” Based on this information, the frequency of occurrence of road densities exceeding the “properly functioning” value of 1 mile of road per square miles was used as a general index of relative effects of roads on water quantity and quality. Table 3.4-6 provides total road miles and road density under existing conditions and after 100 years of full implementation.

Table 3.4-6
Estimated Road Miles and Percent of 6th Field Subwatersheds in Road Density Categories on NFS Lands under Existing Conditions and after 100 Years of Full Implementation[1]

		Alternative				
Road Type	**Existing**	**1**	**2**	**3**	**4**	**5**
Existing Roads [2] (miles)	5,093	5,093	5,093	5,093	5,093	5,093
New Road Construction (miles)	–	944	1,056	1,020	871	994
Road Construction over Decommissioned Roadbeds (miles)	–	428	600	566	445	527
Road Reconstruction[3] (miles)	–	887	1,191	1,129	900	1,058
Total Roads (miles)	5,093	6,036	6,148	6,113	5,964	6,086
Percent New Road Increase	-	19%	21%	20%	17%	19%
Road Density Categories (Mi/Sq. Mi.)[4]						
0	66.6%	57.1%	54.6%	56.4%	62.4%	60.8%
>0 - 1.0	23.9%	32.4%	34.5%	32.5%	27.0%	27.9%
>1.0 - 2.4	8.4%	8.2%	8.4%	8.6%	8.2%	8.6%
>2.4 - 3.0	0.8%	1.3%	1.4%	1.5%	1.5%	1.5%
>3.0	0.3%	1.1%	1.1%	1.0%	1.0%	1.1%
Percent of watersheds with Average Road Density less than 1.0 mile/sq. mi.	90.5%	89.4%	89.1%	88.9%	89.3%	88.8%
Average Road Density (miles/sq. mi.) for all NFS Lands	0.20	0.23	0.24	0.23	0.23	0.23

[1] Assumes full implementation of Forest Plan at PTSQ levels. Includes adjusted road miles estimated to be needed to harvest all scheduled timber in the alternative.
[2] Note that the 5,093 miles of existing roads consists of 46% open roads, 27% closed roads (i.e., in storage), and 27% decommissioned roads.
[3] Estimated existing road miles that would need to be reconstructed.
[4] Percentages are based on 927 6th field subwatersheds that contain at least 100 acres of NFS lands.

Under existing conditions, the average road density on NFS lands in all subwatersheds is about 0.20 mile per square mile (see Table 3.4-6). This translates into about 91 percent of all subwatersheds with road densities currently in the "properly functioning" range (less than 1 mile of road per square mile) for NFS lands.

Total road miles and road density would increase under all alternatives and follow a similar pattern (Table 3.4-6). The increase in new road miles over 100 years relative to existing conditions could range from 17 to 21 percent for the alternatives. The increase in new road construction would be greatest under Alternative 2 and least under Alternative 4, while the amount of reconstructed roads would be highest under Alternative 2, but lowest under Alternative 1. The percentage of reconstructed roads is lowest for Alternatives 1 and 4 (17 percent for both alternatives) and higher for Alternatives 2, 3, and 5 (21 to 23 percent).

The number of subwatersheds that have no roads on NFS lands is currently about 67 percent (Existing, see Table 3.4-6); this percentage would decrease to between 55 and 63 percent under all alternatives. Increases in road densities would be primarily in subwatersheds that already have roads. Alternative 3 and 5 would have slightly higher frequency of subwatersheds with road densities between 1.0 and 2.4 mile(s) per square mile than the other alternatives. In addition, Alternatives 1, 2, and 5 would have slightly higher frequencies of subwatersheds with road densities greater than 3.0 miles per square mile. Overall, the alternatives would reduce the portion of subwatersheds with road densities less than 1 mile per square mile on NFS lands from 90.5 percent under existing conditions to between 88 and 90 percent (Table 3.4-6). After more than 100 years of Forest Plan implementation, the estimated overall road densities on NFS lands would remain nearly unchanged, increasing slightly from 0.20 to between 0.23 and 0.24 mile per square mile under all alternatives. On average, all of these densities are within the range of what the WCF (USDA Forest Service 2011a) characterized as "properly functioning" watershed road densities.

Included in the estimated total road miles, young-growth area beach/estuary fringe and RMA roads have the potential to directly affect the nearshore marine system and stream channels through increased runoff associated with the road network. Table 3.4-7 quantifies the estimated amount of road miles by alternative within the beach/estuary fringe and RMA after 100 years of full implementation.

Table 3.4-7
Estimated Road Construction and Reconstruction (miles) in Beach/Estuary Fringe and Riparian Management Area (RMA) after 100 Years by Alternative

	Beach/Estuary Fringe		RMA	
Alternative	Road Construction[1]	Road Reconstruction	Road Construction[1]	Road Reconstruction
1	21	13	110	71
2	116	88	241	179
3	152	116	127	90
4	66	49	105	72
5	39	28	126	88

[1] Includes new road construction and road construction over decommissioned roadbeds.

In beach/estuary fringe areas, Alternatives 2 and 3 would have the highest number of road construction and reconstruction miles (Table 3.4-7). Alternatives 1, 4, and 5 would have substantially lower amounts of road construction and reconstruction in beach/estuary fringe areas than Alternatives 2 and 3, while Alternative 1 would have the least among the alternatives. In the RMAs, Alternative 2 would have substantially more miles of road construction and reconstruction (420 total miles, nearly double the amount of the other alternatives) than any of the other alternatives. Alternatives 1 and 4 and Alternatives 3 and 5 would have similar amounts of road construction and reconstruction within the RMAs, with Alternatives 3 and 5 slightly higher than Alternatives 1 and 4, with all four alternatives much less than Alternative 2.

Potential effects that additional road construction and increases in road densities would have on any specific subwatershed and related watershed condition would ultimately be estimated during project planning, at which point the rate of entry into subwatersheds and locations of proposed harvest units and roads would be analyzed. The actual effects on stream flows can only be determined by site-specific monitoring. The Water Quality and Watershed Condition subsections below provide further information related to roads within the RMA and beach/estuary fringe.

Water Quality

As described in the *Affected Environment* section, changes in stream temperature and sediment and other factors are the two primary environmental consequences associated with proposed timber management activities. The subsections below evaluate the potential effects on stream temperature and sediment and other factors associated with timber harvest and roads for the alternatives.

Stream Temperature

As described in the Affected Environment subsection, riparian vegetation shading helps maintain stream temperature along most streams. Under each of the alternatives, riparian tree retention would be adequate to maintain stream temperatures. DeWalle (2010) examined the effect of riparian vegetation height, width, and density relative to stream width at maintaining adequate shade on streams. DeWalle (2010) concluded that for moderate to high density canopy thickness, a ratio of buffer height to stream width of five would maintain adequate shade to control effects of solar heating on stream temperature. Because on the Tongass National Forest all Class I, II, and III streams have no-cut buffers (except some areas for Class III streams under Alternatives 2 and 5, with at most 35 percent of trees removed in any stand along Class III streams), only Class IV streams in clear-cut units are likely to experience increased solar radiation due to harvest.

Class IV streams are small (between 1 and 5 feet in bankfull width) and are typically only delineated by conducting detailed ground surveys during the planning stages of specific proposed timber management activities. Because Class IV streams are typically only located during a specific proposed project, they are substantially underestimated in the Tongass National Forest streams dataset, in both harvested and unharvested subwatersheds. Due to the underestimate of Class IV streams, effects analysis associated with these streams and subwatersheds are best conducted during the planning stages of a specific proposed timber management activity.

Based on the DeWalle (2010) model, moderately dense vegetation or stream banks with heights of 5 to 25 feet (for streams 1 to 5 feet wide) would be sufficient to adequately prevent solar-induced heating of these streams. Many of these Class IV streams would initially be nearly fully shaded from banks or other remaining vegetation, and would soon be fully shaded from bank brush and sapling tree regeneration following timber harvest. In addition to the DeWalle (2010) model results, Janisch et al. (2012) found that, in Washington coast forests, unbuffered small headwater streams had a maximum summer temperature increase that was only about 1.5°C greater in unharvested control streams than harvested. Janisch et al. (2012) also found that within 3 years of harvest maximum temperatures were further reduced (less than 1.0°C greater than unharvested control streams). These results, combined with the supporting studies in the Affected Environment subsection, suggest that clearing along Class IV streams is not likely to significantly affect stream temperatures.

Although the main concern for potential stream temperature increases is riparian removal associated with direct timber harvest, removal due to road development through riparian areas and crossing of streams, may also be a contributing factor. Generally, road crossings of streams are the most common locations where associated removal of riparian vegetation decrease stream shade and contribute to solar radiation. Such removal would likely have little to no effect on increasing stream temperature at any one site because the clearing area is typically limited and the stream crossing structure (e.g., culvert, bridge) would contribute full shading to the stream. In some studies from other forested areas, stream temperature changes below road-stream crossings have been noted (Story et al. 2003), while other studies have found no change in stream temperature from before and after road crossing installations (Aust et al. 2011).

A study conducted by Tucker and Thompson (2010) on the Tongass National Forest assessed some of the effects of harvest-related actions, including roads, on stream temperature. It was found that all studied drainages had exceedances of state water temperature criteria, with effects of past harvest practices on stream temperature not apparent. As described in the Affected Environment subsection, Tucker and Thompson (2010) concluded that drainage characteristics and local weather may have masked changes in stream temperature from upland and riparian harvest. Based on these studies and those presented in the Affected Environment section, stream temperature is not expected to change appreciably by alternative, even when effects from climate change are considered, and therefore no further discussion is provided in this section.

Sediment and Other Factors

As described in the Affected Environment subsection, road and timber landings construction near streams, even where the road does not actually cross the stream, may contribute to increased sediment loads in streams, and poses a potential risk to overall watershed conditions (Reid and Dunn 1984; Furniss et al. 1991; Rashin et al. 1999; Gucinski et al. 2001; Luce and Wemple 2001; Gomi et al. 2005). Road location, or the distance between soil disturbance and a stream, as well as the presence of vegetation (riparian) buffers between roads and streams, affects the amount of sediment delivered to a stream through hill-slope runoff, road runoff, or roadside ditches (MacDonald et al. 2001; Croke and Hairsine 2006; Rashin et al. 2006, Steel et al. 2007; McCune 2010).

Projected effects on water quality within subwatersheds Forest-wide can be generally assessed by the amount of timber harvest, road miles and density (including on unstable slopes), landslide potential, and road-stream crossings. This subsection provides estimated landslide potential and road miles on potentially unstable soils. Additionally, and as described in the Affected Environment subsection, the Forest Service Watershed Condition Classification Technical Guide (USDA Forest Service 2011a) uses the percent of road miles within 300 feet of waterbodies as one of the metrics to indicate watershed functional status condition relative to hydrologic and sediment regimes. The estimates of timber harvest and road miles and densities on NFS lands under existing conditions and after 100 years of full implementation for each of the alternatives were discussed above under the Water Quantity subsection.

Although the amount of timber harvest, road miles and densities (including on unstable slopes), landslide potential, and stream crossings provides a general approach to assessing projected effects on water quality, the potential effects on water quality within subwatersheds Forest-wide are expected to vary depending on the relative amount of timber harvest and roads within a given subwatershed and the applicable Forest-wide standards and guidelines (see Chapters 4 and 5 and Appendix D of the Forest Plan). The effects from changes in water quality in a particular subwatershed can only be estimated during project planning, when the rate of entry into subwatersheds and locations of proposed roads and harvest units would be analyzed in further detail. The actual effects on water quality can only be determined by site-specific monitoring.

Landslides and roads are two of the greatest contributors of sediment to stream channels. Landslide debris (e.g., sediment, large wood) that enters streams may block or shift channels, fill pools, and increase the presence of fine sediment in the channel network. Increased sediment yield, including yields during road construction, road use during timber harvest activities, roads on unstable slopes, and lack of sufficient maintenance or proper closure following timber harvest activities, are all viewed as potential areas of risk for increased sediment to stream channels.

Landslides
Timber harvest on high gradient unstable slopes can potentially increase landslides that may add debris and sediment to streams, thereby affecting overall water quality. Unstable soils can cause slumping and mass wasting, and while most of the soil types of highest risk potential would be excluded from timber harvest, some areas may still be harvested. The *Soils* section provides estimates of landslides in the next 25 years. These estimates are used to compare the long-term landslide estimates that may result from the individual harvest levels proposed under each alternative. Based on the data presented in the *Soils* section, all proposed alternatives have a higher landslide potential (i.e., maximum increase in number of landslides over first 25 years) than under the 2008 Forest Plan (Alternative 1) because there are more total acres being harvested in order to transition to young-growth harvest. Alternatives 3, 4, and 5 would have slightly lower potential increase in the number of landslides than Alternatives 2. Alternative 2 has an estimated increase of 13 landslides over 25 years when compared to the 2008 Forest Plan (Alternative 1). See the *Soils* section for additional information.

Roads
Roads built on unstable soils are considered at greater risk of slumping or mass failure, and thereby increasing the chance of large amounts of sediment entering streams. Soils of high risk for landslide or mass wasting failure are those indicated as a mass movement index of 3 (MMI 3) (generally gradient of 55 to 72 percent). The upper ranges of these soils (65 to 72 percent) generally have the higher risk of slope failure. Those soils with slopes greater than 72 percent mass movement index of 4 (MMI 4) are removed from the suitable timber base, but may have small inclusions within the MMI 3 layer. In addition, current standards and guidelines, in consideration of these concerns, recommend avoiding building roads on slopes greater than 67 percent. Based on these recommendations, roads built on soils with slopes greater than 67 percent are considered the greatest risk for affecting water quality.

The miles of road likely to be constructed on soils greater than 67 percent are shown in Table 3.4-8. Although the amount of road miles are small among all alternatives, due to the limited number of new roads and standards and guidelines that restrict construction of roads in regions of this slope category, the differences among the alternatives demonstrate those with the greatest potential to effect water quality. Overall, Alternatives 2 and 3 have the highest portion of new roads on potentially unstable soils, with Alternatives 1 and 4 the least. Alternatives 5 would have intermediate potential effects to water quality, which would be greater than Alternatives 1 and 4, but less than Alternatives 2 and 3.

Table 3.4-8
Estimated Maximum Road Miles on Potentially Unstable Soils Based on Slopes Greater Than 67 Percent over the Length of the Project (approximately 100 years)[1]

	Alternative				
Road Type	1	2	3	4	5
Road miles > 67% Slope	9	11	11	9	10

[1] Includes both new road construction and road construction on decommissioned roadbeds. Based on the proportion of existing roads on slopes greater than 67 percent.

In addition to sediment contributions from the construction of roads on unstable slope, stream channel erosion has the potential to increase from the construction of roads because of the destabilizing effect of cuts, fills, and drainage alterations, and the lack of protective vegetation cover on road surfaces and other disturbed areas. In young-growth stands, there are existing legacy roads with detrimental soil conditions that may be reconstructed for future young growth harvests. Table 3.4-6 above provides the amount of reconstructed roads by alternatives and Table 3.4-8 above provides the amount of road miles on slopes greater than 67 percent by alternatives.

The amount of road construction by alternative is used as a measure of both soil productivity losses and erosion potential. In one attempt to quantify road induced erosion, Kahklen and Hartsog (1999) developed a multiple regression analysis based on road induced erosion studies in the Tongass National Forest, but found that road induced erosion was highly variable. The primary variables that correlated with greater sediment yields were heavier traffic volumes, more rainfall, higher road gradients, and lack of road resurfacing. These and other site-specific variables would be evaluated more precisely during project planning, based on the specific conditions found at the project site, and would vary based on soil parent materials, rock durability, slope, location within a subwatershed, mass movement hazard, and other factors.

Paustian (1987) measured short-term effects of road building on soil erosion in the Kadashan watershed that resulted in increased suspended sediment yield equivalent to 2 percent of the estimated annual sediment yields. Potential increases in total estimated sediment yield over a 2-year post-road construction period ranged from 20 to 66 percent in three Kadashan study streams. Montgomery (1994) found that drainage concentration from ridgetop roads caused both landsliding and integration of the channel and road networks. Road drainage concentration increased the effective length of the channel network and strongly influenced the distribution of erosional processes in Southeast Alaska.

As discussed in the Affected Environment subsection, Bryant et al. (2004) and Woodsmith et al. (2005) did not find a statistical relationship between fine streambed sediment and subwatershed disturbance in Southeast Alaska. Ross (2013) found evidence of smaller median particle size in stream substrate in watersheds with historical timber harvest along stream banks. Cederholm et al. (1981) conducted a study on Washington’s Olympic Peninsula that found that the accumulation of fine sediment in streambeds was highest in basins where the road area exceeded 2.5 percent of the basin area. Road construction near streams, even where the road does not actually cross the stream, may contribute to increased sediment loads in streams, and poses a potential risk to overall watershed conditions (Reid and Dunn 1984; Furniss et al. 1991; Gucinski et al. 2001; Luce and Wemple 2001; Gomi et al. 2005).

Roads in beach/estuary fringe and RMAs have the potential to more directly affect water quantity and quality than those in other areas due to their proximity to nearshore marine system and stream channels. As noted in the Affected Environment subsection, the percentage of waterbodies within 300 feet of roads is considered an indicator for watershed conditions: the higher the percentage, the more likely the watershed function, relative to hydrology and sediment, would be reduced. All alternatives propose road construction and reconstruction within both the beach/estuary fringe and RMA, where waterbodies would be present (Table 3.4-7). Alternatives 2 and 3 propose the most road construction and reconstruction miles within both the beach/estuary fringe and RMA. Alternative 1 has the least amount of road miles within both the beach/estuary fringe and RMA, while Alternatives 4 and 5 have greater road miles than Alternative 1, but less than Alternatives 2 and 3. Because roads in most beach/estuary fringes and RMAs would be within 300 feet of streams, Alternatives 2 and 3 would likely have the greatest increases in the percent of subwatersheds with waterbodies within

300 feet of roads. This could increase the risk of sediment entering waterbodies, affect overall water quality, and ultimately reduce watershed function level.

While riparian protection (e.g., buffers) can greatly reduce sediment delivery to streams (Chamberlin et al. 1991; Belt et al. 1992), they provide little reduction in the risks to stream channels caused by roads during construction or reconstruction. Road construction and reconstruction practices require additional attention and adherence to BMPs to ensure that risks to fish (see the *Fish* section) and stream channels are minimized. The effects in a particular subwatershed can only be estimated during project planning, after which point the rate of entry into subwatersheds and locations of proposed roads and harvest units would be analyzed in further detail. The actual effects on water quality can only be determined by site-specific monitoring.

In addition to the effects of roads near waterbodies, the number of road crossings of streams increases the risk of adding sediment to streams. Generally, the greater the number of road crossings by alternative the greater the chance of increased sediment to streams, with new crossings on average having a greater risk of affecting sediment than rebuilt crossings. Currently, about 6,102 Class I, II, and III stream crossings exist on the Tongass National Forest. The various alternatives would add between 1,714 and 2,177 new stream crossings on Class I, II, and III streams, and a similar number of reconstructed stream crossings, increasing the risk of introducing sediment to streams (see Table 3.6-4 in the *Fish* section). The relative ranking of the alternatives for potential sediment effects to streams based on the number of new crossings is discussed in the *Fish* section.

The specific effects in a particular subwatershed at any individual site would be influenced by the existing conditions at the crossing. Some existing crossings needing reconstruction may require minimal changes because the stream crossing structures are fully adequate to meet new road uses. Conversely, other crossings may require complete reconstruction. An index of risks of added sediment from road crossings based primarily on new crossing is shown in the *Fish* section. The application of BMPs found in the National Core BMP Technical Guide FS-990a (USDA Forest Service 2012b) and the Alaska Region Soil and Water Conservation Handbook, FSH 2509.22 for all alternatives combined with the Fish and Riparian Standards and Guidelines (see Chapters 4 and 5 and Appendix D of the Forest Plan) would help minimize or prevent adverse effects on water quality from the amount of riparian area with forest clearing (only Alternatives 2 and 5) and road construction (all alternatives), yarding corridors, and stream road crossings, and from any non-commercial timber harvest that may occur.

Watershed Condition

As described in the Affected Environment subsection, the WCF established a nationally consistent approach for classifying watershed condition (USDA Forest Service 2011a). Based on this approach, indicators associated with water quantity and quality were evaluated in the previous sections. Using this approach, watershed function associated with existing conditions and each of the proposed alternatives were evaluated. The Riparian Areas and Beach Fringe subsections below provide further evaluation of watershed conditions specifically within the RMAs for existing conditions and each of the proposed alternatives.

Riparian Areas

Riparian areas, as a component of aquatic and riparian ecosystems, would continue to be protected through use of the Fish and Riparian Standards and

Guidelines (see Chapters 4 and 5 and Appendix D of the Forest Plan) under all alternatives, which protects water quality parameters such as stream turbidity, temperature, and nutrients. This protection includes the no-harvest buffers included in the past Forest Plans to reduce impacts and risk of impacts to water quality and fish bearing streams. As previously described, these areas include the 1990 TTRA 100-foot buffers and additional distances intended to preserve the functions of the riparian areas with the sum of both designated as RMA. These RMA buffers, including the RAW buffers, reduce sediment runoff and instability from steep slopes adjacent to streams, and are included in riparian management to reduce windthrow.

For the FP process group, the RMA allows for stream channel braiding, migration, and storage of flood flows. For the AF process group, the RMA allows adequate buffer for channel movement, sediment deposition, and peak flow dispersion. Timber harvest and road construction within an RMA buffer reduce the function of the riparian areas, especially for floodplain and alluvial fan channels, but also have the potential to affect riparian/wetland soil polygon areas. Effects in general from harvest within the RMA include reduction in available large woody debris (LWD) and direct sediment contribution to riparian/wetland soil polygon areas.

As part of the no-harvest TTRA buffers included in the past Forest Plans reducing impacts and risks of impacts to water quality and fish-bearing streams, these buffers helped ensure adequate LWD is supplied to streams. LWD contributes towards sediment sorting and routing and fish habitat structure (see the *Fish* section). Nearly all LWD to streams is supplied from a stream-side distance of one site potential tree height (SPTH) (McDade et al. 1990). The SPTH along Tongass streams generally ranges from about 85 to 140 feet depending on process group, with nearly all LWD supplied within the 100 foot of the stream bank (Murphy and Koski 1989; Martin et al. 1998). In addition, most other important functions, such as allochthonous input, shade, overland sediment trapping, occur within the SPTH (Murphy 1995).

Although most of the LWD (generally greater than 90 percent) recruited to stream channels would occur from the TTRA buffer, some reduction in LWD in stream channels could occur over time if harvest occurs in RMAs outside of the TTRA buffer. This has the greatest potential to affect LWD for FP and AF process groups due to the mobility of these channel types and possibilities of re-alignment within RMA harvested areas. Collins et al. (2011) noted that in floodplain channels, structure and maintenance is dependent on development of mature trees in the floodplain. Latterell and Naiman (2007) found in a floodplain river system in Washington that large wood was contributed from all across the floodplain width over time. Floodplains in some larger channels in the Tongass can be over 200 feet wide (Appendix D of the 2008 Forest Plan). This suggests that, over the long term, floodplain channel movement has the potential to result in wood sources entering from outside of a TTRA buffer. Removal of trees from the floodplain tends to destabilize the areas (Collins et al. 2011). Similar to the FP process group, the loss of large wood outside of the TTRA buffer could destabilize the areas and alter channel characteristics.

Riparian soils may be one of the more sensitive to ground-disturbing actions in the Tongass (USDA Forest Service 2015c). The harvesting methods within the RMAs associated with FP and AF process group areas are likely to include tractor logging (Landwehr et al. 2012). Soil disturbance would have local long-term effects on future development of large trees, as red alder dominate these disturbed areas inhibiting growth of large conifers, especially in the alluvial soils found in floodplain and alluvial fan channels (USDA Forest Service 2014d).

Future disturbance of similar areas would likely also be recolonized with red alder. The function of these areas is important to overall watershed condition.

In addition to the FP and AF process groups, should harvest occur in RMA buffers along channels associated with the HC process group, increased sediment to downstream MM, FP, and AF process group's may occur from upslope harvest and loss of bank stability as these streams typically have no TTRA buffers. For other riparian/wetland soil polygon areas, such as lakes, the RMA buffers supply some of the same functions as on streams (e.g. reducing sediment input, adding allochthonous input). These areas have no TTRA buffer, so RMA harvest could occur to the lake shoreline under Alternatives 2 and 5 which could result in increased sediment entry to lakes. Regardless of process group, because the RMAs are ecologically tailored to ensure the integrity of the stream channel, maintain supply of large wood, and protect other functions critical to soil, water, fish, and wildlife in Southeast Alaska (USDA Forest Service 2015c), any timber harvest or roads within the RMA have the potential to decrease the overall watershed condition.

The 2008 Forest Plan indicates that site-specific adjustments to the RMA Standards and Guidelines may be changed, but only if the adjustments will achieve channel process group objectives. A determination of whether the objectives can be maintained by modification of RMA buffers can only be made through a watershed analysis (see Forest Plan, Appendix C). For Alternatives 1, 3, and 4, no harvest is proposed within the RMA. For Alternatives 2 and 5, some timber harvest and road construction in young-growth RMA outside of TTRA buffers is proposed (see Table 3.4-9). The largest portion (approximately 49 percent for both Alternatives 2 and 5) of projected harvest of RMA would occur in the "other" category (i.e., riparian/wetland soil polygon), which includes likely wooded suitable wetland habitat not directly adjacent to any stream process group. However, a portion of RMA affected under these two alternatives would occur on some of the most sensitive and productive alluvial soil areas (i.e., floodplains and alluvial fans). The function of these areas in providing LWD supply to streams is important to maintaining stream channel processes, which would be reduced where timber harvest occurs. Although there is some uncertainty regarding the outcome of the proposed treatments in Alternatives 2 and 5, silvicultural treatments that defer late seral forest conditions of large, widely spaced conifers would not achieve the desired future condition of these riparian areas (USDA Forest Service 2015c). Although functions associated with floodplain and alluvial fan channels would be impacted where timber harvest occurs, the overall areas affected under Alternatives 2 and 5 (see Table 3.4-9) would be small relative to the portions of these floodplain and alluvial fan channel types available on the Forest. The effects associated with timber harvest in the RMA are quantified under the Water Quantity and Water Quality subsections above, with additional information provided in Table 3.4-9 and below.

No RMA harvest would occur and current Riparian Management objectives would be maintained as proposed under Alternatives 1, 3, and 4 (see Table 3.4-9). Alternatives 2 and 5 require that management in young-growth riparian areas accelerate POG characteristics to improve riparian function, but would allow some harvest in young-growth RMA outside of TTRA buffer areas (see Table 3.4-9). Alternative 5 would allow up to 10-acre maximum open cut areas and commercial thinning of up to 35 percent of the total stand acres, while Alternative 2 would allow only commercial thinning of up to 33 percent of the stand in these RMAs outside of TTRA buffers. Alternative 5 has the highest potential to reduce stream function in primarily FP and AF channels through group selection harvested areas plus commercial thinning where it occurs. Overall, the area harvested under Alternative 5 would be small, because this would only occur in development LUDs and temporarily within the Old-growth Habitat LUD, and planned selections of harvest in RMAs would have to meet stream process group objectives. The estimated overall area affected over a 15-year period, with no additional harvest occurring in the remainder of a 100-year projected harvest period, would be low (1,089 acres) under Alternative 5 (see Table 3.4-9).

While the estimates (see Table 3.4-9) suggest that overall harvest area in the RMA for Alternative 5 would be relatively small, if this harvest type were widespread it could have more pronounced effects on water quantity and quality, although there are no current plans for this to occur. As previously described, this could reduce wood supply and channel stability in primarily FP and AF channels by removing trees in the RMA outside of the TTRA buffers. Because these channels migrate, the associated process groups require expansive floodplain extents. If through migration these channels re-align into the group selection harvested areas (i.e., up to 10-acre clearings), the area would be set back from achieving its management objectives of meeting old-growth characteristics. Old-growth areas would supply the larger pieces of wood needed to develop “key pieces” for the formation of structural wood jams, and associated bars and large pool formation, all necessary for a functioning watershed condition in these systems. In addition to harvest-related effects, access to these areas would likely be through shovel logging that could cause additional impacts to these sensitive FP and AF areas. Although Alternative 5 has the potential to have more pronounced effects on water quantity and quality, it includes restrictions to only occur in the first 15 years and no more than 35 percent of the current stand. With these restrictions, the overall areas affected would be small relative to the portions of these process groups available in the Tongass.

Table 3.4-9
Riparian Management Area (RMA) Acres and Past and Future Young-Growth Harvest (see note) by Process Group by Alternative

	Process Group (acres)												
Total/Harvest Period	**AF**	**ES**	**FP**	**GO[1]**	**HC**	**LC**	**MC**	**MM**	**PA**	**UC**	**Lake[2]**	**Other[3]**	**Grand Total**
Total RMA	50,622	12,450	199,299	52,890	366,730	12,726	75,692	118,433	63,093	25	81,243	229,329	**1,262,531**
Harvest—1991-2015	359	0	328	7	2,611	16	150	501	60	1	19	975	**5,025**
Harvest—Pre TTRA	4,958	201	9,620	698	12,960	369	1,457	6,910	1,298	7	254	14,171	**52,904**
Total Past Harvest in RMAs[4]	5,317	201	9,948	705	15,571	385	1,607	7,411	1,358	8	273	15,145	**57,928**
Alternative 1 – Harvest	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Alternative 2 – Harvest (CT)[5]	1,504	37	3,317	134	6,968	3	51	1,077	21	1	230	12,688	**26,030**
Alternative 3 – Harvest	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Alternative 4 – Harvest	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Alternative 5 – Harvest (OC and CT)[6]	62	0	140	6	291	0	2	45	1	0	1	540	**1,089**

See Table 3.4-1 for process group definitions
Note that young-growth harvest is conducted on past harvest so no additional RMA is added to the total harvest area.
[1] All glacial outwash channel types included under the GO designation.
[2] Lake = RMA lake buffers
[3] "Other" includes riparian/wetland soil polygon designations adjacent to other stream RMAs.
[4] A total of 30,291 (52%) of the Grand Total past RMA harvest occurred in RMA areas outside of the TTRA buffers.
[5] Commercial thinning.
[6] Open cut (up to 10 acre openings) and commercial thinning, except no RMA harvest within 100-foot buffer around all lakes and a 200-foot no-cut beach buffer.

There would be some potential for reduced function in Alternative 2 through thinning due to potential loss of organic matter and LWD input, should channels move to areas of harvest before forest regrowth occurs. However, because RMA harvest would also occur in non-development LUDs, the area of RMA affected would be much larger (26,030 acres) under Alternative 2. This could result in a loss of LWD to primarily FP and AF channels over a large area, but with relatively low overall loss per acre because future growth may augment some of the loss, although ground disturbance, which could affect future tree large conifer tree development affecting LWD supply, may be substantial.

Although the overall RMA affected under Alternatives 2 and 5 would be small (see Table 3.4-9) relative to the portions on the Forest, a watershed analysis (as described in the Forest Plan Appendix C) would still be needed for implementing any alternative that proposed to enter the RMA. In addition, the application of BMPs found in the National Core BMP Technical Guide FS-990a (USDA Forest Service 2012b) and the Alaska Region Soil and Water Conservation Handbook, FSH 2509.22 for all alternatives combined with the Fish and Riparian Standards and Guidelines (see Chapters 4 and 5 of the Forest Plan) would minimize or prevent adverse effects on water quality from the limited amount of riparian area with forest clearing (only Alternatives 2 and 5) and road construction (all alternatives), yarding corridors, and stream road crossings, and from any non-commercial timber harvest that may occur.

Beach Fringe

Beach fringe harvest under Alternatives 2 through 5 may have an effect on water quantity and quality, and thereby overall watershed condition, due to proximity to the marine system and potential for nearshore benthic disturbance (see *Fish* section for details of biologic effects). Young-growth area beach fringe harvest has the potential to affect the nearshore marine system from the timber removal methods that may be employed. Some of the potential harvest areas would not be directly accessible by new or reconstructed roads, or be harvested by helicopter. The result would be that some harvest activity could occur directly from beach areas. This would be less for Alternative 5 than Alternative 2 because Alternative 5 would have a 200-foot no-cut beach buffer.

Harvest in the beach fringe may include shovel logging or A-frame yarding to or across the beach (see *Timber* section). This could include logging equipment directly traveling over intertidal areas, landing craft affecting these areas, and, in the case of floating or beached A-frame harvest, possible subtidal disturbance from anchors. These activities may cause increased local sediment runoff to the nearshore waters, which could exceed water quality criteria in local areas. The amount of harvest by alternative in the beach fringe is shown in Table 3.4-5. Generally, the greater the harvest, the higher the potential impact on water quantity and quality, although the type of harvest that is permitted would influence the level of impact to overall watershed condition.

As previously described, the effects from changes in water quantity and quality, and thereby watershed condition, in a particular subwatershed can only be estimated during project planning, after which point the rate of entry into subwatersheds and locations of proposed harvest units and roads would be analyzed. The actual effects on watershed condition can only be determined by site-specific monitoring. See the *Fish* section for overall alternative ranking of potential biological and fish effects.

Water Use

The Municipal Watershed LUD is applied to 45,236 acres in 11 watersheds serving the 9 incorporated cities and boroughs (Ketchikan, Petersburg, Sitka, Juneau, Wrangell, Kake, Klawock, Craig, and Hydaburg [see the Forest Plan, Chapter 3, Municipal Watershed]). All of the alternatives would include the same protections to these watersheds. Watersheds serving the Community Water System category and the other three water system categories would be managed under Forest-wide standards and guidelines (see Chapters 4 and 5 of the Forest Plan). None of the alternatives propose timber harvest in the Municipal Watershed LUD. While most of the public water systems across the Forest have LUD designations that do not allow timber harvest and road construction under any alternative, some watersheds and the associated stream network that supply water may have LUD designations that allow timber harvest. Effects on water supply in a particular watershed can only be estimated during project planning. In addition, prior to actions in any of these watersheds, the Forest Plan (Chapter 4, Soils and Water Standards) requires the Forest Service to conduct a watershed analysis and consult with the ADEC, as well as with owners and operators of public water systems, prior to authorizing management activities that may cause pollution.

Renewable Energy Development

All renewable energy development projects in Southeast Alaska have to meet detailed local, state, and, in most cases, federal laws, regulations, and requirements to be developed and operated. Additionally, the Tongass National Forest applies land use restrictions for energy development, which would remain in place under Alternative 1, but these restrictions would be removed under all other alternatives (Alternatives 2 through 5) and replaced by new Plan direction for Renewable Energy. The *Renewable Energy* sections supplies the details of the alternatives.

Renewable energy projects include a variety of ways to produce energy that include wind, solar, geothermal, tidal, wave, biomass, and hydroelectric. Most energy projects on the Forest are hydroelectric, supplying 96 percent of all energy in Southeast Alaska. Future plans of development are mostly hydroelectric (see *Renewable Energy* section for details of type and number).

The types of effects from renewable energy projects, including hydroelectric projects, on water and fish resources are discussed in more detail under the *Fish* section. In summary for hydroelectric projects, these types of projects can have effects on flow quantity and timing from water diversion and storage (e.g., lakes and reservoirs) and sediment from construction of roads and other facilities (e.g. dams, powerhouse, diversion structures). Furthermore, hydroelectric projects can have effects on water quality, such as temperature, dissolved oxygen, and nutrient levels, from water storage and diversion practices. In addition, the construction and maintenance of transmission lines for a project has the potential to reduce streamside vegetation from right-of-way clearing over streams (e.g., affecting local runoff and stream temperatures) and increase the miles of roads in watersheds (e.g., affecting runoff and sedimentation) (see *Fish* section for more details).

Although there is some potential for increasing the number or timing of projects and related effects from changes in the standards and guidelines (see Chapters 4 and 5 of the Forest Plan) over the current conditions (Alternative 1), the chance of this is low as projects are still likely to be built under the 2008 Forest Plan standard and guidelines. The largest effect from Alternatives 2 through 5 is in the permitting process for the developer; the process would likely be less burdensome and result in more rapid permitting for a site, but not a substantial increase in the number of sites developed. Regarding the current number of new projects, these are widely distributed across the Forest. The spread of these projects across the Forest would likely reduce cumulative effects of these actions on any specific watershed. Overall, Alternatives 2 through 5 would likely have little effect to water quantity, use, and quality on the Forest relative to current conditions (Alternative 1).

Cumulative Effects

One of the main cumulative factors affecting water quantity, quality, and use, in addition to actions taken on NFS lands, is ongoing and additional regional land development actions on non-NFS lands. These actions, in addition to the various effects of the considered alternatives, may have compounding effects on water resources. While BMPs applied on NFS lands would moderate these effects, some effects on water quantity, quality, and use may remain, and with the addition of other actions, may increase risk to water resources. Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

Factors associated with potentially adverse effects to water resources are timber harvest, roads, including culvert and bridge installation, and potential hazardous substance spills. While the main factor contributing toward potential adverse effects on water resources in and near the Tongass National Forest is potential future timber harvest-related activity, other expected future activities have the potential to contribute toward cumulative effects to water and watershed resources. As listed in the *Introduction* and Appendix C, these other potential contributing cumulative effects could include activities such as mining, transmission line interties, future transportation facilities, hydroelectric site developments, watershed restoration actions, and a variety of miscellaneous land development–related actions and natural conditions like windthrow and climate change.

Mining, which is occurring or may be developed at more than five locations on the Tongass, includes the development of roads, water use, and potential discharge of sediment and potentially hazardous substances like heavy metals to streams. Some transboundary mining issues, including at least three mines in Canada, could potentially affect water quality relative to potentially toxic substances, including possibly heavy metals, in transboundary waters. Transmission interties, like that proposed for Kake to Petersburg, can include the development of roads, culverts, and forest clearing along a linear route that could potentially influence sediment and temperature in streams. Transportation projects, primarily roads, are anticipated to be developed in several community areas; these would add to road density in watersheds that could have cumulative local affects in some areas. Approximately nine hydroelectric projects are proposed for future development (see Table 3.12b-3) and these projects can modify water flow in a subwatershed and potentially lead to the development of small reservoirs in stream habitat. Watershed restoration activities are occurring and will continue in the future based partly on the WCF rating of watershed conditions in 2011. Some of these restoration activities, which may include road maintenance and improvements, road closures, and/or stream habitat improvements (e.g., LWD additions, riparian plantings), could, in the short-term, add sediment to streams. In the long term, restoration activities could result in higher quality and function in watershed conditions by improving overall water quality. Climate change, which was incorporated in the preceding subsections, may contribute to varied watershed and water quantity and quality changes, including negative effects. Although these other potential contributing cumulative effects could contribute to lower water quality and watershed conditions in the Tongass cumulatively, these actions would occur in relatively limited areas and the permitting process would greatly restrict future effects from these activities and developments on water resources.

As a partial indicator of cumulative effects region-wide to water resources, the amount of timber harvest provides an indication of cumulative effects to water quantity, use, and quality because of potential effects on stream flows, sediment and stream detritus input, and flow patterns. Tree harvest areas in the Tongass National Forest are primarily characterized as POG vegetation regions. POG in 1954 accounted for about 35 percent of the land area within the Tongass National Forest boundary, which includes NFS lands as well as state and private lands. Therefore, land disturbance related to harvest is primarily limited to a small portion of the total land area. Non-POG areas include areas with small trees, muskeg, or wetlands; all regions where streams may be common; and ice fields and rocky mountainous areas where few streams may be present.

Table 3.4-10 indicates the cumulative portion of POG area that would be harvested within the Forest boundary (including all non-NFS lands) under each alternative, and the portion of all lands inside the Forest boundary that would potentially be disturbed by forest clearing. This latter calculation represents an index of overall watershed disturbance associated with vegetation removal by forest clearing and does not consider roads outside of harvest units, urban areas, etc., which are a minor portion of the total disturbance area.

Table 3.4-10
Percent of Original POG Remaining on All Lands within the Tongass Forest Boundary and Percent of All Lands inside the Boundary that are Not Directly Disturbed by Timber Harvest after Full Implementation of the Forest Plan (approximately 100+ years)[1]

Alternative	Percent of All Original POG Remaining [2]	Approximate Percent of All Lands Not Disturbed by Timber Harvest [3]
Existing	86%	95%
1	83%	94%
2	83%	94%
3	83%	94%
4	83%	94%
5	83%	94%

[1] Assumes full implementation of Forest Plan plus future non-NFS harvest for 100 years.
[2] Original POG equals about 35 percent of all land area (17,934,000 acres) of this region.
[3] Value represents the percent of all 17,934,000 acres inside the Tongass boundary (plus Annette Island) covering Biogeographic Provinces 1 through 21, that would be disturbed by timber harvest and is used as an index of overall watershed disturbance associated with timber harvest. It does not include the acreage of other forms of ground disturbance (e.g., roads, towns) beyond the harvest of POG.

Currently, most (86 percent) of the POG acreage within the Forest boundary has not been harvested. Considering all lands inside the Forest boundary, 95 percent of the total land base has not been harvested (Table 3.4-10). Alternative 1, including non-NFS harvest, would result in a reduction in POG area to 82 percent of the original acreage; 94 percent of all lands inside the Forest boundary would remain undisturbed by direct timber harvest. Alternatives 2 through 5 would also result in 83 percent of the POG remaining; 94 percent of all lands would remain undisturbed by direct timber harvest after 100 years of projected harvest. It is likely some local effects on water quantity and quality from all alternatives. On a Forest-wide basis, however, the overall effects would be very minor for all alternatives. As noted above for roads, lesser riparian protections on state and private lands would have a greater likelihood of causing adverse effects to water quantity and quality in watersheds on non-NFS lands, which could be compounded if NFS lands are harvested in the same watersheds. Potential cumulative effects of timber harvest, road construction, and other actions would be evaluated at the project-specific level in order to ensure that any adverse effects to water resources would be reduced, moderated, mitigated, or eliminated.

In addition to the amount of timber harvest as a partial indicator of cumulative effects region-wide to water resources, the amount of roads provides an indication of cumulative effects to water quantity, quality, watershed condition, and water use because of potential effects on stream flows, sediment and stream detritus input, and flow patterns. While the effects would vary with location and type of activity, the amount of road miles is a partial indicator of cumulative effects region-wide. Table 3.4-11 shows the change in road miles on a regional basis, including non-NFS roads. Currently, there are about 5,093 total road miles (including all authorized and non-system roads) on NFS lands and an additional 4,258 miles on adjacent non-NFS lands (Table 3.4-11). Many of these roads are associated with non-NFS timber harvest activities. In general, timber harvest activities on non-NFS areas are not as protective of stream riparian areas. Reduced protection of these areas has a greater risk of increasing impacts to water quality and resident fish species. Therefore, roads constructed on non-NFS lands may be associated with greater water quantity and quality impacts per mile of road than on NFS lands. Generally, however, the amount of roads (i.e., existing, new, and reconstructed) may be an indicator of cumulative effects on water resources of the Tongass National Forest and adjacent areas; therefore, the cumulative effects to water resources would generally be proportional to overall changes in road miles.

Table 3.4-11
Estimated Number of Road Miles on All Lands within the Tongass Forest Boundary for Each Alternative after Full Implementation of the Forest Plan for approximately 100 years[1]

Road Categories	Existing	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Total New Miles on NFS Lands	0	944	1,056	1,020	871	994
Total Miles on NFS Lands	5,093	6,036	6,148	6,113	5,964	6,086
Total Miles on Non-NFS Lands[2]	4,258	6,593	6,593	6,593	6,593	6,593
Total Miles on All Lands	**9,351**	**12,629**	**12,741**	**12,705**	**12,556**	**12,679**

[1] Assumes full implementation of Forest Plan plus future non-NFS harvest.
[2] Assumes an increase of 2,335 road miles on non-NFS lands by state, private, and municipalities over 100 years. Annette Island is included because it is surrounded by areas within the Forest boundary.

Road development on NFS lands under Alternative 4 would have the lowest contribution to cumulative effects by increasing total road miles on NFS lands by about 16 percent over existing conditions after 100 years; however, road construction on both NFS and non-NFS lands together would result in a total increase in road miles of about 34 percent because non-NFS road development would likely increase substantially. Alternative 2 would have the largest cumulative effect when including all roads, resulting in an increase in cumulative road miles equal to about 36 percent over existing conditions. The other alternatives (1, 3, and 5) would result in a cumulative increase in road miles equal to about 35 to 36 percent over existing conditions, when both NFS and non-NFS roads are included.

In addition to total road miles, the greater the density of roads in a subwatershed, the greater risk there is water quantity, quality, and use. As previously described, "properly functioning" watersheds are defined as 1 mile per square mile, with increased risk to watershed condition as road densities increase beyond this value. The average road densities by alternative and for the region are shown in Table 3.4-12. For the purposes of this cumulative effects evaluation, an increase in road miles on non-NFS lands for the life of the project (100+ years) was assumed. The average road density on non-NFS lands is much higher than on NFS lands. This higher average density is partly the result of the high number of road miles in city areas, as well as concentrated timber harvest areas. Even though the amount of non-NFS land area is relatively low, high road density on these lands results in the overall average densities increasing sharply relative to NFS lands. Even with these increases, overall averages remain relatively low and consistent for all alternatives at 0.45 mile per square mile.

Table 3.4-12
Estimated Average Total Road Density on Tongass NFS Lands and Non-NFS Lands within the Tongass National Forest Boundary by Alternative over 100+ years[1]

Alternative	Road Density as Miles/Square Mile Road Density on NFS Lands	 Road Density on Non-NFS Lands[2]	 Total Road Density All Lands
Existing	0.20	2.29	0.33
Alternative 1	0.23	3.55	0.45
Alternative 2	0.24	3.55	0.45
Alternative 3	0.23	3.55	0.45
Alternative 4	0.23	3.55	0.45
Alternative 5	0.23	3.55	0.45

[1] Assumes full implementation of Forest Plan at PTSQ levels plus future non-NFS harvest. Includes adjusted roads miles estimated to be needed to harvest all scheduled timber in the alternative. Annette Island is included because it is surrounded by areas within the Forest boundary.). Annette Island is included because it is surrounded by areas within the Forest boundary.

[2] Assumes an estimated the increase in non-NFS road miles within the Forest boundary from 4,258 miles at present to 6,593 after 100 years.

Although overall averages remain relatively low for any alternative, there are watersheds that have higher road densities that are increased by the addition of roads from the alternatives (Table 3.4-13). Currently, most (66.6 percent) of the watersheds on NFS lands have no roads and only just over 10 percent have road densities exceeding 1 mile per square mile. The inclusion of non-NFS lands reduces the percentage of watersheds with no roads to 60.2 percent and increases the portion of watersheds exceeding 1 mile per square mile by approximately 15.4 percent. Under Alternative 3 for all lands combined, the percentage of watersheds exceeding 1 mile per square mile would increase by 20 percent after 100 years. In contrast, under Alternatives 1, 2, 4, and 5, the percentage of watersheds exceeding 1 mile per square mile would increase between 19.6 and 20.2 percent.

Table 3.4-13
Estimated Road Miles and Percent of Watersheds in Road Density Categories on NFS Lands and on All Lands Combined within the Tongass National Forest Boundary by Alternative after 100+ years of Full Implementation[1]

Road Density Categories[2]	Alternative Existing	 1	 2	 3	 4	 5
Road Miles Per Sq. Mi.	**NFS Lands**	**NFS Lands**	**NFS Lands**	**NFS Lands**	**NFS Lands**	**NFS Lands**
0	66.6%	57.1%	54.6%	56.4%	62.4%	60.8%
>0 - <1.0	23.9%	32.4%	34.5%	32.5%	27.0%	27.9%
1.0 - 2.4	8.4%	8.2%	8.4%	8.6%	8.2%	8.6%
>2.4 - 3.0	0.8%	1.3%	1.4%	1.5%	1.5%	1.5%
>3.0	0.3%	1.1%	1.1%	1.0%	1.0%	1.1%
New Road Construction	-	944	1,056	1,020	871	994
Construction on Decom. Roads & Reconstruction	**-**	1,315	1,791	1,695	1,345	1,585
Total Miles (after 100 years)	**5,093**	**6,036**	**6,148**	**6,113**	**5,964**	**6,086**

Table 3.4-13 (continued)
Estimated Road Miles and Percent of Watersheds in Road Density Categories on NFS Lands and on All Lands Combined within the Tongass National Forest Boundary by Alternative after 100+ years of Full Implementation[1]

Road Density Categories[2]	Alternative					
	Existing	**1**	**2**	**3**	**4**	**5**
Road Miles Per Sq. Mi.	All Lands	All Lands	All Lands	All Lands	All Lands	All Lands
0	60.2%	50.5%	49.1%	48.8%	51.5%	51.0%
>0 - <1.0	24.5%	29.8%	30.9%	31.0%	28.9%	29.2%
1.0 - 2.4	12.8%	13.7%	14.1%	14.3%	13.6%	13.8%
>2.4 - 3.0	1.6%	3.0%	2.9%	2.9%	3.1%	3.0%
>3.0	1.0%	2.9%	3.0%	3.0%	2.9%	3.1%
New Miles Constructed	-	3,278	3,390	3,335	3,206	3,328
Total Miles	**9,351**	**12,629**	**12,741**	**12,705**	**12,556**	**12,679**

[1] Assumes full implementation of Forest Plan at PTSQ levels plus future non-NFS harvest for 100+ years. Estimated the increase in non-NFS road miles within the Forest boundary from 4,258 miles at present to 6,593 after 100+ years. Annette Island is included as a VCU because it is surrounded by areas within the Forest boundary.
[2] For NFS lands, percentages are based on 927, sixth-field watersheds that contain at least 100 acres of NFS lands. For all lands, percentages are based on all 932, 6th field watersheds inside the Forest boundary, including Annette Island.

Climate Change

Climate change has the potential to affect water quantity and quality on the Tongass National Forest. Several modeled results presented in recent literature demonstrate that precipitation and air temperatures in Southeast Alaska and the Tongass National Forest will increase this century (EcoAdapt 2014; Shanley et al. 2015), although the degree to which changes occur vary substantially between areas across the Forest. In general, increases in air temperature are expected in the winter months with increases in precipitation expected in the fall and winter, with much of the precipitation occurring as rain instead of snow (EcoAdapt 2014). The warmer air temperatures would likely result in much of the precipitation occurring as rain instead of snow and contribute to the melting of glaciers, higher peak flows in the fall and winter in most streams other than glacial-fed streams, and lower summer flows primarily in snow-melt and rain dominated watersheds (Shanley and Albert 2014; Shanley et al. 2015). In addition, the warmer air temperatures may result in increased stream temperatures, but the degree to which increases would occur depend greatly on local factors (e.g., glacial systems, groundwater inputs, presence of lakes and ponds, and stream shading) and any potential increase may be lessened by the potential increases in rainfall occurring in the summer and fall (EcoAdapt 2014).

Southeast Alaska is characterized by high rainfall, so small reductions in precipitation have limited potential to significantly reduce stream flows. Because Southeast Alaska is dominated by high rainfall, increased precipitation as rain instead of snow in the fall and winter has the potential to increase peak flows in most streams and alter the overall timing and frequency of events in a given watershed. Although increased peak flows and altered timing and frequency are likely, the degree to which water quantity in a given watershed is affected by climate change will be based primarily on local factors. Whether water quantity will be affected by the combination of climate change and the cumulative effects associated with timber harvest and road construction between each alternative is uncertain; however, because the cumulative effects do not differ substantially amongst the alternatives, changes in water quantity Forest-wide will likely be dictated more by climate change locally than by the alternatives. In addition, given the short-term that the Forest Plan will be in place before being modified again (likely 10 to 15 years), large magnitude changes in water quantity are highly unlikely.

Streams on the Tongass National Forest, both in harvested and unharvested watersheds, have occasionally been documented with brief periods of temperature criteria exceedances. Theoretically, if air temperature changes were large enough, these exceedances could become more frequent. Currently, there are no 303(d) streams listed for temperature exceedance. Whether temperature changes associated with climate change, even when combined with the cumulative effects associated with forest clearing and road construction between each alternative, would be large enough to cause changes to this level are unknown. However, in the short-term that the Forest Plan will be in place before being modified again (likely 10 to 15 years), large magnitude changes in stream temperature are highly unlikely.

In summary, there is general agreement that the climate is warming, precipitation will increase, flows will increase in the fall and winter, but decrease in the summer in snow- and rain-dominated watersheds. However, there is considerable uncertainty surrounding specific predictions of when and the magnitude, and even more uncertainty regarding the effect of these changes on water quantity and quality.

Wetlands

Affected Environment

Definition and Regulatory Aspects

The U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) jointly define wetlands as "those areas that are inundated or saturated by surface or groundwater with a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Wetlands are considered to be important for the physical, biological, chemical, social and/or economic functions they provide. These functions include flood flow moderation, groundwater recharge and discharge, nutrient cycling, wildlife and fish habitat, and water quality protection.

The Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2; USACE 2007), collectively, "The Manual," provide the standards for determining areas of wetlands and deepwater habitats. Areas are defined as wetlands when soil, hydrology, and vegetation all meet the technical criteria defined in The Manual for identifying wetlands.

For federal regulatory purposes, wetlands are considered a subclass of Special Aquatic Sites (40 Code of Federal Regulations [CFR] Section 230.3) and most, but not all wetlands, have been deemed Waters of the United States (33 CFR 328.3). All waters of the United States are subject to regulation through the Clean Water Act by the Corps and EPA. Sections 404 and 401 of the Clean Water Act were created specifically with the intent "to restore and maintain the chemical, physical, and biological integrity of our Nation's waters." Executive Order 11990, as amended (42 United States Code 4321 et. seq.), requires federal agencies "to avoid...adverse impacts associated with the destruction or modification of wetlands...wherever there is a practicable alternative" and to "include all practicable measures to minimize harm to wetlands." Further, the agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibilities.

Wetland Mapping, Classification, and Distribution

On the Tongass, wetlands may be found from sea level to alpine elevations, and in marine, estuarine and riparian settings. The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) has mapped wetlands on the Tongass National Forest based on aerial photo interpretation and limited ground verification. The NWI classifies wetland types using a classification system (described below), developed by Cowardin et al. (1979).

Palustrine wetlands include the vegetated wetlands traditionally referred to as marshes, swamps, bogs, fens, and prairies. They include all nontidal wetlands dominated by trees, shrubs, persistent emergent plants, mosses or lichens, and all such wetlands where salinity due to ocean-derived salts is below 0.5 percent. Palustrine wetland classes on the Tongass include emergent wetlands (including peatlands), scrub-shrub wetlands, forested wetlands, and other palustrine classes. Classes are described in the following paragraphs.

Forested class. Over half (52 percent) of the NWI-mapped wetland acres on the Tongass are forested wetlands. Forested wetlands are characterized by woody vegetation greater than 20 feet tall. Vegetation ranges from scrubby mixed conifer forests to mixed conifer, western, or mountain hemlock stands. Shrubs and forbs dominate the understory.

Emergent class. Approximately 25 percent of the NWI-mapped wetland acres on the Tongass are classified as emergent. The emergent class is characterized by erect, rooted herbaceous plants, and mosses and lichens. Peatlands (muskegs) are included in the emergent class of wetland. In Southeast Alaska, all relatively open bogs that have a groundcover high in sphagnum mosses and/or sedges are called "muskegs," and are a type of peatland.

Scrub-Shrub class. Approximately 13 percent of the NWI-mapped wetland acres on the Tongass are scrub-shrub. Scrub-shrub wetlands include wetlands dominated by woody vegetation less than 20 feet tall. This class is the most vegetatively varied wetland class in Southeast Alaska. Plant species may include true shrubs, young trees, and tree and/or shrubs that are small or stunted because of environmental conditions. Scrub-shrub wetlands are associated with three broad wetland plant communities: scrub-shrub alder/willow, scrub-shrub evergreen/emergent, and forested scrub-shrub evergreen/emergent.

Other classes. Approximately 1 percent of the NWI-mapped wetland acres on the Tongass consist of other palustrine classes including aquatic bed, open water, unconsolidated bottom, and unconsolidated shore. Aquatic bed wetlands include areas dominated by floating or submerged vegetation (i.e., plants that grow primarily on or below the surface of the water for most of the growing season in most years). Open water includes small bodies of water such as ponds. Both unconsolidated bottom and unconsolidated shore include wetlands with varying substrates, but both types have less than 30 percent cover of vegetation.

Lacustrine wetlands include all permanently flooded lakes, reservoirs, and tidal lakes with ocean-derived salinities below 0.5 parts per thousand, larger than 20 acres. Approximately 4 percent of the NWI-mapped wetland acres on the Tongass are lacustrine.

Estuarine wetland system. Estuarine wetlands are those areas that are predominantly intertidal, and are those parts of the rivers or streams or other bodies of water having an unimpaired connection with the open sea, where the sea water is diluted with freshwater derived from land drainage. Approximately 2 percent of the NWI-mapped wetland acres on the Tongass are estuarine.

Riverine wetland system. The riverine wetland system includes all channel-contained streams and rivers. These areas are bounded by uplands, channel banks, or palustrine wetlands dominated by trees, shrubs, emergent mosses or lichens. In braided streams, the riverine wetland system is bounded by the banks forming the outer limits of the depression within which the braiding occurs. Approximately 1 percent of the NWI-mapped wetland acres on the Tongass are riverine.

Table 3.5-1
Mapped Acres of Wetlands on the Tongass National Forest by Wetland System and Class

Wetland Systems	Wetland Classes	Acres
Palustrine	Forested	2,114,432
	Emergent (including peatlands/muskegs)	1,015,739
	Scrub-shrub	535,922
	Palustrine - other	51,465
Lacustrine		187,224
Estuarine		82,759
Riverine		59,779
Total Wetlands		**4,047,320**

Source: National Wetland Inventory Database, USFWS 2006a, and Tongass National Forest GIS database.

Past Wetland Impacts

Due to the prevalence of wetlands in Southeast Alaska, total avoidance of wetlands during timber harvest, road construction, and other activities (e.g., utility line projects, mining) on the Tongass has not been possible. Past timber harvest has impacted approximately 35,156 acres of wetlands (Table 3.5-2). Additionally, there are approximately 1,193 miles of roads within wetlands on the Tongass, including non-system roads and closed roads (Table 3.5-2). This represents 23 percent of the 5,155 total road miles on the Tongass. The majority of these roads were constructed as part of forestry activities and the majority of these roads (877 miles) have impacted forested wetlands (Table 3.5-2). Previously logged forested wetlands are in the process of regenerating and support young forests. Past road construction; however, in wetlands is considered a permanent wetland impact.

Table 3.5-2
Past Acres of Timber Harvest and Existing Miles of Roads in Wetlands on the Tongass

	Palustrine Wetlands							
	Forested	Scrub-Shrub	Emergent (including peatlands / muskegs)	Other[1]	Lacustrine Wetlands	Estuarine/Marine Wetlands	Riverine Wetlands	Total Wetlands[2]
Timber Harvest (Acres)[3]	27,188	2,552	3,714	240	70	1,074	415	**35,253**
Existing Roads (Miles)	877	62	225	5	1	12	11	**1,193**

[1] "Other" includes aquatic bed, moss-lichen, unconsolidated bottom, and unconsolidated shore.
[2] Totals may not appear to sum correctly due to rounding.
[3] Acres are based on NWI wetland data superimposed on harvest unit data; this results in numerous small inclusions of non-forested wetland types being included in the harvest units. These non-forested wetland areas are avoided during harvest.
Source: NWI database (USFWS 2006a) and Tongass National Forest GIS database.

Environmental Consequences

Direct and Indirect Effects

The physical, biological, and chemical integrity of wetlands on the Tongass has been, and is currently, affected primarily through timber harvest operations, which includes the construction and maintenance of roads, landings, stream crossing structures, marine access points, and log transfer facilities (LTFs). The magnitude of timber harvest-related effects to wetlands depends, in part, on the intensity, location, and duration of the timber harvest activity or road construction. In addition to timber harvest and road construction, development of renewable energy (e.g., hydroelectric power) projects have impacted, and will continue to impact, wetlands on the Tongass.

Limited research has been conducted on the effects of timber harvest, road construction, or renewable energy and utility line projects on wetlands in Southeast Alaska. Research on the effects of timber harvest on wetland systems have been primarily focused on regeneration of trees (Julin and D'Amore 2003; Duncan 2002). Studies on road construction on wetland sites have been focused on the effects to hydrology, and only a few wetland sites were studied (Glaser 1999; Kahklen and Moll 1999; McGee 2000).

Silvicultural operations, such as harvesting trees, are generally exempt from Corps' permitting requirements (33 CFR 323.4). The construction or maintenance of forest roads in support of silvicultural practices, and temporary roads for moving mining equipment, are also generally covered under this exemption for the discharge of dredged or fill material into waters of the United States. This exemption is contingent on construction and maintenance being conducted in accordance with the Corps' Best Management Practices (BMPs) as stated in 33 CFR 323.4(a)(6). These practices have been incorporated into BMP 12.5 of the Alaska Region's BMP Handbook (Forest Service Handbook 2509.22). Construction of roads not associated with silvicultural operations is not exempt and requires a Section 404 permit.

Under each of the alternatives, project-level analysis and planning would be used to avoid construction in wetlands, and would provide site-specific plans to minimize effects. Additionally, Forest-wide standards and guidelines (including BMPs) are applied to activities in and around wetlands. All Alternatives would follow the 2008 Tongass Land and Resource Management Plan (Forest Plan) standards and guidelines for wetlands which provide direction to avoid development activities in wetlands to the extent feasible, minimize effects on wetlands, and locate and design roads to minimize effects on wetlands. However, under Alternatives 2 through 5, additional guidelines specific to young-growth timber harvest, as well as development of renewable energy projects are proposed (see Chapter 5). These objectives, standards, and guidelines would allow and/or facilitate young-growth timber harvest and renewable energy development in areas that currently would restrict these areas (e.g., beach and estuary fringe). Effects to wetlands from the Alternatives are discussed in more detail below.

Effects Common to All Alternatives

Timber Harvest

Timber harvesting on wetland sites would have direct effects on the wetlands themselves and indirect effects on adjacent or nearby wetlands. The effects would potentially include altering hydrology, changing nutrient pathways, removal of nutrients, increased sedimentation (which can diminish water quality), increased soil temperature, alteration in water yield and stream flow patterns, change of plant species composition and growth, and reductions in available wildlife habitat.

Removal of the forest canopy through timber harvest can increase the amount of precipitation reaching the ground surface and lower evapotranspiration rates, which can lead to an increase in soil moisture and slower growth in seedlings and saplings (USDA Forest Service 2013). Additionally, removal of vegetation also allows precipitation to reach the soil surface faster, resulting in soil saturation occurring more rapidly, which can result in accumulation of water on the surface of the wetland (Sheldon et al. 2005). Effects on soil moisture within harvested wetlands are less in partially harvested stands.

Forested wetlands in Southeast Alaska have been found to successfully regenerate and grow into dense, differentiated stands after clearcutting (Julin and D'Amore 2003; Duncan 2002). According to a study on regeneration of forested wetlands, tree growth was slow but consistent on histosols (wet, organic soils), and exceeded the minimum USDA Forest Service volume-production standard for commercial timberland (Julin and D'Amore 2003). Revegetation of forested wetland sites is expected to occur in the same timeframe as other forested sites. Site quality on wetland soils; however, may be lower than on sites with better drainage, and may require additional time for trees to reach merchantable size on wetlands compared to drier sites.

Although timber harvest can result in a short-term reduction in hydrologic and biogeochemical wetland functions, these functions begin to return as soon as there is tree revegetation. The habitat functions provided by forest areas may require more time and forest regrowth to return. Some of the habitat functions are dependent on, or related to, characteristics of the old-growth ecosystem. Habitat values for many species using forested habitat are discussed in the *Wildlife* section of this chapter.

Road Construction and Reconstruction

Construction of roads within wetlands permanently removes the wetland area and wetland functions under the roadbed itself. Within the disturbed soil corridor wetland soils are excavated, buried, and/or compacted and water movement over and through soils within the disturbed soil corridor is altered (Landwehr 2011). Constructing roads across wetlands can also affect hydrologic connectivity across the wetland due to road ditches or road fills (USDA Forest Service 2013). Additionally, crossing wetlands with roads without adequate provision for cross-drainage could lead to sedimentation from road construction or changes in hydrologic patterns.

In deep peat wetlands, road construction can crush "soil pipes" (subsurface flow paths) that allow the wetland to process extra water without surface erosion. This can result in saturation of the site and increased water on the surface of the wetland (Landwehr 2011). It may take many years, up to 30 years, for the resulting hydrologic and vegetation changes to become evident (Holden et al. as cited in Landwehr 2011). Road construction can also directly impact wetland vegetation through the removal of vegetation within the road clearing and grubbing limits and indirectly impact wetland vegetation as a result of changes in soil hydrology adjacent to road clearing limits or grubbing and fill areas (Landwehr 2007).

As stated above, there are approximately 1,193 existing road miles on wetlands on the Tongass. There has been limited research on the effects of forestry roads constructed in the past on wetlands or uplands in the Tongass National Forest. The results of the wetland and upland studies on the Tongass suggest that the hydrologic effects of roads remain within a few meters of the road (Glaser 1999; Kahklen and Moll 1999; McGee 2000). In Southeast Alaska, this limited hydrologic effect appears to be primarily due to the low hydraulic conductivity of peat wetlands and relatively high rainfall through the year (Landwehr 2011). Studies conducted in other areas with similar climates (cool, moist, and year-round precipitation) have found similar results. In northern England, researchers studied the effects of ditching on peatlands and found that the measurable effects of ditches on peatland hydrology were limited to less than 3 meters from the ditches (Stewart and Lance 1991; Coulson et al. 1990). Data collected during wetland implementation and effectiveness monitoring on the Tongass have indicated that the impacts to wetland vegetation from road construction is also limited, typically to less than 5 meters beyond the physically disturbed soil corridor (Landwehr 2011).

Monitoring was conducted on the Tongass in 2006, 2008, and 2011 to document whether BMPs have been implemented during road construction activities on the Tongass and whether these BMPs were effective at minimizing or avoiding impacts to wetlands (Landwehr 2007, 2008b, and 2011). The most recent 2011 monitoring assessment indicates that wetlands were avoided to the extent practicable while meeting project goals and objectives and impacts to wetlands were minimized (Landwehr 2011).

Reconstruction of a road for timber harvest maintains the original investment and makes it suitable and safe for the intended use. Reconstruction involves rehabilitation of the original roadbed and can include cleaning ditches, replacing drainage structures, reinstalling bridges, and grading and shaping. Generally, reconstruction of existing roadbeds for timber harvest would not add impermeable surface to wetlands. However, some reconstruction can include upgrading a road and widening the roadbed. Widening an existing roadbed in wetlands adds to the impermeable surface and increases the total effects to wetlands.

Some road reconstruction activities, such as replacing drainage structures or cleaning road ditches, have potential to affect wetland hydrology. These activities may have a positive or negative effect on wetland hydrology depending on the condition of the existing road in the wetland. Road maintenance can include reconditioning the original road template, grading the road surface, cleaning roadside ditches, and removing vegetation that may encroach upon the road or block vision. In general, this would have no effect, or it could improve wetland hydrology in areas where drainage has become blocked.

Renewable Energy Development

In addition to timber harvest and road construction, wetlands on the Tongass would also be impacted by development of renewable energy sites (e.g., hydroelectric) under each of the alternatives. There are 11 renewable energy projects in Southeast Alaska that are currently actively being proposed (see *Renewable Energy* section). Six of these projects are hydroelectric projects, three are non-FERC hydroelectric projects, one is a geothermal project, and one is a wave energy project. All 11 active projects are either on or considered likely to affect National Forest System (NFS) lands. Additionally, many of the proposed projects include associated transmission lines and in some cases, access roads on NFS lands.

Hydroelectric power projects can be either a reservoir or “run-of-the river” system. For reservoir projects, a dam is constructed across the entire stream and a reservoir is created behind the dam. For run-of-the river (or streaming) projects, either a diversion system (also called a diversion dam) diverts a portion of the stream or river through the hydroelectric turbines, or a relatively small impoundment with limited storage is created by a dam, known as pondage. Run-of-the river hydroelectric power projects may divert flow which could result in a reduction in stream water flow, or they could rely on an upstream larger reservoir or reservoirs. Construction of dams may involve impoundment of stream flow and creation of ponds or reservoirs. These ponds or reservoirs could flood adjacent wetlands, if present, and wetland resources could be permanently and/or seasonally lost due to inundation. Over time, similar wetland communities may develop adjacent to the new reservoir margins depending on steepness of the adjacent slope. Rising and/or fluctuating reservoir levels due to operation of the hydroelectric power facility could alter hydrology and wetland functions of non-inundated adjacent wetlands and indirectly alter the nature, composition, and stability of the adjacent wetland vegetation. Alteration of species composition and hydrologic regimes in these wetlands could also result in the loss or modification of wetland habitat. Although the impacts would likely be less, diversion of stream flow for run-of-the river hydroelectric projects could also affect wetlands adjacent to the riverine system where flow is diverted. Wetland hydrology and, in turn, wetland vegetation could be affected by run-of-the river hydroelectric projects depending on the timing and magnitude of stream flow being diverted, as well as the length of the diversion.

In addition to creation of a reservoir or diversion of stream flow, facilities and activities that could directly or indirectly affect wetlands, depending on the project, include construction and operation of a dam and/or diversion dams, intake structures, power plants (powerhouse), surge tanks, pipeline (penstock), access spur roads, and temporary staging areas. Impacts to wetlands from construction and operation of hydroelectric projects could include temporary and permanent loss of wetlands, vegetation removal, soil disturbance, and hydrologic changes. In addition to the permanent loss of wetlands, introduction of fill material for construction of permanent facilities could affect surface or subsurface hydrology.

Impacts to wetlands from utility line construction and operation could result from structure installation, construction of new access roads and access spur roads, reconstruction of existing access roads, construction of helicopter pads, and/or right-of-way clearing and maintenance. Impacts to wetlands from these activities include temporary or permanent fill of wetlands, soil disturbance, and vegetation clearing. Effects to wetlands from access and spur roads would be similar to those described for road construction above.

Right-of-way clearing for utility lines would primarily affect forested wetlands. The effects of right-of-way clearing on wetlands would be similar to effects resulting from timber harvesting as described above. Where removed for construction, shrubs and trees would be expected to quickly revegetate the right-of-way allowing soil moisture levels and hydrology to partially return to normal. However, unlike timber harvest, future vegetation maintenance would prevent trees from growing to maturity in areas along the right-of-way needed for maintenance of the utility line. This vegetation maintenance might not convert wetlands to uplands; however, it could convert forested wetlands to shrub or emergent wetlands.

Renewable energy sites, under all alternatives, would be subject to analysis under the National Environmental Policy Act (NEPA) and may require a Section 404 permit. Additionally, mitigation measures to reduce impacts to wetlands would be implemented. Mitigation measures for hydroelectric power projects may include:

- Siting project facilities (including utility lines) to avoid wetlands to the extent possible;
- Ensuring project design minimizes the amount of wetland fill required to the extent practicable;
- Revegetating temporarily disturbed areas and slopes subject to erosion to minimize erosion and sedimentation;
- Implementing sediment prevention measures;
- Stockpiling materials in upland areas; and
- Implementation of BMPs and Forest Service Standards and Guidelines.

Effects Specific to Each Alternative

The difference between alternatives on the effects to wetlands generally falls within three categories: 1) short-term or long-term effects due to timber harvest, 2) loss of wetland acres and function due to road construction, and/or 3) short-term or long-term effects and/or loss of wetland acres from construction and operation of renewable energy sites. The effects to wetlands from these activities under each alternative are discussed below.

Timber Harvest and Road Construction

Acres of timber harvest and miles of road construction in wetlands can be used to provide comparisons between alternatives. However, actual acres of harvest in wetlands are likely to be lower, particularly in scrub-shrub and emergent wetlands, when acres are dropped in units with poor timber volume. Miles of road would likely be less than shown in this analysis because road layout for individual projects would avoid wetlands to the extent feasible, as required in the Forest-wide standards and guidelines.

Alternative 1, the No-Action Alternative, would follow the 2008 Forest Plan which includes standards and guidelines to protect beach and estuarine, riverine, and lacustrine areas. Under the 2008 Forest Plan, the beach and estuary fringe, an area of 1,000 feet slope distance around all identified estuaries and from all saltwater shorelines, is classified as unsuitable for timber activities and roads are discouraged. Additionally, the standards and guidelines include riparian area protection. Riparian area protection varies depending on the classification of the stream and include restrictions on programmed timber harvest in riparian management areas (RMAs) and within 100 feet of Class I fish-bearing streams as well as Class II streams that flow into Class I streams. These standards and guidelines would provide further protection for wetlands that occur in estuarine, riparian, and lacustrine areas under Alternative 1.

Alternatives 2 through 5 would allow for young-growth timber harvest in the beach and estuary fringe (Table 3.5-3). Alternative 2 would allow young-growth clearcut timber harvest in the beach and estuary fringe for 15 years; thereafter, timber harvest would be restricted to commercial thin harvest in the beach and estuarine fringe. Under Alternatives 3 and 4, young-growth commercial thin harvest would be allowed in beach and estuary fringe and under Alternative 5, young-growth group selection harvest, with the size of harvest openings limited to less than 10 acres, would be allowed within beach and estuary fringe areas. However, under Alternative 5, young-growth harvest is not allowed within a 200-foot buffer area extending from the shore.

Young-growth timber harvest would also be allowed in RMAs under Alternatives 2 and 5. Alternative 2 would allow young-growth commercial thin harvest and Alternative 5 would allow group selection harvest in RMAs but would restrict harvest openings to less than 10 acres and limited harvest to one entry. Commercial young-growth timber harvest would not be allowed within RMAs under Alternatives 1, 3, and 4. Thus, Alternatives 2 and 5 do not provide the same level of protection for wetlands in beach, estuarine and riparian areas as Alternatives 1, 3, and 4.

Table 3.5-3
Alternatives that Allow for Harvest in Beach and Estuary Fringe and RMAs

Conservation Strategy Component	Harvest Allowed (Yes/No)?				
	Alt 1	Alt 2[1]	Alt 3[2]	Alt 4[3]	Alt 5[4]
Harvest in Beach Buffer	No	Yes	Yes	Yes	Yes
Harvest in RMA	No	Yes	No	No	Yes

[1] Alt 2 Prescriptions: Young Growth - Clearcutting is permitted in Beach Buffer for first 15 years; thereafter, only Commercial Thinning is permitted. Only Commercial Thinning is permitted in RMAs.
[2] Alt 3 Prescriptions: Young Growth - Only Commercial Thinning is permitted in Beach Fringe.
[3] Alt 4 Prescriptions: Young Growth - Only Commercial Thinning is permitted in Beach Fringe.
[4] Alt 5 Prescriptions: Young Growth - Group Selection and Commercial Thinning are permitted in Beach Buffers and RMAs subject to a one time entry limitation; thereafter, no harvest is permitted; Harvest openings would be restricted to less than 10 acres in RMAs. Harvest in the beach fringe must leave a 200 foot buffer along the seaward edge.

The alternatives also differ in the maximum acres of timber harvest and miles of road construction that would potentially occur in wetlands. Table 3.5-4 displays the proposed maximum acres of young-growth and old-growth timber harvest within mapped wetlands under the proposed alternatives.

Timber harvest activities would impact the fewest acres of wetlands under Alternative 4 (maximum harvest of 31,291 acres over 100+ years); whereas, timber harvest activities under Alternative 2 would have the greatest impact on wetlands (maximum harvest of 36,625 acres over 100+ years). However, old-growth harvest within wetlands under Alternative 2 would be lower (9,200 acres) than under any of the other alternatives. Alternative 1 would conduct harvest activities on a maximum of 34,416 acres of wetlands, less than Alternatives 2, 3, and 5; however, it would result in the greatest acres of old-growth harvest (17,672 acres) of all the alternatives. Alternatives 3 and 5 would conduct harvest activities on a maximum of 35,805 acres and 33,815 acres of wetlands, respectively (Table 3.5-4).

Over time, Alternative 2 would have a higher risk of direct and indirect effects to wetlands due to timber harvest activities than the other alternatives. However, Alternative 1 would result in the greatest acres of old-growth harvest in wetlands than the other alternatives. Return to pre-harvest conditions following old-growth timber harvest in wetlands would take longer than a return to pre-harvest conditions following young-growth harvest within wetlands. Alternative 4, which would result in the lowest total maximum acres of harvest in wetlands, would have the lowest overall risk of effects to wetlands from timber harvest activities.

Table 3.5-4
Maximum Harvest Area in Mapped Wetlands by Alternative after 100+ Years of Full Implementation[1]

		Palustrine Wetlands							
Alternative		Forested	Scrub-Shrub	Emergent (including peatlands and muskegs)[2]	Other[3]	Lacustrine Wetlands[2]	Estuarine/ Marine Wetlands[2]	Riverine Wetlands	Total Wetlands[1]
1	OG	14,746	557	2,300	20	3	36	10	17,672
	YG	14,562	428	1,675	31	3	26	19	16,744
	Total	**29,308**	**985**	**3,975**	**51**	**6**	**62**	**29**	**34,416**
2	OG	7,689	289	1,187	10	2	18	5	9,200
	YG	21,694	1,786	2,807	165	39	770	165	27,425
	Total	**29,383**	**2,075**	**3,994**	**175**	**41**	**788**	**170**	**36,625**
3	OG	8,474	432	1,525	11	2	10	3	10,457
	YG	20,787	1,139	2,528	136	9	718	31	25,348
	Total	**29,261**	**1,571**	**4,053**	**147**	**11**	**728**	**34**	**35,805**
4	OG	10,595	355	1,711	12	2	17	5	12,697
	YG	15,950	464	1,808	30	4	329	9	18,594
	Total	**26,545**	**819**	**3,519**	**42**	**6**	**346**	**14**	**31,291**
5	OG	9,217	291	1,430	11	2	15	5	10,975
	YG	18,790	1,402	2,330	122	11	43	142	22,840
	Total	**28,007**	**1,693**	**3,760**	**133**	**13**	**58**	**147**	**33,815**

[1] Totals may not appear to sum correctly due to rounding.
[2] Fractional acres mapped as marine wetlands occur within the alternatives.
[3] "Other" includes aquatic bed, unconsolidated bottom, and unconsolidated shore.
Source: NWI database, USFWS 2006a; Tongass National Forest GIS database.

The alternatives also differ in the maximum miles of new roads that would potentially be constructed within wetlands. Table 3.5-5 displays the maximum miles of new roads in wetlands under the proposed alternatives. Alternative 1 would result in the most miles (160 miles) of new road construction in wetlands; whereas Alternatives 2 and 5 would result in the least miles (130 miles) of new road construction in wetlands. Alternatives 3 and 4 would be in the middle of the alternatives with a maximum of 133 and 131 miles of roads constructed in wetlands, respectively.

Table 3.5-5
Maximum Miles of New Roads in Wetlands by Alternative after 100+ Years[1]

	Palustrine Wetlands							
Alternatives	Forested	Scrub-Shrub	Emergent (including peatlands/ muskegs)	Other[2]	Lacustrine Wetlands	Estuarine Wetlands	Riverine Wetlands	All Wetlands
1	135	5	20	+[3]	+	+	+	160
2	105	6	15	+	+	2	+	130
3	108	6	16	+	+	2	+	133
4	111	4	16	+	+	1	+	131
5	108	5	15	+	+	+	+	130

[1] Totals may not appear to sum correctly due to rounding.
[2] "Other" includes aquatic bed, unconsolidated bottom, and unconsolidated shore.
[3] A "+" indicates >0 but <0.5 mile of new roads.
Note: This assumes that the full Projected Timber Sale Quantity is harvested each year for 100 years and that wetland avoidance is not practiced.
Source: NWI database (USFWS 2006a) and Tongass National Forest GIS database.

Over time, Alternative 1, the No-Action Alternative, and Alternative 5 would have a higher risk of direct and indirect effects to wetlands due to road construction than the other Alternatives. Alternatives 2 and 3 would have the lowest risk of effects to wetlands from road construction.

Renewable Energy Development

Development of renewable energy sites would occur under all alternatives; however, Alternatives 2, 3, 4, and 5 would include new management direction (i.e., plan components) in the Forest Plan that improves flexibility in renewable energy development. Alternative 1 would not facilitate the development of renewable energy sites to the extent that Alternatives 2, 3, 4, and 5 would. Therefore, these alternatives could result in greater impacts to wetlands than Alternative 1 from development of renewable energy sites. Under all alternatives, however, renewable energy site development would be subject to site-specific environmental analysis under NEPA and will also be subject to Section 404 permitting.

Cumulative Effects

When considering cumulative effects to wetlands, it is important to look at incremental effects of past, present, and reasonably foreseeable future activities both on and off NFS lands. Individual wetlands provide important physical, biological, and chemical functions, and are not isolated from each other or from other resources when viewed on a larger scale. Surface and subsurface water, along with many organisms, move through the landscape. As discussed in the direct and indirect effects section, changes to or loss of functions in an individual wetland can have effects that extend beyond individual wetlands as they contribute to the overall functioning within a watershed and landscape.

Each landscape area or watershed has different physical, chemical, and biological characteristics and vegetation patterns. The importance of incremental effects of past, present, and reasonably foreseeable future activities to individual wetlands would depend on the amount and type of disturbance in the analysis area, wetland locations and distribution in the watersheds, the distance to other wetlands and waterbodies, and connectivity of hydrology and habitat between them. Assessing cumulative effects to wetlands will be done for individual projects for the relevant analysis area as part of the NEPA process under all alternatives. However, past plus expected timber harvest, road construction for forestry and other uses, and development of renewable energy sites on all land ownerships within the Tongass National Forest boundary can be used to compare the risk of the alternatives adding to cumulative effects to wetlands.

Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

Impacts from Timber Harvest and Road Construction

Non-NFS lands comprise approximately 6 percent of the lands within the Tongass National Forest boundary and 22 percent of Southeast Alaska. Silviculture on NFS and non-NFS lands are generally exempt from the Corps' permitting requirements contingent on the construction and maintenance of roads being conducted in accordance with the general Corps' BMPs as stated in 33 CFR 323.4(a)(6). Timber harvest on state, municipal, and private land is also governed by the Alaska Forest Resources and Practices Act (AS 41.17). Alaska Forest Resources and Practices Regulations (Alaska Department of Natural Resources [ADNR] 2013) includes regulations designed to prevent adverse impacts to fish habitat and water quality from timber operations. The regulations are less extensive than the standards and guidelines that direct activities on the Forest. The state regulations provide direction to avoid and minimize road building, sedimentation, establishment of landings, and damage to vegetative cover of marshes and non-forested muskegs. The regulations also provide buffers for forested wetlands if classified as anadromous water bodies or tributaries to anadromous water bodies. Harvest and associated activities are not specifically regulated on forested wetlands that are otherwise classified.

As stated above, timber harvest can alter wetland function and type but is not expected to convert wetlands to uplands. The hydrologic and biogeochemical functions begin to return as soon as there is tree revegetation, but the habitat functions provided by forested areas may take longer and more forest regrowth to return. This is especially true for timber harvest activities within forested wetlands in old-growth. Some of the habitat functions are dependent on, or related to, characteristics of the old-growth ecosystem, which would not develop during the life of the Forest Plan (10 to 15 years). Therefore, the effects of a project may add to cumulative effects to wetlands or their functions, particularly habitat functions in an area. Habitat and habitat changes are discussed in greater depth in the *Biodiversity* section.

To compare the potential for cumulative effects due to timber harvest activities on wetlands, past, present, and future harvest within wetlands was analyzed for all lands, regardless of ownership, within the Tongass Forest Boundary (plus Annette Island, which is surrounded by the Forest). Table 3.5-6 displays the potential cumulative impacts to wetlands from past, present, and reasonably foreseeable timber harvest on the Tongass and adjacent non-NFS land under each of the alternatives. Without any future harvest on NFS land, an estimated 2.0 percent of all wetlands on NFS and non-NFS lands will have been harvested after 100 years. With implementation of one of the alternatives, the percent of wetlands harvested will range from 2.1 to 2.4 (Table 3.5-6).

Table 3.5-6
Estimated Cumulative Percent of each Wetland Category Harvested on All Ownerships within the Forest Boundary under each Alternative after 100 Years[1]

	Palustrine Wetlands							
Alternative	Forested	Scrub-Shrub	Emergent (including peatlands / muskegs)	Other[2]	Lacustrine Wetlands	Estuarine/Marine Wetlands	Riverine Wetlands	Total Wetlands[1]
1	3.5	1.2	1.1	1.2	0.1	1.7	1..8	**2.4**
2	3.1	1.1	1.0	1.1	0.1	1.7	1.7	**2.1**
3	3.2	1.2	1.0	1.1	0.1	1.7	1.7	**2.2**
4	3.3	1.1	1.0	1.2	0.1	1.7	1.7	**2.2**
5	3.3	1.1	1.0	1.2	0.1	1.7	1.7	**2.2**

[1] "Totals may not appear to sum correctly due to rounding.
[2] Other" includes aquatic bed, unconsolidated bottom, and unconsolidated shore.
Source: NWI database (USFWS 2006a) and Tongass National Forest GIS database.

Increases in impervious surfaces, such as through construction of roads, alters the movement of water through the watershed by increasing surface runoff and reducing infiltration. This typically reduces the time that water resides in wetlands or streams in a watershed and can lead to more severe flooding or more dry spells in streams. Research has observed that the percent of impervious area and percent of forested cover governs the extent of alteration of hydrologic process and impacts to aquatic habitats, including wetlands, within a watershed (Sheldon et al. 2005).

No documentation was found regarding a threshold at which impervious surfaces (such as roads) interact to an extent to have a qualitatively or quantitatively substantial effect on wetlands in Southeast Alaska. Research in the State of Washington and in southern Ontario has indicated that impacts to the integrity and functions of wetlands and streams occurred when impervious surfaces reached 10 to 20 percent within a watershed (Steedman 1988; Taylor 1993 as cited in Sheldon et al. 2005; Booth and Jackson 1997). However, many scientists hold the opinion that there is no accurate threshold and that deterioration begins immediately (Booth et al. 2002; Sheldon et al. 2005).

On the Tongass, impervious surfaces are generally forestry roads. The cumulative effect of road construction in an individual wetland, when added to other alterations to the hydrology in an area, could result in significant alterations in hydrologic process and functions of wetlands and streams within the watershed (Azous and Horner 2001 as cited in Sheldon et al. 2005). Thus, road density (miles per square mile) within the National Forest Boundary regardless of land ownership can be used to examine cumulative effects from road construction.

Table 3.5-7 shows the existing and maximum average future road density for each for all land ownerships within the Forest boundary under each alternative. It includes forestry and other roads proposed for construction on NFS land and reasonably foreseeable roads on non-NFS lands. All alternatives would result in approximately the same maximum future average road density. Therefore, management actions under all alternatives, would have similar risks of cumulative effects to wetlands from impervious surfaces.

Table 3.5-7
Existing and Estimated Future Maximum Road Density (miles per square mile) for NFS Lands and for All Ownerships within the Forest Boundary by Alternative after 100+ Years[1]

	Existing Road Density (miles per square mile)	Estimated Future Road Density by Alternative (miles per square mile)				
		1	2	3	4	5
National Forest System Land	0.20	0.23	0.24	0.23	0.23	0.23
All Ownerships	0.33	0.45	0.45	0.45	0.45	0.45

[1] Road density is for all lands of all ownerships within the Forest boundary, not just roads within wetlands.

Impacts from Renewable Energy Site Development and Other Activities

Other past, present, and foreseeable activities also need to be considered when determining cumulative effects to wetlands. These activities include mineral extraction, renewable energy site projects, transportation developments, and urban and recreational site development.

Existing mining includes Greens Creek on Admiralty Island, Kensington Gold Mine north of Juneau, as well as other existing locations. Potential future mining sites include the Bokan Mountain and Niblack sites on the southern end of Prince of Wales Island. There are also several regional transportation projects and regional energy and utility line projects planned for construction, including the Kake to Petersburg Transmission Line Intertie Project, regional transportation development defined in the Southeast Alaska Transportation Plan and Forest Service Alaska Region Long Range Transportation Plan, road paving on Prince of Wales Island, and construction of the Angoon Airport. Urban and recreational site development includes the growth in the cruise ship and guiding industries, development of fishing, other lodges, and recreational cabins, and expansion of cities including Juneau and Ketchikan.

Existing and foreseeable renewable energy projects within the Tongass National Forest Boundary include the potential geothermal development at Bell Island, potential hydroelectric development at Angoon, Sweetheart Lake, and Soule River, and expansion of the Swan Lake hydroelectric facility.

Each of the activities described above could include impacts to wetlands during construction and operations. Therefore, these activities have the potential to affect wetlands and their functions and these effects would be considered during individual project analysis. The effects of these projects would be the same for each alternative.

Impacts from Climate Change

Changes in Southeast Alaska's climate (discussed in the *Climate and Air* section) could affect the size, type, and functions of wetlands and, therefore, could add to cumulative effects. While the models do not fully agree on the climate change predictions for Southeast Alaska, they generally predict warmer weather, increased rainfall, and a decrease in snowfall in some areas. Recent research by Shanley et al. (2015) predicted an increase in mean annual temperature of approximately 3 to 10°F, a 3 to 18 percent increase in mean annual precipitation, and a 22 to 58 percent decrease in snowfall in Southeast Alaska by the 2080s (Shanley et al. 2015). These changes would potentially result in lower soil moisture due to increased evaporation during warmer summer months. Also, a precipitation shift from snow to rain could lead to more water running off the landscape rather than being stored as snow. Snowmelt is an important water source for wetlands in the spring and summer. Thus, increased evaporation and less water storage could lead to drier meadows or bogs and, possibly, fewer wetlands. Additionally, sea level is projected to rise under current climate change scenarios, which could lead to the loss of tidal wetlands (Shanley et al. 2015).

Changes in temperature could favor some plants and stress others. Longer growing seasons with warmer temperatures would likely result in faster growth. Those conditions would also favor increased rates of decomposition that could lead to changes in the organic matter in wetland soils. Changes in climate could shift wetlands from being carbon sinks to sources of aerial and aquatic carbon due to more rapid decomposition during warmer summers. All of these factors could lead to changes in wetland types, such as shifts in vegetation from herbaceous to shrub, from shrubs to trees, or from bogs to more productive forests. However, as discussed in the *Climate and Air* section, the models do not always agree and the predictions for total precipitation in portions of Southeast Alaska differ.

Fish

Affected Environment

Fish and the aquatic resources on the Tongass National Forest provide major subsistence, commercial, and sport fisheries, as well as support traditional and cultural values. Abundant rainfall, streams with glacial origins, and watersheds with high stream densities provide an unusual number and diversity of freshwater fish habitats. These abundant aquatic systems of the Tongass provide spawning and rearing habitats for the majority of fish produced in Southeast Alaska. Maintenance of this habitat, and associated high-quality water, is a focal point of public, state, and federal natural resource agencies, as well as user groups, Native organizations, and individuals.

Through involvement of private and public groups and agencies, a number of watersheds and Value Comparison Units (VCUs) in the Tongass have recently been evaluated for relative importance for several metrics relating to fish and wildlife. Included among these are conservation priority areas identified by the The Nature Conservancy (TNC) and Audubon Alaska (Audubon Alaska and The Nature Conservancy 2007), and the “Tongass 77” (T77)[1] watersheds identified by Trout Unlimited. Audubon Alaska and TNC identified conservation priority watersheds that include high-value intact watersheds in primarily intact conditions and generally encompass the highest current ecological values within each province; these areas were recommended to be managed for intact ecological values and habitat productivity. Trout Unlimited’s evaluation

[1] The Tongass 77 (T77) refers to VCUs, which approximate major watersheds located on National Forest System lands that Trout Unlimited, Alaska Program, identified as priority salmon watersheds. Four watersheds were removed from the T77 in 2014 as a result of the Sealaska Land Entitlement Finalization in the Carl Levin and Howard P. “Buck” McKeon National Defense Authorization Act for Fiscal Year 2015 (Public Law 113-291).

concluded that, based on their outstanding habitat values, fish production, and diversity of fish species present, the highest and best use of these TNC/Audubon conservation priority areas and T77 watersheds should be for the production of salmon and trout (Trout Unlimited undated; The Tongass 77 undated). Further assessment, considering land use designations and land transfer, resulted in some changes to the ranking. Some watersheds were removed and some added, with the final number of the T77 changing to 73. (See Chapter 2, Alternative 5 description; Hieronymus 2016).

About 46,000 stream miles and 213,000 acres of lakes and ponds are present on Tongass National Forest lands (Table 3.6-1). Of these, approximately 14,900 stream miles and 3,300 lakes and ponds are mapped as Class I water bodies (based on Tongass Geographic Information System [GIS] data); these water bodies are considered to be anadromous or high-value resident fish habitat. Another 9,500 stream miles and 1,000 lakes and ponds are mapped as resident fish habitat. Most of the Forest's streams and rivers empty into bays or estuaries, which are important during some life stages of anadromous species, as well as for many saltwater fish species. Marine invertebrates, such as clams and crabs, are commonly found in the estuaries and nearshore marine environment of Southeast Alaska. Some marine animals, including Dungeness crab (*Cancer magister*), butter clams (*Saxidomes giganteus*), and other benthic and epibenthic organisms primarily in nearshore or estuarine areas, may be affected by upland management activities, such as timber harvest, road construction, and related log transfer and storage facilities.

Table 3.6-1
Mapped Amount of Streams, Lakes and Ponds on the Tongass National Forest Lands

	Classification[1]					
Water Type	**Anadromous**	**Resident**	**Non-Fish (Class 3)**	**Non-Fish (Class 4)**	**No Designation**	**Total**
Stream Miles	14,873	9,478	21,691	1,619	375	48,036
Number of Lakes/Ponds	3,268	993	849	39	15,512	20,661
Acres of Lakes/Ponds	123,173	21,081	40,279	149	28,813	213,495

[1] Some small streams may not be included, mostly class 4, as their locations require ground surveys, which have not occurred in all areas.
Lake class determined by GIS stream layer in lake, so "no designation" lakes have no associated stream layer.
Values are only on National Forest System Lands.

Subsistence, commercial, and sport fisheries are all important to the way of life for Southeast Alaskan residents. Sport fishing is a favorite activity of residents and visitors. Hatcheries, and the enhancement of wild fish, among other aquaculture projects, contribute to resource availability and abundance. The primary fish species harvested in these fisheries are shown in Table 3.6-2.

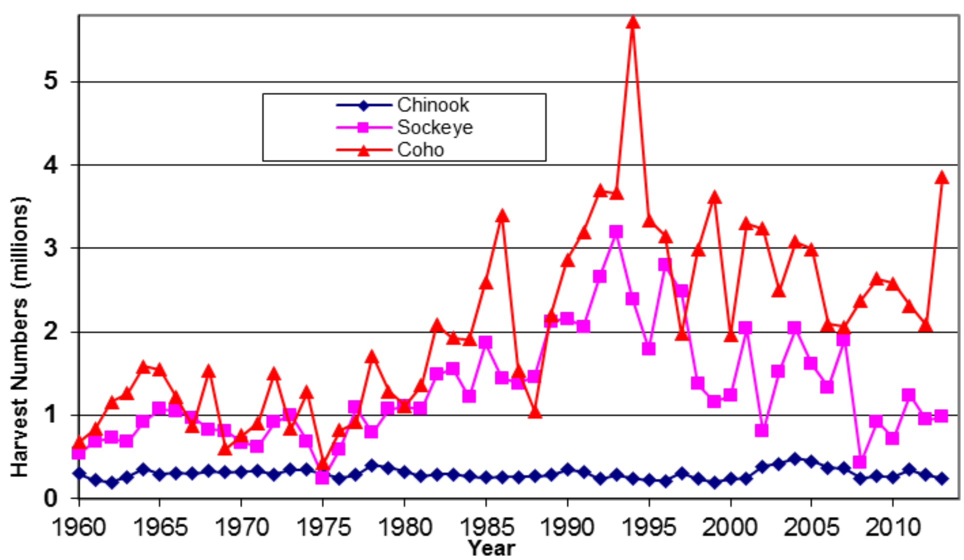
Table 3.6-2
Commonly Caught or Harvested Sport, Subsistence, and Commercial Fish

Species[1]	Sport	Subsistence	Commercial
Pink salmon (*Oncorhynchus gorbuscha*)	X	X	X
Chum salmon (*Oncorhynchus keta*)	X	X	X
Coho salmon (*Oncorhynchus kisutch*)	X	X	X
Sockeye salmon (*Oncorhynchus nerka*)	X	X	X
Chinook salmon (*Oncorhynchus tshawytscha*)	X	X	X
Cutthroat trout (*Oncorhynchus clarki*)	X	X	
Rainbow trout and steelhead (*Oncorhynchus mykiss*)	X	X	
Dolly Varden char (*Salvelinus malma*)	X	X	
Eulachon smelt (*Thaleichthys pacificus*)		X	

[1] Alternate names commonly used for the same species include pink or humpback; chum or dog; coho or silver; sockeye or red; Chinook or king; and eulachon, hooligan, or candlefish.

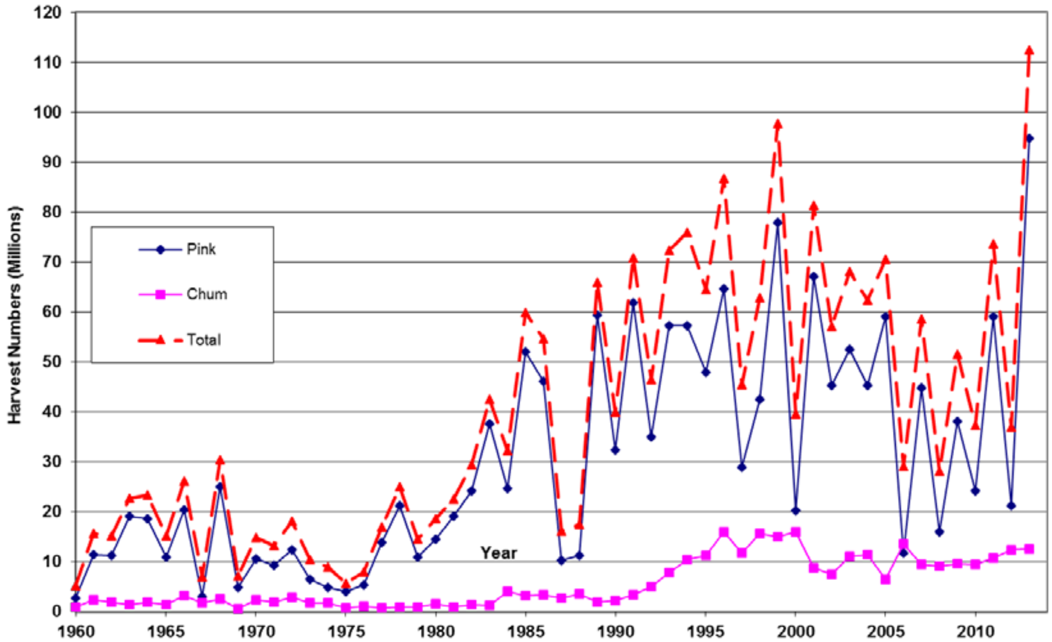
Commercial fish harvest in the waters of Southeast Alaska (includes Yakutat area harvest) can fluctuate widely from year to year. For example, salmon harvest in Southeast Alaska averaged approximately 50 million fish between 1935 and 1940. It then declined steadily to less than 20 million fish in 1950. From 1950 to 1975, harvests were generally low, falling below 6 million fish in 1975 (Figures 3.6-1 and 3.6-2). Since 1975, harvest has generally increased in Southeast Alaska. Peak annual harvests since Alaska statehood have all occurred since 1975. Record harvest occurred for each of the main species: Chinook (2004), sockeye (1993), coho (1994), pink (2013), and chum salmon (1996) (Conrad and Gray 2014a). Record harvest of total salmon occurred in 2013, when 112 million salmon were captured (Conrad and Gray 2014a). Overall, commercial salmon harvest since early to mid-1990s has generally been high but with large fluctuations in the last decade due to the relatively weak returns of pink salmon in even years. This species has averaged 76 percent of total commercial harvest since 1962 (Conrad and Gray 2014a) (Figures 3.6-1 and 3.6-2).

Figure 3.6-1
Commercial Harvest of Chinook, Sockeye and Coho Salmon in Southeast Alaska 1960–2013



Data Sources: Bachman et al. 2005; Conrad and Gray 2014a

Figure 3.6-2
Commercial Harvest of Pink, Chum, and Total Salmon in Southeast Alaska 1960-2013

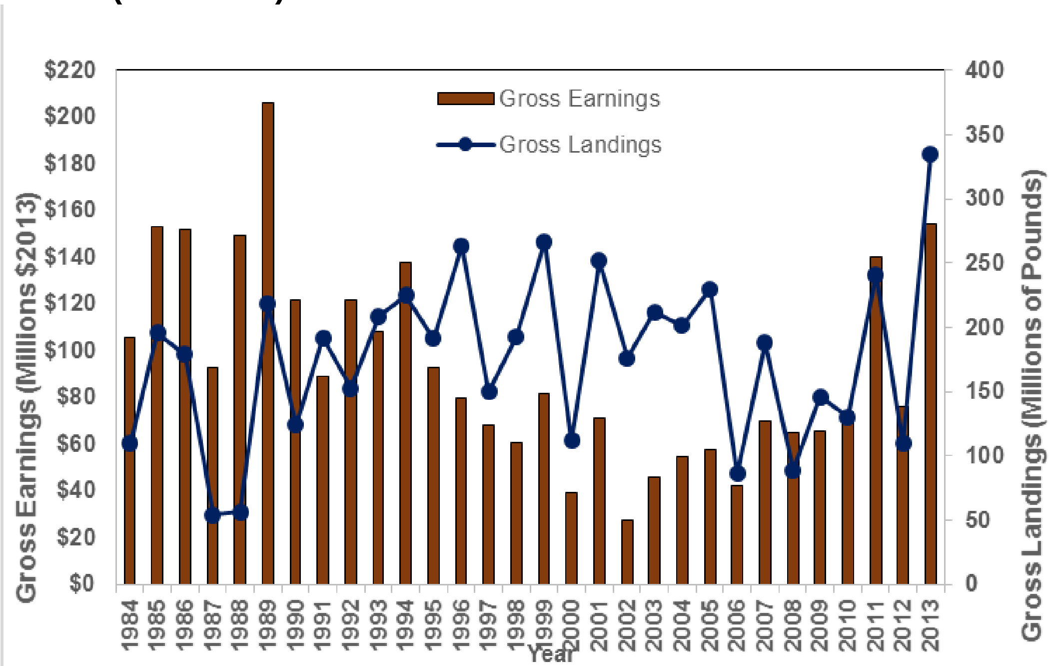


Data Sources: Bachman et al. 2005; Conrad and Gray 2014a

Based on the estimated portions of each species originating from the Tongass National Forest, about 80 percent of the total harvested fish began their life in streams and lakes within the Forest boundaries. Fluctuations in commercial harvest trends are partly attributable to changes in ocean productivity. The productivity of marine waters in the Gulf of Alaska, and the survival of salmon and steelhead trout, is both highly variable and cyclic. From the mid-1970s into the mid-1990s, favorable ocean currents have resulted in high productivity and, consequently, high marine survival of salmon (USDA Forest Service 1995). Survival, growth or production of varied southeast Alaska salmon stocks have correlated with changes in indexes of ocean conditions and have been more variable in recent years (Malick et al. 2009; Wertheimer et al. 2013; Beamish et al. 2009; Shaul et al. 2008 and 2011).

Based on the estimate of salmon produced from streams originating in the Tongass National Forest, estimated annual average commercial salmon harvest (1984 to 2013) was over 176 million pounds, with a wholesale value (ex-vessel value) over $93 million (adjusted to 2013 dollars) (Figure 3.6-3). The harvesting and processing of these salmon provided a substantial number of direct and indirect jobs in Southeast Alaska. In the most recent year reported, 2013, more than 335 million pounds of salmon were harvested worth more than $153 million in Southeast Alaska (Figure 3.6-3). The contribution of commercial fishing to the regional economy is discussed in more detail in the *Economic and Social Environment* section of this document.

Figure 3.6-3
Commercial Harvest and Wholesale (Ex-vessel) CPI Adjusted Value of Salmon Produced from the Tongass National Forest, Southeast Alaska (1984-2013)



Data Sources: Martin 2006; Bachman et al. 2005; Jacobson 2014

Hatchery production has also contributed substantially in overall fish production regionally. Hatchery production statewide has greatly increased since 1977 with releases of more than 1 billion fish occurring annually since 1988, peaking in 2012 with about 1.7 billion juvenile fish released statewide (Vercessi 2014). A substantial portion of hatchery production and harvest occurs in Southeast Alaska, with juvenile salmon releases equaling over one-third of total state release in 2013 (Vercessi 2014). Harvest of hatchery fish is a substantial portion of total salmon harvest in the Southeast Alaska region. Overall, an increasing period of hatchery-produced fish occurred from 1977 to about the mid-1990s. From 1994 through 2013, commercially harvested fish (including cost recovery harvest) in Southeast Alaska averaged about 22 percent of the total number of commercially harvested fish, or about 12 million fish annually (Alaska Department of Fish and Game [ADF&G] 2004; Vercessi 2014). Chum salmon have been the most intensively cultured salmon species in Southeast Alaska, averaging over 80 percent of all commercial harvest of this species from 1994 to 2013. Average hatchery fish harvest of other species was 30 percent or less over this same period.

State subsistence and personal use salmon fisheries averaged 50,000 fish from 2004 to 2013 for Southeast Alaska and Yakutat, down from an average of 61,000 fish in the 10 years prior (1994–2003). Sockeye salmon account for approximately 83 percent of the reported harvest for Southeast Alaska and Yakutat combined since 1994 (Conrad and Gray 2014b). Subsistence and/or personal use permits issued averaged 3,374 in Southeast Alaska and Yakutat combined from 2004 to 2013 and 3,931 in the 10 years prior to that (1994–2003). This includes Haines management area subsistence permits (Conrad and Gray 2014b).

In addition to the State managed subsistence and personal use salmon fisheries, federal subsistence fishing permits for salmon have been issued in Southeast Alaska and Yakutat since 2002. In 2004, a subsistence fishery for salmon on the Stikine River was established under terms of a separate federal subsistence permit. Federal harvest is typically far lower than harvests reported on state-issued permits, as federal jurisdiction does not include marine waters (Reeves 2016). Federal subsistence salmon fisheries averaged 2,511 fish from 2004 to 2013 for Southeast Alaska and Yakutat. Sockeye salmon account for approximately 64 percent of the reported federal harvest for Southeast Alaska and Yakutat combined since 2004. Federal subsistence permits issued averaged 299 in Southeast Alaska and Yakutat combined from 2004 to 2015 (Office of Subsistence Management 2016).

Approximately 85 percent of Southeast Alaska's sport fishing occurs in the vicinity of the Tongass National Forest. Sport fishing for salmon has been substantial over the last two decades (averaging over 400,000 fish per year) without distinctive trends in number harvested (ADF&G Sport Fish Survey data 1996-2013, at https://www.adfg.alaska.gov/sf/sportfishingsurvey/index.cfm?ADFG=region.home).

With more than 46,600 miles of streams and 212,000 acres of ponds and lakes (based on GIS measurements), the Forest provides abundant fish habitat. The habitat has been inventoried and classified, and estimates have been made of fish production. This section begins with a description of key habitat components, then presents a review of information on the effects of past harvest in Southeast Alaska on salmonid stocks, includes a description of how fish habitat is mapped and classified on the Tongass, and finishes with a summary of fish habitat enhancement and restoration.

Fish Habitat

Important Components of Fish Habitat

Stream Temperature and Dissolved Oxygen

Salmon and trout have optimum temperature ranges for rearing, spawning, and adult migration. Generally, salmonid require cool stream temperature to thrive in most stream conditions (Bjornn and Reiser 1991). While very cool water conditions can be a limiting factor to salmon and trout survival and production, warmer temperatures are most often the more limiting condition within most of the range of Pacific salmon. However, in much of Southeast Alaska, increased summer temperature is much less of a concern than for more southerly regions due to the normal cool climatic conditions (Murphy and Milner 1997). Heating of streams reduces the amount of dissolved oxygen in the water, which can be detrimental to salmonid production and survival. Past and potential effects of timber harvest on stream temperature are discussed in the *Water* section.

Situations where elevated temperature and low dissolved oxygen have been found to occur, and associated with fish die-offs, have been related mostly to the characteristics of stream morphology, hydrology, season, and number of fish present, not past timber harvest (Pentec 1991; Murphy 1985; Murphy and Milner 1997). Generally, small basins of low elevation, low stream flow, confined intertidal conditions, with high numbers of adult fish during warm weather periods were areas that occasionally had die-offs of adult salmon due to low oxygen (Murphy and Milner 1997).

Sediment

Sediment includes both the coarse (gravel, cobble, bolder, bedrock) and fine (sand, silt) substrate composition in the stream channel. The relative composition affects many factors in stream production, including spawning areas and spawning success for salmon and trout, and benthic organism composition, which is an important food resource for fish. The amount of coarse sediment affects available spawning habitat and influences pool filling and bank stability (Spence et al. 1996). High levels of fines also affect pool filling, but also greatly influence survival of eggs and fry in spawning nests of salmon and trout (Chapman and McLeod 1987; Chapman 1988; Iwamoto et al. 1978; Gregory and Bisson 1997; McNeil 1964). Generally, the greater the portion of fines in spawning areas, the lower the survival of eggs and fry (McNeil 1964; Koski 1972; Chapman 1988). Increased fines in streams also reduce interstitial spaces in large substrate that are important habitat for many common cool water mountain stream aquatic insects. Effects that timber harvest may have on sediment levels in streams are provided in the *Water* section.

Large Woody Debris

Large woody debris (LWD) in stream channels includes entire trees, rootwads, and larger branches. LWD is an important component of good trout and salmon habitat, especially in heavily wooded regions (Swanson et al. 1976; Bisson et al. 1987; Naiman et al. 1992; Beechie and Sibley 1997; Spence et al. 1996; Murphy et al. 1986). LWD provides channel complexity, cover, and is especially important in the formation of pools (Bisson et al. 1987; Sullivan et al 1987; Benda et al. 2003). LWD has been found to form over 70 percent of all pools in a typical Alaskan valley bottom stream (Heifetz et al. 1986). The benefits of LWD in streams include critical sediment retention (Keller and Swanson 1979; Sedell et al. 1988), structural diversity (Ralph et al. 1994), gradient modification (Bilby 1979), nutrient production (Cummins 1974), and protective cover from predators. Its presence is often critical for overwinter habitat for various salmon and trout (Murphy and Milner 1997; Murphy et al. 1985; Koski et al.1984). Wood controls sediment movement downstream, minimizing the risk of debris flows in small headwater streams. In large streams, coarse sediment accumulated behind LWD often provides spawning gravels (Bilby and Bisson 1998; Montgomery et al. 2003). LWD has been found to increase spawning habitat and use for both coho salmon and steelhead (House and Boehne 1985). Newly entered LWD plays an important role in streams by providing inputs of leaf litter and needles and, as it ages, enhances nutrient dynamics.

Sources of LWD to streams include a variety of processes such as windthrow, stream bank erosion, natural tree mortality, and debris slides, deep-seated mass soil movement, and input from upstream areas (Swanson and Lienkaemper 1978; Benda et al. 2003). Small headwater streams can provide wood to larger channels downstream (Potts and Anderson 1990; Prichard et al. 1998; Coho and Burges 1991; Benda et al. 2003; Reeves et al. 2003).

Debris flows and dam-break floods during high flow occurrences can cause the transport of wood from upstream to downstream regions (Swanson and Lienkaemper 1978). Because of the large size of much of the wood that enters streams, its ability to float during this type of event is limited to larger third- to fifth-order streams (Swanson and Lienkaemper 1978). While much less frequent than high-flow events, large amounts of LWD can be added by debris torrents (Lamberti et al. 1991). The entry of LWD and coarse sediment at tributary junctions by debris torrents can form complex habitat, including pools and cover, and add spawning gravel to the main channel (Benda et al. 2003).

In streams of the Tongass, Murphy and Koski (1986) found that 40 percent of LWD in streams originated within 3 feet of the bank and 99 percent within 100 feet of the stream channel. Martin et al. (1998) found similar results estimating that 94 percent of LWD entered streams in unharvested Southeast Alaska areas originated within 98 feet of the stream channel. There may be exceptions to this in certain streams. Reeves et al. (2003) found that about 65 percent of the LWD pieces in Oregon coastal streams originated in upslope areas, primarily from steep slopes intersecting stream channels. Reeves et al. (2003) noted that similar conditions were observed in California and Washington states. The width of the stream valley and the slope of intersecting tributaries were the main factors determining the portion of wood entering from side streams. Reeves et al. (2016) summarized information developed in Washington and Oregon Cascade and coastal forests that indicated 95 percent of wood in streams originated from 0.46 to 0.82 of site potential tree height. While there are some areas that have trees over 100 feet tall along Alaska streams, a buffer of 100 feet would, in nearly all cases, maintain complete LWD supply to these streams, especially the larger size pieces that are most critical to habitat development and maintenance.

The primary timber-related actions that may affect LWD supply to streams include buffer width along streams, stream class and channel characteristics that buffers are placed on, size of trees remaining in the buffer area, and effects on windthrow from adjacent harvest.

Murphy and Koski (1989) used a model to estimate that, for moderate-sized valley bottom streams in Southeast Alaska with no buffers, LWD would decrease to about 30 percent of pre-harvest levels in about 90 years. Some studies have documented reduced LWD in Alaska clearcut streams relative to old-growth stream channels over time (Heifetz et al. 1986; Johnson et al. 1986, Murphy et al. 1986; Murphy and Milner 1997; Tucker and Caouette 2008). In the short term, however, LWD may be higher in clearcut areas (Lisle 1986) and may persist at elevated levels in some areas for years (Gomi et al. 2001). Limited long-term monitoring has occurred on Southeast Alaska streams to document changes. However, it was found that Maybeso Creek had a decrease in number and size of LWD 30 years after harvest (Bryant 1980) with similar changes in Harris River (Bryant 1985, cited in Murphy and Milner 1997). Some Tongass forest-wide monitoring has found statistically significant lower LWD values in streams of past harvested areas relative to unharvested area streams (Tucker and Caouette 2008). However, most of these watersheds were intensively logged under conditions that had no buffer strips on streams; buffers were almost completely absent during timber harvest until the late 1980s. Buffer strips have greatly increased in frequency and size since then.

Ross (2013) also compared habitat factors in streams from past harvest practices (harvest to stream banks primarily 1980-1990) with streams in unharvested area in Southeast Alaska. While Ross did not examine differences in LWD composition between harvested and unharvested streams, he noted that remnant wood entering the stream prior to harvest was still common in the harvested reaches and, based on riparian conditions, future wood entering the streams would be smaller and less functional at forming habitat than is currently present. His assessment of stream habitat factors typically controlled by LWD in streams in Southeast Alaska found no significant differences in major pool characteristics (residual depth, pool area, pool density) between harvested and unharvested riparian stream reaches, but noted this was likely affected by the presence of remnant wood in harvested streams.

Buffer strip blowdown affects timing of LWD entry to streams. Several studies have shown that blowdown in buffers increases after harvest, primarily in the short term (Pentec 1996; Martin 1996). Effects were short term, however, with rate of blowdown decreasing over time and the effects on total LWD loading to streams slight. There has been some documentation of a large increase in rootwads in a stream due to blowdown, which was considered beneficial to fish habitat (Murphy and Milner 1997). Recent monitoring of newly harvest areas (between 2000 and 2007) has found highly variable rates and amounts of windthrow adjacent to harvest units currently averaging about 7 percent (median 1 percent) of the trees in the monitored buffer areas, with decreasing rates of windthrow over time; however, effects on stream LWD supply were not assessed (USDA Forest Service 2014a). However, Martin and Grotefendt (2007) found that windthrow on non-National Forest System (NFS) lands with 20-meter buffers would, on average, reduce the long-term LWD supply in Southeast Alaska forest streams by about 5 percent relative to unharvested areas (an additional 5 percent would be lost due to harvest).

Thinning or partial cutting in older even-aged stands can greatly reduce windfirmness (Harris 1989). This vulnerability might be offset through light thinning treatments that begin early in the life of the stand. In addition to consideration of topographic variability and stand species composition factors, young-growth stands with high height-to-diameter ratios and/or low live crown ratios that are exposed to prevailing winds or local winds will be at higher risk of windthrow. This is especially true for those stands that have not been previously thinned and consist of trees that have adapted their crown ratios and roots to stand conditions of competition mortality. These stands are relatively unprepared for clearcut harvest edges and are vulnerable to windthrow. To aid in reducing the chance of loss of buffer due to windthrow, the Reasonable Assurance of Windfirmness (RAW) buffer documents by Landwehr (2007) and Harris (1989) are used to provide guidance when establishing these buffers during planning and final layout.

Food Sources

Food sources for stream fish can originate directly within the stream or enter from the adjacent terrestrial environment, upstream aquatic environment, or returning salmon. The main sources are from leaf and litter deposits from the adjacent riparian vegetation, algae growth and production on the stream bottom, and from returning salmon carcasses. This is ultimately the food base for smaller aquatic organisms (e.g., aquatic insects) that become food sources for stream fish. Detrital input is the main source from heavily shaded small- and medium-sized streams (Richardson 1992; Gregory et al. 1991). Larger streams in contrast derive much more of their food sources from algae production. Nutrient and organic input from returning salmon are also important but highly variable (Wipfli et al. 1998; Tiegs et al. 2009; Ruegg et al. 2011; Janetski et al. 2009). Past timber harvest has been found to influence the contribution of this nutrient input from returning salmon, with a greater watershed timber harvest rate corresponding to reduction in the quantity of salmon nutrient influence in Southeast Alaska river systems studied (Tiegs et al. 2008). The primary mechanism is likely a change in substrate size in harvested systems, which overall is still within that of unharvested systems (Tiegs et al. 2008). Small streams, many of which are not fish-bearing, also supply nutrients that contribute substantially to larger streams (Independent Multidisciplinary Science Team 1999). When riparian trees are removed, the primary source of food is initially shifted to algae production within the stream and is derived less from leaf and needle organic matter (Murphy and Milner 1997). Basin timber harvest may also contribute to increased dissolved plant nutrients downstream (Gravelle et al. 2009). Overall production along many streams with canopy removal in Southeast Alaska actually increased (those where light was limiting), while in some there was no change (Murphy and Milner 1997; Hernandez et al. 2005). When second-growth areas regrow, however, production may be reduced due to increased shade compared to shade produced by the original old growth. Small streams in Alaska have also been found to substantially contribute food for fish to larger streams through downstream transport of terrestrial and aquatic prey directly and detritus resources indirectly for fish (Wipfli 1997, Wipfli and Gregovich 2002, Piccolo and Wipfli 2002, Wipfli et al. 2007). The type of riparian forest along these small streams affects both the amount and type of resources passed downstream. In some cases, the regrowth of alder trees along streams following harvest has resulted in higher amount of resources both locally and to downstream fish streams (Piccolo and Wipfli 2002, Hernandez et al. 2005). While changes to riparian vegetation on fishless streams will alter the composition of the food sources transported downstream, the overall effect on downstream fish streams over the long term is not clear, as actions near these small stream may have additional effects (e.g. sedimentation) on stream production (Wipfli and Gregovich 2002).

Habitat Access and Passage

Fish passage and access to suitable habitat in streams and lakes is critical to fish stocks. Natural falls and barriers in systems have been found in some areas to prevent the use of suitable fish habitat especially for anadromous stocks in some natural systems. Man-made barriers in the form of dams, diversion, and road crossing structures have been common partial or complete barriers to fish movement in much of the developed areas where fish are present. Road crossings (e.g., culverts) over much of the range of salmonids in the Pacific Northwest have often reduced or eliminated access to substantial portions of habitat to migratory fish use.

Effects of Past Forest Management Practices on Salmonid Fish Stocks

Past timber harvest practices and related actions in many regions of native Pacific salmon distribution range have been associated with declines of fish stocks (Everest and Reeves 2007). Reductions in salmon stocks have not been observed in Alaska (Bryant and Everest 1998). This may be partly because other human-induced disturbances (e.g., agriculture, dams, urban development), which are common in other regions, are rare in Southeast Alaska. As noted above, older forest practices (mostly prior to 1980) in the Tongass National Forest have had documented adverse effects to anadromous fish habitat conditions, including spawning habitat, rearing habitat, and migration conditions (Murphy and Milner 1997). Harvest during this timeframe accounts for about 60 percent of all timber harvest on the Tongass National Forest. In one study of multiple streams in Southeast Alaska, numbers of summer fry coho salmon increased in clearcut areas, but fall and winter stages of juvenile coho had reduced numbers similar to old-growth systems (Murphy et al. 1986). In another study, increased summer abundance of coho salmon juveniles in clearcut areas had reduced the number of outmigrating coho salmon smolts relative to old-growth areas (Thedinga et al. 1989). Similarly, juvenile steelhead abundance, while high in unbuffered clearcut streams in the summer, became very low in the winter as these fish moved to buffered and old-growth habitats where cover was higher (Johnson et al. 1986). One study of a historically heavily harvested Tongass watershed (Staney Creek), showed with modeling, that improving watershed and stream conditions to pre-harvest status would more than double current average coho salmon production (Stillwater Science 2012).

However, studies addressing potential long-term effects of timber harvest and related actions on actual numbers of fish produced are rare within the range of Pacific salmon, including Alaska (Bryant and Wright unpublished manuscript). Bryant and Wright (unpublished manuscript) compiled and analyzed the data from multiple juvenile fish studies in 26 streams in Southeast Alaska in an attempt to determine what long-term effects past harvest management actions have had on fish production by comparing fish abundance in managed and old-growth watershed streams. The managed watershed all had timber harvest activity prior to 1980, which generally included clearcutting of riparian trees. Partly because most studies examined were not specifically designed to address long-term effects, overall results of this analysis were limited. They examined population densities of juvenile fish from studies conducted from 1978 to 2000, including data on coho salmon, Dolly Varden char, steelhead, and cutthroat trout. Even with the variability of data, they found statistically significant differences between the managed and old-growth watersheds. Coho salmon and Dolly Varden densities were significantly lower in harvested areas, while steelhead density was greater in harvested areas. Where long-term trends were significant, they were downward in harvested areas. There were many differences in overall production among regions, differences between seasons, and morphological differences among streams that contributed to much overlap in abundance between treatment groups and the lack of clear results. Overall, this study suggests some negative effects on some populations from older harvest practices (prior to 1980). New forest practices in the Tongass National Forest are intended to prevent the habitat degradation in riparian areas and headwater streams that have contributed to these adverse effects on populations (Bryant and Wright unpublished manuscript).

Monitoring of resident stream fish populations (Dolly Varden and cutthroat trout) was performed beginning in 1999, based on specific sampling designs intended to assess effects of recent timber harvest practices under forest management standards and guidelines for fish habitat as outlined in the Tongass Land and Resource Management Plan (Forest Plan) (USDA Forest Service 2014a). However, after 11 years of data collection (1999-2009), an insufficient number of the monitored streams had timber harvest treatments completed to meet the criteria of the sample design. The result was that monitoring plan changes were needed in design and protocol to represent the range and degree of management prescriptions across the Tongass. These new designs and sampling have been implemented but statistical results of past monitoring and the new design results are not yet available. Thus, determinations cannot yet be made about effects of management practices on resident fish populations (USDA Forest Service 2014a).

As shown earlier (Figures 3.6-1 and 3.6-2), overall trends in Southeast Alaska commercial harvests from 1960 to 2013, including coho, pink, chum, and sockeye salmon, do not indicate specific downward trends in these populations, or specific trends that could be correlated with amounts of timber harvest activity. In addition, wild coho salmon abundance estimates, excluding hatchery coho salmon, have remained fairly constant over the time (1997–2013), and Southeast Alaska stocks are considered in excellent condition (USDA Forest Service 2014a) which may suggest limited affects to these fish from any land based activities. While many factors outside of forest management practices in Southeast Alaska (e.g., ocean conditions, weather, hatchery releases, harvest management, watershed conditions in other areas) influence these numbers, no obvious effects can be discerned from harvest or escapement data. However, the effects of these moderating factors may be too great to permit harvest data to demonstrate any effects on fish populations resulting from timber harvest in specific Southeast Alaska watersheds, particularly if they are relatively small (Bryant and Wright unpublished manuscript; Bryant and Everest 1998).

Stream Classification on the Tongass

Fish habitat on the Tongass is classified, for management purposes, using two classification systems (see the *Water* section of this chapter). The first is stream class, which relates primarily to presence or absence of fish, type of fish, and water quality. The second category is stream process group, which characterizes streams based on channel and drainage basin morphological conditions.

Stream Class Inventory

Streams are categorized by stream class, a classification system designed to categorize stream channels based on their fish production values. The value classes do not imply either ecological importance or prioritization of fish harvest over maintenance of watershed function. Class I streams are anadromous and high-value resident fish streams or habitat upstream of fish migration barriers known to provide reasonable enhancement opportunities for anadromous fish, Class II streams are other resident fish streams, Class III streams have no fish populations or fish habitat but have immediate influence on downstream water quality and fish habitat capability, and Class IV streams are small streams that do not directly influence downstream water quality or fish habitat capability. Refer to the *Water* section for more detailed descriptions (also see the *Glossary* in the Forest Plan volume for more complete definitions.)

Channel Type Inventory

Perennial and many intermittent streams on the Forest have been inventoried for channel type. The channel types provide a system to estimate the amount and quality of fish habitat, and can be used to predict their physical response and sensitivity to different management activities. Channel types have been categorized into distinct groups, called "stream process groups." Process groups describe the interrelationship between watershed runoff, landform relief, geology, and glacial or tidal influences on fluvial erosion or depositional processes. They are described in Channel Type User Guide Tongass National Forest Southeast Alaska (Paustian et al. 1992, as amended in 2010). Process groups, in conjunction with stream class, are used for assigning the Riparian Standards and Guidelines. The estimated miles of stream by process group and class within the Tongass National Forest are shown in Table 3.4-1 in the *Water* section of this chapter.

Fish Habitat Enhancement and Restoration

Fisheries Habitat Enhancement

Much emphasis has been placed on the enhancement of fish habitat on the Tongass National Forest. From 1980 to 1995, the Forest Service implemented 148 fisheries habitat enhancement projects on the Tongass (USDA Forest Service 1997a, Appendix H). In more recent years, enhancement projects have continued with 53 total project completed between 1996 and 2014 (Table 3.6-3). Future known planned or evaluated projects include similar project types and are noted as part of the Tongass Integrated Plan on the Tongass National Forest web site (http://www.fs.usda.gov/detail/tongass/landmanagement/?cid=stelprd3812864 [Accessed September 2015]).

Table 3.6-3
Tongass National Forest Fish Habitat Enhancement and Restoration Projects Completed During 1996-2014

Activity	Number of Projects
Fishways	7
Falls Modification	9
Spawning Channels	1
Debris Removal Sites	0
Lake/Stream Fertilization	5
Lake Stocking	7
Stream Stocking	8

Table 3.6-3 (continued)
Tongass National Forest Fish Habitat Enhancement and Restoration Projects Completed During 1996-2014

Activity	Number of Projects
Rearing Ponds	16
Incubation Boxes	0
Total Enhancement Activities	**53**
Restoration Activity	
In-stream Large Wood Debris Management	70
Culvert Replacement and Removal [1]	513
Total Restoration Activities	**583**

[1] Number of culverts since 1998.

Many of the fish habitat enhancement projects implemented on the Tongass National Forest are cooperative projects involving multiple agencies and organizations, including the Forest Service, ADF&G, Regional Aquaculture Associations, timber companies, and other non-profit hatcheries. Types and numbers of enhancement projects prior to 1996 are presented in Appendix H of the 1997 Forest Plan Environmental Impact Statement (EIS). Similar project types have been developed since than as shown in Table 3.6-3.

The anticipated salmon production from fish habitat enhancement projects on the Tongass National Forest is calculated based on site-specific habitat conditions and an analysis of limiting factors for salmon production. The test for these habitat production estimates consists of monitoring conducted on individual projects and the subsequent feedback of the monitoring results into the project planning process.

The 1997 Tongass Land Management Plan Revision Final Environmental Impact Statement (FEIS) identified 158 potential projects for initiation during the first 10 years of implementation of the Forest Plan (USDA Forest Service 1997a). The plan was part of the Forest Service implementation of the Alaska National Interest Lands Conservation Act (ANILCA) process in forest planning and has not been modified since its initial development. The extent of implementation of these projects has been varied across the Forest. The public continues to expect the maintenance or improvement of fish habitat values. Public interest for subsistence, commercial, and sport-harvested fish remains high.

Demand for subsistence fish is discussed in the *Subsistence* section of this chapter, while commercial and sport fish demand is reviewed in this section. Commercial fish demand is calculated based on goals set by Regional Salmon Planning Teams for annual fish production for several species. Some of the “year 2000” harvest goals, were set in 1981 in the Comprehensive Salmon Plan for Southeast Alaska, Phase I (Joint Southeast Alaska Planning Team 1981). The updated Comprehensive Salmon Enhancement Plan for Southeast Alaska: Phase III (ADF&G 2004) did not specifically carry these harvest objectives forward. Comparison of annual harvest numbers to these original harvest objectives did, however, supply a metric to evaluate how recent harvest compares to these values. Annual commercial harvest usually achieved these harvest objectives for pink salmon (70 percent), but infrequently for coho salmon (44 percent), and sockeye salmon (17 percent), and chum salmon (26 percent) for the period of 1991 through 2013 (ADF&G 2004; Vercessi 2014; other ADF&G annual reports). Harvest has been highly variable during this period. Tongass rivers, lakes, and streams produce 80 percent of the commercial salmon annually harvested from Southeast Alaska, which is about 49 million salmon per year (USDA Forest Service 2015d).

Given the abundant fish resources in the fresh and marine waters of Southeast Alaska, there has been considerable sport fishing effort in this area, as indicated by both license sales and overall fishing effort. Alaska sport fishing licenses sold have exceeded 400,000 since 1994 (Jennings et al. 2011a). The number of anglers in Southeast Alaska has had an increasing trend from about 60,000 in 1984 to about 110,000 in 1994. Numbers remained fairly stable from 1994 through 2003 at 105,000 to 115,000, followed by a sharp increase to about 130,000 from 2004 to 2008, before falling back to about 110,000 in 2009–2010 (Mills 1991; Howe et al. 1995; Walker et al. 2003; Jennings et al. 2011a; Jennings et al. 2011b). However, the number of Southeast Alaska resident anglers has had a slight declining trend from a high of about 37,000 in 1991 to 28,000 in 2010, mostly ranging from 28,000 to 32,000 per year from 2001 to 2010. In contrast, non-resident licenses in Southeast Alaska have been on an increasing trend from 1991 numbers (about 59,000) to a high of about 100,000 for 2004-2008, with a sharp decline again in 2009–2010, possibly related to the national economic downturn (Mills 1991; Howe et al. 1995; Walker et al. 2003; Jennings et al. 2011a; Jennings et al. 2011b).

The sport fishing effort in Southeast Alaska from 1996 through 2014 followed somewhat similar trends where data are comparable to that of license sales. Effort was lowest during the 1996–1998 period ranging from about 370,000 to 440,000 angler days (ADF&G 2016). Effort increased in 1999 and remained fairly constant through 2009, ranging from 469,000 to 568,000 angler days, peaking in 2005 when license sales were also high. Effort decreased in 2010, similar to license sales, but has been on an increasing trend through 2014 ranging from 444,000 to 564,000 angler days.

Fish Habitat Restoration

Along with enhancement, substantial effort and funding have been directed at restoring or supplying access to habitat that was affected by past timber harvest practices. This effort has included in-stream and road-related activities. The restoration efforts have included primarily in-stream and stream bank restoration based primarily on LWD addition and replacement or removal of road-stream crossing structures, primarily culverts that failed to meet current juvenile fish passage design criteria. From 1980 to 1995, the Forest Service implemented 28 fisheries habitat restoration projects on the Tongass (USDA Forest Service 1997a, Appendix H). In more recent years, restoration projects have continued with 70 LWD projects and 266 fish culvert replacements or removals completed between 1996 and 2014 (Table 3.6-3). Like enhancement projects, these may be cooperative projects involving multiple organizations.

Restoration actions have been partly based on watershed condition ratings, use, and aquatic value criteria (see the *Water* section for more on watershed condition). This led to designation of Priority Watersheds for restoration focus. The Forest Supervisor formally established seven Priority Watersheds (Harris River, Twelvemile Creek, Staney Creek, Luck/Eagle Creek, Saginaw Creek, Sitkoh River, and Sitkoh Creek) in 2011. Watershed improvement activities include a variety of actions that were primarily direct stream habitat restoration (e.g., LWD placement), riparian vegetation improvement, upland vegetation improvement, road storage and decommissioning, and improved road drainage structures to reduce sediment entry to streams and improve fish passage. A variety of these actions have occurred and continue in the Priority Watersheds noted above. Watershed condition has since been restored and is considered “functioning properly” in the Harris River and Twelvemile Creek watersheds on Prince of Wales Island and Sitkoh River and Sitkoh Creek watersheds on Chichagof Island. Restoration also continues in the other Priority Watersheds. Another Priority Watershed (Iris Meadows/Shelikof Creek on Kruzof Island) was added to the list in 2014. Other watersheds are slated for improvement actions as funding becomes available.

Large Wood Debris Management including In-Stream and Streambank Restoration

LWD structures are sometimes constructed in stream channels and on floodplains to stabilize spawning gravels, form and maintain pools, provide cover and temperature regulation, produce aquatic insects, and capture plant litter, all of which are important to the various life stages of wild salmon and other fish and organisms. Although individual structures can be low in cost, costs vary depending on construction technique utilized, channel size, and site access. Larger stream channels need to utilize excavators and/or helicopter for wood placement and construction, while smaller streams might utilize hand crews to place wood.

Culvert Replacements/Removals at Road-Stream Crossings

Providing for fish passage at stream and road intersections to ensure fish migration is an important consideration when constructing, reconstructing, or storing forest roads. Improperly located, installed, or maintained stream crossing structures can restrict these migrations, thereby adversely affecting fish populations. These structures can present a variety of potential obstacles to fish migration. The most common obstacles are excessive vertical barriers, debris blockages, and extreme water velocities that can inhibit fish passage, especially for smaller or juvenile fish. Fish passage standards and guidelines including drainage structure design criteria have evolved over time, and are still evolving as information on fish swimming performance, fish movement patterns, and culvert hydraulics is improved.

Culvert replacement and repair has been an ongoing activity to improve access for anadromous and resident fish that were cut off from full access by the culvert designs that did not meet current juvenile fish passage design criteria. A survey of most of the approximately 5,000 miles of Forest Service roads (4,055 miles permanent and 953 miles of temporary roads) found about 3,700 fish stream crossings (Jacobson 2016; USDA Forest Service 2014a). About 90 percent of all fish stream road crossings (about 55 percent of the crossings are culverts) have been assessed as to their suitability to ensure juvenile fish passage. About 1,100 of the assessed crossings, or 35 percent of all crossings (mostly culverts), did not meet current juvenile fish passage standards (Jacobson 2015). Of those not meeting standards, more than 83 percent were on Class II streams. Habitat upstream of the crossings with passage problems was estimated to equal about 0.5 percent and 2.0 percent of all Class I and Class II stream miles on the Tongass National Forest, respectively. However, the amount of habitat actually prevented from use by resident and anadromous fish by structures (e.g., culverts) is likely much less than these estimates. For example, about 66 and 72 percent of the habitat reaches upstream of culverts, estimated to be passage barriers for anadromous and resident fish, respectively, have resident or anadromous fish present (Alaska Forest Association undated). Additionally, the criteria used to indicate a passage structure is a blockage is conservative, meaning during many flow conditions various life stages of fish would be able to pass many of these structures, which is confirmed by fish presence upstream of many of these structures. Considering these factors, the overall habitat area completely restricted to fish access from road crossing structures is slight.

Nevertheless, even though the habitat area may be small, averaging about one-quarter mile of fish habitat upstream of each crossing, the effect on an individual stock may be important. Most of these culverts were installed prior to implementation of the 1997 Forest Plan standards and guidelines for culvert installation. Since 1998, about 513 crossing structures (mostly culverts) have been removed, replaced, or retrofitted. About half of the recently installed culverts have been monitored for suitability of meeting fish passage criteria. About 95 percent of these meet present criteria (USDA Forest Service 2014a). Many of those not meeting passage criteria were installed on streams not considered, at the time of installation, as being fish streams. Culvert replacement, removal, or retrofitting is an active, ongoing process.

From 1998 through 2014, about $18.5 million (2015 dollars) has been spent on stream crossing remediation, about $11.1 million just on culvert replacement (Jacobson personal communication 2015). This has included repair or removal of about 513 structures (mostly culverts) to improve known fish passage issues. The removal and repair rate of known or potential fish passage barrier structures has been fairly consistent over this period, averaging about 31 structures a year.

Special Status and Invasive Species

Fish Management Indicator Species

National Forest Management Act (NFMA) regulations direct the use of Management Indicator Species (MIS) in forest planning to help display the effects of forest management. MIS are species whose population changes are believed to indicate the effects of land management activities. For the 1997 Forest Plan, pink salmon, coho salmon, Dolly Varden char, and cutthroat trout were selected as MIS. Pink salmon were selected to represent anadromous fish that are limited in their freshwater life period by spawning gravel quality and quantity; coho salmon to represent anadromous fish that are generally limited in their freshwater life period by stream and lake rearing area; Dolly Varden char because of their ubiquitous distribution in freshwater habitats; and cutthroat trout because of their dependency on small freshwater stream systems, which are most susceptible to effects from management activities. These MIS, and their habitats, are described in the 1997 Forest Plan Revision FEIS (USDA Forest Service 1997a).

A series of workshops were held in 2011 with representatives from ADF&G, National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and the Forest Service to evaluate the current Tongass MIS and develop a set of proposed MIS that would more effectively serve the needs of the Tongass concerning indicators of land management practice effects. After following a structured process used to revise MIS lists elsewhere on NFS lands (Hayward et al. 2004), the group recommended retaining coho salmon, Dolly Varden char, and cutthroat trout on the current aquatics species MIS list, and dropping pink salmon (Hayward and Jacobson 2011).

Threatened and Endangered Fish Species

Federally listed threatened and endangered species are those plant and animal species formally listed by the USFWS or NMFS, under authority of the Endangered Species Act (ESA) of 1973, as amended. An endangered species is defined as one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as one that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

No federally listed fish species or stocks originate from Alaska streams. However, some federally listed fish stocks may occur in marine waters within the boundary of the Tongass National Forest (NMFS 2015a). These fish include the following:

Endangered species:

- Snake River sockeye salmon
- Upper Columbia River spring-run Chinook salmon

Threatened species:

- Upper Columbia River steelhead
- Snake River spring/summer Chinook salmon
- Snake River fall Chinook salmon
- Puget Sound Chinook salmon
- Lower Columbia River Chinook salmon
- Upper Willamette River Chinook salmon
- Hood Canal summer chum salmon
- Lower Columbia River coho salmon
- Snake River Basin steelhead
- Lower Columbia River steelhead
- Upper Willamette River steelhead
- Middle Columbia River steelhead
- Green Sturgeon – Southern DPS

These listed stocks of salmon and steelhead do not spawn in Alaska, but are known to seasonally inhabit marine waters on the outside coast to the west and occasionally in inside waters of the Tongass National Forest (McNeil and Himsworth 1980; Trudel et al. 2004; Trudel et al. 2009; Burgner 1991; Haggerty 2009; Groot and Margolis 1991; Tucker et al. 2011). They may feed on fish that are dependent on coastal marine waters of the Tongass National Forest at some stages of their lives. The southern distinct population segment (DPS) of the green sturgeon is an anadromous species that spawns in the Sacramento River in California (NMFS 2015b). Green sturgeon also do not rear or spawn in freshwaters of Southeast Alaska but have been rarely found to be present in marine waters of Southeast Alaska and may feed on benthic organisms found in these waters, likely in waters less than 100 meters deep (Lindley et al. 2008; Huff 2012; Colway and Stevenson 2007). One tagged green sturgeon was detected at an acoustic array in the Cape Spencer area (Lindley et al. 2008). Several specimens have been collected in the Taku River/Stephens Passage area of Southeast Alaska (Mecklenburg et al. 2002). Green sturgeon could be present in the inside waters of Southeast Alaska, particularly during the winter.

Pursuant to Section 7 of the ESA, a Biological Assessment (BA) was prepared to assess the effects of the 1997 Forest Plan revision on the endangered Snake River sockeye salmon and the threatened Snake River spring/summer Chinook salmon and Snake River fall Chinook salmon, and submitted to NMFS for review and concurrence in the Tongass Forest Plan process (Appendix J of the 1997 Tongass Forest Plan Revision EIS). This assessment was updated to address the listed fish species relative to the alternatives considered in the Forest Plan amendment of 2008 (see Appendix F of the 2008 Forest Plan Amendment).

BAs evaluating the effects of the selected alternative of this Forest Plan amendment on listed species have been prepared (one containing fish and wildlife species to NMFS and another containing one wildlife species to USFWS) and are included in the planning record. In accordance with Forest Service Manual 2670, a Biological Evaluation (BE) covering federally listed threatened and endangered and Region 10 sensitive species (no sensitive fish species) was also prepared (Krosse 2016); this BE contains an evaluation and comparison of all alternatives and is also in the planning record.

Essential Fish Habitat

The *Magnuson–Stevens Fishery Conservation and Management Act* mandates that agencies initiate consultation with NMFS for any activities that could affect essential fish habitat (EFH). EFH has been broadly defined by Congress for federally managed species to be "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

NMFS (2005) clarified what the specific definition is for EFH in Alaskan waters. EFH is the general distribution of a species described by life stage. It is generally the habitat area that includes 95 percent of that life stage, where it is known, to occur. Where distribution data is unknown, surrogate species may be assumed. Maps were presented in NMFS (2005) defining EFH for species and life stages; other than for salmon species, little EFH is present in the inside waters of Southeast Alaska. Those groundfish species that are present include some sole species life stages only. Several other species, however, have some life stages located in the marine waters offshore of Southeast Alaska and some enter outer nearshore waters. In general, EFH for marine groundfish species (e.g., rockfish, sablefish, sole, plaice, cod, pollock), are extremely limited near Tongass waters. EFH information underwent a thorough review in 2010 in the 5-Year EFH Review (NMFS 2011). EFH amendments were made to five of six federal fishery management plans. The 2010 modifications are modest and slightly refined EFH, better aligning the Habitat Areas of Particular Concern process schedule, and included updated research priorities.

Salmon EFH covers freshwater, estuarine, and marine waters from the high tide level to 200 meters deep and out to the 200 nautical mile U.S. exclusion zone, depending on life stage. The freshwater EFH is defined primarily by what is present in the ADF&G's Catalogue of Waters Important for Spawning, Rearing, or Migrations of Anadromous Fishes (Johnson and Litchfield 2015). Freshwater EFH for salmon in the Tongass would include all streams, lakes, ponds, and wetlands currently or historically accessible to salmon. The shallow marine waters adjacent to forest lands are considered EFH for salmon, but little of this area is EFH for most groundfish species.

Sensitive Fish Species

Sensitive species are those plant and animal species identified by the Regional Forester for which population viability is a concern on NFS lands within the region. The goal of the Forest Service Sensitive Species Program (Forest Service Manual 2670) is to ensure that species numbers and population distribution are adequate so that no federal listing will be required and no extirpation will occur on NFS lands.

The Alaska Region Sensitive Species List was updated in 2009 (USDA Forest Service 2009b). There currently are no fish species designated as sensitive species in the Alaska Region.

Invasive Aquatic Species

Species are considered invasive if they are not native to an ecosystem, and if they are likely to cause harm to human health, the economy, or the environment (Executive Order 13112). Due to its remote landscape, northern climate, small human population, and few concentrated disturbed habitat areas, Alaska has relatively few invasive species compared to the rest of the United States. However, as of 2008, Alaska has 116 non-native species according to ADF&G's Alaska Aquatic Nuisance Species Management Plan (Fay 2002; Alaska Invasive Species Working Group 2010). However, factors such as altered disturbance patterns, constant flow of marine-based shipping and cruise ships, fishing and recreational boating traffic, and climate change may increase the prevalence of invasive aquatic species. The most significant vectors for transport of invasive species in Alaska marine waters include oil and liquid natural gas tanker traffic, military vessels, oil and gas drilling rigs, cruise ships and other commercial recreational barges and vessels (Alaska Invasive Species Working Group 2010). Global climate change may create conditions suitable for new invasives, as well as range expansions, by altering geographic range limits and making habitats no longer as suitable for existing native species.

Invasive aquatic species can affect native species by eating them, competing with them, hybridizing with them, disrupting or destroying their habitat, or introducing pathogens or parasites that sicken or kill them (Schrader and Hennon 2005). In addition to natural range extension, several potential pathways exist for introduction of invasive aquatic species. These pathways included fish farms, international and local movement of bait and game fish, trade in live seafood, aquaculture, and contaminated sport angle gear brought into Alaska, as well as ballast discharge from international vessels (Fay 2002; Schrader and Hennon 2005). Several aquatic species have been noted as potential threats to Alaska, including fish (northern pike, Atlantic salmon, yellow perch, ornamental aquarium fish), invertebrates (green crab, New Zealand mudsnail, Chinese mitten crab, zebra mussel, signal crayfish, spiny water flea), plant (cordgrass and Elodea), and several additional miscellaneous taxa (Fay 2002; Schrader and Hennon 2005). Additionally, eastern brook trout (non-native) and non-endemic rainbow trout have been stocked in many areas where they were not native and compete or hybridize with native trout (Schrader and Hennon 2005). Of these fish, transplanted northern pike and Atlantic salmon are the two fish species of greatest concern (Fay 2002).

Even though the invertebrates Chinese mitten crab, green crab, and New Zealand mudsnail have not been found in Alaska, they are of major concern because of their potential to do serious damage to the Alaskan ecosystems (Hines et al. 2004; Schrader and Hennon 2005). The green crab, while not in Alaskan marine waters, has been reported to be in British Columbia coastal waters (ADF&G 2015a). Atlantic salmon that have escaped from fish farms off British Columbia and Washington State pose a threat to native salmon by competing for habitat and introducing diseases and parasites. This species has been observed in Southeast Alaska marine waters and, rarely, in streams (Fay 2002). Also, northern pike, which has not appeared in Southeast Alaska (with the exception of a native stock in Yakutat), have caused widespread damage to resident trout where they have been introduced, and could potentially affect coho salmon through predation. Northern pike have the potential to cause serious environmental and economic damage to highly productive salmon streams in Southeast Alaska (Fay 2002). In the Tongass, there is a risk that these and possibly other non-native sport fish may be introduced into lakes and rivers by individuals seeking to increase sport fishing opportunities. As the road network is extended into more areas and have more of Southeast Alaska and have greater use, this risk increases. Refer to the ADF&G Aquatic Nuisance Species Management Plan (Fay 2002) for additional details.

Renewable Energy Projects

Hydroelectric projects are the major non-diesel energy development project in Southeast Alaska and are an abundant renewable energy resource for the region. There are about 22 hydropower faculties currently in operation. Powerlines are associated with all of these projects. Currently, no other renewable facilities are in operation but some are planned. The deployment and operations of these and their infrastructure have the potential to affect fish resources including potential fish blockage, flow modification, sediment input and loss of stream side vegetation. The details of current facilities are provided in the *Renewable Energy* section.

Environmental Consequences

Direct and Indirect Effects

The current standards and guidelines in the 2008 Forest Plan were developed substantially through work that was done initially by the Anadromous Fisheries Habitat Assessment (AFHA) (USDA Forest Service 1995). Follow-up work in the Tongass after 1995 and other studies have contributed to modifications of these standards and guidelines both in the 1997 and 2008 Forest Plans. Monitoring in the Tongass has helped confirm that the actions taken under the standards and guidelines have protected fisheries resources in the Tongass. The currently considered actions will consider the information history of the implementation and evaluation of the Plans direction as well as how considered modification of the current plan considered under some alternatives may affect fish resources.

Fish Habitat

Roads

Roads pose the greatest risk to fish resources on the Tongass (Dunlap 1996), partly because they pose the largest risk of management-caused sediment input to streams (Reid and Dunne 1984; Furniss et al. 1991; Gomi et al. 2005; Hassan et al. 2005). Road construction, road drainage, level of road use, number of road stream crossings, watershed road density and related actions in forested areas may all influence the amount of sediment to streams (Gomi et al. 2005; Furniss et al. 1991; Swanson et al. 1987; Chamberlin et al. 1991; Reid and Dunne 1984).

As discussed in the *Water* section, road effects to aquatic systems and fish are likely to vary among the alternatives. Factors that vary among alternative that would increase risk or harm to fish include:

- Miles of new and reconstructed roads
- Roads on steep or unstable slopes
- Road density
- Roads in beach fringe
- Roads in riparian areas
- Number of streams crossed by roads
- Number of fish streams crossed by roads

Generally, the higher the number for each of the road parameters noted above, the greater the risk to fish resources. While standards and guidelines are in place to help moderate these effects, some adverse effects, or increase in risk of adverse effects, would occur with these road parameters.

Other than number of road crossing of streams, which is discussed below, the effect of each alternative relative to these parameters is presented in the *Water* section and is summarized relative to fish resources in the Alternative Summary section below.

Fish Passage

Roads may also increase risk to fish movement due to improper construction affecting fish passage (Gibson et al. 2005) and blocked culverts. Stream-rearing fish, particularly cutthroat trout and Dolly Varden, which occupy the smaller headwater streams during some parts of their lives, are at the greatest risk. Juveniles of stream-rearing fish are often highly mobile during their freshwater stage, moving seasonally between stream reaches.

The number of road crossings of streams increases the risk of both adding sediment to streams and impeding fish passage (Class I and II streams). While BMPs for constructing culverts and bridges reduce the risks for sediment and turbidity, monitoring of some streams has found occasional increases in turbidity, at least in the short term, as described in the Forest Service Tongass Monitoring Reports (USDA Forest Service 2004a). Also, fish passage guidelines (Forest Service Handbook 2090.21 Aquatic Habitat Management Handbook [USDA Forest Service 2001]) for culvert design greatly reduces the risk of new culvert installation impeding fish passage on Class I and II streams, but some risks remain.

Reconstruction of existing road crossings also carries risk relating to increased sediment to streams but less than for new construction because in many cases much of the stream disturbance (e.g., new bank disturbance, tree removal) has already occurred. Sediment from reconstructed roads near stream crossings would be less than from new roads as some of the sources of sediment have already had initial erosion (e.g., cut and fill areas), having lost some of the more mobile sediment and becoming more armored and revegetated, which helps stabilize potential erosion areas (Baird et al. 2012). Additionally, the highest erosion rates from roads typically occurs in the first 2 years after construction. While reconstruction would disturb some of the area, it would be less than would occur from developing an entirely new road (e.g., limited new cut and fill, and retention of some bank vegetation). Additionally, some of the sites noted as needing reconstruction would require minimal changes because existing stream crossing structures are fully adequate to meet fish passage and new road uses. However, older reconstructed roads may require completely new structures. Because of this, crossings on roads that would be reconstructed over decommissioned roads were conservatively included in the new crossing category in this analysis. Some of the sites that would be reconstructed would also include replacing old non-fish-passable structures with new fish-passable structures, although this is not a project-level requirement. Thus, the number of reconstructed sites are not comparable in level of potential impact to fish streams as new crossings relative to potential sediment additions.

Some of the original valley bottom crossings of important and sensitive fish habitat areas (e.g., alluvial fans and floodplains) would also not be reconstructed due to cost and risk to fish, thus avoiding some of the potential areas of greater concern. At this planning stage, specific locations where roads would be reconstructed have not been determined.

An index of risks of fish passage impedance based on total new and reconstructed crossings is shown in Table 3.6-4. Currently, about 3,700 fish-bearing stream crossings exist on the Tongass. Any of the alternatives would add substantially to this number, increasing risk. Based on the number of new and reconstructed crossings, Alternatives 2 and 3 would have the greatest risk, while Alternatives 1 and 4 would have the least risk. Alternative 5 would be intermediate based on the number of new and reconstructed crossings. The number of newly constructed crossings at Class I, II, and III streams would be the best indicator of potential sediment increases from crossing construction. The ranking of the alternatives based on the amount of sediment added, based on the number of new crossings only, would be the same as that noted for risk to fish passage impedance, with Alternatives 1 and 4 the least risk, and 2 and 3 the highest, Alternative 5 intermediate.

Table 3.6-4
Estimated Number of Existing[1] and Maximum New Stream Crossings for New Roads[2] and Reconstructed Roads[3] Stream Crossing by Alternative over the Length of the Project (approximately 100+ years)

Stream Class		Alternative									
		1		2		3		4		5	
	Existing[1]	New[2]	Recon[3]	New	Recon	New	Recon	New	Recon	New	Recon
I	1,312	384	259	466	355	438	331	367	262	414	300
II	2,357	691	465	838	639	787	595	660	471	743	539
III	2,433	720	484	873	666	820	620	688	491	775	562
Total	**6,102**	**1,795**	**1,208**	**2,177**	**1,660**	**2,045**	**1,546**	**1,714**	**1,225**	**1,931**	**1,402**

[1] Based on USDA Forest Service 2016 stream crossing data file (Jacobson, personal communication, 2016).
[2] Based on roads estimated to be needed to harvest all scheduled timber in the alternative. Includes new roads and new roads constructed over decommissioned road beds.
[3] Maximum number of stream crossing to be constructed over stored (maintenance level 1) roads, some subset will need replacement or repair

Timber Harvest

Timber harvest activities can increase risk to fish resources. Protection of riparian areas, including floodplains, areas of riparian vegetation, and certain wetlands associated with riparian systems, is of particular concern. As discussed earlier, riparian vegetation serves many important functions for stream fish habitat, including supplying LWD, food input, and stream shade to name a few. Also of concern is the amount of protection afforded steeper channels (often not fish-bearing) in the headwaters areas and protection of steep hillslope areas. These streams (e.g., Class III streams) also require LWD to properly function (Paustian et al. 2006), as well as contributing nutrients, food resources, and, in some situations, LWD to downstream fish streams. Protection of estuaries and beach fringe is also important when locating roads and timber harvest units. The 2008 Forest Plan standards and guidelines associated with riparian areas, wetlands, and beach and estuary fringe are expected to protect fish resources from significant impacts associated with timber harvest, but there is still some level of risk.

Windthrow risk will be evaluated when prescribing thinning and openings treatments in current timber harvest areas and in RMA areas of some of the alternatives to minimize accelerated windthrow. In order to protect the RMA, a RAW zone adjacent to the RMA buffer will be established in situations where multiple high risk factors are present. The risk is related to the level of harvest, the portion of streams in the harvest area, and quantity of potentially unstable slopes in the harvest area associated with each alternative. However, some alternatives would increase the risk to fish and their habitat because Forest Plan standards and guidelines for young-growth harvest riparian areas, wetlands, and beach fringe would be less protective, especially during the first 15 to 25 years of the 100-year projected period under some alternatives.

Effects of timber harvest on water quality issues are addressed in the *Water* section, including the potential for increased landslides that would affect stream habitat quality. The risk of landslides in the future will be moderated by the requirement to evaluate slope stability for slopes over 72 percent prior to approval to harvest, which would continue to be required for young-growth harvest (see *Soils* section). Timber harvest activities on the Forest could potentially affect as many as 272,733 (Alternative 1) to 3367,952 total acres (Alternative 2) after full implementation of the Forest Plan (100+ years) (see *Water* section Table 3.4-4). Alternative 1 would harvest the least acreage, followed by Alternatives 4, 5, 3 and 2 (from least to greatest). The values are expected to reasonably approximate future Forest-wide harvest (see the *Timber* section). Additionally, sediment to streams from landslides is likely to be the greatest under Alternative 2, which has highest estimated increase of landslides at 13 landslides over 25 years when compared to the 2008 Forest Plan (Alternative 1). See the *Water* section for details.

Beach Fringe Harvest

Marine riparian forest areas serve much of the same function in the marine environment as they do on streams (Brennan et al. 2009; Lemieux et al. 2004). This includes reduction of overland sediment entry to local marine waters (see *Water* section), shading primarily shoreline beach areas, adding LWD to the marine system, providing organic input such as insects (a food source for fish) and leaf fall, and bank stability from the root system of large trees. Thus, the harvest of beach fringe in Alternatives 2 through 5 could have some impact on marine and anadromous nearshore marine fish resources. The type of harvest, timber removal methods, and total acres affected differ between alternatives and would influence the magnitude of potential effects to fish and their habitat.

There are some important differences that likely reduce the overall effects from loss of marine riparian forest relative to flowing systems. In most areas, entry of any increased sediment runoff to the marine system would be greatly diluted due to large volume of water in marine systems compared to streams, although some nearshore impacts could occur to benthic resources and, to a lesser extent, fish, which would be more able to avoid such higher turbidity areas. Input of organics may be less important to the marine system due to the relatively high production in these systems relative to streams. However, input of insects to marine systems has been found in some areas to be important food sources for early rearing juvenile salmonids (e.g., Chinook, chum, pink, and coho salmon) (Brennan et al. 2004, 2009; Bollens et al. 2010; Duffy 2003; Moulton 1997; Hillgruber et al. 2007; Fresh 2006; Salo 1991). Romanuk and Levings (2005) found that Pacific salmon (Chinook, chum, and pink) along the British Columbia coast obtained 6 to 40 percent of their carbon from supralittoral vegetation (which include insects), although in some studies insects appear to be very minor food source for juvenile salmonids in some marine waters (Godin 1981; Landingham et al. 1997; Salo 1991). The sources of insects in the marine systems include areas other than just the adjacent forest, such as stream drift and windblown swarms (Brennan et al. 2004). However, a study in Puget Sound found that reduced shoreline vegetation resulted in lower insect diversity and abundance entering the nearshore intertidal areas (Sobocinski et al. 2010). Thus, the importance of marine riparian forests could be highly variable for juvenile marine rearing fish including commercial and recreationally important salmonids.

While LWD in marine systems does not have as great a site-specific effect at forming important habitat as it does in streams, it serves many functions in the marine system (Brennan and Culverwell 2004). LWD helps trap and stabilize sediment in salt marshes where juvenile salmonids may feed, local falling trees on banks affect longshore movement of sediment, and some may become imbedded while others move on. Where LWD accumulates, it may aid in the development of wrack (vegetation derived from both aquatic and upland sources), which helps to stabilize beaches and develop diverse habitats and associated organisms. LWD also supplies substrate for organisms to attach and grow, and may supply cover for small fish to help reduce predation (Brennan and Culverwell 2004). The tree root systems, especially in steep areas, help protect areas from slumping into the marine environment.

Shading from trees is unlikely to have much effect on local marine water temperature, although shading of beach areas (overhanging branches, and abundant trees) has been found to help control sand habitat temperatures and possibly reduce sand desiccation when the tide is out (Rice 2006). These conditions have been found to be important in some areas for development and survival of some organisms. It was found in Puget Sound that surf smelt, which are present in Alaska and spawn in the upper intertidal region, had greater survival in shaded intertidal areas that remained moist and had lower temperature than unshaded areas (Brennan and Culverwell 2004; Rice 2006; Rossell and Dinnel 2007).

The young-growth harvest methods including skid trails, beach traveling equipment, and marine yarding and transport of timber, may results in adverse effects on marine nearshore organisms (see *Water* section). In the short term, benthic organisms may be directly killed in small areas, and fish shellfish resources, possibly including juvenile rearing salmonids, juvenile Dungeness crab, and other primarily juvenile stages of other marine fish, may be displaced while activities are occurring in the nearshore beach areas. While effects would likely be short term, they would be most pronounced for the alternatives removing the greatest number of acres (Alternatives 2, 3, and 4; Table 3.4-4 in the *Water* section). Harvest methods effects to the marine system from Alternative 5 would likely be less than from the other alternatives (except Alternative 1) because the area would be small and the 200-foot buffer would limit further shoreline harvest vehicle access and therefore disturbance.

Overall, the total area of estuarine and shoreline areas that would be affected by any alternative would be small relative to the total shoreline area of the Tongass. Thus, fish resources that could potentially be affected would be slight for any action where harvest is allowed.

Alternative 1 retains current protections allowing no commercial harvest within 1,000 feet of estuarine or beach fringe fully protecting marine resources relative to potential nearshore effects (Table 3.4-4 in the *Water* section). The largest potential effect in the short term would be for Alternative 2, which would allow clearcut to the water edge for the first 15 years of harvesting as well as in non-development Land Use Designations (LUDs), except for Congressionally designated and administratively withdrawn areas, such as Wilderness, and islands less than 1,000 acres in size. Complete removal of the forested stands in the beach fringe would likely reduce all functions of marine and estuarine riparian area at least in the short term.

Alternatives 3 and 4 would allow commercial thinning (up to 33 percent of the basal area) but Alternative 3 would allow it to occur both within and outside of development LUDs and in roadless areas affecting more areas. Harvest in Inventoried Roadless Areas (IRAs) is inconsistent with the 2001 Roadless Rule. If an alternative were selected with harvest in IRAs, harvest would be deferred until the Roadless Rule changes or the Tongass Roadless Rule Exemption is reinstated. Commercial thinning would allow much of the function of riparian forest to remain at a reduced level, as some loss of organic and LWD input would occur, some reduction of shading and less buffering upslope sediment input and reduced bank stability.

Alternative 5 would likely have little effect on the nearshore marine fish resources due to relatively low harvest area and the retention of the 200-foot no harvest buffer. Although the specific harvest opening areas (up to 10 acres maximum) would carry higher risk for soil disturbance effects downslope than comparable commercial thinning areas. Brennan et al. (2009) assessed what size marine riparian buffers were needed to adequately protect their functional contributions of Puget Sound in Washington State. They determined buffer widths that would provide greater than 80 percent effectiveness protection for the functions of fine sediment control, shade, LWD input, and organic input to the marine environment ranging from 79 to 190 feet (depending on the function) of marine riparian forests. Thus, while most riparian functions would be retained with a 200-foot buffer area, some reductions could occur with Alternative 5.

RMA Harvest Outside of TTRA Buffers

Restrictions on timber removal from Riparian Management Area (RMA) buffers are in place to protect both water quality and fish habitat. Details of existing riparian area conditions, how these relate to RMAs, and effects of alternatives on water quality and important watershed components that affect fish resources are described in the *Water* section.

RMA buffers reduce sediment input to streams and also with certain channel types (primarily floodplain and alluvial fan) and conditions supply LWD to streams which is an important habitat component to fish streams. Removal of trees from these areas may reduce future LWD inputs to streams, reduce successful regrowth of future LWD, and cause adverse sediment effects to streams (see *Water* section). The LWD supply, which is critical to floodplain habitat formation and maintenance, would thus be reduced if supply was restricted to the current Tongass Timber Reform Act (TTRA) area and harvest occurs in RMA buffers along some stream systems outside of TTRA buffers. For example, while commercial thinning would grow larger diameter trees faster, it is considered to reduce future LWD abundance in areas harvested (USDA Forest Service 2014d).

Overall harvest in RMAs would reduce large key LWD, probably decrease the stability and longevity of LWD accumulations, and thus diminish the beneficial functions of LWD in the stream ecosystem (Heimann 1988; Murphy and Koski 1989). Furthermore, abundance of juvenile salmonids in a stream often is directly related to the amount of LWD (Murphy et al. 1986; Bisson et al. 1987).

Additionally, harvest in RMA along Class III channels, such as high gradient contained channels, may add sediment to streams that could be transported to fish streams, impacting rearing and spawning habitat. RMA harvest along lakeshores could also contribute to sediment increases, potentially reducing lake fish production.

As discussed in the *Water* section, Alternatives 1, 3, and 4 would generally prevent harvest in RMAs. Alternatives 2 and 5 both have harvest along important channel types outside of TTRA buffers (see *Water* section and Table 3.4-9). As noted in the *Water* section, much of the projected harvest in RMA areas would be in areas not directly adjacent to streams or lake (see "Other" category harvest in Table 3.4-9). Alternative 2 would have a substantial area of harvest (Table 3.4-4 in the *Water* section) but would be limited to commercial thinning, which would reduce site-specific effects. However, commercial thinning under this alternative would occur over a majority of all the available second-growth RMA areas. About 86 percent of past harvested RMA, outside of TTRA buffers, would be harvested by commercial thinning under Alternative 2. Alternative 5 would have a greatly limited RMA harvest area based on model assessment but this alternative would have less restrictive harvest methods (some open areas up to 10 acres maximum in first 15 years only, up to 1,100 RMA acres total), which could have more local, site-specific effects to fish streams than Alternative 2 methods. Overall estimates of RMA area to be affected under Alternative 5 are small, greatly limiting potential adverse effects to fish habitat. See the *Water* section for complete alternative comparison on effects related to water and watershed conditions that have direct and indirect effects to fish.

The Tongass 77 Watersheds and TNC/Audubon Conservation Priority Areas

As noted in the Affected Environment section, there are a number of watersheds and VCUs, including the TNC/Audubon conservation priority areas, that have been evaluated by public, private, and agency groups and considered of importance for fish habitat quality and production. The 2008 Forest Plan (Alternative 1) or Alternatives 2, 3, or 4 do not provide any special management practices for any suitable timber harvest in the Tongass 77 Watersheds or the TNC/Audubon Conservation Priority Areas. Alternative 5 would, however, exclude future old-growth timber harvest in these watersheds. Additionally, based on internal scientific review in collaboration with others, 16 of these VCUs are considered high value watersheds that should be monitored to determine the likely impact to fish and wildlife habitat from young-growth timber projects. Overall, Alternative 5 would afford additional protections, reducing risks associated with old-growth timber harvest actions, to some of the more important watersheds for fish resources in the Tongass.

Fish Habitat Enhancement

Fish enhancement projects, such as fishways and falls modifications, stream and lake stocking, and lake fertilization, would not be affected by any of the considered alternatives. Project enhancement funding and selection of projects is primarily independent of amount or location of timber harvest; therefore, all alternatives would have similar effects on enhancement activities.

Log Transfer Facilities

Timber (logs) are often transported from the harvest areas by barge or log rafts through log transfer facilities (LTFs). The details of the number of LTF sites and the Memorandum of Understanding concerning agreements on use of LTFs by the Forest Service are discussed in the *Transportation* section. As noted in that section, while there are over 100 LTF sites in the Tongass, only 55 LTFs have active permits. The Forest Service currently has state-granted rights to marine access up to a potential of 126 sites, 66 of which have been implemented.

The number of additional log storage and transfer sites that would be developed has not been determined at this time as locations where transport would occur cannot be determined until a Logging System and Transportation Analysis is completed for suitable lands or actual timber sales are proposed. However, considering that past log transport, which was much more intensive than proposed in any future alternative, was handled with the existing LTF sites; it is not anticipated that a substantial number of new LTF facilities would be developed under any alternative and that current sites would primarily be used.

LTF construction and operations in the past have been found to affect benthic resources and some fish-rearing habitat primarily through the accumulation of bark from dumping, storage, and rafting of logs. Some shoreline disturbance can occur from the development of these sites, including modification or loss of habitat through the addition of rock or other structures on the shoreline. There is potential for runoff of sediment and oils from the landing area as well. But the major risk of these sites is the addition of bark to the marine system (Faris and Vaughan 1985). Historically, LTFs have affected approximately 2 acres of marine benthic habitat for the average site, mostly due to bark accumulation (Faris and Vaughan 1985). Bark and other wood fragments that sinks to the bottom, if abundant, can have varied adverse effects to marine areas by reducing organism diversity, burying benthic organisms, and reducing organism abundance (Sedell et al. 1991). If bark accumulations are high enough, specific benthic areas may become anoxic or locally toxic. This could result in adverse effects to organisms such as crabs, shrimp, and nearshore rearing marine and anadromous fish. The bark can remain for extended periods (decades) but, based on dive survey results for LTF sites of concern, the bottom area covered with bark (based on bottom area with continuous coverage) can be greatly reduced within a few years (e.g., 1 to 10) after operations cease (ADEC 2008). Additionally, after deposition has stopped, over time these areas can become biologically similar to areas unaffected by even large accumulations of bark and wood debris (Germano and Browning 2005). Log rafts also have the potential to cause adverse effects to habitat primarily from grounding of the rafts, which can damage intertidal habitats and organisms that are present.

ADEC regulates the permitting of LTF sites in Alaska. While many sites historically were found to violate the state standards for water quality (residue standards), all evaluated sites have improved. The past state standard for residue accumulation was for LTF sites to have less than 1.5 acres of continuous bark coverage. ADEC (2008) reported the results of evaluating 15 sites of concern and found that none of the sites exceeded this standard and did not warrant 303(d) listing. Current requirements for any permitted site are more stringent, requiring less than 1.0 acre of continuous bark coverage at an LTF site.

The Forest Service also has detailed requirements that future LTF sites must meet to be developed (Appendix G of the Forest Plan). Several factors in the guidelines would reduce potential adverse effects to marine fish and shellfish resources. Sites would need to be located where strong currents could disperse bark, be sited in relatively unproductive tidal and subtidal waters, not be sited adjacent to extensive tide flats, kelp or eelgrass beds, or harvest areas of marine organisms. Additionally, log rafts or bundles, should be stored in water over 40 feet deep to prevent grounding. These and other parameters in the guidelines will reduce adverse effects to fish and shellfish resources of any future LTF facilities developed or used.

However, some benthic organisms and rearing fish may be injured, killed, or displaced during the operations of these facilities. Some local habitat reduction in quality would also occur from the bark accumulation, although this would be limited due to the above guidelines and state requirements. Intermittently, some additional bottom disturbance would also occur from barge vessels at specific sites (e.g., anchors and propeller wash).

Generally, effects to marine aquatic resources would be proportional to the amount of timber harvest, as the harvest amount would typically indicate amount of logs transferred through LTFs. This would result in small areas of mostly shallow nearshore habitat covered with wood debris (primarily bark) (most less than 60 feet deep, although some deeper areas), affecting primarily benthic marine organisms in areas of tidal and subtidal habitat, as no more than 1.0 acre of continuous bark coverage would be allowed. Each active or intermittently active sites also would be monitored for extent, distribution, density of accumulation, and thickness of bark layer. These results would be reported to the state to ensure compliance with state criteria. Other monitoring (e.g., oil sheen, site runoff) would occur, depending on site specific characteristics (see Appendix G of the Forest Plan). With the current state regulations, Forest Service guidelines, limited marine area affected, and required monitoring, the level of effects to marine fish and shellfish would be slight for any alternative. In addition, effects of specific LTF use would be evaluated in detail during any future proposed timber sale where LTFs would be used. At this planning-level evaluation, the effects from LTF operations on marine organisms would be greatest in descending order for Alternatives 2, 3, 5, 4, and 1 based primarily on the amount of projected total harvest acres (see Table 3.4-3 in the *Water* section).

Renewable Energy Development

Current and alternative Forest Plan requirements for energy development are provided in the *Renewable Energy* section and Appendix F of this EIS. All renewable energy development projects in Southeast Alaska have to meet detailed local, state, and, in most cases, federal laws, regulations, and requirements to be developed and operated. Additionally, the Tongass National Forest currently applies Transportation and Utility Systems standards and guidelines to this type of development (see *Renewable Energy and Transportation Systems Corridors* section and the current 2008 Forest Plan). These standards and guidelines apply to Alternative 1. The other Alternatives (2 through 5) would eliminate the Transportation and Utility Systems direction and replace it with the Renewable Energy plan components found in the Forest Plan Chapter 5. Under all alternatives, renewable energy projects could be developed on any NFS lands, and the proposed new direction under Alternatives 2 through 5 would eliminate "avoidance areas" which could increase the efficiency and likelihood of developing these projects. The type and number of renewable energy projects currently in or planned in the Tongass are described in the *Renewable Energy* section, with the majority being hydroelectric projects.

Potential effects to fish resources from the construction and operation of renewable energy projects are many. Hydroelectric projects can have a host of potential effects to fish resources. Construction can include the development of additional roads, some permanent and some temporary. As noted above, roads can increase sediment to fish streams affecting fish spawning and rearing conditions, increase basin water runoff adding to peak flow and bed scour. Other construction associated with these projects also could increase potential for landslides, as they often are located in steep areas. The issue of fish passage at road crossings is of further concern. Hydroelectric projects modify stream flow possibly in fish streams, which also could affect habitat quantity and suitability for fish. Rapidly changing rate of flow in streams can result in fish strandings. Natural lakes may be used or reservoirs formed to enhance and control flows. This again could affect habitat in a lake including potential dewatering of shoreline areas that could affect benthic food production and in some cases spawning areas of shoreline spawning fish (e.g., sockeye salmon and kokanee). The formation of a reservoir would result in loss of flowing stream habitat. Dam formation could also block movement of fish, resident or anadromous from accessing streams above the dam, as well as downstream passage of fish and juvenile salmon smolts. The presence of turbines could result in fish mortality for those fish that pass through turbines, and can be mitigated using downstream bypass screens. Other water quality conditions could be affected from flow modifications, or lake and reservoir use such as temperature, dissolved oxygen, and nutrients.

Associated transmission lines also have sets of impacts to fish resources. The construction on land involves clearing of forest, and often road construction. The clearing of forest over streams normally involves removing all trees from the TTRA and RMA buffers on streams crossed. This clearing would result in loss of some of the riparian function on short reaches of streams crossed. Since routes are linear, rarely is any one stream directly affected more than once, although some slight cumulative effects could occur in basins as multiple tributaries to some streams would be cleared. This would include loss of LWD input and reduction of direct organic input from large trees, although lower brush would remain contributing organic input. Loss of shade potentially affecting temperature would occur, although this would again be slight due to the small area and remaining low brush adding shade. The associated roads would have similar effects as those noted for timber management, although they may be rarely used after construction, reducing long-term sediment effects. Marine cables are also a potential transmission route of energy from projects. Their construction would displace and likely kill some benthic resources in small areas along the route and cause possibly greater disturbance and short-term loss of shallow water benthic resources where cables may be buried near entry and exit locations. There would be no long-term effects in the marine system from cables.

Of the 11 known currently proposed renewable energy projects (see Table 3.12b-3), 6 are hydroelectric sites. Nearly all would have some operational effect on anadromous fish resources but, through proper site selection, design, and mitigative actions, impacts to important anadromous fish resources would be greatly reduced or eliminated. All of these proposed sites have water intake, or a proposed dam, upstream of natural anadromous fish resources. The most common types of effect on anadromous fish resources by these projects are changes in downstream flow, downstream substrate supply, or stream temperature, or some combination of these. In most cases, anadromous segments of streams that are downstream of a project are small, with most less than a few hundred feet in length. The proper amount of flow that would need to be maintained in streams to protect fish resources. The amount of instream flow needed, as well as the effects of substrate transport on fish resources, would be determined by the agencies that manage fish resources before the projects could be permitted. In some cases, nearshore marine issues with project siting and construction or sediment movement could have potential effects on early marine rearing habitat for juvenile anadromous fish.

All of these potential impacts for currently proposed or future projects to fish resources would be addressed during the permitting and licensing of these projects. However, even with detailed regulations, some impacts from almost any project would remain that would be compounded with other basin impacts. In basins most heavily developed through other federal, state, and private actions, the development of these projects may be of concern. While under current direction (Alternative 1), renewable energy projects could be developed throughout the forest, the change in Forest Plan direction for renewable energy projects (Alternatives 2 through 5) would, in effect, make it simpler to site projects in what are currently considered “avoidance areas.” The result would be more consideration given to renewable energy site proposals and not necessarily an increase in the number of sites developed. Also, the current number of projects in place and planned are widely distributed across the Forest. This would likely reduce cumulative effects of these actions on any specific basin area. Overall, Alternatives 2 through 5 would likely have little additional adverse effects to fish resources relative to current conditions (Alternative 1).

Alternative Summary

Generally, the alternatives with more roads, greater removal of riparian areas especially including developing small open areas (up to 10-acre maximum) harvest in these areas, and excursions into beach and estuary fringe have the highest potential for adverse effects to fish and watershed resources in the Tongass. The effects to the water conditions, which ultimately affect aquatic habitat, are presented in the *Water* section and contribute to the overall evaluation of alternative effects to fish. Development of the 1997 Forest Plan included an expert panel of physical scientists and fish biologists to evaluate a range of alternatives (Dunlap 1996, 1997). Generally, their assessments are still relevant to the type of timber harvest-related actions that can affect fish resources in the Tongass. These experts stated that as the number of road miles and harvest increased, the likelihood of meeting riparian management objectives and maintaining anadromous and resident fish stocks in the Tongass would be reduced. Also, the greater the riparian protections, the greater the chance riparian objectives would be met in the future. They also stated that a 100-foot buffer on estuarine areas was likely inadequate for protection of salmonids. Of major concern was removal of timber from floodplains, riparian vegetation, and certain wetlands associated with riparian systems. Locating roads in estuarine areas was also of concern for fish resources. These factors were considered in the above metrics presented and summarized below by alternative.

It should be noted that all of the currently considered future alternatives would have considerably less harvest acres and road miles than were being evaluated in the 1997 Forest Plan. The 1997 Forest Plan considered effects of harvest on about 1 million acres of old-growth forest, whereas current alternatives consider up to 370,000 acres of harvest, with a maximum harvest in old-growth forest of about 63,000 acres. Although there has been substantial harvest since 1997, the amount of area potentially affected is still much less than that considered in 1997 under any alternative. Additionally, while there are differences among the alternatives, the overall risk to fish resources and watersheds is unlikely to be large.

Alternative 1: This alternative would have the lowest future harvest, second lowest new road construction, and lowest portion of reconstructed roads of any of the alternatives. This alternative would also have the second lowest number of new stream crossings and lowest potential number of reconstructed crossings of any alternative. All crossings increase risks to fish passage, and new crossings have a greater risk of sediment effects. Given the lower number of new and reconstructed stream crossings under this alternative, there would be an overall lower risk of sediment addition and passage issues than under most other alternatives. Also, riparian (e.g., RMA) and beach/estuary protection would be high because the alternative's Riparian and Beach/Estuary Standards and Guidelines are essentially the same as the 2008 Forest Plan standards and guidelines, while all other alternatives have some reduction in these.

Overall, this alternative has RMA and beach/estuary protections that are equal to or greater than other alternatives with low harvest, low amount of new roads construction and lower number of new stream crossing among the alternatives. Although differences among alternatives are low, considering the importance of the parameters and the relative magnitude of the differences from a fish and watershed status, Alternative 1 likely has the lowest risk level of the alternatives for these resources.

Alternative 2: Because of this alternative's emphasis on young-growth harvest including entry outside of the development LUDs and reduced restrictions on beach fringe and RMAs harvest, it has the highest amount of new and reconstructed roads and total acres harvested. The result would be the greatest number of new and potential reconstructed stream crossings. It would have some of the highest amount of harvest and roads in beach/estuary fringe. Much of this road development and reconstruction and harvest would occur in the first 15-year period when even-age management in beach fringe would be allowed. This alternative would also have the highest harvest of RMAs of any alternative although as commercial thinning (e.g., less than 33 percent of stand basal area), which would minimize LWD supply loss (most pronounced in effects to floodplain and alluvial fan channels). This alternative's high RMA harvest acreage and substantial beach fringe amount and methods all add to the risk to aquatic habitat. Nearshore marine fish effects could occur from marine access harvest methods and log transport, which would be second highest of all alternatives in acres. While the differences among alternatives are not large, this alternative likely has the highest overall risk to fish and watershed conditions.

Alternative 3: Alternative 3 is similar to Alternative 2 in road miles, number of stream crossings, and acres harvested. It has the second highest new and reconstructed road miles, and similar ranking for new and reconstructed road stream crossings. It has a similar but somewhat less amount of harvest than Alternative 2. Unlike Alternative 2, riparian protection would remain high for the same reasons as for Alternative 1 with no harvest in RMAs. However, this alternative would have highest number of road miles and harvest in the beach/estuary fringe over the 100-year period. Since only commercial thinning (e.g., less than 33 percent of stand basal area) would be used in these habitats, potential adverse effects to fish resources would be moderated. Nearshore marine fish effects could occur from this alternative's marine access harvest methods and log transport, which would be the highest of the alternatives. Considering the relatively high amount of roads and stream crossing, good protections for RMA, and lower beach/estuary fringe protections, this alternative would rank low among the alternatives in maintaining fish and watershed resources.

Alternative 4: This alternative has the second lowest and lowest number of both new and reconstructed roads, and new and reconstructed road crossings, respectively. Additionally, it has the second lowest amount of harvest. Beach/estuary fringe protections are reduced from the 2008 Forest Plan, with commercial thinning (e.g., less than 33 percent of stand basal area) allowed but only in development LUDs, resulting in third highest harvest and reconstructed road miles in these habitats. Nearshore marine fish effects could occur from this alternative's marine access harvest methods and log transport, which are lower than most of the alternatives. Riparian areas retain current protections with no additional effects in RMAs ensuring stable LWD supply to all channel types. With a lower amount of new road miles and harvest, full protection of riparian areas, but some reduction in protection of beach/estuary fringes, this alternative would rank in the lower risk range of alternatives to fish resources.

Alternative 5 (Preferred): This alternative falls in about the middle of the alternatives for risks to fish resources and watershed conditions. Total harvest, new and reconstructed road miles, and new and reconstructed road stream crossings fall midway in rank among alternatives. Although RMA and beach/estuary fringe protections are reduced from current conditions, the total amount of these habitats that would be affected is small. Relative to other alternatives, there would be relatively few miles of constructed roads in the RMA habitat over a 100-year period, with most in the first 15 years. It would have the least road miles and harvest acres in the beach fringe of the four action alternatives that would allow harvest there. Also, less than 4,000 acres of beach/estuary fringe would be affected, including optional maximum 10-acre open area cuts. No harvest could occur within 200 feet of the beach, greatly limiting effects to the nearshore marine habitat from the limited open area harvest management. Nearshore marine fish effects are unlikely to occur from harvest access methods as marine access harvest is unlikely. While open area harvest up to 10 acres maximum plus commercial thinning up to 35 percent of existing stands would be allowed in RMAs, these would only occur in development LUDs and the Old-growth Habitat LUD. These alternative characteristics, and other Forest Plan restrictions and levels of harvest, would result in few acres (less than 1,100) of young-growth timber being harvested in RMAs over the first 15 years, and none after. While some RMA and beach/fringe protections would be reduced from current plans, the overall effects of this change Forest-wide would be low. Additionally, there are 73 VCUs and TNC/Audubon Conservation Priority Areas considered important to fish resources that would be excluded from future old-growth timber harvest, eliminating risk to fish resources in these watersheds from old-growth timber harvest. The overall effects from this alternative's actions would be in the middle range of effects to fish resources among alternatives considered.

Special Status and Invasive Species Assessments

Threatened and Endangered Species

Consultation requirements for the Forest Plan Revision under Section 7 of the ESA, as amended, were completed with the USFWS and NMFS for the 1997 Forest Plan EIS. Both USFWS and NMFS reviewed the biological assessments for threatened and endangered species under their regulatory jurisdiction and concluded that the Tongass Forest Plan Revision was "not likely to adversely affect" threatened or endangered species occurring on the Tongass for the 1997 Plan. These findings were made subject to the programmatic scope of the Forest Plan Revision and following the associated Forest-wide standards and guidelines (see Chapter 4 of the 1997 Forest Plan).

Formal and informal consultation procedures (as directed by the ESA, as amended in 50 CFR 17.7, and Forest Service Manual 2670) are used with NMFS and USFWS on all projects that implement the 1997 Forest Plan and subsequent amendments. Forest-wide standards and guidelines (see Chapter 4 of the Forest Plan) for threatened, endangered, and sensitive species direct that all projects would comply with requirements of the ESA, as amended, and Forest Service policy (Forest Service Manual 2670).

The Selected Alternative (Alternative 6) of the 2008 Forest Plan Amendment FEIS was deemed through the consultation process to not likely adversely affect any of the threatened or endangered fish species occurring on the Tongass. The action alternatives being examined in this EIS would also likely fall in this category because the considered actions have the same or similar protective measures as Alternative 6 from the 2008 FEIS with a few potential exceptions, as discussed below. Additionally, future considered alternative plans have much lower harvest levels and therefore less use of LTF facilities and associated developments, further reducing potential adverse effects to listed fish.

As stated in the Affected Environment section, there are six Chinook salmon, one sockeye salmon, one coho salmon, one chum, five steelhead, and one green sturgeon evolutionarily significant units (ESUs)/DPSs that are federally ESA listed that may be present in waters potentially affected by project alternatives. Consultation with NMFS concerning potential project actions and their effects on these listed ESU/DPSs was initiated with the development of a BA (included in the planning record) and will be finalized with the completion of the FEIS and Record of Decision.

No ESA-listed stocks of salmon or steelhead originate (spawn) in Alaska streams. Listed species and stocks originate in freshwater habitats in Washington, Idaho, and Oregon. Some of these listed species migrate into marine waters off the coast of Alaska. While distribution of these stocks is primarily in outer coastal waters, some are occasionally present in the inner waters of Southeast Alaska and they may feed on prey resources originating within marine and estuarine waters of the Tongass National Forest.

The southern DPS of the green sturgeon is rarely present in Southeast Alaska waters. Most are believed to stay south, but some could be present in the inside waters of Southeast Alaska, particularly during the fall and winter. They migrate south again in spring (Lindley et al. 2008). The adults live in nearshore waters typically less than 100 meters deep (Lindley et al. 2008). Based on their regional and seasonal distribution, they would be uncommon in nearshore areas where potential project actions may have some effect.

Beach and estuarine fringe harvest of Alternatives 2, 3, 4, and 5 have a greater chance of affecting nearshore habitat that may supply prey resources to listed salmon, steelhead, or green sturgeon than actions evaluated in the 2008 Forest Plan Amendment. Currently, there are about 17,000 miles of shoreline in the Tongass National Forest lands, and about 500 miles have past harvest. A subset of these areas, depending on the alternative, would be harvested over a 100+-year period. Nearshore marine bottom disturbance to intertidal and subtidal habitats could be caused by nearshore log yarding, vehicle travel on beaches, log rafting, and log loading and yarding vessel anchorage and associated activities. Effects on marine bottom disturbance could cause some short-term local reduction in some prey resources that could be utilized by rearing salmon, steelhead, or green sturgeon. Marine access to harvest these beach fringes would be limited for all of the alternatives, because much of the harvest would occur by road and helicopter, which would reduce the potential for nearshore disturbance. Runoff from the logging areas could also contribute sediment to the nearshore areas, which may smother benthic and epibenthic organisms, some of which are prey resources for juvenile salmonids and green sturgeon. These effects would be short term and local, primarily restricted to central landing areas along the beach, although some may occur near any skidder trails that may be accessed by the beach. Anchorage of barge log loading, log rafting, and possible A-frame yarding barges would have limited bottom disturbance either from grounding and/or anchor location. In most nearshore locations, the dynamic nature of beach and intertidal areas would be accustomed to moderate, natural disturbance and therefore somewhat resistant to additional disturbance that may be caused by shoreline harvest-related actions. As discussed in the Beach Fringe Harvest section above, there could be some reduction in terrestrial food sources with removal of trees from these area. These sources of food have been found to be of use by some salmonid rearing stages. These reductions, however, would be very small relative to other sources of food in the marine system. Overall, some indirect effects could occur to food sources for the listed species. For any of the listed fish species, however, the area of effects would be limited and use of any of these areas would be remote considering their limited distribution in Southeast Alaska marine nearshore waters.

Site-specific nearshore marine habitat-disturbing actions, or any other ground disturbing action, are not, however, directly authorized under the considered alternatives of the Forest Plan. Thus, the considered actions of the alternatives will not have any direct adverse effects to any of the listed species addressed in this section from potential nearshore marine disturbance. Any proposed actions indirectly resulting from the considered alternatives will be evaluated on a case-specific basis as to their effects to listed species. This may include formal or informal consultation with NMFS at the time of project-specific evaluations.

Because of the listed fish species' very limited distribution relative to the project area and lack of direct project-authorized action effects to the marine environment, it is not anticipated that adverse effects would occur to any endangered or threatened salmon, steelhead, or green sturgeon ESU/DPS listed species from any of the alternatives. The details of potential effects to listed species are presented in the BA, which is included in the planning record.

Essential Fish Habitat Assessment

Section 305(b)(2) of the Magnuson-Stevens Act requires all federal agencies to consult with the Secretary on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. This consultation is completed for site-specific projects with ground-disturbing activity. The application of Forest-wide standards and guidelines and best management practices (BMPs) developed to meet soil protection, water quality standards, and fish habitat protection will help protect EFH on the Tongass National Forest and adjacent estuarine and marine waters. Adoption of the Forest Plan does not specifically result in any actions that could affect EFH, and any action that would be taken following adoption of the Plan that could affect EFH would have a formal EFH developed. No formal EFH will be developed for the considered actions in this EIS.

Sensitive Species

There are no aquatic sensitive species on the Tongass National Forest.

Invasive Aquatic Species

ADF&G lists four species of fish that are non-native to Alaska found in Alaskan waters (Fay 2002). Only two, the Eastern Brook trout and Atlantic salmon, have been found in the aquatic habitats of the Tongass National Forest. Additionally, northern pike, which has only been found in apparently native waters in the Yakutat area in the Tongass, is of greatest concern because of its potential to directly impact native salmon species. Other aquatic species, including the Chinese mitten crab and New Zealand mudsnail, both of which can inhabit freshwater, are a major concern for impacts they would cause if they invaded these aquatic habitats (Schrader and Hennon 2005; Fay 2002). Also, the green crab, while not in Alaskan marine waters, has been reported to be in British Columbia coastal waters (ADF&G 2015a). While no alternative would have substantial effects on invasion or establishment of non-native aquatic species, some actions could have indirect effects. One of the biggest concerns for invasive fish is active stocking of waters primarily with species often considered game fish in other areas. This would apply primarily to northern pike, which can inhabit lakes and rivers. In general then, alternatives that increase human access to fresh waters within the Forest would have the greatest risk of increasing invasive aquatic species in aquatic habitat of the Forest. The major form of increased access to aquatic habitats of the Forest would be through increased roads where people may travel with invasive species either intentionally, such as northern pike, or by accident, such as in the case of some aquatic species, like the New Zealand mudsnail. Based on this criterion, the relative risk would be proportional to road miles (Table 3.4-5), with Alternative 1 having the least and Alternative 5 the most risk. Additionally, increased use of marine vessels for log transport or shoreline harvest of beach fringe areas (primarily Alternatives 2, 3, and 4) would increase risk of inadvertent entry of marine invasives like the green crab.

Conclusions – Direct and Indirect Effects

Much of this EIS evaluation has been based on the conclusions, derived from scientific literature, monitoring reports, and expert evaluations, that 2008 Forest Plan standards and guidelines, practices, and related BMPs are adequate to ensure minimal or no harm to fish resources, at least for most of the alternatives considered. However, there is a degree of scientific uncertainty associated with these conclusions. The current Plan has only been in place for 20 years, although many of the practices have been in place longer. The active monitoring that has been occurring does not suggest marked problems with water quality or fish resources as a result of these actions (USDA Forest Service 2004a, 2007, 2014a). While active monitoring has been occurring, the full effect of these types of actions has not had an extensive period of evaluation. Even though relevant information indicates protections would be adequate under most of the alternatives, there is some risk to fisheries resources in implementing any of the considered alternatives because all would result in increased road construction, reconstruction, stream crossings, and increased harvest. Also, some have less protection for important fish-related habitat than the 2008 Forest Plan.

Based on best available science, it can be concluded that there is a relatively low long-term risk to fish habitat from any alternative because of low levels of timber harvest and road construction and reconstruction, and the relatively high riparian protections offered by Forest Plan standards and guidelines for most alternatives. However, the allowance of harvest in previously protected beach/estuarine fringe and or RMA areas increase risk to resources where the harvest in these areas occur under Alternatives 2 through 5. Each of these four alternatives includes actions to reduce adverse effects to beach fringe and RMA conditions. For RMA areas, no harvest would be allowed in the TTRA buffers that supply most of the functions to most fish stream habitat in the Tongass National Forest. Also, none of alternatives would allow more than 33 to 35 percent of existing RMA stand to be removed, and, for Alternative 5, maximum open area harvest would be limited to 10 acres. Selection of these areas for harvest would only occur when other young-growth areas are not available, all of which would moderate but not eliminate adverse effects. Any designated commercial harvest in RMAs may reduce the objective of advancing the seral stages toward old-growth conditions in RMA habitat (USDA Forest Service 2015c). Beach fringe harvest effects would be moderated by allowing only commercial thinning (less than 33 percent of the stand) (Alternatives 3 and 4), restrictions on when harvest could occur (first 15 years only for Alternative 2), and a 200-foot beach buffer (Alternative 5).

Among alternatives with commercial harvest allowed in beach and estuary fringe or RMA, Alternative 2 would have the most risk because it has some of the highest harvest rates, includes even aged management in the beach fringe, and has a higher number of new and reconstructed road miles.

Cumulative Effects

General

The effects of the alternatives on fish resources may be influenced by other actions occurring in the project area. Appendix C provides a complete list of past, present and reasonably foreseeable actions considered for cumulative effects and indicates which of these interact with aquatic resources affected by the Forest Plan alternatives. The main factors affecting fish are related to land development actions that occur regionally. This primarily includes other timber harvest-related actions on non-NFS lands, especially associated roads. The total lands within the Tongass National Forest boundary, which includes all NFS lands and other non-NFS lands, is about 17.8 million acres. Of this, only about 6 percent (1.1 million acres) are non-NFS lands. However, development actions on these non-NFS lands, which include most cities and towns in Southeast Alaska, are moderately intense.

Cumulative effects to fish resources include those actions that affect water and watershed resources, such as the development of roads. These cumulative effects are detailed in the *Water* section. Generally, overall average road density, which is an indicator of potential adverse sediment effects to streams, would increase markedly on non-NFS lands, but across the region (NFS and non-NFS combined) would only increase slightly in the future 100 years (Table 3.4-12) for all alternatives. The number of watersheds that would be considered to be either “fair” or “poor” (implying likely reduced fish production potential), based on road density greater than 1 mile per square mile (USDA Forest Service 2011a), would increase in the future (Table 3.4-13). However, few watersheds would change to these lower function categories and that number varies little among alternatives (range 19.6 to 20.0 percent of all watershed in these categories for all alternatives).

Effects on fish resources are less directly tied to the amount of timber harvest than to roads, but harvest may affect fish through effects to water quality, riparian condition, and where the harvest occurs, as discussed under Direct and Indirect Effects. The cumulative effects of timber harvest on water quality were discussed in the *Water* section for all lands (including non-NFS lands) within the Forest boundary and relate to potential effects to fish resources. Existing conditions include retention of 86 percent of the original productive old-growth forest inside the Forest boundary and 95 percent of the land area remaining undisturbed from direct timber harvest (Table 3.4-10 of the *Water* section). Overall, the cumulative effects to fish relating directly to quantity of timber harvest would be similar under all alternatives; about 82 percent of the original productive old growth on all lands within the Forest boundary would be retained for each alternative. Total cumulative effects to fish resources, based on relative amount of area disturbed, and would be slightly lower than existing conditions at 94 percent. However, some local regions may have fish resources affected where watershed harvest levels and road density are high. Additionally, with less protection for riparian areas on state and private land (e.g., no required buffers on non-fish-bearing streams and resident fish-bearing streams), a greater risk to fish resources would occur in watersheds that have a high portion of non-NFS harvest occurring. Again, effects of harvest activities on fish resources would ultimately be considered at the project-specific levels, ensuring minimal adverse cumulative effects.

Climate Change

Climate change is one factor that has some unquantifiable potential to affect fishery resources on the Tongass. Several models used in recent literature agree that temperatures and precipitation in Southeast Alaska and the Tongass National Forest will increase this century (Shanley et al. 2015; EcoAdapt 2014). One set of models specifically for Southeast Alaska projects annual air temperature increase of 0.5 to 3.5 degrees Celsius (°C) by 2050 and 2 to 6°C by 2100. Annual precipitation increases are projected to be 5 to 15 percent by 2050 and 15 to 35 percent by 2100 (summary from EcoAdapt 2014). These value estimates vary substantially between locations in Southeast Alaska. Higher temperature increases are expected in the winter months, with greatest precipitation increases expected in winter and fall (EcoAdapt 2014). With warmer temperatures, much of the precipitation that currently is snow will fall as rain. The result will include greater melting of glaciers, higher peak flows in the winter and fall in most streams other than glacial-fed streams, and, even with increased precipitation, lower summer flows primarily in snowmelt- and rain-fed dominated basins, which would include the majority of major fish-producing systems in Southeast Alaska (Shanley and Albert 2014; Shanley et al. 2015).

The effects to fish resources in the Tongass National Forest from these changes would be both positive and negative and will vary by species, life stage, and location. Reduced stream flow in summer months and high water temperatures during this same period have been a common concern for salmonid populations in much of their native range.

One of the main factors affecting fish resources would be changes in stream temperature. Higher temperatures would result in faster egg development and emergence of fry. In the case of pink and chum salmon, which migrate directly to the marine environment after emergence, this may be a negative conditions as the historical planktonic food sources may not be as abundant in the marine system earlier in the late winter and early spring (Heard 1991; Salo 1991). Increased temperature could result in faster growth of rearing fish as long as food supply is adequate and temperatures do not become stressful. Unlike streams in the lower Pacific Northwest (e.g., Washington, Oregon), summer temperatures in most locations in the Tongass are well below upper levels of concern for rearing fish so some temperature increase would not be an issue in many areas. Although some areas, especially where nutrients are limited, production may not be enhanced with elevated temperatures. In the case of coho salmon, side channels may have lower flows and increased temperatures, which could reduce their usability. Coho salmon in Southeast Alaska typically rear for 2 years before smolting, likely because low production is related to low stream temperature. Should growth increase, some may smolt after one year's growth. This could be an advantage because they would not suffer an extra year of overwinter freshwater mortality, which can be high. This may be complicated if they are relatively small after one year's growth while entering the ocean, because the small size would be a disadvantage for marine survival. Elevated temperatures in lakes may also be of benefit for lake-rearing species because growth may increase in these systems, if available food supply is adequate, perhaps most noticeable in sockeye salmon, which generally need lake systems for rearing. Elevated lake temperatures may also benefit coho salmon and resident trout and char in those lake systems. Increased growth of coho and sockeye salmon has been observed in a lake system in Southeast Alaska during a period of higher water temperatures (Shanley et al. 2015). However, elevated temperature would likely increase rate of predation on juvenile fish by other fish species (e.g., cutthroat trout and Dolly Varden).

Life history of some species may be affected by temperature changes. Increasing water temperatures may affect whether *Oncorhynchus mykiss* (rainbow trout/steelhead) are anadromous or resident. While anadromous behavior is influenced by genetics, it is also influenced by environmental factors (Kendall et al. 2015; Pearse et al. 2009). Some studies have found that warmer waters increase the rate of anadromous smolt formation in *O. mykiss* stream populations (Sloat and Reeves 2014). Also in some similar natural stream systems studied by Kendall et al. (2009), those with higher temperatures, among other factors, tended to be dominated by anadromous and not resident forms *of O. mykiss*.

Elevated stream temperatures in the late summer may also be detrimental to returning spawning fish, primarily pink and chum salmon, that enter in late summer during low flows, and may hold in pools. These pools may have elevated temperatures and related low dissolved oxygen that could affect timing of entry or survival for fish that do hold in these pools (Bryant 2009). The upstream migration of sockeye salmon also occurs in the late summer and may be adversely affected by warmer waters. Prior to spawning, however, these salmon usually hold in lakes, which would be buffered from the streams' potentially higher temperatures and lower oxygen conditions.

Increasing precipitation in the winter likely increases the risk of landslides and debris flows that may enter streams (Bryant 2009). Areas that historically received precipitation as snow may get more as rain as estimated for climate change. Saturated soil and intense rainfall increases the risk of slides (Bryant 2009), which could affect streams by adding sediment and scouring stream beds, while also adding wood. Heavy sedimentation and bed scour is detrimental to rearing and spawning habitat, while the addition of large woody debris may be beneficial because it aids in habitat formation and retention within streams.

Change in flow regime also would have positive and negative effects. Increased winter and fall flow may supply increased overwinter habitat including access to and formation of off-channel habitat areas for some species (e.g., coho salmon, Dolly Varden, cutthroat trout, and steelhead). However, if flows are high with elevated peaking in fall and winter, egg scour could occur, which would be detrimental for many fall spawning species (e.g., all salmon species) (Shanley and Albert 2014; Bryant 2009). Sloat et al. (in press) modeled the likely effects of future flow changes from climate change on spawning conditions in Southeast Alaska. They noted that median annual average flood flows would increase by 28 percent by 2080. The estimated effects on habitat varied by watershed and stream morphology–specific conditions. Many species of Pacific salmon have adapted to high flows by selecting coarser spawning substrate (depending on species size) and locations away from the channel center (May et al. 2009).

Low summer flows would be detrimental to over-summer rearing fish, which could include coho and Chinook salmon, steelhead, cutthroat trout, and Dolly Varden, by reducing rearing habitat area and possibly food supply. However, reductions in summer flow may need to be substantial to affect overall juvenile salmonid survival and growth (Harvey et al. 2006; Grantham et al. 2012). If summer mortality rates increase because of higher temperatures, later life-stage survival rates may increase to compensate for this increased seasonal mortality (i.e., density dependence). The diversity of the local fish stocks and their life stages will contribute to resiliency of regional species to moderate effects of both temperature and flow changes.

Climate change could also result in sea-level change. This sea-level rise could inundate estuarine rearing areas for fish. Stream mouth areas of some low-gradient small streams, which are used by some rearing fish including coho salmon, could also be inundated with salt water if sea-level rises were substantial. Pink and chum salmon in some areas spawn in intertidal regions, which could be affected with sea level rise. Current predictions are for a sea-level rise of 1.3 to 2.1 feet by 2081-2100 (Shanley et al. 2014). However, the Southeast Alaska land mass is rising in many areas; due to isostatic rebound from past glaciers, sea level in Southeast Alaska is decreasing by as much as about 3 cm/year (1.2 inches/year) (Larsen et al. 2005). Some areas, particularly in northern Southeast Alaska, may rise 1 to 4 feet over the next century (Kelly et al. 2007). This rate of land rebound increase would likely offset sea level rises over most of the Tongass shorelines. Thus, overall effects on estuarine areas, coastal stream mouths, and fish stocks would vary considerably and changes are difficult to predict and may even be difficult to detect.

In summary, there is general agreement that the climate is warming, precipitation will increase, and flows will increase in the fall and winter but decrease in summer in snow- and rain-dominated watersheds. However, there is uncertainty surrounding specific predictions and even more uncertainty regarding the effect of these changes on resources including fish.

Conclusions – Cumulative Effects

Overall, the cumulative effects of the Forest Plan alternatives, in conjunction with other actions described in Appendix C, primarily roads and timber harvests, would increase the regions of greatest risk for fish resources. While all alternatives would increase high road density areas, overall the number of watersheds with increased risks to fish remain relatively small. There is little difference among the alternatives on risk of road density increasing into undesirable conditions at the watershed level because the overall amount of new roads remains low on a forest level, with higher road density areas (e.g., greater than 1 mile/square mile) ranging from about 19.6 to 20.2 percent among the alternatives for all lands combined. Cumulative effects of actual timber harvest would follow a similar trend among the alternatives; however, the potential cumulative effects of harvest, road building, and other actions would be evaluated on a project-specific basis so that the potential for adverse cumulative effects to fish resources within a given watershed could be reduced or eliminated. The cumulative effects of climate change are not clear but some of the changes could be detrimental to fish resources.

This page intentionally left blank.

Plants

Affected Environment

This section describes the affected environment for plants on the Tongass National Forest. It is divided into the following areas of focus: Plant Communities, Threatened and Endangered Species, Region 10 Sensitive Plants, Rare Plants, and Invasive Plants. The *Plant Communities* and *Vegetation Classification* subsections provide an overview of vegetation and describes the process and status of vegetation classification and vegetation mapping on the Tongass. The *Threatened, Endangered, Sensitive, and Rare Plants* and *Invasive Plants* subsections include an overview of current conditions. The detailed description and effects analysis to vegetation on a habitat/landscape scale are in the *Biodiversity* section of this chapter.

Plant Communities

The composition, age, and structure of the plant communities on the Tongass are the result of interactions between biological and physical environments, natural disturbances, and land use history. This subsection introduces the ecological context for the common forested and non-forested plant communities.

The coastal forest of Southeast Alaska is within the cool, temperate rainforest that extends along the Pacific coast from northern California to Cook Inlet in Alaska. The forest is dominated by conifers, primarily western hemlock *(Tsuga heterophylla)*, Sitka spruce *(Picea sitchensis)*, and western redcedar *(Thuja plicata)* (south of Frederick Sound). Mountain hemlock *(Tsuga mertensiana)* grows throughout the forest and is the dominant tree just below and at treeline. Pacific yew (*Taxus brevifolia*) and Pacific silver fir (*Abies amabilis*) grow at the extreme southern end of the Tongass. Lodgepole pine (*Pinus contorta* var. *latifolia* and *P.contorta* subsp. *contorta)* and yellow-cedar *(Callitropsis* [*Chamaecyparis*] *nootkatensis)* are scattered throughout the forest. Populations of subalpine fir (*Abies lasiocarpa*) grow from upper Lynn Canal south along the mainland to the Hyder area and west to Prince of Wales Island. Red alder *(Alnus rubra)* is common along streams, beach fringes, and on soils recently disturbed by management activities. Black cottonwood *(Populus balsamifera* subsp. *trichocarpa)* grows on the floodplains of major rivers and recently deglaciated areas.

Blueberry and huckleberry *(Vaccinium* spp.), rusty menziesia (*Menziesia ferruginea*), devil's club *(Oplopanax horridus)*, and salal *(Gaultheria shallon)* in the south, are common shrubs in forested communities. The forest floor supports a variety plants, including false lily-of-the-valley *(Maianthemum dilatatum)*, bunchberry *(Cornus canadensis)*, five-leaf bramble *(Rubus pedatus)*, and oak fern (*Gymnocarpium dryopteris)*. Because of the high amount of rainfall and high humidity, a wide variety of mosses and liverworts grow in great profusion on the ground, fallen logs, the trunks and branches of trees and shrubs, as well as in forest openings. Hundreds of lichen species grow on tree trunks, branches, and on the ground, especially in old-growth forests, riparian areas, and maritime beach fringe forests.

Upper beaches, estuaries, lake margins, and muskeg edges support grass and sedge meadows. Thickets dominated by willow *(Salix* spp.) and Sitka alder (*Alnus viridis* subsp. *sinuata*) occur in recently deglaciated areas, river channels, avalanche chutes, sub-alpine communities and beach/forest ecotones. Muskeg (peatland) communities, which occur in poorly drained areas throughout the forest, are dominated by peat moss *(Spaghnum* spp.), sedges *(Carex* spp.), low shrubs and scattered shore pine *(Pinus contorta* subsp. *contorta)*. These non-forest vegetation types are also described in the *Wetlands* and *Biodiversity* sections of this chapter.

Above the treeline, a mosaic of plant communities blanket the subalpine meadows and alpine tundra. Subalpine meadows support an array of taller herbs and grasses. Plants of the more exposed alpine tundra are mat-forming, grow close to the ground and include plants from the heath and rose families, willows, clubmosses and lichens. Cushion-forming plants and non-vascular plants (lichens, mosses, and liverworts) occupy exposed rock outcrops, crevices, and talus slopes.

Vegetation Classification

Integrating vegetation information in analysis, planning, and decision making requires the development of vegetation classifications, which in turn are applied to vegetation maps, some of which are developed from remotely sensed imagery or ecological models. Classification of vegetation types is an established tool designed to group similar entities into named types or classes based on shared characteristics that facilitate our study, understanding, and communication of ecological information. Vegetation classifications are the basis for development of vegetation types at various spatial scales which have been widely used in forest planning, project planning, wildlife management, and silviculture in the National Forests. Vegetation classifications can be used to identify realistic objectives and management opportunities, determine capability and suitability, and evaluate forest health (USDA Forest Service 2011b). They can also be used to streamline monitoring design and facilitate extrapolation of monitoring interpretations; determine effects of disturbance or management actions; assess risks for the introduction of invasive species, fire, insects, and disease; and describe current habitats for plant and animal species based on current vegetation composition, structure, and function (USDA Forest Service 2011a).

On the Tongass National Forest, fine-scale vegetation communities known as plant associations have historically been used for analysis of silvicultural treatments. Work on describing forested plant communities on the Tongass began in the early 1980s. Three guides, one each for the former Ketchikan, Stikine, and the Chatham Areas, were developed to identify and describe forested plant associations (DeMeo et al. 1992; Pawuk and Kissinger 1989; Martin et al. 1995). Additionally, a fourth guide described plant communities of all lifeforms (herbaceous, shrub and forest types) in the Yakutat Foreland (Shephard 1995). Non-forested plant communities have also been described for the Stikine and Taku River ecological subsections, as part of the Key Coastal Wetland Initiative (Turner 2010). These guides provide a key for identifying the plant associations based on dominant and diagnostic species in the tree, shrub, and herb layers of the Forest. Forested plant association names consist of the dominant tree species that occurs in the overstory canopy, along with dominant or diagnostic species found in the shrub and/or herb strata (layers). Plant association descriptions include species cover and constancy (how often a species occurs in a particular association), productivity estimates, and management considerations to guide the interpretation of site productivity on an area with a specific plant association.

In the Tongass plant association guides, forested plant associations are grouped into the following series (also known as alliances) based on the dominant tree species in the overstory canopy:

- Black Cottonwood Series
- Mixed-Conifer Series
- Mountain Hemlock Series
- Shore Pine (Lodgepole Pine) Series
- Sitka Spruce Series
- Sitka Spruce – Black Cottonwood Series
- Western Hemlock Series
- Western Hemlock-Western Red Cedar Series
- Western Hemlock-Yellow Cedar Series

Vegetation Mapping

Forest-wide overstory vegetation has been mapped using “CoverType”, a Geographic Information System–based data set that is a photo-interpreted delineation of the Forest by land type and timber cover type. CoverType delineates the Forest according to broad forest canopy cover types. CoverType also tracks vegetation changes through time (as modified by natural events or management activities) in addition to its natural condition. Information for forested stands includes forest cover type (dominant overstory tree species), size class (e.g., seedling, sapling, young growth, or old growth), productivity class, and volume class. Generalized non-forested conditions are also mapped (e.g., rock, ice and snowfields, alder, brush, muskeg-meadow, uplifted beach, alpine, sand dune, etc.).

Additionally, a model for classifying commercially productive forests of the Tongass has been developed that organizes forested stands into seven structural classes, using tree size (quadratic mean diameter) and tree density (trees per acre) categories (Caouette and DeGayner 2005). This map product, referred to as Size-Density, is described in the *Biodiversity* section of this chapter, and has been used to describe forest structural diversity and wildlife habitats.

Mapping vegetation communities at the plant-association level has not occurred on the Forest. Producing plant-association maps requires large amounts of field data and high-resolution imagery combined with modeling; therefore, plant-association maps are not now possible at the Forest scale. It is possible that in the future plant associations map products, which meet national standards for vegetation maps, may be developed on a project-specific basis. New and updated mid-level (alliance and/or dominance type) maps of vegetation types sufficient for Forest- or watershed-scale analysis may also be developed in the near future.

Threatened, Endangered, Sensitive, and Rare Plants

Threatened and Endangered Plants

There are no federally listed or proposed threatened or endangered plants under the Endangered Species Act known to occur on the Tongass National Forest. The only federally listed or proposed plant in Alaska is the Aleutian hollyfern (*Polystichum aleuticum)*, which is listed as endangered. It is only known to occur on Adak Island and is not expected to occur on the Tongass National Forest. A petition to list yellow-cedar (*Callitropsis nootkatensis*) was filed with the U.S. Fish and Wildlife Service (USFWS) on June 24, 2014. The 90-day finding of this petition, published on April 10, 2015 (80 Federal Register 19263), determined that the petition to list yellow-cedar presented "substantial scientific or commercial information indicating that the petitioned action [to list the species under the Endangered Species Act] may be warranted". A 12-month status review will be conducted by the USFWS to determine whether this petitioned action is in fact warranted. Yellow-cedar is broadly distributed across the Forest, although it is absent or rare over large portions of the Forest that appear to be suitable habitat (Hennon et al. in review).

Alaska Region Sensitive Plants

Sensitive plants are those plants identified by the Regional Forester for which population viability is a concern on National Forest System (NFS) lands within the region. A viability concern is identified by either a significant existing or predicted downward trend in population numbers or density, or a significant existing or predicted downward trend in habitat capability that would reduce a species' existing distribution. The objective of the Forest Service Sensitive Species Program (Forest Service Manual 2600 [USDA Forest Service 1991]) is to ensure that species numbers and population distributions are adequate so that no federal listing will be required and no extirpation will occur on NFS lands. Revisions to the Regional Forester's Sensitive Plant Species list are periodically completed based on new information derived from recent publications, field work, and laboratory analysis. The Alaska Region Sensitive Species list was updated in 2009 (Goldstein et al. 2009). Eighteen plants are designated as sensitive; 14 of these are known to occur on the Tongass National Forest, with an additional two that are not known but are suspected to occur. The 16 sensitive plants known or suspected to occur in the Tongass National Forest are listed in Table 3.7-1. This table includes a general range and habitat description for each species.

Sensitive plant surveys are conducted as part of project planning to identify populations or habitats of sensitive species within planning areas. Our understanding of sensitive and rare plant distribution across the Tongass is limited because most botanical surveys are focused on specific project areas.

Rare Plants

The Alaska Natural Heritage Program (ANHP) maintains a list of plants that are rare in Alaska. The ANHP Rare Vascular Plant List was most recently updated in 2012. This list contains 126 plants documented to occur on the Tongass National Forest. The 2008 Tongass Land and Resource Management Plan (Forest Plan) defines rare plants as:

> "…those with potential conservation concerns on the Tongass National Forest. They may be common elsewhere; however, the edge of their range is known or suspected to be on the Tongass National Forest, or disjunct populations of the plant species occur on the Tongass National Forest."

Table 3.7-1
2009 Alaska Region Sensitive Plants Known or Suspected to Occur on the Tongass National Forest[1]

Common Name (Scientific Name)	Range and Habitat[2]
Eschscholtz's little nightmare (Aphragmus eschscholtzianus)	This plant grows in southern Alaska and adjacent Canada in a band extending from the Aleutians through the southwest Yukon. There are also disjunct populations on the Seward Peninsula and in the Brooks Range. It is suspected to occur in mountainous areas on the northern mainland of the Tongass. It grows in moist mossy areas, seeps, heaths, and scree slopes in subalpine and alpine areas. Because the plant is so small, it is easily overlooked. This plant is suspected on, but has not been documented on the Tongass.
Spatulate moonwort (Botrychium spathulatum)	This plant is distributed from the upper Great Lakes east to southeastern Quebec, as well as in the mountains of northern Montana and Idaho to the Wrangell-St. Elias Range in Alaska. In southeastern Alaska, populations are known from Kruzof Island (on lands managed by the state of Alaska, which is surrounded by the Tongass) and a small population on Chicagof Island on the Tongass (USDA Forest Service 2015e). Habitat includes coastal forests, stabilized coastal dunes, upper beach meadows, well-drained open areas, alpine habitats, and riparian forests.
Moosewort fern, no common name (Botrychium tunux)	Moosewort fern grows on upper beach meadows, coastal dunes, stream terraces, river bars and subalpine and alpine slopes. There are nine known occurrences of this species on the Tongass; seven on the Yakutat Ranger District, one on the Wrangell Ranger District and one in the Admiralty National Monument.
Moonwort fern, no common name (Botrychium yaaxudakeit)	Wrangell St. Elias Range to Glacier bay, southwest across Canada to Alberta, with disjunct alpine populations in Montana, Oregon and California. Across its range, this fern grows on upper beach meadows, beach dunes, coastal outwash plains, abandoned fields and roadsides. There are 11 known occurrences in Alaska (ANHP 2015), including five occurrences in beach meadows on the Yakutat Ranger District.
Macoun's thistle (Cirsium edule var. macounii)	This plant ranges from southern Southeast Alaska, disjunct to southern British Columbia, to the North Cascades and Olympics of Washington and northern Oregon. It grows in moist to dry open meadows, open forests in the upper montane to lower alpine zone, on scree slopes and talus slopes, and along glacial streams and lakeshores. There are 2 known occurrences of Macoun's thistle on the Tongass, both on the Ketchikan-Misty Fiords Ranger District.
Mountain lady's slipper (Cypripedium montanum)	This orchid ranges from California north to British Columbia and east to the Rockies of Alberta, Idaho, and Montana. In Alaska it is known from Glacier Bay, the Haines area and Etolin Island. Habitat includes upper beach meadows, areas along the beach-forest ecotone, open forests, muskegs, and wet meadows. It is often found on calcareous substrates. There is one known population on the Tongass; on the Wrangell Ranger District.
Large yellow lady's slipper (Cypripedium parviflorum var. pubescens)	This plant's range is discontinuous and extends across boreal North America and south to Montana. On the Tongass, this orchid grows in peatlands on calcareous substrates (USDA Forest Service 2015e). There are two known occurrences of large yellow lady's slipper on the Tongass, both on northern Prince of Wales Island.
Calder's lovage (Ligusticum calderi)	This plant is endemic to coastal British Columbia and Southeast Alaska and is known from Vancouver Island north through the southern part of the Tongass (Dall and Prince of Wales Islands). Habitat includes alpine and subalpine meadows, boggy slopes, open mixed conifer forests, and rocky areas. There are 24 known occurrences on the Tongass; 23 on the Craig Ranger District and one on the Thorne Bay Ranger District.
Lichen, no common name (Lobaria amplissima)	In North America, this lichen is known primarily from Alaska, although one occurrence has been documented from California.There are 30 known occurrences on the Tongass. This lichen grows on trunks and main branches of Sitka spruce, Pacific crab apple (Malus fusca), and western hemlock in old-growth beach fringe forest (Dillman 2004 as cited in Goldstein et al. 2009).

Table 3.7-1 (continued)
2009 Alaska Region Sensitive Plants Known or Suspected to Occur on the Tongass National Forest[1]

Common Name (Scientific Name)	Range and Habitat[2]
Pale poppy (Papaver alboroseum)	Pale poppy is distributed from Kamchatka and northern Kurile Islands; across the Aleutians to south central Alaska and the east side of the Juneau Icefields in north central British Columbia. This plant grows in open, well-drained areas, in rocky tundra of ridges and mountain summits, ash and cinder slopes, and in sand and gravel of glacial outwash and river floodplains (FNA 2014). Occasional disturbance can create or maintain habitat; infrequent (versus continuous) disturbances (e.g., stabilized road sides, railroad trackbeds) by humans can create habitat (Goldstein et al. 2009). Although suspected to occur on the Tongass, there are no known occurrences on the Tongass. This plant is no longer listed on the ANHP rare plant list.
Alaska rein orchid (*Piperia unalascensis*)	The range extends disjunctly from Unalaska east to southeastern Alaska, south into northern California, along the Sierra Nevadas into Mexico, and south along the Rocky Mountains into Utah. There are also disjunct populations in Colorado, New Mexico, Montana, South Dakota and Newfoundland. This plant is known from 18 occurrences on the Tongass. Habitat includes dry open sites, under tall shrubs in riparian areas, mesic meadows, drier areas in coniferous and mixed evergreen forests, and bogs and heath habitat from low to subalpine elevations. On the Tongass, this plant generally grows in low-productivity forests at lower elevations in poorly drained soils (Dillman 2011a).
Lesser round-leaved orchid (*Platanthera orbiculata*)	This plant is widely distributed across North America from southeastern Alaska disjunctly across boreal and north temperate North America to Tennessee and South Carolina. Throughout its range it occurs in a variety of habitats including temperate, boreal, deciduous, and wetland forests (Dillman 2008). In Alaska, it grows in low elevation forested wetlands, medium to high volume old-growth hemlock forests with high bryophyte cover and a red cedar component, forest edges or near gaps in shady forests, and near muskegs, open water, or boggy areas (Dillman 2008). There are 291 known occurrences, comprising 61 distinct populations known on the Tongass (USDA Forest Service 2015e).
Kruckeberg's swordfern (*Polystichum kruckebergii*)	This fern's range includes disjunct populations in Southeast Alaska, the Cascades and Coast Range of British Columbia, mountains of northern California, and the Rockies (centered on Idaho). There are nine known occurrences comprising three distinct populations in Southeast Alaska; one within a development LUD (Timber Production) on the Ketchikan-Misty Fiords Ranger District, one within a non-development (Wilderness) LUD on the Sitka Ranger District, and one on non-National Forest lands. Habitat includes ultramafic rock outcrops.
Unalaska mist-maid (*Romanzoffia unalaschcensis*)	This plant ranges from the Aleutian Islands through Prince William Sound, disjunct to the Tongass. It grows on ledges and crevices in rock outcrops and in gravelly areas along stream banks, often along coasts. There are two known occurrences on the Tongass; both on the Thorne Bay Ranger District.
Henderson's checkermallow (*Sidalcea hendersonii*)	Endemic to the Pacific Northwest from Oregon to British Columbia with a disjunct population in Alaska. This plant's habitat includes wet meadows, estuaries, and tidal flats (Douglas et al. 1999). On the Tongass, the one known population grows at the upper edge of an upper beach meadow near the edge of a hemlock and spruce forest (USDA Forest Service 2015e). This population was located on the Juneau Ranger District; however, during surveys of the site conducted in 2013, the occurrence was not located (USDA Forest Service 2015e).
Dune tansy (*Tanacetum bipinnatum* subsp. *huronense*)	This species is distributed disjunctly across boreal and arctic North America and disjunctly south along the Pacific coast to California. Habitat for this species includes upper beaches, sand dunes, and well drained and calcareous soils. There is one known occurrence of this species on the Tongass, on a sandy beach of Kruzof Island on the Sitka Ranger District.

[1] Sensitive Plant list updated February 2009.
[2] Range, habitat, and occurrence information, unless otherwise noted, based on: Goldstein et al. 2009; Nawrocki et al. 2013; USDA Forest Service 2012; and USDA Forest Service 2014e

Under the 2008 Forest Plan rare plants have similar protection in the Forest-wide standards and guidelines as sensitive plants. The ANHP Rare Vascular Plant List, with global and state rankings, is used as guidance for determining which rare plants may be evaluated in the project-level analysis. This list with state and global rankings is available online at: http://aknhp.uaa.alaska.edu/botany/rare-plants-species-lists/rare-vascular-hulten/#content. Generally, plants with a state ranking of S1 (critically imperiled in state) or S2 (imperiled in state) are given consideration during project analysis. Plants with a state ranking of S3-5 are sometimes given consideration if they are known to be rare in a specific location on the Forest.

Invasive Plants

Invasive plants can adversely affect an area either when invasive plants become established or when an existing invasive plants spread to occupy a larger area. Invasive plants can negatively affect habitat by competing with native plants for resources such as water and light, establishing and changing the community composition, eliminating or reducing native plants, or by changing the vegetation structure. The changes in community composition or vegetation structure can reduce native plant populations as well as negatively affect habitat for wildlife and fish. Highly invasive plants often have aggressive reproductive methods and can successfully compete for resources (Schrader and Hennon 2005).

In the past, Alaska's remoteness, cold climates, and relatively low level of human disturbance have provided some protection from infestations of invasive plants (Carlson and Shephard 2007). Compared to the other states, Alaska has a low amount of invasive plant infestations, but the amount of invasive plant infestations within the state are increasing (Carlson and Shephard 2007; Nawrocki et al. 2011; Schrader and Hennon 2005). Not all non-native plants are invasive. Executive Order 13112 (1999) defines an "invasive species" as a species that is 1) non-native (or alien) to the habitat under consideration, and 2) whose purposeful or accidental introduction causes or is likely to cause economic or environmental harm or harm to human health. This Executive Order directs all federal agencies to address invasive species concerns and refrain from actions likely to increase invasive species problems. A considerable body of law and policy provide direction for managing invasive plants.

Policy and guidance for managing invasive plants are provided by the Forest Service Manuals and Handbooks. The Invasive Species Management Policy (Forest Service Manual [FSM] 2900) lists and details the law, regulations, and executive orders relating to managing invasive species. It also lays out objectives, policy, details responsibilities and lists definitions for managing invasive species. In concert with Forest Service policy, the *National Strategic Framework for Invasive Species Management* (USDA Forest Service 2013e) provides broad strategic direction for Forest Service's programs and guides and prioritizes invasive species management. The Alaska Region Invasive Plant Strategy (USDA Forest Service 2005) (under revision) and the Tongass National Forest Invasive Plant Management Plan (Lerum and Krosse 2005) provide Regional and Forest guidance. All alternatives would follow Forest-wide standards and guidelines regarding invasive species. FSM 2900 and these standards and guidelines include direction to review proposed projects to determine the risk of introduction or spread of invasive plants and implement appropriate mitigation measures. They also include direction to control existing invasions and rehabilitate habitats impacted by invasive species.

Although the term invasive plants is used in this document, invasive plants can also be referred to as non-native, exotic, noxious, weeds, alien, or invasive alien; depending on the context of the term's use.

Occurrences of invasive plants throughout Alaska are tracked by the Alaska Exotic Plants Information Clearinghouse (AKEPIC). The AKEPIC is a cooperative project between the Forest Service, State and Private Forestry, the National Park Service, U.S. Geological Survey, University of Alaska, and other federal, state, and local agencies. The AKEPIC database maintains a georeferenced inventory of Alaska's invasive plants (AKEPIC 2015). Additionally, all invasive plant surveys, invasive plant finds, and treatments are entered into the Forest Service's Natural Resource Information System (NRIS) georeferenced invasive species database (USDA Forest Service 2016a).

The invasiveness of non-native plants has been ranked to better assess what species could be most problematic in Alaskan ecosystems. Of the 124 (Table 3.7-2) species of invasive plants on the Tongass, 94 have been given an invasiveness ranking (some plants have not yet been ranked). The invasiveness ranking is based on analysis of the following four parameters for each species:

- Ecological impact: impact on processes, community structure and composition, and other trophic levels.
- Biological characteristics and dispersal ability: mode of reproduction, methods of dispersal, potential to be spread by human activities, competitive abilities, and habitat.
- Ecological amplitude and distribution: United States and global distribution, and level of impact in other locations.
- Feasibility of control: seed bank viability, other methods of reproduction, and effort known to be required for control.

Invasiveness rankings range from 1 to 100 (100 representing the highest invasiveness rating) (Carlson et al. 2008). The invasiveness rankings of non-native plants in Alaska are available online through the ANHP at: http://aknhp.uaa.alaska.edu/botany/akepic/non-native-plant-species-list/#content

During the past decade, surveys have been conducted for invasive plants along most forest highway roads, as well as many trails, trailheads, and other sites of recent human activity in Southeast Alaska. Recently, systematic surveys of all invasive plants have been initiated in areas of heavier use that are more susceptible to invasive plant invasion. The areas of greatest invasive plant diversity and extent of invasion have been found around towns and the most heavily traveled areas. The areas with the lowest number of species were further from population centers or paved roads (Arhangelsky 2005). Schrader and Hennon (2005) cited references suggesting that the greatest invasive plant diversity and density are in areas of human activity, such as roads, recreational areas, industrial, commercial, and industrial development.

Surveys conducted between 2005 and 2010 documented species occurrences but did not accurately map invasive plant infestations. After 2010, this information was used to generate an invasive plant map which resulted in on overall under-representation of acres infested. Therefore, the current Forest Service database (NRIS-INVP) and associated map provides an estimate of the extent of infestation, as well as the locations of species observed. Table 3.7-2 lists the number of invasive plant species known on the Tongass.

Table 3.7-2
Number of Invasive Plant Species on the Tongass National Forest by District

Ranger District	Number of Invasive Plant Species
Admiralty National Monument	17
Craig Ranger District	51
Hoonah Ranger District	40
Juneau Ranger District	52
Ketchikan-Misty Fiords Ranger District	53
Petersburg Ranger District	54
Sitka Ranger District	47
Thorne Bay Ranger District	80
Wrangell Ranger District	45
Yakutat Ranger District	19
Total	**124**

Source: USDA Forest Service 2016a

Table 3.7-3 is a list of all invasive plants known on the Tongass National Forest and their invasiveness ranking.

Table 3.7-3
Invasive Plants on the Tongass: Number of Occurrences and Invasiveness Ranking

Common Name	Scientific Name	Number of Occurences[1]	Invasiveness Ranking[2]
alfalfa	*Medicago sativa*	1	59
alsike clover	*Trifolium hybridum*	609	57
annual bluegrass	*Poa annua*	956	46
annual canarygrass	*Phalaris canariensis*	1	not ranked
big chickweed; common mouse-ear chickweed	*Cerastium fontanum* subsp. *vulgare; Cerastium fontanum*	1,560	36
big trefoil	*Lotus pedunculatus*	1	not on list[3]
bigleaf lupine	*Lupinus polyphyllus* ssp. *polyphyllus*	101	71
birdeye pearlwort	*Sagina procumbens*	29	39
bird's foot trefoil	*Lotus corniculatus*	16	65
Bishop's goutweed	*Aegopodium podagraria*	2	57
bitter dock	*Rumex obtusifolius*	9	48
black bindweed	*Polygonum* (*Fallopia*) *convolvulus*	3	50
black medic, hop clover	*Medicago lupulina*	64	48
bladder campion	*Silene latifolia*	1	42
Bohemian knotweed	*Polygonum* (*Fallopia*) *bohemicum*	3	87
brittlestem hempnettle	*Galeopsis tetrahit*	20	50
bull thistle	*Cirsium vulgare*	45	61
burr medic	*Medicago minima*	2	not ranked
butter and eggs	*Linaria vulgaris*	2	69
Canada bluegrass	*Poa compressa*	73	39
Canada thistle	*Cirsium arvense*	23	76
Canadian horseweed	*Conyza canadensis*	1	not ranked
colonial bentgrass	*Agrostis capillaris* (*A. tenuis*)	59	not ranked
common brassbuttons	*Cotula coronopifolia*	2	42
common chickweed	*Stellaria media*	50	42
common comfrey	*Symphytum officinale*	1	48
common dandelion	*Taraxacum officinale*	1,727	58
common dogmustard	*Erucastrum gallicum*	2	not ranked

Table 3.7-3 (continued)
Invasive Plants on the Tongass: Number of Occurrences and Invasiveness Ranking

Common Name	Scientific Name	Number of Occurrences[1]	Invasiveness Ranking[2]
common eyebright	*Euphrasia nemorosa*	17	42
common groundsel; old man-in-the-spring	*Senecio vulgaris*	9	36
common gypsyweed	*Veronica officinalis*	1	not ranked
common hawkweed	*Hieracium lachenalii*	3	57
common nipplewort	*Lapsana communis*	25	33
common plantain	*Plantago major* var. *major*	2,663	44
common sheep sorrel	*Rumex acetosella*	93	51
common St. Johnswort	*Hypericum perforatum*	27	52
common tansy	*Tanacetum vulgare*	24	60
common velvetgrass	*Holcus lanatus*	128	56
common wheat	*Triticum aestivum*	1	not ranked
common yarrow	*Achillea millefolium* var. *millefolium*	99	not on list[3]
creeping bentgrass	*Agrostis stolonifera*	50	not ranked
creeping buttercup	*Ranunculus repens*	738	54
crested wheatgrass	*Agropyron cristatum*	1	not ranked
curly dock	*Rumex crispus*	16	48
curlytop knotweed	*Polygonum lapathifolium* (*Persicaria lapathifolia*)	1	47
disc mayweed; pineappleweed	*Matricaria discoidea*	104	32
dooryard dock; garden dock	*Rumex longifolius*	4	48
European mountain ash	*Sorbus aucuparia*	5	59
fall dandelion	*Leontodon autumnalis*	3	51
field mustard	*Brassica rapa* *Brassica rapa* var. *rapa*	45	50
field sowthistle	*Sonchus arvensis*	24	73
fowl bluegrass	*Poa palustris*	720	not on list[3]
foxtail barley	*Hordeum jubatum*	9	63
garden strawberry	*Fragaria ananassa*	9	not on list[3]
garlic mustard	*Alliaria petiolata*	2	70
Gerrman chamomile	*Matricaria recutita*	1	not on list[3]
germander speedwell	*Veronica chamaedrys*	2	not ranked
green bristlegrass	*Setaria viridis*	1	not ranked
hairy cat's ear	*Hypochoeris radicata*	142	44
horseradish	*Armoracia rusticana*	1	not ranked
Italian ryegrass	*Lolium perenne* ssp. *multiflorum*	21	41
Japanese knotweed	*Polygonum cuspidatum* (*Fallopia japonica*)	14	87
Kentucky bluegrass	*Poa pratensis*	670	52
lady's mantle	*Alchemilla mollis*	1	56
lambsquarters	*Chenopodium album*	1	37
lesser burdock	*Arctium minus*	1	49
lesser hawkbit	*Leontodon taraxacoides* ssp. *taraxacoides* (*L. hirtus*)	1	not ranked
marsh cudweed	*Gnaphalium palustre*	11	not ranked
max chrysanthemum	*Leucanthemum maximum*	5	not ranked
mayweed, stinking chamomile	*Anthemis cotula*	2	41
meadow fescue	*Schedonorus pratensis* (*Lolium pratense*)	9	not ranked
meadow foxtail	*Alopecurus pratensis*	18	52
meadow hawkweed	*Hieracium caespitosum*	10	79
narrowleaf hawksbeard	*Crepis tectorum*	27	56
narrowleaf hawkweed	*Hieracium umbellatum*	9	51
orange hawkweed	*Hieracium aurantiacum*	355	79

Table 3.7-3 (continued)
Invasive Plants on the Tongass: Number of Occurrences and Invasiveness Ranking

Common Name	Scientific Name	Number of Occurrences[1]	Invasiveness Ranking[2]
orchardgrass	*Dactylis glomerata*	593	53
oxeye daisy	*Leucanthemum vulgare*	663	61
paleyellow iris	*Iris pseudacorus*	1	66
perennial cornflower	*Centaurea montana*	3	46
perennial rye grass	*Lolium perenne* ssp. *perenne*	141	52
prickly lettuce	*Lactuca serriola*	5	not ranked
prostrate knotweed	*Polygonum aviculare*	1	45
purple foxglove, foxglove	*Digitalis purpurea*	65	51
quackgrass	*Elymus repens*	1	59
Queen Anne's lace	*Daucus carota*	1	not ranked
rampion bellflower	*Campanula rapunculooides*	1	64
red clover	*Trifolium pratense*	147	53
red fescue	*Festuca rubra*	2	not on list[3]
red sandspurry	*Spergularia rubra*	1	34
redtop	*Agrostis gigantea*	338	not ranked
reed canarygrass	*Phalaris arundinacea*	4,138	83
Robert geranium	*Geranium robertianum*	3	67
rough bluegrass	*Poa trivialis*	43	52
rugose rose	*Rosa rugosa*	1	72
scentless mayweed	*Tripleurospermum perforatum* (*T. inodorum*)	9	48
scotch broom	*Cytisis scoparius*	2	69
shepherd's purse	*Capsella bursa-pastoris*	5	40
Siberian wildrye	*Elymus sibiricus*	1	53
slender hairgrass	*Deschampsia elongata*	300	35
smooth brome	*Bromus inermis* ssp. *inermis*	5	62
sneezeweed	*Achillea ptarmica*	2	46
spearmint	*Mentha spicata*	2	43
spiny sowthistle	*Sonchus asper*	14	46
splitlip hempnettle	*Galeopsis bifida*	4	50
spotted knapweed	*Centaurea stoebe* ssp. *micranthos* (*C. biebersteinii*)	6	86
sticky chickweed	*Cerastium glomeratum*	1	36
suckling clover	*Trifolium dubium*	3	50
sweet vernalgrass	*Anthoxanthum odoratum*	13	not ranked
tall buttercup	*Ranunculus acris*	14	54
tall fescue	*Schedonorus phoenix* (*S. arundinaceus; Festuca arundinacea*)	620	63
tall oatgrass	*Arrhenatherum elatius*	3	not ranked
tansy ragwort, stinky willie	*Senecio jacobea*	13	63
thyme-leaf speedwell	*Veronica serpyllifolia* ssp. *serpyllifolia*	205	36
timothy	*Phleum pratense*	1,769	54
true forget-me-not	*Myosotis scorpioides*	41	54
wall hawkweed	*Hieracium murorum*	35	not ranked
wall lettuce	*Mycelis muralis*	45	31
water foxtail	*Alopecurus geniculatus*	2	49
western dock	*Rumex aquaticus* var. *fenestratus*	4	not on list[3]

Table 3.7-3 (continued)
Invasive Plants on the Tongass: Number of Occurrences and Invasiveness Ranking

Common Name	Scientific Name	Number of Occurrences[1]	Invasiveness Ranking[2]
white clover	*Trifolium repens*	2,612	59
wormseed mustard, wormseed wallflower	*Erysimum cheiranthoides*	3	not on list[3]
yellow salsify, goatsbeard	*Tragopogon dubius*	1	50
yellow sweet clover	*Melilotus officinalis*	18	69

[1] USDA Forest Service 2016: http://data.fs.usda.gov/geodata/edw/datasets.php?dsetParent=InvasiveSpecies
[2] AKEPIC 2016: http://aknhp.uaa.alaska.edu/botany/akepic/non-native-plant-species-list/#content
[3] Plant not listed on the AKEPIC non-native species list

Environmental Consequences

The alternatives described in Chapter 2 differ in the locations, type, and extent of timber harvest. Effects from the proposed alternatives would mainly apply to productive old-growth (POG) and young-growth forests. Although there would be effects on unproductive forest, non-forest or other vegetation types, these effects would be limited since these vegetation types would not be the focus of any proposed action. Renewable energy projects and road construction activities (construction, reconstruction and maintenance), however, would impact unproductive forest, non-forest, and other vegetation types. Impacts to POG and young growth are described in the *Biodiversity* section, and thus will not be further discussed, except as relevant to this section.

This section compares effects of the five alternatives on sensitive, rare, and invasive plants. There would be no effects to threatened or endangered plants because none are known on the Tongass.

Direct and Indirect Effects

Sensitive and Rare Plants

Effects Common to All Alternatives

Direct effects of the proposed alternatives on sensitive or rare plants during timber harvest would include physical damage by cutting, trampling, or crushing them with vehicles, other machinery, foot traffic, or felled trees. Severe impacts may cause mortality, or inhibit the vigor and reproductive capability of the plants.

Construction of new roads and construction of renewable energy projects and associated utility lines would also involve temporary and permanent removal of vegetation within the path of the road or construction footprint. Additionally, if a hydroelectric power project involves creation of a reservoir, inundation would result in the removal of vegetation within the inundation zone. These activities could affect rare and sensitive plants that inhabit the specific habitat found within the location of a new road, renewable energy project facility or utility line corridor. Roads and utility lines can be constructed in many types of habitat, depending on the need for access for forestry activities or energy transmission.

Road reconstruction maintains the original investment and makes the road suitable and safe for the intended use and typically involves the rehabilitation of the original roadbed. It can include cleaning ditches, replacing drainage structures, re-installing bridges, and grading and shaping. The roadbed had been created and used (compacted) in the past and, in general, no longer supports sensitive or rare plants; however, newly exposed bedrock in unique geological areas could create new habitat for some rare and sensitive plants. Road maintenance can include reconditioning the original road template, grading the road surface, cleaning roadside ditches, and removing vegetation that may encroach upon the road or block vision. Because the maintenance activities remain in the existing road prism, these activities would be unlikely to have an effect on sensitive or rare plants or their habitat.

Indirect effects to sensitive or rare plants from timber harvest, road construction, and construction of renewable energy projects and associated utility lines involves alteration of habitat, such as changes in sunlight and moisture availability, herbivore or pollinator behavior, soil structure and fertility, vegetation structure, fragmentation of habitat, and competition from other native plants as well as invasive plants. Some indirect effects, such as changes in sunlight or moisture, can be beneficial or harmful depending on the effect and the species' life history. For example, if a plant has habitat requirements of partial sun, then increasing the size of a forest opening may benefit that species; however, that same opening may be harmful to a plant that requires shade. Activities likely to cause indirect effects to sensitive and rare plants include removal or reduction of tree canopy, road construction, changes in hydrology associated with road construction, reservoir creation or flow diversion, increased competition from invasive plants, increased off-road vehicle use, increased access, and increased use and associated trampling by recreationists.

Under all alternatives, a biological evaluation (BE) was conducted for sensitive plants for the planning area (Krosse 2016). A BE is also conducted as part of the site-specific environmental analysis for individual project proposals. This type of sensitive plant review is required to include sufficient detail to determine how any proposed action may affect each sensitive species. The intensity and scope of inventories selected to provide information for effects analysis is required to be commensurate with the potential risk of a proposed project to sensitive plant species. The review is used to evaluate project-level impacts to sensitive plants in order to ensure that proposed project activities do not contribute to population or habitat declines that could lead to federal listing or loss of viability in the plan area (the Tongass National Forest). In addition, existing Forest-wide standards and guidelines would be applied to avoid or minimize impacts to those sensitive plants and their habitat.

The Forest-wide standards and guidelines include a provision for reviewing the implementation and effectiveness of conservation actions for sensitive plants. This review provides information to improve conservation efforts and reduce the likelihood of negative effects to sensitive plant species due to management actions.

As a part of National Environmental Policy Act (NEPA) analysis, an effects analysis may also be conducted for rare plants; however, a formal BE is not required. All alternatives would continue to follow the current Forest-wide standards and guidelines for rare plants.

Effects Specific to Each Alternative

Impacts to sensitive and rare plant species from timber harvest, road construction, and renewable energy development, as well as species specific impacts to the 16 sensitive plant species known or suspected to occur on the Tongass under each alternative are discussed in the sections below.

Approximately 126 plants listed on the ANHP Rare Vascular Plant List have been documented on the Tongass; because of the large number of rare plants, species specific impacts to rare plants are not discussed in this document, but if, during project planning, they are known or suspected within the project area, they would be evaluated.

Timber Harvest and Road Construction

In general, alternatives with fewer acres of timber harvest and miles of road construction would have less risk of direct and indirect adverse effects to sensitive and rare plants. Alternatives with more acres proposed for harvest and miles of road construction would have more risk of adverse effects. Other activities related to timber harvest, such as log transfer facility (LTF) construction, would increase with elevated timber harvests.

Table 3.7-4 displays the maximum acres of timber harvest and miles of road construction that would occur under each alternative after 100 years. Based on the proposed maximum acres of timber harvest and miles of road construction for each alternative (Table 3.7-4), Alternatives 2 and 3 would have a higher risk of direct and indirect effects to sensitive and rare plants due to harvest and road work than the other alternatives. Alternative 1 would result in the least amount of timber harvest (maximum harvest of 272,733 acres over 100 years), but would result in the greatest acreage of old-growth timber harvest (Table 3.7-4). Alternatives 4 and 5 propose fewer acres of harvest than Alternatives 2 and 3; however, Alternatives 4 and 5 would harvest more acres of old growth than either Alternatives 2 or 3.

Alternative 2 would result in the greatest amount of total road construction (new and reconstructed roads) and the greatest amount of new road construction, followed by Alternatives 3, 5, 1, and 4 (Table 3.7-4). As stated above, new road construction has a greater risk of adverse effects to sensitive and rare plants than road reconstruction. Increased harvest of POG and new road construction could increase the risk of adverse effects to sensitive and rare plant species as compared to harvest of young-growth and road reconstruction activities. A species distribution is limited to areas that can meet the species-specific physical and biological needs. Due to the limited scope of surveys conducted within the Tongass, exact distributions of plants and their habitat are unknown. Although it is not possible to predict the exact distribution of each species, knowing the preferred habitats for sensitive and rare plants can aid in assessing the potential risk for each species from timber harvest, road construction, and other activities under the proposed alternatives. Therefore, in addition to the number of acres of timber harvest and miles of road construction, the locations of these activities may increase or decrease the potential risk of adverse effects to sensitive and rare plant species.

Table 3.7-4
Maximum Acres of Harvest and Maximum Miles of Road Construction by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Maximum Acres Likely to be Harvested after 100 years					
Productive Old Growth	62,851	32,609	35,568	42,597	42,479
Young Growth	209,882	335,344	313,216	234,885	284,144
Total Acres	272,733	367,953	348,784	277,482	326,623
Maximum Miles of Road Likely to be Constructed after 100					
New Road Construction	944	1,056	1,020	871	994
Road Reconstruction	1,315	1,790	1,696	1,344	1,585
Decom. Roadbeds and Road Reconstruction					
Total Road Work (includes reconstruction)	2,259	2,846	2,716	2,216	2,579

Source: Tongass National Forest GIS database

Table 3.7-5 below (and Table 3.9-13 in the *Biodiversity* section) displays the acres of projected young-growth and old-growth timber harvest in beach buffer, Riparian Management Areas (RMAs), old-growth reserves (OGRs), other non-development land use designations (LUDs), and 2001 Roadless Areas under each alternative. Harvest of young growth and old growth would not occur in any of these areas under Alternative 1. This represents the current condition from the 2008 Forest Plan Amendment. Old-growth harvest would not occur in beach buffers, RMAs, OGRs, or other non-development LUDs under any of the other alternatives and would only occur in 2001 Roadless Areas under Alternatives 2 and 3 (Table 3.7-5). Projected harvest of young-growth would be greatest in RMAs, OGRs, and other non-development LUDs under Alternative 2. Projected harvest of young growth would be greatest in beach buffers and 2001 Roadless Areas and second greatest in OGRs and other non-development LUDs under Alternative 3. Under Alternative 4, young-growth harvest is only projected to occur in beach buffers. Under Alternative 5, young-growth harvest would occur in beach buffers, RMAs, and OGRs. Alternative 1 would have the lowest risk of potential direct and indirect effects to sensitive and rare plant species found in beach buffers, RMAs, OGRs, other non-development LUDs, and 2001 Roadless Areas compared to the other alternatives. Alternative 2, followed by Alternative 3, would have the highest risk of potential direct and indirect effects to sensitive and rare plant species found in these habitats compared the other alternatives.

Table 3.7-5
Projected Harvest of Young Growth[1] and Old Growth in Beach Buffers, RMAs, Old-Growth Reserves, other Non-Development LUDs, and 2001 Roadless Areas by Alternative

Conservation Strategy Component	Estimated Acres of Harvest over 100 Years									
	Alt 1		Alt 2[1]		Alt 3[2]		Alt 4[3]		Alt 5[4]	
	YG	OG	YG	OG	YG	OG	YG	OG	YG	OG
Harvest in Beach Buffer	0	0	21,871	0	30,769	0	11,114	0	3,903	0
Harvest in RMA	0	0	26,030	0	0	0	0	0	1,089	0
Harvest In OGRs	0	0	31,640	0	26,186	0	0	0	1,811	0
Harvest in other Non-Development LUD	0	0	11,641	0	10,593	0	0	0	0	0
Maximum Harvest in 2001 Roadless Areas	0	0	9,104	2,171	11,809	17,037	0	0	0	0

[1] Alt 2 Prescriptions: Young Growth - Clearcutting is permitted in Beach Buffer for first 15 years; thereafter, only Commercial Thinning is permitted. Only Commercial Thinning is permitted in RMAs. Clearcutting is permitted in OGRs, Non-Development LUDs, and Roadless Areas, unless otherwise restricted. Old Growth - Clearcutting is permitted in Roadless Areas.
[2] Alt 3 Prescriptions: Young Growth - Only Commercial Thinning is permitted in Beach Buffers. Clearcutting is permitted in OGRs, Non-Development LUDs, and Roadless Areas, unless otherwise restricted. Old Growth - Clearcutting is permitted in Roadless Areas.
[3] Alt 4 Prescriptions: Young Growth - Only Commercial Thinning is permitted in Beach Buffers.
[4] Alt 5 Prescriptions: Young Growth - Group Selection and Commercial Thinning are permitted in Beach Buffers, OGRs, and RMAs for first 15 years; thereafter, No Harvest is permitted.

Renewable Energy Site Development

Development of renewable energy sites would occur under all alternatives; however, Alternatives 2, 3, 4, and 5 would include new management direction (i.e., plan components) in the Forest Plant that improves flexibility in renewable energy development. Alternative 1 would not facilitate the development of renewable energy sites to the extent that Alternatives 2, 3, 4, and 5 would. Therefore, these alternatives could result in greater impacts to sensitive and rare plant species than Alternative 1 from development of renewable energy sites. Under all alternatives; however, renewable energy site development would be subject to site-specific environmental analysis under NEPA.

Species Specific Impacts to Sensitive Plants

Potential effects to the 16 sensitive plant species known or suspected to occur on the Tongass National Forest under each of the alternatives are discussed below. In addition to assessing potential impacts to sensitive species based on locations and acres of timber harvest and miles of road construction, potential impacts to known occurrences of sensitive plant species can be estimated by looking at the proportion of occurrences of each sensitive plant species in areas suitable for young-growth and old-growth harvest, and the percent of harvest expected in each of these suitable areas under each alternative. Table 3.7-6 below displays the proportion of known occurrences of the three sensitive species expected to be in old-growth or young-growth harvest units after 100 years.

Eschscholtz's little nightmare (Aphragmus eschscholtzianus):

This species grows within moist mossy areas, seeps, heaths, and scree slopes in subalpine and alpine locations, areas where timber harvest and renewable energy development would likely not occur. Additionally, very little access to timber (i.e., road construction) through its preferred habitat (alpine or subalpine areas) would likely occur under any of the alternatives. Although suspected to occur on the Tongass, no populations of Eschscholtz's little nightmare have been documented; therefore, no known populations of this species would be impacted by timber harvest, road construction, or renewable energy development under any of the alternatives. If previously undocumented populations of this species are located during project surveys, Forest-wide standards and guidelines under all alternatives would consider protection to minimize impacts to this species on the Tongass. Because this species is not currently documented on the Tongass, because it may receive protection from existing Forest-wide standards and guidelines, and because there is a very low chance of impacting populations or habitat for Eschscholtz's little nightmare, there is a very low risk that any alternative would impact this species.

Spatulate moonwort (Botrychium spathulatum):

Across its range, habitat for this species includes coastal forests, riparian forests, stabilized coastal dunes, maritime and upper beach meadows, well-drained open areas, limestone, alpine habitats and areas historically disturbed by humans such as roadsides. On the Tongass, this species is currently only known from one population located on a calcareous, subalpine ridge (USDA Forest Service 2015e) which would likely not be impacted by timber harvest, road construction, or renewable energy and utility line projects under any of the alternatives. Additionally, no known occurrences of spatulate moonwort are expected in old-growth or young-growth harvest units under any of the alternatives. However, due to the small stature of this species and the difficulty of correct identification, spatulate moonwort has likely been overlooked or misidentified; therefore, it is likely that additional populations of this species exist on the Tongass (USDA Forest Service 2015e).

Table 3.7-6
Proportion of Known Occurrences of Sensitive Plant Species with the Potential to be in Old-Growth or Young-Growth Harvest Units after 100 Years

	Alternative									
	1		2		3		4		5	
Species	Known Occurrences Estimated to be in OG Harvest Units	Known Occurrences Estimated to be in YG Harvest Units	Known Occurrences Estimated to be in OG Harvest Units	Known Occurrences Estimated to be in YG Harvest Units	Known Occurrences Estimated to be in OG Harvest Units	Known Occurrences Estimated to be in YG Harvest Units	Known Occurrences Estimated to be in OG Harvest Units	Known Occurrences Estimated to be in YG Harvest Units	Known Occurrences Estimated to be in OG Harvest Units	Known Occurrences Estimated to be in YG Harvest Units
Lichen, no common name (*Lobaria amplissima*)	0	0	0	0.9	0	0.9	0	0.9	0	0
Alaska rein-orchid (*Piperia unalascensis*)	0.6	0	0.3	0	0.1	0	0.3	0	0.4	0
Lesser round-leaved orchid (*Plantathera orbiculata*)	16.1	16.7	8.4	23.2	5.9	23.2	9.3	14.2	8.7	20.1

Under Alternative 1, timber harvest would not occur in the beach buffer and RMAs, two of the preferred habitats where this species may occur. Under Alternatives 2 and 5, young-growth timber harvest would be allowed in the beach buffer and in RMAs suitable for timber production and, under Alternatives 3 and 4, timber harvest would be allowed in the beach fringe (Table 3.7-5). Alternatives 2 through 5, therefore, would result in increased risk of potential adverse effects to undocumented occurrences of spatulate moonwort compared to Alternative 1. Alternatives 2 and 3 would have the greatest projected timber harvest in RMAs and beach buffers; therefore, they would have a greater risk of potential effects to undocumented occurrences of spatulate moonwort from timber harvest than all the other alternatives. Additionally, Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would pose a greater risk of potential effects to spatulate moonwort from road construction and reconstruction than the other alternatives.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to this species if populations are located during pre-project surveys. Because spatulate moonwort may receive protection from existing Forest-wide standards and guidelines and because there is a very low chance of impacting the one known occurrence of this species, there is a low risk that any alternative would impact this species.

Moosewort fern (Botrychium tunux):
Across its range, habitat for moosewort fern includes upper beaches, beach meadows, coastal dunes, riparian forests, stream terraces, and river bars. Habitat on the Tongass also includes subalpine and alpine rocky slopes (USDA Forest Service 2015e). Due to the small stature of this species, it has likely been overlooked and there are potentially additional populations on the Tongass National Forest (USDA Forest Service 2015e). On the Tongass, eight of the nine known occurrences of moosewort fern are found within non-development LUDs, including seven occurrences on beach meadows (within non-development LUDs) in the Yakutat area. One known occurrence of this species is located within a non-forested area Timber Production LUD on the Wrangell Ranger District. However, no known occurrences of moosewort fern are expected in old-growth or young-growth harvest units under any of the alternatives.

Under Alternative 1, timber harvest would not occur in non-development LUDs, or in beach buffer and RMAs, which are the preferred habitat for this species. While access to timber through beaches may be needed under Alternative 1 if new LTFs are required, it would be infrequent. Under Alternatives 2 and 5, young-growth timber harvest would occur in the beach buffer and RMAs and under Alternatives 3 and 4 timber harvest would occur in the beach buffer (Table 3.7-5). Therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to undocumented populations of moosewort fern and its habitat from timber harvest compared to Alternative 1. Alternatives 2 and 3 would have the greatest projected timber harvest in RMAs and beach buffers and; therefore, they would have a greater risk of potential adverse effects to moosewort fern from timber harvest than the other alternatives. Additionally, Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would have a greater risk of potential adverse effects to moosewort fern from road construction and reconstruction than the other alternatives.

Alternatives 2 through 5 would also facilitate the development of renewable energy projects and would allow their development in the beach buffer and RMAs. Therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to moosewort fern and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to this species if populations are located during pre-project surveys. Because moosewort fern may receive protection from existing Forest-wide standards and guidelines and because no known occurrences of moosewort fern are expected in old-growth or young-growth harvest units under any of the alternatives, there is a low chance of impacting known occurrences of this species.

Moonwort fern (Botrychium yaaxudakeit)
Habitat for this species includes upper beach meadows, beach dunes, coastal outwash plains, and abandoned fields and roadsides. The five occurrences of moonwort fern on the Yakutat Ranger District are located in a non-development LUD (Semi-Remote Recreation). No known occurrences of moonwort fern are expected in old-growth or young-growth harvest units under any of the alternatives.

Under the Alternative 1, timber harvest would not occur in non-development LUDs or the beach buffer and RMAs which are the preferred habitat for this species. While access to timber through beaches may be needed under Alternative 1 if new LTFs are required, it would be infrequent. Therefore, under Alternative 1, there is essentially no risk of impact to this species from timber harvest and road construction. Under Alternatives 2 through 5, young-growth timber harvest would be allowed in the beach buffer which could potentially result in impacts to undocumented occurrences of moonwort fern. Alternatives 2 and 3 would have the greatest projected timber harvest in RMAs and beach buffers (Table 3.7-5). Additionally, Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to moonwort fern from timber harvest and road construction and reconstruction than the other alternatives.

Alternatives 2 through 5 would also facilitate the development of renewable energy projects and would allow their development in the beach buffer. Therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to moonwort fern and its habitat from renewable energy development compared to Alternative 1.

If populations of this species are located during project surveys, Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to this species. Because no known occurrences of moonwort fern would be impacted under any of the alternatives and because this species may receive protection from existing Forest-wide standards and guidelines, there is a low risk that any alternative would impact this species.

Macoun's thistle (Cirsium edule var. macounii):
Two occurrences of Macoun's thistle are known on the Tongass, both on the Ketchikan-Misty Fiords Ranger District. One occurs in a non-development LUD (Nonwilderness National Monument) and one occurs in a Development LUD (Timber Production). The likelihood of adverse effects to this species from timber harvest and associated road construction under all alternatives is low because habitat for this plant includes open meadows, open forests in the upper montane to lower alpine zone, scree slopes, and along glacial streams and lakeshores where harvest typically would not occur. However, access to timber through these types of habitat may be needed. Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would have a greater risk of potential adverse effects to Macoun's thistle from road construction and reconstruction than the other alternatives.

Alternatives 2 through 5 would facilitate the development of renewable energy projects; therefore, Alternatives 2 through 5 may result in a slightly increased risk of potential adverse effects to Macoun's thistle and its habitat compared to Alternative 1. Because this species is not likely to be impacted by timber harvest and because protection from the Forest-wide standards and guidelines would consider protection to minimize adverse impacts to this species from road construction and reconstruction and renewable energy projects under all alternatives, there is a low risk that any alternative would impact this species.

Mountain lady's slipper (Cypripedium montanum):
Within its range, this species is known from a variety of habitats including upper beach meadows, areas along the beach-forest ecotone, open forests, muskegs, and wet meadows. On the Tongass, this species is currently only known from one location on Etolin Island on the Wrangell Ranger District. This population is adjacent to an existing road, which is to be reconstructed (USDA Forest Service 2015e).

Under Alternative 1, timber harvest would not occur in the beach buffer. While access to timber through beaches may be needed under Alternative 1 if new LTFs are required, this would be infrequent. Under Alternatives 2 through 5, young-growth timber harvest would be allowed in the beach buffer (Table 3.7-5). Projected harvest in the beach buffer would be greatest under Alternatives 2 and 3, followed by Alternatives 4 and 5. Therefore, Alternatives 2 and 3 would have a greater risk of potential adverse effects to mountain lady's slipper than the other alternatives. Additionally, Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to mountain lady's slipper from road construction and reconstruction than the other alternatives. Alternatives 2 through 5 would facilitate the development of renewable energy projects and would allow their development in the beach buffer. Therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to mountain lady's slipper and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to this species if it is located during pre-project surveys. However, because only one occurrence of this species is known in the plan area, coupled with the potential for some level of impacts to this occurrence from future timber harvest and road construction, an increased level of risk to this species exists under all alternatives.

Large yellow lady's slipper (Cypripedium parviflorum var. pubescens):
Across its range this species is known from scree slopes, rock outcrops, and river bluffs and is often associated with open spruce forest and aspen woodlands. On the Tongass, this orchid is known from peatlands on calcareous substrates. There are two known occurrences of large yellow lady's slipper on the Tongass, both within a Timber Production LUD on northern Prince of Wales Island. Although the habitats where this species is suspected to occur are not generally vulnerable to timber harvest, the known occurrences of this species are located near existing roads (USDA Forest Service 2015e).

Based on the limited number and small size of the occurrences on the Tongass and existing threats to known occurrences from proposed road construction, additional impacts to this species from road construction or renewable energy and utility line projects under all alternatives could impact the ability of this species to persist over time. Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to large yellow lady's slipper from road construction and reconstruction than the other alternatives. Alternatives 2 through 5 would also facilitate the development of renewable energy projects; therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to large yellow lady's slipper and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to known occurrences of this species and new occurrences of this species located during pre-project surveys. However, due to the low numbers of known occurrences of this species in the plan area, coupled with the potential for some level of impacts to these occurrences from future road construction, an increased level of risk to this species exists under all alternatives.

Calder's lovage (Ligusticum calderi):
Habitat for this plant includes alpine and subalpine meadows, boggy slopes, open mixed conifer forest, and rocky areas. Twenty-four occurrences of this species have been documented on the Tongass, 11 within development LUDs and 13 within non-development LUDs. However, no known occurrences of Calder's lovage are expected in old-growth or young-growth harvest units under any of the alternatives.

Although the habitats where this species is suspected to occur are not generally vulnerable to timber harvest, they may be impacted by road construction activities. Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to Calder's lovage from road construction and reconstruction than the other alternatives. Alternatives 2 through 5 would also facilitate development of renewable energy projects and would allow their development in the beach buffer and RMAs. Therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to Calder's lovage and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to the known occurrences of this species and new occurrences of this species located during pre-project surveys. Because habitat for this species is generally not vulnerable to timber harvest and because of the relatively low projected impacts from future road construction to the 24 known occurrences of this species on the Tongass, a low level of risk to this species exists under all alternatives.

Lichen, no common name (Lobaria amplissima):
In Southeast Alaska, this lichen is only known as an epiphyte on tree trunks and branches of the forest/beach ecotone (Dillman 2011b). Forested habitat where this species is found tends to be well drained, with old growth Sitka spruce and/or western hemlock trees. Known sites of this species are also exposed to the open ocean or other large bodies of marine water (e.g., ocean entrances to bays and inlets) (Dillman 2011b).

There are 30 documented occurrences of *Lobaria amplissima* on the Tongass, 5 of which are located in development LUDs and 25 of which are located within non-development LUDs. Under Alternatives 2, 3, and 5, timber harvest would occur in OGRs, and under Alternatives 2 and 3 harvest would occur in other non-development LUDs, which would increase the risk of potential adverse effects to *Lobaria amplissima* in these areas as compared to Alternatives 1 and 4. No known occurrences of this species are expected within old-growth or young-growth harvest units under Alternative 1 or Alternative 5 (Table 3.7-6). Approximately 0.9 of the known occurrences are expected to be within young-growth harvest units under Alternatives 3, 4, and 5 (Table 3.7-6).

Under Alternative 1, young-growth timber harvest would not occur in the beach buffer. While access to timber through beaches may be needed under Alternative 1 if new LTFs are required, it would be infrequent. Under Alternatives 2 through 5, young-growth timber harvest would occur in the beach buffer (Table 3.7-5). Alternative 3 would have the greatest projected harvest in the beach buffer, followed by Alternatives 2, 4, and 5. Additionally, Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to *Lobaria amplissima* from timber harvest and road construction and reconstruction than the other alternatives. Alternatives 2 through 5 would also facilitate the development of renewable energy projects and would allow their development in the beach buffer. Therefore, Alternatives 2 through 5 would result in increased risk of potential adverse effects to *Lobaria amplissima* and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to known occurrences of this species and new occurrences of this species located during pre-project surveys. Because only about one of the 30 known occurrences is expected to be within young-growth harvest units, there would be a relatively low level of risk to this species under all alternatives.

Pale poppy (Papaver alboroseum):
Although suspected to occur on the Tongass, no populations of pale poppy have been documented; therefore, no known populations of this species would be impacted under any of the alternatives. This plant occurs in open, well-drained areas, recently deglaciated areas, rock outcrops, rocky tundra of ridges and mountain summits, sand and gravel of glacial outwash and river floodplains; areas where timber harvest would not typically occur. While road construction for access to timber through this type of habitat may be needed, it is not likely. Alternatives 2 through 5 would facilitate the development of renewable energy projects, which could impact habitat for this species. Therefore Alternatives 2 through 5 would have a slightly increased risk of potential adverse effects to pale poppy and its habitat from renewable energy development compared to Alternative 1.

If previously undocumented occurrences of this species are located during project surveys, Forest-wide standards and guidelines under all alternatives would consider protection to minimize impacts to this species. Because pale poppy is not currently documented on the Tongass, because it may receive protection from the Forest-wide standards and guidelines, and because of the very low chance of impacting potential habitat, there is a very low risk that any alternative would adversely impact this species.

Alaska rein orchid (Piperia unalascensis):
Habitat for Alaska rein orchid includes dry open sites, under tall shrubs in riparian zones, mesic meadows, drier areas in coniferous and mixed evergreen forests, and bogs and heath habitat from low to subalpine elevations. On the Tongass, this species often grows at the ecotone between forested and muskeg habitats and is generally found in low productivity forests at lower elevations in poorly drained soils (Dillman 2011a). However, some of the forest stands where the species is found are managed for timber production (USDA Forest Service 2015e). A few occurrences are located in the rights-of-way of forest roads; it is not known if they are remnants that have survived the disturbance, or if they have colonized the areas due to modification of habitat (USDA Forest Service 2015e).

There are 18 known occurrences of Alaska rein orchid on the Tongass, 8 of which occur in development LUDs and 10 of which occur in non-development LUDs. Under Alternatives 2, 3, and 5, timber harvest would occur in OGRs, and under Alternatives 2 and 3 harvest would occur in other non-development LUDs, which would increase the risk of potential adverse effects to Alaska rein orchid in these areas as compared to Alternatives 1 and 4. Approximately 0.6 of the known occurrences of Alaska rein orchid are expected to be within old-growth harvest units under Alternative 1, 0.3 occurrences under Alternatives 2 and 4, 0.1 occurrences under Alternative 3, and 0.4 occurrences under Alternative 5 (Table 3.7-6).

Under Alternative 1, young-growth timber harvest would not occur in RMAs, habitat preferred by Alaska rein orchid. Under Alternatives 2 and 5, approximately 36,092 and 882 acres of young-growth timber harvest would occur in RMAs, respectively (Table 3.7-5). Timber harvest in RMAs would not occur under Alternatives 3 and 4. Therefore, Alternatives 2 and 5 would result in greater potential risk to Alaska rein orchid from young-growth timber harvest in RMAs than the other alternatives. Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to Alaska rein orchid from and road construction and reconstruction than the other alternatives.

Development of renewable energy projects would be facilitated under Alternatives 2 through 5 and these alternatives would allow their development in RMAs; resulting in an increased risk of potential adverse effects to Alaska rein orchid and its habitat under these alternatives compared to Alternative 1. Considering all factors, Alternative 2 would have the greatest potential risk of adverse effects to Alake rein orchid.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to known occurrences of this species and new occurrences of this species located during pre-project surveys. Because only a portion of one of the 18 known occurrences of this species is expected to be within old-growth harvest units, there would be a relatively low level of risk to this species under all alternatives.

Lesser round-leaved orchid (Platanthera orbiculata):
Habitat for lesser round-leaved orchid on the Tongass includes mesic areas of coniferous forests, forested wetlands, old-growth hemlock forests with high bryophyte cover and a red cedar component, and along the edges of forest near muskegs, open water, or boggy areas. There are 291 known occurrences of this species currently located at least partially on NFS land. Of these occurrences, 205 are located within development LUDs. These occurrences have recently been condensed into 61 distinct populations by the Alaska Natural Heritage Program (Fulkerson 2015 in progress). Of the total area occupied by the 61 known populations, 44 percent is located within non-development LUDs and 56 percent is located within development LUDs (USDA Forest Service 2015e). A recent pilot monitoring study of population trends for lesser round-leaved orchid on Prince of Wales Island suggested a potential 57 percent decrease in population density of observed plants over the two-year monitoring period (USDA Forest Service 2015e), indicating a possible concern about the long-term persistence of this species on this portion of the Tongass. However, the sample size of the pilot study was small resulting in high variation among sample plots and the monitoring was focused on known locations in only a portion of the Forest. Therefore, inferences regarding downward trends may only apply to populations on the portion of Prince of Wales Island where monitoring has occurred and should not be used to make accurate inferences to this species' viability across the Tongass. Additionally, factors related to a potential downward trend are uncertain and may include a number of variables, such as this species' inherent periodic dormancy, requirement for specific mycorrhizal symbiont, and herbivory, in addition to management actions such as timber harvest and road construction. Additional details on the pilot monitoring and

the status of lesser round-leaved orchid can be found in the Plants BE (Krosse 2016).

The proportion of known occurrences expected to be within old-growth harvest units under each alternative includes 16.1 occurrences under Alternative 1, 8.4 occurrences under Alternative 2, 5.9 occurrences under Alternative 3, 9.3 occurrences under Alternative 4, and 8.7 occurrences under Alternative 5 (Table 3.7-6). The number of occurrences expected to be within young-growth harvest units under each alternative includes 16.7 occurrences under Alternative 1, 23.2 occurrences under Alternatives 2 and 3, 14.2 occurrences under Alternative 4, and 20.1 occurrences under Alternative 5 (Table 3.7-6). Therefore, Alternative 2 has the potential to impact a greater proportion of the known occurrences of lesser round-leaved orchid than the other alternatives.

Under Alternatives 1 and 4, young-growth harvest would be restricted in non-development LUDs (Table 3.7-5). Additionally, fewer acres of timber and fewer miles of road are expected to be harvested and constructed under Alternatives 1 and 4 than under the other alternatives (Table 3.7-4). Alternatives 2, 3, and 5 would allow young-growth timber harvest in old-growth reserves and Alternatives 2 and 3 would also allow young-growth timber harvest in other non-development LUDs (Table 3.7-5). Additionally, acres of timber harvest and miles of road construction would be greatest under Alternative 2, followed by Alternative 3; therefore, Alternatives 2 and 3 would result in greater risk of potential adverse effects to lesser round-leaved orchid from timber harvest and road construction than the other alternatives.

Alternatives 2 through 5 would facilitate the development of renewable energy projects to a greater extent than Alternative 1. Therefore, Alternatives 2 through 5 would have a greater risk of potential adverse effects to lesser round-leaved orchid and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to known occurrences of this species and new occurrences of this species located during project surveys. Because, at the most, out of the 291 distinct occurrences on the Tongass approximately 16 known occurrences are expected to be within old-growth harvest units, and another 23 known occurrences are expected to be within young-growth harvest units, there would be a relatively low level of risk to this species under all alternatives. Additional details on the assessment of impacts to lesser round-leaved orchid is provided in the Plants BE (Krosse 2016).

Kruckeberg's swordfern (Polystichum kruckebergii):
There are nine known occurrences of Kruckeberg's swordfern comprising three distinct populations in Southeast Alaska, one within a development LUD (Timber Production) on the Ketchikan-Misty Fiords Ranger District, one within a non-development (Wilderness) LUD on the Sitka Ranger District, and one on non-NFS land. On the Tongass, habitat for this species includes talus slopes and ultramafic rock outcrops, areas where timber harvest, road construction, and renewable energy development would not likely occur. While access to timber through this species' habitat may occur, it is not likely. No known occurrences of Kruckeberg's swordfern are expected in old-growth or young-growth harvest units under any of the alternatives.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to known occurrences of this species and new occurrences of this species located during project surveys. Because Kruckeberg's swordfern may receive protection from existing Forest-wide standards and guidelines and because there is a very low chance of impacting occurrences or habitat for this species, there is a low risk of adverse impacts to this species under all alternatives.

Unalaska mist-maid (Romanzoffia unalaschcensis):
The plant grows on ledges and crevices within rock outcrops, in gravelly areas along stream banks, often along the coast; areas where timber harvest would likely not occur. Neither of the known occurrences of this species are expected in old-growth or young-growth harvest units under any of the alternatives. Habitat for this species; however, could potentially be impacted by road construction and renewable energy projects.

Both of the two known occurrences of Unalaska mist-maid on the Tongass occur within non-development (Special Interest Area) LUDs on the Thorne Bay Ranger District. Under Alternatives 1, 4, and 5, young-growth timber harvest would not occur in non-development LUDs (Table 3.7-5) whereas, under Alternatives 2 and 3, young-growth timber harvest would be allowed in non-development LUDs.

Timber harvest would not occur in RMAs (preferred habitat for this species) under Alternatives 1, 3, and 4; whereas, Alternatives 2 and 5 would allow approximately 36,092 and 882 acres of young-growth harvest in RMAs, respectively (Table 3.7-5). Alternatives 2 would also result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4). Alternative 2, therefore, would result in a greater risk of adverse impacts to this species compared to the other alternatives

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to known occurrences of this species and new occurrences of this species located during project surveys. Because Unalaska mist-maid may receive protection from existing Forest-wide standards and guidelines and because there is a low chance that any of the known occurrences will be associated with old-growth or young-growth timber harvest or other proposed activities in the future, there is a low risk that any alternative would adversely affect this species.

Henderson’s checkermallow (Sidalcea hendersonii):
Potential habitat for this species includes wet meadows, estuaries, and tidal flats in the lowland zone (Douglas et al. 1999). There is one known occurrence of Henderson’s checkermallow on the Tongass; within a non-development (Semi-remote Recreation) LUD on the Juneau Ranger District. This occurrence, which is located in an upper beach meadow at the edge of hemlock and spruce forest on Howard Bay, could not be relocated during surveys in 2012 (USDA Forest Service 2015e). This occurrence is not expected to be located in old-growth or young-growth harvest units under any of the alternatives.

Under Alternative 1, timber harvest would be restricted in the beach buffer, which is the preferred habitat for this species. While access to timber through beaches may be needed under Alternative 1 if new LTFs are required, this would be infrequent. Therefore, under Alternative 1, there is essentially no risk of adverse impacts to Henderson’s checkermallow. Under Alternatives 2 through 5, young-growth timber harvest would occur in the beach buffer which could potentially result in impacts to undocumented occurrences of Henderson’s checkermallow or its habitat. Projected timber harvest in beach buffers would be highest under Alternatives 2 and 3; therefore, these two alternatives would result in a greater risk of potential adverse impacts to undocumented occurrences of this species and its habitat than the other alternatives (Table 3.7-5). Additionally, Alternatives 2 and 3 would result in more miles of road construction and reconstruction than the other alternatives (Table 3.7-4); thus, these two alternatives would result in a greater risk of potential adverse effects to Henderson's checkermallow from and road construction and reconstruction than the other alternatives.

Alternatives 2 through 5 would facilitate the development of renewable energy projects and would allow development of renewable energy projects in the beach buffer. Therefore, Alternatives 2 through 5 would have a greater risk of potential adverse effects to Henderson's checkermallow and its habitat from renewable energy development compared to Alternative 1.

Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to the known occurrence and new occurrences of this species located during project surveys. Because Henderson's checkermallow may receive protection from existing Forest-wide standards and guidelines and because no known occurrences of this species would be impacted under any of the alternatives, there is a low risk that any alternative would adversely impact this species.

Dune tansy (Tanacetum bipinnatum ssp. huronense):
There is only one known occurrence of this species on the Tongass, located within a Development LUD (Modified Landscape) on the Sitka Ranger District. This population has been declining due to habitat loss from beach erosion (USDA Forest Service 2015e). Habitat for dune tansy includes upper beaches and sand dunes on well-drained and calcareous soils, areas where timber harvest activities would not likely occur; and the one known occurrence of dune tansy is not expected in old-growth or young-growth harvest units under any of the alternatives. Access to timber harvest units through beaches or sand dunes may be needed for new LTFs; however, this need would be infrequent. If dune tansy is located during project surveys, Forest-wide standards and guidelines under all alternatives would consider protection to minimize adverse impacts to this species. Because of the possible protection from the Forest-wide standards and guidelines, and the very low chance of impacting the one known occurrence or unknown occurrences of this species or its habitat, there is a low risk that any alternative would adversely affect this species.

Invasive Plants

Effects Common to All Alternatives
Ground disturbance associated with timber harvest, road construction, renewable energy development, and other management activities on the Forest provides an opportunity for invasive plant introduction or expansion. Introduction and spread of invasive plants are potential direct effects of timber harvest, road construction, or renewable energy project development and operation, because these activities disturb soil and/or remove existing vegetation, providing openings for invasive plants to establish or spread. Additionally, movement of equipment and personnel can also provide opportunities for transport of invasive plant seeds or propagules into new areas. Indirect effects can include the establishment or spread of invasive plants through the use of roads after harvest for recreation or during road maintenance. Similarly, construction and maintenance of energy and utility line projects and associated road construction, maintenance, and use increases the risk of invasive species spread and colonization. The impacts of invasive plant spread and colonization can often spread beyond the area of disturbance.

Effects Specific to Each Alternative
All of the alternatives include timber harvest and road construction activities, which could directly and indirectly increase the number and spread of invasive plants. Increased disturbance increases the risk of establishment or spread of invasive plants. The effects would vary between alternatives depending on the level of

disturbance due to timber harvest, new roads construction and development of renewable energy projects.

Because of the difficulty in estimating the amount of disturbance that will be caused by each alternative, a relative estimate of total acres of timber harvest and miles of road construction is used to compare each alternative's potential for establishment and spread of invasive plants. However, it should be noted that the acres of timber harvest in either old-growth or young-growth harvest units is many times greater than the soil disturbance that would a result from these activities. Contrary to timber harvest, road construction is a direct source of soil disturbance; therefore, total miles of road construction may be interpreted as a relatively accurate account of the level of soil disturbance created as a result of this activity.

The acres of harvest and miles of road included in each alternative are shown in Table 3.7-4. Alternatives 2 and 3 would have a higher risk of introduction and spread of invasive plants due to the greater maximum acres of timber harvest and miles of road construction that would occur under these alternatives as compared to the other alternatives. Alternative 1 would result in the lowest risk of introduction and spread of invasive plants from timber harvest and road construction and Alternatives 4 and 5 would be intermediate; their risk would likely fall in the mid-range when compared to the other alternatives.

The proposed Renewable Energy plan components, under Alternatives 2, 3, 4, and 5, would facilitate development of renewable energy projects, which would result in an increased risk of introduction and spread of invasive plants compared to Alternative 1. However, procedures to prevent and control the spread of invasive would be included in each of the projects (described in more detail below under *Cumulative Effects*).

Cumulative Effects

Sensitive and Rare Plants

When considering effects to sensitive and rare plants, it is important to look at the cumulative effects of past, present, and reasonably foreseeable future activities on all land ownerships within the geographic area. Each land ownership has differences in vegetation patterns primarily as a result of differences in management activities. The significance of any direct or indirect effect in contributing to the cumulative effects on sensitive and rare plants from management activities depend on the amount and type of disturbance in the cumulative effects analysis area and how that disturbance may affect known locations of sensitive and rare plants. Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

Assessing cumulative effects to sensitive and rare plants will be done for individual projects as part of the NEPA process for the relevant analysis area. For this analysis past plus expected harvest and road construction for forestry and other uses and development of renewable energy projects and associated utility lines on all land ownerships within the Forest boundary can be used to compare the risk that each alternative would add to cumulative effects on both sensitive and rare plants.

Timber harvesting on state, municipal, and private land is governed by the Alaska Forest Resources and Practices Act (AS 41.17). Alaska Forest Resources and Practices Regulations (ADNR 2013) do not address threatened, endangered, or rare plants; however, they do recommend minimizing road construction and limiting disturbance in marshes and muskegs, which would provide some protection for some of the sensitive and rare plants.

There are no federally listed or proposed threatened or endangered plants that are known to occur or are likely to occur on the Tongass National Forest; therefore, there would be no contribution to cumulative effects to threatened or endangered plants under any of the alternatives.

To compare the potential cumulative effects of harvest under the five alternatives on sensitive or rare plants, harvest on lands of all ownerships in Southeast Alaska was analyzed. Therefore, all lands in Southeast Alaska constitute the cumulative effects analysis area for sensitive and rare plants.

There are approximately 21.6 million acres of land in Southeast Alaska. Non-NFS lands comprise about 4.8 million acres or 22 percent of the 21.6 million acres in Southeast Alaska; Glacier Bay National Park consists of about 2.5 million acres. Approximately 30 percent of the lands in Southeast Alaska were originally POG. Approximately 14 percent of the POG on all ownerships had been harvested by 2015. Thus, approximately 86 percent of the original POG on all ownerships was remaining in 2015 (Table 3.7-7). Looking at all ownerships of land in the Forest, the POG forest remaining in 100 years under full implementation of the Forest Plan would be the same for all alternatives at 83 percent (Table 3.7-7). Therefore, the risk of cumulative effects to sensitive or rare plants due to harvest would be similar for all alternatives. Table 3.9-16 in the *Biodiversity* section shows a similar relative risk among the alternatives for cumulative effects by Biogeographic Province.

Table 3.7-7
Cumulative Percent of Original POG Remaining on All Ownerships in 2015 and Estimated Minimum Percent Remaining after 100+ Years[1] for All Lands within the Tongass Forest Boundary[2]

Remaining POG on All Ownerships in 2015 as a Percent of all Original POG	Remaining POG after 100+ Years as a Percent of Original POG[3]				
	Alternative				
	1	2	3	4	5
86%	83%	83%	83%	83%	83%

[1] Assumes full implementation of Forest Plan for project timber sale quantity levels plus future non-NFS harvest.
[2] Annette Island is included because it is surrounded by areas within the Forest boundary.
[3] Note that ¾ of the POG reduction is on private and state lands.
Source: Tongass National Forest GIS database.

Existing road density is greater on the non-NFS lands within the Tongass National Forest boundaries than on the NFS lands due to concentrated harvest and more populated areas. It averages 0.20 mile per square mile on NFS lands and 2.32 miles per square mile for the non-NFS lands. The average for lands of all ownerships is 0.34 mile per square mile; however, those are averages over a very large area and there is great variability. The range of road density by subwatershed shows large variability across the Tongass as seen in Table 3.4-5 in the *Water* section (percentage of subwatersheds by road density category for the Tongass). All subwatersheds have road densities of less than 4 miles per square mile under existing conditions.

Table 3.7-8 shows the average future road density for each alternative. It includes existing roads and forestry as well as other roads proposed for construction on NFS lands and reasonably foreseeable on non-NFS lands. All the alternatives would have similar maximum road densities. Therefore, all alternatives have similar risks that management actions would add to cumulative effects to sensitive or rare plants.

Table 3.7-8
Existing and Estimated Future Maximum Road Density (miles per square mile) for NFS Lands and for All Ownerships within the Forest Boundary by Alternative after 100+ Years[1]

Land Ownership	Existing	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
National Forest Land	0.20	0.23	0.24	0.23	0.23	0.23
All Ownerships	0.34	0.45	0.45	0.45	0.45	0.45

[1] Assumes 100+ years of Forest Plan implementation plus future non-NFS harvest.
Source: Tongass National Forest GIS database

There are other activities that have occurred in the past and are reasonably foreseeable to occur in the future that have the potential to add to cumulative effects to rare and sensitive plants in regional and local areas. They include mineral extraction, energy and utility line projects, hydroelectric projects, transportation developments, and urban and recreational site development. Existing mining is at Greens Creek on Admiralty Island, Kensington Gold Mine north of Juneau, as well as other existing locations. Potential future mining sites include the Bokan Mountain and Niblack sites on the southern end of Prince Wales Island. There are also several regional transportation projects and regional energy and utility line projects planned for construction, including the Kake to Petersburg Transmission Line Intertie Project, regional transportation development defined in the Southeast Alaska Transportation Plan and Forest Service Alaska Region Long Range Transportation Plan, road paving on Prince of Wales Island, and construction of the Angoon Airport. Urban and recreational site development includes the growth in the cruise ship and guiding industries, development of fishing lodges, other lodges, recreational cabins, and expansion of cities. Existing and foreseeable renewable energy projects within the Tongass National Forest boundary include the potential geothermal development at Bell Island, potential hydroelectric development at Angoon, Sweetheart Lake, and Soule River, and expansion of the Swan Lake hydroelectric project.

Each of the activities described above could include clearing vegetation and disturbing habitat for construction and maintenance; therefore, they have the potential to affect sensitive and rare plants and their habitat. These impacts would be considered in project analysis.

Changes in Alaska's climate (discussed in the *Climate and Air* section of this chapter) could affect the hydrology and other habitat conditions where sensitive and rare plants occur. While the models do not fully agree on the climate change predictions for Southeast Alaska, they generally predict warmer weather with increased rainfall, and a decrease of snowfall. Recent research by Shanley et al. (2015) predicted an increase in mean annual temperature of approximately 3 to 10 degrees Fahrenheit, a 3 to 18 percent increase in mean annual precipitation, and a 22 to 58 percent decrease in snowfall by the 2080s (Shanley et al. 2014). These changes would likely result in lower soil moisture due to increased evaporation during warmer summer months. Also, a precipitation shift from snow to rain could lead to more water running off the landscape rather than being stored as snow and feeding streams and wetlands in the late spring and summer, thus increasing evaporation and reducing water storage. These factors could lead to drier streams, meadows, and wetlands.

Changes in temperature and hydrologic conditions would likely favor some plants and stress others. There has been little research into the effects of changes in environmental conditions for each of the sensitive and rare species; consequently, there is uncertainty as to the effect of changes in the climate on sensitive and rare plant species known or suspected to occur on the Tongass.

Invasive Plants

Invasive plants on any land ownership in Southeast Alaska can affect establishment or spread of invasive plants on NFS lands and vice versa. Also, activities on land of any ownership can result in establishment or spread of invasive plants that affect other lands. As mentioned in the direct and indirect effects, activities can have wider effects on invasive plant spread than the specific area of land disturbance due to the interconnectedness of land.

As discussed above, differences in vegetation patterns primarily as a result of differences in harvest intensity are expected to vary between public and private land ownerships. The cumulative effects of invasive plants from management activities of all land ownerships across the Tongass National Forest would depend on factors such as the following:

- Amount of harvest and road building;
- Location and size of renewable energy projects and associated facilities);
- Existence and extent of invasive plants at the time of project implementation;
- Overall habitat alteration due to invasive plants expected as a result of past, present, and foreseeable projects; and
- Anticipated response of invasive plants to the proposed actions and any management considerations or mitigation and monitoring that will be applied to each project.

Past, present, and future harvest and road construction for harvest and other purposes on both private and public lands can be used to compare the risk of cumulative effects of the five alternatives on invasive plant introduction or spread. Table 3.7-8 shows the existing road density and maximum future road density for each alternative for all land ownerships and for NFS lands. The maximum future road density for all alternatives is similar, with Alternative 2 having just slightly less maximum road density after 100 years than the other alternatives.

As discussed under cumulative effects for sensitive and rare plants, there are fewer restrictions on timber activities on non-NFS lands than on NFS lands. Timber activities on non-NFS lands that can contribute to the introduction or spread of invasive plants are not specifically regulated by the State of Alaska. To compare the risk of effects of harvest under the five alternatives on invasive plants, POG remaining on land of all ownerships was analyzed. Looking at all ownerships of land in the Forest, the POG (unharvested) forest remaining in 100 years under full implementation of the Forest Plan would be greatest for Alternative 4 and 5 (83 percent). Alternatives 1, 2, and 3 would have slightly less POG forest remaining (82 percent) in 100 years under full implementation (Table 3.7-7). Therefore, the risk of cumulative effects on the introduction and spread of invasive plants would be slightly higher for Alternatives 1, 2, and 3 than Alternatives 4 and 5.

There are other activities that have occurred and are reasonably foreseeable to occur in the future that have the potential to add to cumulative effects of invasive plants. They include mineral activities, renewable energy and utility line projects, hydroelectric projects, transportation developments, and urban and recreational site development (see above for list of past, present and reasonably foreseeable projects). Each of these activities can include clearing vegetation, construction, transportation for construction and ongoing activities, and maintenance. Therefore, they have the potential to introduce or spread invasive plants in an area and would need to be considered in the project analysis.

Changes in Southeast Alaska's climate (discussed in the *Climate and Air* section of this chapter) could also create the conditions that encourage the spread of invasive plants by altering opportunities for invasive plants to colonize new areas, where could be compounded by climate change. Changing climate may also result in range extensions for some species that are native at more southerly latitudes, and they may become established or become more widespread on the Tongass, as a result. Changes in growing conditions would likely favor some plant species and stress others. There is uncertainty in the effect of changes in the climate to the invasive plants on the Tongass.

With any of the action alternatives, applying mitigation measures in the form of Forest-wide standards and guidelines as well as ongoing invasive plant control and management programs will contribute to lessening the cumulative effects of invasive plants across Southeast Alaska.

Currently, the Forest uses mitigation measures for invasive plant prevention during implementation of management actions. Examples of these types of mitigation measures include vehicle and equipment cleaning in certain locations; use of weed-free forage and gravel; minimizing the removal of overstory trees and shrubs to decrease sunlight and soil disturbance; revegetation practices using non-invasive seed and plant materials; and timing considerations for road maintenance schedules to avoid potential spread of invasive plants during seed emergence. These mitigation measures are considered through a risk assessment for all proposed activities from timber sale and transportation planning and maintenance programs, to renewable energy development, and recreation and wilderness management.

Invasive plant control and management include multiple strategies depending on the invasiveness of the species, its location, and its aerial extent. Strategies such as eradication, containment, and control will be applied to existing and new infestations of invasive plants throughout the Forest for those areas where their presence threatens the ecological integrity or desired condition of the sites they occupy. A strategy of tolerance will equally be applied for other infestations which do not threaten the ecological integrity of habitats. A variety of control measures may be implemented for the eradication or control of infestations using a variety of treatment options, including manual, mechanical and chemical control (e.g., herbicides). All treatments will be evaluated through proper environmental analysis.

As stated above, FSM 2900 and Forest-wide standards and guidelines regarding invasive plant species include direction to review proposed projects to determine the risk of introduction or spread of invasive plants and implement appropriate project-specific mitigation measures. They also include direction to control existing invasions and rehabilitate habitats impacted by invasive species. Specific policies and directions for invasive plant management outlined in FSM 2900 include:

- Initiate, coordinate, and sustain actions to prevent, control, and eliminate priority infestations of invasive species using an integrated pest management approach[1];

[1] Integrated pest management is an ecologically based holistic strategy that focuses on the long-term prevention of pests or their damage by managing the ecosystem. Integrated pest management techniques are defined within four broad categories: 1) biological, 2) cultural, 3) mechanical/physical, and 4) chemical.

- Determine factors that favor establishment and spread of invasive species on NFS lands and design management practices to reduce or mitigate the risk of introduction or spread of invasive species;
- Determine the risk of introduction, establishment, or spread of invasive species associated with any proposed action and provide for alternatives or mitigation measures to reduce or eliminate that risk;
- Ensure that management activities are designed to minimize or eliminate the possibility or spread of invasive species on NFS lands or adjacent areas and ensure that invasive species are not used in any management activities on NFS lands such as site restoration or revegetation work or watershed rehabilitation projects.
- Establish and implement standards and requirements for vehicle and equipment cleaning to prevent spread of invasive species on NFS lands and adjacent lands and make every effort to ensure that all materials used on NFS lands are free of invasive species and/or noxious weeds;
- Monitor all management activities for the potential spread or establishment of invasive species.
- Develop and utilize site-based and species-based risk assessments to prioritize management of invasive species infestations;

Additional directives associated with integrated pest management are provided in FSM 2070 (Native Plant Material Policy) and FSM 2150 (Pesticide Use Management and Coordination Policy). FSM 2070 promotes the use of native plant materials and restricts the use of non-native species for revegetation, rehabilitation, and restoration. FSM 2150 provides direction regarding the use of pesticides and herbicides, including direction to: prepare a site-specific or project-specific analysis prior to pesticide use which includes an assessment of chemicals to be used and evaluation of potential effects to target and non-target species. In addition, a Pesticide-Use Proposal must be completed and reviewed prior to any pesticide application activity planned on NFS lands. FSM 2150 policy also includes directives to conduct all pesticide-use activities in full compliance with applicable U.S. Environmental Protection Agency pesticide label restrictions and applicable federal and state laws and regulations, including regulations that apply to personnel training and licensing.

Forest Health

Affected Environment

Current Situation

Insects, diseases, related decay processes, and windthrow are an integral and natural part of forest ecosystems. Many of these appear to play key roles in gap-level disturbance (see discussion of old-growth forests in the *Biodiversity* section of this chapter) and in providing wildlife habitat. The majority of the forests on the Tongass are old-growth forests. Losses to the timber resource caused by heart rot in live trees are considerable in old-growth forests. Approximately one-third of the volume of the old-growth hemlock-spruce forests in Southeast Alaska is decayed by heart rot fungi (USDA Forest Service and ADNR 2014).

In addition to heart rot, some of the more common destructive insects, diseases, and conditions within Southeast Alaska are listed below.

Black-Headed Budworm, *Acleris gloverana* (Walsingham), is one of the more destructive forest insects in coastal Southeast Alaska. In 1993, a peak year for budworm, approximately 258,000 acres of spruce-hemlock forests were affected. This was the largest outbreak in decades. In the 1950s, almost one-third of the net timber volume was lost on many hemlock sites due to budworm defoliation (USDA Forest Service and ADNR 2000). In 2006, Black-headed budworm populations were at endemic levels, with less than 1,000 acres of mapped defoliation in the previous 3 years (USDA Forest Service and ADNR 2007). The 2014 aerial survey indicates little impact of this insect in Southeast Alaska (USDA Forest Service and ADNR 2015). Larval feeding strips hemlock foliage and can cause growth reduction, top-kill, and, at times, tree mortality (USDA Forest Service and ADNR 2000). Juday et al. (1998) rated many potential impacts on the coastal forests of Southeast Alaska due to climate change. They concluded that there was a high risk of increased damage from black-headed budworm outbreaks.

Hemlock Sawfly, *Neodiprion tsugae* (Middleton), is a serious defoliator of western hemlock throughout Southeast Alaska. Outbreaks tend to be of longer duration in southern Southeast Alaska where widespread damage is usually confined to the area south of Frederick Sound, especially along Clarence Strait. Larvae feed on mature (older) needles rather than current year (new) foliage. Most sawfly outbreaks do not cause tree mortality, but the tops are killed in some trees and tree growth may be reduced. Heavy defoliation by hemlock sawflies is known to reduce radial growth and cause top kill. In 2014, 3,940 acres of hemlock sawfly defoliation were detected (USDA Forest Service and ADNR 2015). At two locations, Etolin and Revillagigedo Islands, damage was detected in 2012, 2013, and 2014. Consecutive infestations are notable because they may cause mortality in hemlock stands.

Spruce Beetle, *Dendroctonus rufipennis* (Kirby), is the most destructive forest insect Alaska-wide, although outbreaks in Southeast Alaska are typically smaller and of shorter duration than those in south/central and interior Alaska. Most outbreaks originate in blowdown or in cull logs left in harvest units and spread to adjacent standing timber. Mortality in unmanaged Sitka spruce stands varies and can be as high as 75 percent. Weather conditions appear to play a role in the expansion or contraction of beetle populations, and warm winters increase the probability of a spruce beetle infestation in southeast Alaska (Bentz et al. 2010). Spruce beetle activity has been noted across the Tongass National Forest and adjacent lands from Yakutat Forelands to Dall Island (USDA Forest Service and ADNR 2000). Spruce beetle activity in 2014 was concentrated on Kupreanof Island, and northwest of Haines. These two areas account for approximately 1,680 acres of mapped spruce beetle outbreak, though other small patches of activity were mapped throughout Southeast Alaska (USDA Forest Service and ADNR 2015).

Spruce Needle Aphid, *Elatobium abietinum* (Walker), is an introduced species that feeds on the needles of Sitka spruce, often causing reduced growth and increasing susceptibility to other mortality agents such as spruce beetle. As with other insect pests, populations have cycles, generally increasing following mild winters. More than 25,000 acres of spruce forest were defoliated in the winter of 1991 to 1992 (USDA Forest Service and ADNR 2000). An outbreak that began in 1998 lasted several years with the worst defoliation occurring in 2003 when more than 30,000 acres were affected. Defoliation by spruce aphids affected approximately 9,120 acres in 2006, mostly in small pockets within the beach fringe from Lynn Canal in the north to Dall Island in the south (USDA Forest Service and ADNR 2007). A large outbreak occurred in 2010, with 40,680 acres affected (USDA Forest Service and ADNR 2011). The most recent aerial survey indicates limited spruce aphid activity, with 425 acres of damage detected near Haines (USDA Forest Service and ADNR 2015).

Hemlock Dwarf Mistletoe, *Arceuthobium tsugense* (Rosendhal, G. N. Jones), is a parasitic flowering plant that infects western hemlock throughout Southeast Alaska as far north as Haines. Infestation levels vary—dwarf mistletoe is absent in some stands, while almost every hemlock is infected in other stands. The upper elevational limit for Hemlock dwarf mistletoe is approximately 500 feet (Shaw and Hennon 1991). Basal area growth in western hemlock trees heavily infected with dwarf mistletoe can be reduced by 36 percent or more (Shaw et al. 2008). In addition to reduced stem growth, infestations cause increased growth and retention of lower branches and distortion and weakening of wood strength at and near swellings. The spread of dwarf-mistletoe in young hemlock stands can result from leaving standing infected hemlock in harvest units (Laurent 1974). Dwarf mistletoe responds to light with increased seed production. Rates of spread to adjacent and lower canopy trees may increase in partial cuts where infected hemlocks remain. Trummer et al. (1998) developed a model for dwarf mistletoe infections in uneven-aged forests of Southeast Alaska that suggests infection rates are significantly correlated with levels of dwarf mistletoe infection in the residual trees. Deal (2001) reports partial cutting resulted in maintaining mistletoe levels at generally undamaging levels, with a trend towards less mistletoe in stands with higher harvest levels. A study of partial cut stands in British Columbia found that most young trees infected with mistletoe were advanced regeneration established before logging (Muir 2006). Barrett et al. (2012) note that dwarf mistletoe is limited in several ways by cold temperatures, and habitat may increase over time under warming conditions. Climate models predict substantial increase in dwarf mistletoe habitat (374% to 757%) in the next century (USDA Forest Service and ADNR 2015).

Alaska Yellow-Cedar. Decline and mortality of yellow-cedar continues to be one of the most widespread and important forest problems in Southeast Alaska. Aerial surveys have mapped over 585,000 acres of decline in a wide band from western Chichagof and Baranof Islands to the Ketchikan area (USDA Forest Service and ADNR 2015). In 2014, approximately 20,000 acres of dying (i.e., active decline) yellow-cedar trees were mapped (USDA Forest Service and ADNR 2015). This decline is associated with wet, poorly drained sites, and recent research has demonstrated that no organism is the primary cause of the decline (Hennon and Shaw 1997). Schaberg et al. (2011) assert that yellow-cedars have roots that are both less cold tolerant and more concentrated near the soil surface than co-occurring species, making them especially susceptible to cold injury. Hennon and Shaw suggest that reduced snow pack in low-elevation areas associated with a warming trend that started in the 1800s has exposed fine surface roots to freezing, which in turn kills trees. As the climate continues to warm, cedar decline is likely to continue to spread, especially in the south and east. Conversely, yellow-cedar appears to be spreading northward as climate warms, into areas that retain snow longer into the spring.

Hemlock Fluting. Hemlocks with fluting have deeply incised grooves and ridges extending vertically along their trunks, a condition that reduces the value of hemlock logs because they yield less sawlog volume and some of the milled wood contains bark. Fluting is a common problem in Southeast Alaska, especially on mid- to high-quality sites at low elevations, on gradual slopes, and with western exposure (Julin et al. 1993). It is rarely found away from the coast. The cause of fluting is not completely understood, but it may be associated with increased wind firmness, especially on shallow soils, due to growth increases triggered by silvicultural treatments or natural disturbance (USDA Forest Service and ADNR 2014). Julin et al. (1993) found that the larger buttresses were generally aligned with the direction of the tree lean. They also concluded that western hemlock trees in Southeast Alaska may be genetically predisposed to form fluted trunks. Silvicultural treatments that favor other species and reduce branch size and retention period would greatly reduce fluting (Julin et al. 1993). However, because fluting primarily occurs in the beach buffer, the effect on timber resources is limited.

Decays. Stem decays cause substantial loss in all tree species in unmanaged stands. Tree death and stem breakage resulting from decay contribute to the structural diversity in stands and may be a major factor in small-scale disturbance in Southeast Alaska (Hennon and McClellan 2003). Many decay fungi enter through tree wounds. The accidental wounding of trees during partial cuts and commercial thinnings can increase the impact from decay organisms in managed stands (USDA Forest Service 1997a, Appendix G). However, Christensen et al. (2002) found very low levels of disease-caused defects in both thinned and unthinned 90-year-old hemlock-Sitka spruce stands on the Tongass compared to old-growth forests. Juday et al. (1998) rated many potential impacts on the coastal forests of Southeast Alaska due to climate change. They concluded that there is a risk that new fungal tree diseases will appear in Southeast Alaska as the climate warms.

Animal Damage. Significant animal damage to trees is apparent at various locations across the Tongass National Forest. Porcupine feeding on hemlock and spruce is common on Mitkof Island and many mainland areas. Young trees in managed and unmanaged stands are often top-killed or killed outright as porcupine feeding girdles the main bole. Bark beetles have been found infesting damaged trees. This damage becomes significant when groups of trees are killed or deformed. As trees grow larger (age 40 to 50 years), porcupine damage shifts from top kill to basal wounds, which serve as entry points for decay fungi. Brown bears cause basal wounds on Alaska yellow-cedar each spring on Baranof and Chichagof Islands. Bears rip off the bark in the spring to lick the sweet cambium.

The majority of yellow-cedar in some stands have basal wounds from bear feeding (USDA Forest Service and ADNR 2015).

Fire. Fire has played a minor role in the forests of Southeast Alaska because of the abundant year-round precipitation. The average fire size on the Forest from 2006 to 2014 was 5.2 acres (Alaska Interagency Coordination Center 2015). More active fire seasons do occur, 2005 for example, when 322 acres burned. Recent General Circulation Model data indicate the area will see increased temperatures in coming decades. However, increased rainfall is predicted as well. These conditions will likely offset, and the impact of fire on resources on the Tongass National Forest is likely to remain low.

Windthrow. Windthrow is the dominant disturbance agent in Southeast Alaska. Two forms occur: small-scale events (gap disturbance) and large-scale events (catastrophic disturbance). Most of the Forest is subject to small-scale windthrow events. Individual trees or small groups of trees blow over during storm events, opening gaps in the canopy that allow young trees to grow to fill the openings. This results in complex, mixed-aged stands. Disease and decay agents also play a role in this process. Nowacki and Kramer (1998) state that diseased trees are more at risk to windthrow and stem-snap, while Hennon and McClellan (2003) report that many of the uprooted or broken-stemmed trees had died before falling. Small-scale events occur on a regular basis and result in openings from 6 to 13 percent on the canopy (Nowacki and Krammer 1998). Areas not protected by topographic barriers from the severe effects of infrequent, major storms are subject to large-scale windthrow events that cause catastrophic damage. Entire stands have been blown down in the past, resulting in the regeneration of more even-aged stands with more uniform canopies (Nowacki and Krammer 1998). Both forms of windthrow are a part of the natural forest generation, growth, and development. Juday et al. (1998) rated many potential impacts on the coastal forests of Southeast Alaska due to climate change. They concluded that there was a high risk of increased large-scale blowdown across Southeast Alaska as well as increased windthrow around harvest units.

Monitoring and Pest Management

Forest pest activity on the Tongass National Forest is typically detected during on-the-ground activities, or during annual aerial surveys conducted by the region's Forest Pest Management group. The timing of surveys coincides with foliage and pest development. Pest activity noted during surveys is documented and reported to the appropriate land manager. In cooperation with land managers, Forest Pest Management people conduct on-site investigations to verify the pest, evaluate the pest and its host(s), and formulate future management alternatives. Often, pest and host monitoring is required to fully understand potential impacts prior to development of management alternatives.

Populations of historically significant defoliating insects are monitored through a sampling system that occurs in conjunction with the annual aerial survey. Defoliating larvae are collected, identified, and counted at designated sites. Gypsy moth pheromone traps have been placed throughout Southeast Alaska to provide an early warning that these insects are present. Data from larvae counts and pheromone traps, in conjunction with the collection of host and weather information, enhance forest pest managers' ability to predict defoliator damage.

The impact of hemlock dwarf-mistletoe and methods of reducing damage from the disease in managed stands have been established by several research studies. In addition, Forest Pest Management has surveyed numerous even-aged stands from 10 to 100 years old to determine the incidence and impact of hemlock dwarf-mistletoe in managed stands.

Research studies have yielded information on the pathology and epidemiology of decline of yellow-cedar (cited above). In addition, information on the distribution of decline and acreage affected has been determined by mapping during aerial surveys. Porcupine damage in managed stands is currently being assessed. As more young-growth stands reach commercial thinning age, forest pest research is beginning to focus on pest activity within these stands.

The Forest develops site-specific prescriptions, based on monitoring information, scientific information, and pest management projections, to prevent or limit insect and disease damage. The objective is to limit infestations of natural insects, disease-causing organisms, and parasites to normal background levels, and to prevent or reduce infestations of non-native organisms to the extent feasible. Similarly, the Forest objective is to limit windthrow to levels that would occur naturally through silvicultural prescriptions prepared for each timber sale.

Environmental Consequences

Direct and Indirect Effects

In general, alternatives that favor high amounts of old-growth harvest would likely reduce timber lost to insect and disease. Alternatives that favor a shift toward decreased old-growth harvest and increased harvest of young stands would tend to perpetuate current disease levels in old-growth forests, but ecological processes and wildlife habitat for old-growth associated species would be maximized. Higher amounts of timber harvest would generally yield young stands with lower levels of insect and disease activity. However, two-aged and uneven-aged management could maintain or even increase levels of hemlock dwarf mistletoe. Two-aged and uneven-aged management may also result in higher levels of stem and root disease caused by injuring residual trees during harvest operations; however, the degree of increase, if any, is uncertain. Two-aged treatments that clump leave trees are less likely to cause damage to residual trees. Similarly, thinning young, even-aged stands may also lead to stem and root disease due to wounding of leave trees during thinning, although a retrospective study did not find that thinning had increased defect levels in thinned stands on the Tongass compared to unmanaged stands (Deal et al. 2002), and Christensen et al. (2002) did not find higher levels of decay in two 90-year-old stands that had been commercially thinned 25 years earlier compared to unthinned stands.

Alternative 1 has over 20,000 more acres of old growth likely to be harvested over the next 100 years than Alternatives 4 and 5, and approximately 27,000 to 30,000 more acres likely for old-growth harvest than Alternatives 2 and 3. Therefore, over time, Alternative 1 and, to a lesser extent, Alternatives 4 and 5 are likely to result in more acres with a lower risk of insect activity and somewhat less forest with high levels of heart rot and other disease organisms than the other alternatives. Conversely, Alternatives 2 and 3 would retain more acres of old-growth forest, which would likely result in somewhat higher levels of insect and disease across the Tongass. There is some concern that two-aged and uneven-aged harvest could lead to higher levels of windthrow, dwarf mistletoe, and stem decay compared to even-aged harvest methods. Deal et al. (2002) report that the number of uprooted trees was somewhat higher in partially harvested stands, but overall tree mortality rates were similar. Bole wounds were common on trees in partially harvested stands, but “natural tree injuries from falling trees and animal feeding were far more abundant at several sites” (USDA Forest Service and ADNR 2002). Alternatives with more two-aged and uneven-aged management may favor shade-tolerant species (western hemlock, mountain hemlock, and yellow-cedar), while even-aged may result in stands with a higher proportion of Sitka spruce. However, retrospective studies indicate that Sitka spruce can be maintained in mixed hemlock-Sitka spruce stands over a wide range of cutting intensities if enough Sitka spruce trees are present in the stand after harvest (Deal et al. 2002).

In general, endemic levels of insect and disease activity in mature and overmature forests would be allowed to run their course under all alternatives. Harvesting flexibility would be maintained to take advantage of timber salvage opportunities, particularly for dead and dying yellow-cedar stands. Insect and disease suppression may be justified in high-quality, mature to overmature stands that cannot be salvaged immediately, or that lie near recreation areas and communities where scenic values are high.

Animal damage, such as that from porcupines, is expected to continue and would likely be increasingly evident in precommercially thinned stands where porcupines are present. Winter feeding by porcupines is known to damage and sometimes kill young trees. The Forest has been alternating precommercial thinning prescriptions to reduce porcupine damage by favoring cedar and deferring thinning in some areas. Bear also damage young trees by removing bark to reach the sweet cambium tissue below the bark. Alternatives that result in creating more young stands, most notably Alternative 1, would lead to more acres of forest that would be vulnerable to animal damage.

Damage from wind would continue to occur; some increase is likely to occur along the edges of harvest units and along stream buffers and other legacy trees. Alternatives with more old-growth harvest and the associated road building (most notably Alternative 1) would tend to increase the risk of harvest- and road-related windthrow compared to those with less harvest and road building (Alternatives 2 and 3). If the current climate trend continues and more gale-force wind storms occur, blowdown may increase for all alternatives in proportion to the amount of harvest.

There may be a short-term increase in fire risk during harvest operations if activities are conducted during dry periods. Alternatives with higher levels of timber harvest may have a small increase in fire risk compared to alternatives with less harvest. Warmer winters are likely to increase insect damage because more insects will survive the winter. This could result in more dead and dying biomass that would contribute to the available fuels, but if the predicted increases in temperatures are paired with increases in precipitation there may be no significant increase in fire risk (refer to the *Climate and Air* sections of this chapter).

Cumulative Effects

The greatest potential forest insect and disease problems are likely to be in mature and overmature stands where disease levels are high. Tree vigor tends to decrease with maturity, causing an increase in susceptibility to insects and diseases. Heart rot levels are directly proportional to both tree and stand ages. The spruce beetle has the potential to significantly alter the desired condition of stands in certain locations near the mainland where the insect has periodically become active. The spruce aphid was introduced approximately 80 years ago and appears to be causing more damage to spruce as the climate warms (Schrader and Hennon 2005). The recent assessment of invasive pathogens in Alaska and its national forests states that Alaskan forests are particularly vulnerable to invasive pathogens because of the relatively small number of native tree species and the narrow genetic base (Schrader and Hennon 2005). The Schrader and Hennon report concluded that the European scolytid bark beetle poses the greatest threat to the spruce forests throughout Alaska if introduced.

Stem and root decay, and the incidence of hemlock dwarf-mistletoe, have historically increased with intensified land management activities, particularly under harvesting systems other than clearcutting (Trummer et al. 1998). If the current warming trend continues, cedar decline and damage from insects are likely to increase, both from species currently present in Southeast Alaska and from those entering the area from other parts of North America or elsewhere. Invasive plants may also adversely affect forest health. Refer to the *Plant* section of this chapter for a discussion of invasive plant species.

Shorter rotations and even-aged silvicultural prescriptions implemented on non-National Forest System (NFS) lands are likely to contribute to decreasing mistletoe, insect, and disease levels in the forests of Southeast Alaska, especially the loss due to heart rot. Alternatives with more even-aged management, especially Alternative 1, would add to these changes. Conversely, increased use of commercial thinning in the may damage leave trees, increasing decay rates. Also, the younger stands established after harvest on all lands are likely to add to the loss of growth and tree mortality caused by animal damage in the region. Harvest-related windthrow may increase on NFS lands and adjacent areas that are harvested using even-aged silvicultural systems whether on NFS or non-NFS lands.

Maintaining biotic and structural diversity provides an opportunity for limiting some insect and disease problems. Some insects and diseases are host-specific, depend upon plants that are under stress, or flourish under homogeneous conditions. In other cases, and particularly for heart rot, favoring younger-aged stands through even-aged management may be the most effective way of limiting insect and disease problems. Maintaining healthy young-growth stands through stand density control (thinning) may reduce insect damage (Neilson 2007).

The careful use of alternatives to even-aged harvest methods can be a tool for maintaining natural but not excessive levels of diseases, such as heart rot and dwarf mistletoe, which have important ecological consequences. Integrated Pest Management provides the opportunity to evaluate these and more traditional clearcut practices. Through prescription processes, stands with unacceptable insect and disease-related losses, as well as those of high risk for future losses, would be identified for treatment. Detection methods such as aerial surveys, currently in use, would continue to be used for the early identification of epidemics.

The current warming trend increases the risk of increased insect and disease outbreaks, and catastrophic blowdown events. Juday et al. (1998) rated many potential impacts on the coastal forests of Southeast Alaska due to climate change. They concluded that there was a high risk of increased large-scale blowdown across Southeast Alaska and increased windthrow around harvest units; although, they also state that as of the date of their report, the increased frequency of storms in the last few decades has not corresponded to an increase in large-scale blowdown in Southeast Alaska. Also, the 2014 Forest Health report noted very little blowdown in aerial and ground surveys (USDA Forest Service and ADNR 2015); however, this does not rule out the risk of increased windthrow in the future as additional warming occurs.

Warmer, drier weather may result in increased levels of insect and disease levels. For example, Juday et al. (1998) concluded that there was a high risk of increased damage from black-headed budworm outbreaks, and there is a risk that new fungal tree diseases will appear in Southeast Alaska as the climate warms.

Appendix C of this EIS provides a full list of all the projects considered in the cumulative effects analysis.

This page is intentionally left blank.

Biodiversity

Affected Environment

Biological diversity, or biodiversity, may be defined as "the variety of and variability within and among living organisms and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems" (United Nations Environment Programme 1991). Biodiversity encompasses the variety of genetic stocks, plant and animal species and subspecies, ecosystems, and the ecological processes through which individual organisms interact with one another and their environments. Under the National Forest Management Act (NFMA), the Forest must provide for diversity of plant and animal communities based on the suitability and capability of specific land areas.

This section provides an overview of the Tongass Conservation Strategy, describes the ecosystems on the Tongass National Forest, and provides a summary of past timber harvest. Landscape connectivity and fragmentation and invasive species are also discussed. Additional information on the background of the Conservation Strategy and its components is provided in Appendix D.

Ecosystem Classification

Southeast Alaska is divided into 23 biogeographic provinces, or ecosystem-based landscape delineations characterized by 1) similarities in terrestrial wildlife species composition, 2) similarities in distributional patterns for many of these species, 3) geologic and water barriers stemming from past events, such as glaciation, and 4) generally similar climatic conditions and physiographic characteristics (USDA Forest Service 2003a). Biogeographic provinces in Southeast Alaska are described in Table 3.9-1 and show in Figure 3.9-1. Twenty-one biogeographic provinces coincide with the Tongass National Forest. Biogeographic provinces provide an appropriate scale for the analysis of impacts to biodiversity because they are ecosystem-based and vary in the level of resource development that has taken place and is allowed within them (see the Suitable Land maps in the Map Packet accompanying this EIS for the distribution of suitable POG and young-growth harvest across the Planning Area). .

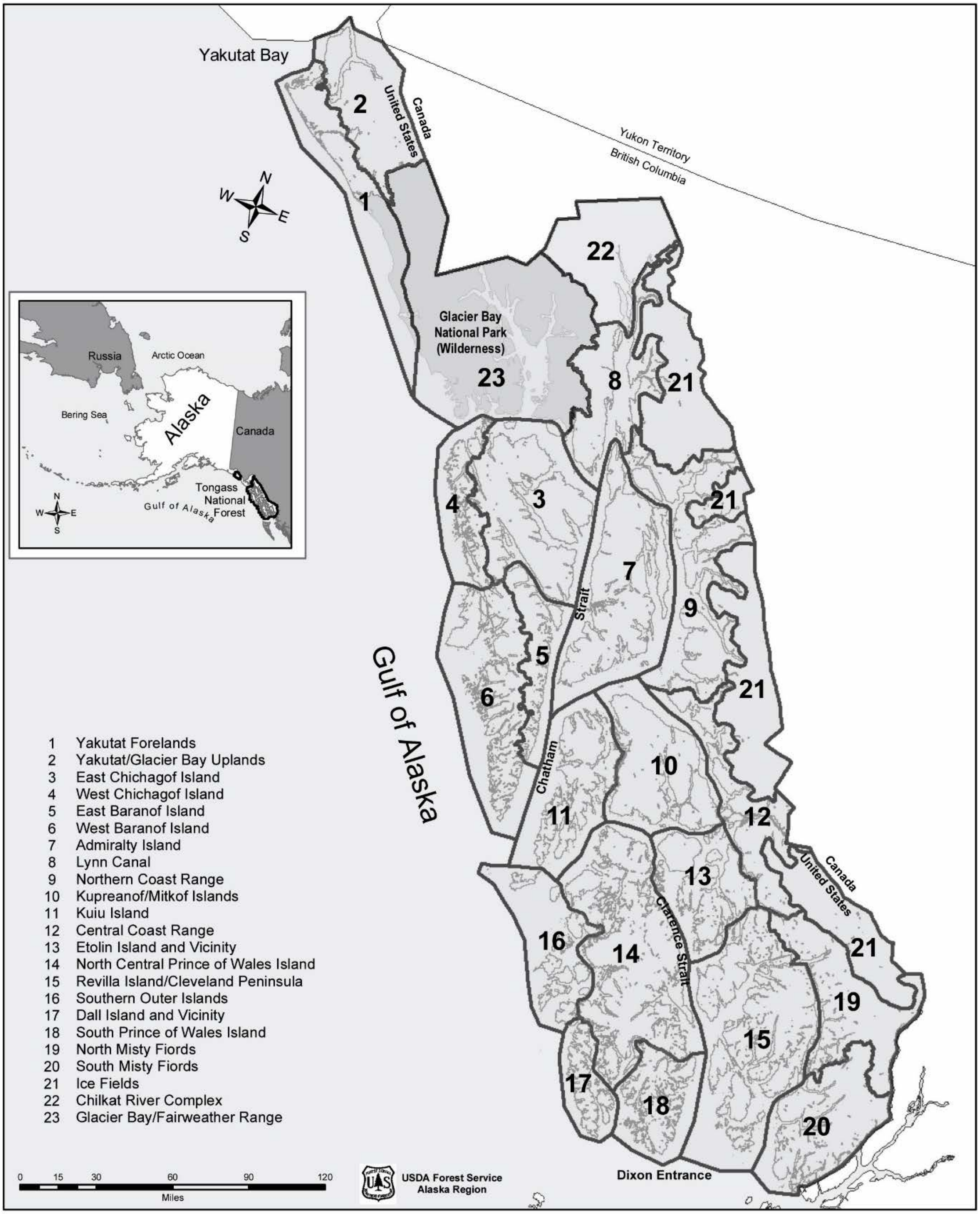
Table 3.9-1
Biogeographic Provinces in Southeast Alaska and the Tongass National Forest

No.	Province	Description
1.	Yakutat Forelands	A very young, nearly flat landscape with extensive flooding and active isostatic rebound (uplifting of the ground after glaciers recede). Most surfaces vary from 200 to 1,500 years old. Dune formation and succession are ongoing processes due to glacial rebound and wave action. Plant community patterns reflect a diverse mosaic of naturally occurring older and young forests, shrublands, bogs, and meadows. Sitka spruce, alder, and cottonwood are abundant on well drained, recently deglaciated, and active fluvial surfaces. Most of the province is inside the Tongass Forest boundary, but the southern lobe that extends into Glacier Bay National Park is not.
2.	Yakutat/ Glacier Bay Upland	The climate varies from very wet hyper-maritime along the coast to very wet maritime inland. Mountains abruptly rising more than 10,000 feet from sea level, extensive active glaciers, and fiords dominate this landscape. Sitka spruce, alder, and cottonwood are abundant at lower elevations; alpine and lichen over rock plant communities dominate the land from 2,000 to over 10,000 feet elevation.
3.	East Chichagof Island	This province is drier and colder than the outer coast of Chichagof Island; the winter snow pack is generally greater. Chichagof Island is deeply dissected into three peninsulas, which may be functioning biologically more like separate islands. Vegetation in this province represents a modal condition similar to the Admiralty Island Province.
4.	West Chichagof Island	This province is dominated by a very wet hyper-maritime climate and exposure to outer coastal storms. Hundreds of small islands dot the coast. Topography is gentle when compared to the mountains of Baranof Island and the coastline is highly irregular. The Sitka spruce/Pacific reedgrass plant association is abundant along the outermost coastal fringe; otherwise, vegetation is similar to the other northern islands.
5.	East Baranof Island	This province is colder than West Baranof or East Chichagof Island. Mountain glaciers occur along the divide between east and west Baranof. Topography is rugged and steep to saltwater, with little flat land. Plant associations on East Baranof are similar to much of the mainland due to the steep topography and cold environment. Spruce, devil's club, salmonberry forest associations are common on avalanche and steep erosional slopes; alpine and rock/lichen plant communities are abundant.
6.	West Baranof Island	This province is similar to the West Chichagof Island Province with the exception of southern Baranof, where precipitation exceeds 250 inches per year. Topographically, Baranof Island is the most rugged of all the islands in Southeast Alaska. The southern half of this province is highly dissected by steep-sided fiords; the outer coast is dotted with hundreds of small islands. All forest plant associations except those in the Western red-cedar series and those found around large mainland rivers occur in this province. Kruzof Island has some unique vegetation communities, which have not been classified.
7.	Admiralty Island	This province is represented by relatively gentle topography and moderate rainfall. Winter conditions are moderated by the surrounding marine environment. Winds from Chatham and Icy Straits, Lynn Canal, and off the mainland are often severe. All forest plant associations but those in the Western red-cedar series, those found around large mainland rivers, and those occurring only on outer coastal areas occur in this province. Forest productivity is high. Fresh and saltwater marshes in the numerous bays and inlets, and alpine and bog communities, are abundant.
8.	Lynn Canal	Rain shadows and the dominating influence of the continental climate make this the driest and seasonally warmest province in Southeast Alaska. Precipitation is generally less than 60 inches per year. The topography is rugged and glaciated. The southern portion of the Chilkat Peninsula is more similar to the East Chichagof Island Province. Western and mountain hemlock and Sitka spruce plant associations are common. Alpine tundra and extensive rock/lichen communities dominate much of the land from 2,000 to over 8,000 feet elevation.
9.	Northern Coast Range	This province has little maritime influence. Topography is rugged and glaciated. The Taku and Whiting Rivers extend into Canada. All forest plant associations except those in the Western red-cedar series and those occurring only on outer coastal areas occur in this province.
10.	Kupreanof/ Mitkof Islands	The climate is cooler and the winter snow pack greater than on the islands to the south. The eastern edge of this province is strongly influenced by wind-born loess (silt) coming from the Stikine River and the mainland. All forest plant associations except those in the Western red-cedar series and those occurring only on outer coastal areas occur in this province. This province contains the highest percentage of muskeg wetlands within the Tongass.
11.	Kuiu Island	Kuiu Island is deeply dissected, creating several prominent peninsulas. The topography is gentle compared to neighboring Baranof Island or the mainland. The climate is cooler and winter snow pack greater than on islands to the south, yet milder than the mainland or islands nearer the mainland. The western portion of Kuiu Island is subject to severe windstorms from both the ocean and Chatham Strait. Most forested plant associations occur here, but those found in outer coastal environments dominate.

Table 3.9-1 (continued)
Biogeographic Provinces in Southeast Alaska and the Tongass National Forest

No.	Province	Description
12.	Central Coast Range	This province is warmer than the Northern Coast Range Province. The topography is similar, but overall less precipitous. The Stikine River system is located in the center of this province and has a major continental influence, providing a migration corridor for plant and animal species. Plant associations found along saltwater are similar to those occurring elsewhere in northern Southeast Alaska except for those near the mouth of the Stikine River. Here, unique plant associations subject to high loess-carrying winds can be found.
13.	Etolin Island and Vicinity	Similar to the Kupreanof/Mitkof Islands Province, this province is also subject to continental influence from the mainland and the Stikine River. Glacial flour (very finely ground particles of rock, silt, or clay created by a glacier when its rock-filled ice scrapes over bedrock and which flow out from beneath a glacier in the meltwater) is present in the marine environment in the northern part of this province nearly year-round. All forest plant associations except those occurring only on outer coast areas are present.
14.	North Central Prince of Wales Island	Topography is relatively gentle, limestone is common, and precipitation is relatively low due to interception by lands to the south and southwest. All forest plant associations except those found around the mainland river systems occur in this province. Overall forest productivity is high. Karst topography and numerous caves are present.
15.	Revilla Island/ Cleveland Peninsula	Climate is variable with warm and wet conditions predominating on land nearest the outer coast; much colder conditions occur near the mainland. Revilla, Gravina, and Annette Islands are influenced by human activities and populations, whereas the Cleveland Peninsula and Duke Island are generally in a natural condition. Revilla Island has many exceptional estuaries. Muskeg ponds are common on Duke Island, attracting many wintering and migratory birds.
16.	Southern Outer Islands	These islands are isolated and are subject to strong oceanic influences. Temperatures are moderate year-round. The topography is low-lying and gentle. These islands are relatively rich in endemic vertebrate species, including dusky shrew, long-tailed vole, and ermine. Major coastal seabird colonies are present.
17.	Dall Island and Vicinity	These islands are subject to strong oceanic influences. Temperatures are moderate year-around. The topography is rugged and dissected, with abundant limestone outcrops. Dall Island appears to be a glacial refugia but inventories of plants and animals are limited. Major coastal seabird colonies are present on Dall Island.
18.	South Prince of Wales Island	The climate is warm and wet, and deep snow is rare or highly transient. The topography is steep and rugged and the coastline is highly dissected. The vegetation in this province is strongly influenced by southeasterly storms; mixed conifer and western hemlock-red-cedar plant associations dominate.
19.	North Misty Fiords	Compared to South Misty Fiords, this province has considerable topographic relief and characterized as having a colder, mainland-type climate with many glaciers. Vegetation occurs in long, narrow strips along the valleys and lower slopes of fiords. Much of the vegetation is muskeg, with cottonwoods in some of the river bottoms and subalpine fir along the Canadian border.
20.	South Misty Fiords	South Misty Fiords is typical of the other mainland provinces and is the warmest. Topographic relief is lower in comparison with North Misty. Forest plant associations are more diverse than the other coastal provinces, and the vegetation is less fragmented by rock and ice than in North Misty Fiords. The southwestern portion of this province is rolling, nearly continuous muskeg with conifer forests in the bottoms and flats. This province is the northern limit of Pacific silver fir, yew, and honeysuckle.
21.	Ice Fields	Permanent ice fields, active glaciers (some advancing and some receding), and nunataks (mountain peaks between glaciers) dominate this province.
22.	Chilkat River Complex	The Chilkat River Complex lies at the northern end of the Inside Passage and is outside the Tongass Forest boundary. It consists of tall ridge systems, large glacial rivers, and includes glaciers and snowfields. Many of the rivers and drainage basins extend across the international boundary into Canada. Because of the overlap of coastal and interior floras and faunas, the province contains Alaska's highest vascular plant species richness and the highest mammalian diversity in Southeast Alaska (Carstensen et al. 2007).
23.	Glacier Bay/ Fairweather Range	This is the largest province in Southeast Alaska (2.5 million acres) and is located outside the Tongass Forest boundary. The vast majority is high mountains and glaciers and the majority is non-vegetated. The highest peaks are in the Fairweather Range along the western edge of the province, with Mt. Fairweather at over 15,000 feet. A large flat, foreland, the Gustavus Foreland, occurs in the area around Gustavus and to the north in the Bartlett River valley. Lowlands are also fairly extensive along the Dundee River and other smaller drainages on the southwest side of Glacier Bay. Glacier Bay National Park protects virtually the entire province (97 percent), except for about 75,000 acres in the vicinity of Gustavus.

Figure 3.9-1
Map of Biogeographic Provinces of Southeast Alaska



Cover Types

The vegetation of Southeast Alaska and the Tongass National Forest is dominated by temperate coastal rain forests at lower elevations (less than about 2,000 feet). Interspersed within the forest are muskegs, other wetlands, and other non-forest types. At higher elevations, alpine vegetation, rock, glaciers, and snowfields dominate. Table 3.9-2 summarizes the breakdown of cover types by biogeographic province. Each of these cover types is described in detail below.

Approximately 60 percent of the Tongass National Forest consists of forest land (including harvested acres). Of this, approximately 5.5 million acres are considered "productive forest land," defined as land capable of producing at least 20 cubic feet of wood fiber per acre per year or having greater than 8,000 board feet per acre of standing volume (see the *Timber* section for additional discussion). The remaining acres (about 4.4 million acres) are considered unproductive because they do not meet these criteria. Historically, old-growth timber harvest and management of young-growth (e.g., thinning) has occurred only within the productive forest land base.

Productive forest land is then divided into productive old growth (POG) and young growth, comprising 30 percent (about 5 million acres) and 3 percent (about half million acres) of the Tongass National Forest, respectively. Young growth includes that resulting from past timber harvest, as well as natural young growth (e.g., created by wind, fire, or glacial retreat).

The remaining 40 percent of the Tongass National Forest (about 6.6 million acres) is classified as non-forest land and includes shrub and herbaceous habitats (e.g., muskeg, alpine, estuaries), sparsely vegetated and non-vegetated areas (e.g., snow, rock, ice), and aquatic habitats (e.g., streams, ponds, and lakes).

Table 3.9-2
Major Cover Types on the Tongass National Forest by Biogeographic Province (NFS Lands Only)

		Productive Forest (acres)			Unproductive Forest (acres)			Non-Forest (acres)		
	Biogeographic Province	POG[3]	Young-growth[1,3]	Total Productive Forest	Forested Muskeg[3]	Other Unproductive Forest[3]	Total Unproductive Forest	Land[2,3]	Water[3]	Total Non-Forest
1	Yakutat Forelands	95,063	40,262	135,325	101,827	25,703	127,530	34,339	7,255	41,595
2	Yakutat Uplands	44,014	13,242	57,256	5,241	14,807	20,048	818,834	20,009	838,843
3	East Chichagof Island	399,206	47,331	446,537	108,710	203,798	312,507	276,080	6,800	282,880
4	West Chichagof Island	72,643	329	72,972	45,204	82,691	127,895	72,722	8,430	81,152
5	East Baranof Island	88,668	14,283	102,951	12,198	90,057	102,255	177,699	6,323	184,022
6	West Baranof Island	214,457	17,716	232,173	70,549	193,754	264,303	242,254	19,678	261,931
7	Admiralty Island	595,432	14,103	609,535	85,110	190,234	275,345	148,513	13,267	161,780
8	Lynn Canal	157,988	8,320	166,309	20,617	100,240	120,857	349,501	2,803	352,305
9	North Coast Range	322,684	5,930	328,614	19,697	159,444	179,141	478,694	15,363	494,057
10	Kupreanof/Mitkof Island	307,752	39,036	346,788	176,592	212,256	388,848	15,478	3,822	19,300
11	Kuiu Island	291,839	30,934	322,773	44,128	88,402	132,530	19,494	2,571	22,065
12	Central Coast Range	246,153	9,269	255,422	27,199	152,597	179,796	268,001	10,612	278,612
13	Etolin Island	221,055	41,419	262,474	71,848	130,102	201,950	22,106	4,836	26,941
14	North Central Prince of Wales	486,160	170,306	656,466	152,189	270,927	423,116	45,859	21,953	67,812
15	Revilla Island/Cleveland Peninsula	504,827	49,119	553,946	175,045	311,591	486,636	91,126	36,079	127,205
16	Southern Outer Islands	112,035	18,114	130,149	27,148	44,386	71,535	4,926	909	5,835
17	Dall Island and Vicinity	66,951	1,299	68,249	6,467	26,553	33,020	9,773	2,962	12,735
18	South Prince of Wales	151,074	4,275	155,349	45,287	105,889	151,176	27,438	10,902	38,340
19	North Misty Fiords	198,210	6,549	204,759	21,227	264,636	285,863	461,818	14,394	476,212
20	South Misty Fiords	309,132	2,405	311,537	80,097	292,249	372,346	204,948	14,714	219,663
21	Ice Fields	116,893	10,006	126,899	8,628	171,804	180,432	2,606,398	15,588	2,621,986
Forest-wide		**5,002,255**	**544,250**	**5,546,504**	**1,305,009**	**3,132,122**	**4,437,131**	**6,376,478**	**239,272**	**6,615,750**

[1] Includes 83,000 acres of natural young growth, 422,000 acres of even-aged harvested stands, and about 40,000 acres of partial harvested stands.

[2] Non-forest land classes primarily include alder brush, brush, alpine, ice and snow fields, muskeg meadow, recurrent slide, and rock.

[3] Totals may not sum or match exactly to other tables in this section due to rounding.

Productive Old-Growth Forest

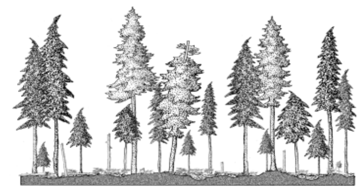
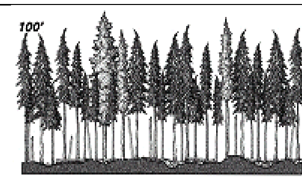
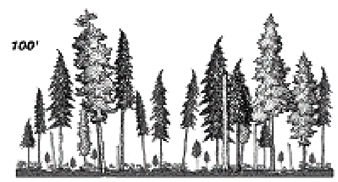
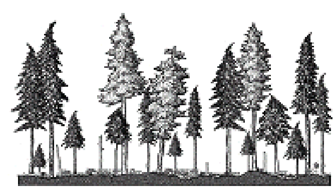
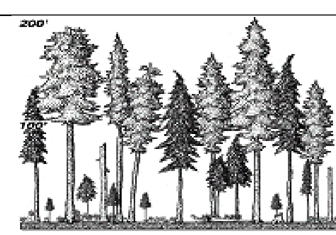
Old-growth forests support biodiversity due to their structural and ecological complexity. Franklin (1993) estimated that invertebrate biota, creatures essential to ecosystem function through such processes as nitrogen fixation and decomposition, may represent more than 90 percent of the species diversity of old-growth forests in the Pacific Northwest. In Southeast Alaska, old-growth forests are greater than 150 years old, and are characterized by multiple canopy layers; an interspersion of trees of multiple age classes; the presence of snags, decadent trees, and fallen trees; presence of forbs; and variation in the amounts and distribution of live trees (USDA-FS R10-TP-28). These features create intricate habitat niches that support many plant and animal species (Spies 2004). In Southeast Alaska, old-growth forests have been the focus of past timber harvest making them the most susceptible ecosystem to changes caused by forest management activities. For these reasons, old-growth forest is described in detail below.

Old-Growth Forest Classification

The Size-Density Model (SDM), which uses a combination of tree sizes and tree densities to classify forest structure (Caouette and DeGayner 2005), is used by the Tongass to map POG and assess impacts to old-growth habitat. This classification system builds on the timber volume-based classification system (volume strata) for POG used developed prior to the 2008 Land and Resource Management Plan (Forest Plan) (low-, medium-, and high-volume strata), which used hydric soils and steep slopes as measures of productivity and growth. While timber volume may be a good indicator of the overall productivity of a forested stand, volume fails to recognize key differences in forest structures. Forest structure is important because it reflects the complex spatial and temporal interactions between plant growth (e.g., dispersal and competition), environmental gradients (e.g., geology, soils, slope, aspect, elevation, and climate), and disturbance (e.g., wind and logging) (Caouette and DeGayner 2005). To move beyond the limitations of timber volume, the SDM was developed as a mean to produce a classification system based on forest structure. By modeling forest structure patterns using two measurable forest attributes: tree sizes and densities, the SDM is more applicable in assessing biodiversity, estimating timber values, and describing wildlife habitat than using timber volume alone (Caouette and DeGayner 2005). Seven POG types have been defined, which were used to develop a hierarchical mapping model for predicting tree sizes and densities on the Tongass National Forest. Figure 3.9-2 presents a description of each of the categories and illustrates the most probable forest type based on land form and forest condition.

POG forest can be further described in terms of two categories which have the highest importance from a biodiversity standpoint. High-volume POG is defined as the grouping of the three tree size and density classes that represent the highest volume strata—SD5S, SD5N, and SD67 types. Large-tree POG is defined as the SD67 class, representing the most productive of the POG types, and typically containing the highest density of large trees. The 2008 Forest Plan Final Environmental Impact Statement (FEIS) provides more information on the development and use of the SDM (USDA Forest Service 2008b).

Figure 3.9-2
Tree Size and Density Model used to Describe Forested Conditions across the Tongass National Forest

SD Class	*Land and Forest Condition* Most Probable Forest Type	*Tree Sizes and Densities* Most Probable Forest Type [1]	*Illustration* Most Probable Forest Type
4H	Low productive older forests associated with wet, poorly drained land types (e.g., muskegs, fens, rolling hills, broken mountain slopes, plateaus, glacial outwash zones). Canopy closure is variable. Trees are small, old, and defective. Stand volume is low.	Low densities **(SDI < 280)** of small-diameter trees **(QMD < 17 inches)**. Tree size distribution and spacing is variable and patchy. Tree diameters greater than 40 inches are generally not present.	
4N	Low to moderately productive older upland forests. Canopy characteristics are variable and patchy, with moderate canopy closure and relatively coarse canopy texture. Stand volume is low to moderate.	Low densities **(SDI < 280)** of medium diameter trees **(17 < QMD < 21 inches)**. Tree size distribution and spacing is variable and patchy. Tree diameters greater than 40 inches are rare.	
4S	Highly productive younger upland forests. Stand volume is moderate, but increasing rapidly. Crown competition is high. Canopy characteristics tend to be uniform, with high canopy closure and fine canopy texture.	High densities **(SDI > 280)** of medium-diameter trees **(17 < QMD < 21 inches)**. Tree size distribution and spacing tends to be more uniform. Tree diameters greater than 40 inches are rare.	
5H	Moderately productive older forests associated with wet, somewhat poorly drained land types. Canopy closure, texture, and structure tend to be variable and patchy. Stand volume and annual growth is also variable and patchy.	Low densities **(SDI < 280)** of medium-diameter trees **(17 < QMD < 21 inches)**. Tree diameters greater than 40 inches are somewhat common, but not uniformly distributed throughout the stand.	
5N	Moderately productive older upland forests. Stand volume is moderate to high. Canopy characteristics tend to be variable, with moderate canopy closure and coarse canopy texture.	Low densities **(SDI < 280)** of medium-to-large diameter trees **(17< QMD < 21 inches)**. Tree size distribution and spacing is variable and patchy. Tree diameters greater than 40 inches are common, but not uniformly distributed throughout the stand.	
5S	Highly productive upland forests. Stand volume is high. Canopy characteristics tend to be uniform, with moderate to high canopy closures.	High densities **(SDI > 280)** of medium-diameter trees (**17 < QMD < 21 inches)**. Tree size distribution and spacing tends to be uniform. Tree diameters greater than 40 inches are somewhat common, but not uniformly distributed throughout the stand.	
67	Highly productive forests associated with riparian areas, alluvial fans, colluvial toe slopes, karst geology, and wind-protected uplands. Stand volume is high. Stand age can vary. Canopy closure is low to moderate and canopy texture is coarse.	Low densities **(SDI < 280)** of large-diameter trees **(QMD > 21 inches)**. Tree diameters greater than 40 inches are common and uniformly distributed throughout the stand.	

[1] SDI=Stand Density Index; QMD=Quadratic Mean Diameter; >=greater than; <=less than

Old-Growth Habitat

There are approximately 5 million acres of POG forest on the Tongass National Forest. Of this amount, approximately 16 percent is low-volume POG (SD 4H type), 42 percent is medium volume POG (SD 4N, 4S, and 5H types), and 42 percent is high-volume POG (SD 5S, 5N, and 67 types), of which 25 percent is large-tree POG (SD 67 type; Table 3.9-3). Table 3.9-3 provides the distribution of existing POG forest by biogeographic province. The greatest amounts of POG forest are located in the Admiralty Island, Revilla Island/Cleveland Peninsula, and North Central Prince of Wales biogeographic provinces. These biogeographic provinces also contain the most high-volume POG, but there are also six additional biogeographic provinces which each contain over 100,000 acres of high-volume POG (Table 3.9-3). Large-tree POG is not as well distributed across the Forest, with close to 40 percent concentrated in the North Central Prince of Wales and Admiralty Island biogeographic provinces.

Elevation is considered one of the most significant landscape variables influencing the distribution and availability of POG forest. Lower elevation stands (at or below 800 feet) hold the highest value for many wildlife species because they remain relatively accessible during winter (see the *Wildlife* section for additional discussion). Forest-wide, approximately 59 percent of POG forest occurs at low elevations (Table 3.9-4).

Table 3.9-3
Distribution of Productive Old-Growth Forest on the Tongass National Forest by Biogeographic Province (NFS Lands Only)

		POG Type							
		Low Volume	Medium Volume			High Volume			
	Biogeographic Province	SD4H	SD4N	SD4S	SD5H	SD5N	SD5S	SD67 (Large-tree)	Total POG[1]
1	Yakutat Forelands	7,236	9,462	17,655	2,027	4,810	9,786	44,086	95,063
2	Yakutat Uplands	2,818	6,338	19,613	940	2,928	7,955	3,422	44,014
3	East Chichagof Island	62,554	53,403	102,274	22,113	45,303	79,309	34,249	399,206
4	West Chichagof Island	14,370	12,889	24,961	1,942	6,255	10,205	2,021	72,643
5	East Baranof Island	10,238	15,056	28,694	4,581	12,165	15,934	1,999	88,668
6	West Baranof Island	32,287	38,900	80,413	7,190	19,561	32,010	4,095	214,457
7	Admiralty Island	86,690	53,040	110,609	43,387	64,465	139,659	97,582	595,432
8	Lynn Canal	21,197	20,584	46,114	9,059	13,009	36,072	11,952	157,988
9	North Coast Range	35,539	38,193	88,207	23,434	42,808	72,156	22,346	322,684
10	Kupreanof/Mitkof Island	83,983	32,071	63,614	21,802	30,124	56,570	19,587	307,752
11	Kuiu Island	42,752	19,502	41,743	24,830	44,565	83,920	34,527	291,839
12	Central Coast Range	30,442	27,179	66,014	12,942	27,058	62,492	20,026	246,153
13	Etolin Island	49,821	24,777	54,019	11,892	25,011	43,053	12,483	221,055
14	North Central Prince of Wales	105,415	26,834	63,175	69,451	42,078	77,283	101,923	486,160

Table 3.9-3 (continued)
Distribution of Productive Old-growth Forest on the Tongass National Forest by Biogeographic Province (NFS Lands Only)

	Biogeographic Province	POG Type: Low Volume SD4H	Low Volume SD4N	Medium Volume SD4S	Medium Volume SD5H	High Volume SD5N	High Volume SD5S	High Volume SD67 (Large-tree)	Total POG
15	Revilla Island/Cleveland Peninsula	79,213	43,718	94,573	54,625	69,974	130,787	31,937	504,827
16	Southern Outer Islands	17,397	10,290	26,735	9,203	15,613	20,346	12,450	112,035
17	Dall Island and Vicinity	7,457	5,724	16,801	3,473	10,995	14,580	7,920	66,951
18	South Prince of Wales	25,437	11,198	32,240	10,316	11,043	22,010	38,830	151,074
19	North Misty Fiords	13,543	35,198	78,979	3,858	18,996	34,893	12,743	198,210
20	South Misty Fiords	52,861	40,471	104,917	11,396	29,521	55,878	14,089	309,132
21	Ice Fields	4,940	21,671	50,563	1,479	10,426	21,939	5,875	116,893
Forest-wide		786,196	546,500	1,211,915	349,950	546,711	1,026,839	534,143	**5,002,255**

[1] Totals may not sum or match exactly to other tables in this section due to rounding.

Table 3.9-4
Distribution of Old-Growth Forest on the Tongass National Forest by Elevation (NFS Lands Only)

Elevation Zone	Description	Productive Old Growth	Unproductive Old Growth	Total Old Growth
Less than 800 feet	All upland old growth below 800 feet in elevation	2,931,865	1,975,371	4,907,236
800 to 1,500 feet	All upland old growth between 800 and 1,500 feet in elevation	1,454,171	1,033,305	2,487,476
Greater than 1,500 feet	All upland old growth more than 1,500 feet in elevation	616,219	1,428,456	2,044,674
Total		5,002,255	4,437,131	9,439,386

Source: Tongass GIS database 2015

Young-Growth Forest

There are approximately 544,000 acres of young-growth forest on the Tongass National Forest, of which approximately 84 percent is a result of past timber harvest and approximately 15 percent a result of natural processes (e.g., wind, fire, glacial retreat). Over 90 percent of the harvested young growth is from even-age harvest. Approximately 20 percent of young growth from even-age harvest is 25 years old or younger, in the stand initiation stage. Of this age class, stands up to about 10 years tend to have high species diversity, in particular their shrub layer, which expands as a result of the open canopy after harvest. The remaining approximately 80 percent of young growth is older and mostly in the stem exclusion stage. This type of stand condition has very low species diversity. Some of these older young-growth stands are considered suitable for timber harvest, and could help support the Tongass National Forest's transition to young-growth harvest. See the *Timber* section for additional discussion on young-growth harvest and suitability. Table 3.9-5 shows the distribution of young-growth forest across the Tongass National Forest. Approximately 62,000 acres of previously harvested young-growth occur in the beach and estuary fringe and an additional 64,000 acres of previously harvested young-growth occur in Riparian Management Areas (RMAs) (Table 3.9-5). There are also approximately 44,000 acres of previously harvested young growth within the Old-growth Habitat Land Use Designation (LUD). Management of young-growth stands through release, pre-commercial, and commercial thinning has the potential to increase biodiversity by concentrating growth in fewer, larger trees that, if allowed to grow over time, promote conditions that accelerate natural succession in order to achieve old-growth stand characteristics at a faster rate than would occur without treatment (Caouette et al. 2000; Carey 2003). Thinning also opens the canopy, which allows light needed for understory development to penetrate to the forest floor, and increases the amount of understory forage available for a variety of wildlife species. Most young-growth stands are pre-commercially thinned prior to 20 years of age. Commercial thinning may or may not occur.

Young-growth on the Tongass National Forest is not suitable under the 2008 Forest Plan for commercial timber production within Non-Development LUDs or within other reserve areas such as the 1,000-foot-wide beach fringe and RMAs. While these stands are not managed for timber production, they can be thinned to improve habitat quality.

Unproductive Forest

Approximately 27 percent of the Tongass is classified as unproductive forest (Table 3.9-2). Many unproductive forest stands meet the definition of old growth, but the trees are typically small and stunted (under 40 feet in height) and the canopy is open (10 to 40 percent canopy closure). Hemlock, cedar, and lodge pole pine are the most common trees; blueberry and rusty menzesia are the most common shrubs. Near wet bogs or muskegs, many plants in the heath family and graminoids (grasses, sedges, and rushes) assume increasing dominance. Past disturbance to this habitat type has occurred primarily as a result of road construction, which has resulted in some permanent reduction in total acres of these unproductive forest types, also classified as forested wetlands. This disturbance is discussed further in the *Wetlands* section.

Non-Forest Lands

Non-forest ecosystems provide valuable habitat types that include wetland and other areas of shrub and herbaceous types (e.g., muskegs, alder and willow brush, alpine, estuaries), non-vegetated areas (e.g., snow, rock, ice), and aquatic sites (e.g., streams, ponds, and lakes). These habitats contribute greatly to the species diversity on the Tongass National Forest by providing a mosaic of habitat types throughout the otherwise forest-dominated landscape. They also provide unique microsites and openings that contain shrub and herbaceous vegetation within forested stands. Approximately 40 percent of the Tongass National Forest consists of non-forest lands (Table 3.9-2). A majority of the non-forest land area consists of rock (30 percent), ice and snow fields (28 percent), and brush (16 percent); the remaining types each comprise less than 10 percent of the non-forest land area.

Table 3.9-5
Forest-wide Distribution of Young Growth (NFS Lands Only)[1]

	Biogeographic Province	Natural Young Growth (acres)	Harvested Young Growth (acres)[2] 0-25 Years	26-50 Years	>50 Years	Total Harvested Young-growth	Total Young-growth[3] (acres)	Harvested Young Growth in the Beach and Estuary Fringe[4] (acres)	Harvested Young Growth in RMA[4] (acres)	Harvested Young Growth in Old-growth Habitat LUD[4] (acres)
1	Yakutat Forelands	36,670	1,213	2,363	24	40,262	40,314	13	116	10
2	Yakutat Uplands	11,869	708	666		13,242	13,258	-	94	0
3	East Chichagof Island	3,296	9,303	29,180	4,596	47,331	46,456	5,264	10,875	8,041
4	West Chichagof Island	329	0	0	0	329	337	-	-	-
5	East Baranof Island	868	2,192	4,799	6,214	14,283	14,117	2,988	2,932	1,667
6	West Baranof Island	864	6	9,938	6,468	17,716	17,348	2,410	5,302	3,027
7	Admiralty Island	5,280	457	2,094	3,179	14,103	11,088	3,707	1,065	-
8	Lynn Canal	2,951	863	4,519	0	8,320	8,338	480	1,937	1,051
9	North Coast Range	5,253	0	0	459	5,930	5,714	534	76	0
10	Kupreanof/Mitkof Island	1,652	7,714	23,153	4,329	39,036	36,888	5,735	2,523	3,533
11	Kuiu Island	3,463	4,236	18,584	2,121	30,934	28,473	3,585	2,918	1,231
12	Central Coast Range	2,750	589	2,324	3,388	9,269	9,054	1,306	1,382	95
13	Etolin Island	3,403	7,504	23,451	5,352	41,419	39,843	6,874	2,205	3,496
14	North Central Prince of Wales	51	33,570	102,636	25,911	170,306	162,363	14,155	21,197	14,619
15	Revilla Island/Cleveland Peninsula	555	13,969	15,619	14,067	49,119	44,346	9,336	4,905	3,999
16	Southern Outer Islands	258	2,191	12,007	1,042	18,114	15,525	2,634	1,465	920
17	Dall Island and Vicinity	-	0	0	285	1,299	285	762	75	4
18	South Prince of Wales	-	851	1,689	679	4,275	3,226	1,323	565	569
19	North Misty Fiords	280	0	1,001	77	6,549	1,357	673	1,629	313
20	South Misty Fiords	-	0	0	0	2,405	0	353	355	-
21	Ice Fields	3,333	5	4,007	51	10,006	7,395	-	2,457	1,759
	Forest-wide	**83,125**	**85,372**	**258,029**	**78,216**	**421,616**	**544,250**	**62,133**	**64,073**	**44,333**

[1] Totals may not sum or match exactly to other tables in this section due to rounding
[2] Includes 422,000 acres of stands from even-aged harvest.
[3] Includes 83,000 acres of natural young growth, 422,000 acres of managed stands from even-aged harvest, and about 40,000 acres of partial harvested stands.
[4] Includes all harvested acres from even-age and partial harvest.

Overview of Existing Levels of POG Forest on NFS Lands

This section provides a brief overview of past timber harvest on the Tongass National Forest. The amount of POG forest is compared to the amount present in 1954 prior to large-scale commercial timber harvest. Because management activities are most likely to affect productive forest, other habitat types are likely to be maintained and will contribute toward overall biodiversity. This analysis assumes that the biogeographic provinces with the greatest amounts of POG forest remaining will support the highest levels of OG associated species and help maintain the biodiversity associated with this habitat type.

Of the 5.4 million acres of original (1954) POG that occurred on National Forest System (NFS) lands on the Tongass National Forest, approximately 92 percent remains (Table 3.9-6). Low elevation, larger-tree stands have been disproportionately harvested on the Tongass National Forest. These highly productive and economical sites (i.e., those easiest to access) were targeted in the early years of commercial timber harvest because they tended to be adjacent to the beach and within floodplain riparian areas where large Sitka spruce were available and abundant. Forest-wide, 84 percent of the original high-volume POG and 82 percent of the original large-tree POG remains (Table 3.9-7). The greatest amount of timber harvest has occurred in the North Central Prince of Wales biogeographic province (74 percent of the total original POG forest remaining), followed by Etolin Island, East Baranof, Southern Outer Islands, East Chichagof Island and Kupreanof/Mitkof Islands biogeographic provinces (85, 87, 86, 90, and 89 percent of the original total POG forest remaining, respectively; Table 3.9-6). These biogeographic provinces, in addition to West Baranof Island biogeographic province, have also had the most harvest of high-volume and large-tree POG forest harvested. The Revilla Island/Cleveland Peninsula province also ranks among the highest when considering large-tree POG harvest. For additional discussion of past harvest on the Tongass, see the *Timber* section and Appendix C.

Table 3.9-6
Original and Percent Remaining Total POG, High-Volume POG (SD5S, SD5N, SD67) Total and Below 800 feet, and Large-Tree POG (SD67) Total and Below 800 feet by Biogeographic Province (NFS Lands Only)

		Acres Original POG[1/, 2/]					% Original POG remaining				
	Biogeographic Province	Total POG	High-Volume POG	High-Vol. POG <800 ft	Large-tree POG	Large-tree POG <800 ft	Total POG	High-Vol. POG	High-Vol. POG <800 ft	Large-tree POG	Large-tree POG <800 ft
1	Yakutat Forelands	98,656	61,377	61,240	45,164	45,073	96%	96%	96%	98%	98%
2	Yakutat Uplands	45,387	15,335	14,825	3,834	3,595	97%	93%	93%	89%	89%
3	East Chichagof Island	443,241	191,888	121,364	47,460	35,953	90%	83%	77%	72%	69%
4	West Chichagof Island	72,643	18,480	14,532	2,021	1,916	100%	100%	100%	100%	100%
5	East Baranof Island	102,083	40,159	30,513	6,023	5,492	87%	75%	70%	33%	33%
6	West Baranof Island	231,308	68,304	52,778	9,150	8,611	93%	81%	77%	45%	43%
7	Admiralty Island	604,254	308,323	175,317	100,229	63,447	99%	98%	96%	97%	96%
8	Lynn Canal	163,358	65,061	37,150	13,563	8,901	97%	94%	91%	88%	85%
9	North Coast Range	323,361	137,818	64,615	22,549	13,457	100%	100%	99%	99%	99%
10	Kupreanof/Mitkof Island	345,136	134,319	83,651	30,802	23,018	89%	79%	73%	64%	61%
11	Kuiu Island	319,310	183,616	127,805	42,768	27,964	91%	89%	86%	81%	74%
12	Central Coast Range	252,672	114,465	69,176	21,982	16,569	97%	96%	93%	91%	89%
13	Etolin Island	259,071	109,059	67,742	23,888	16,224	85%	74%	67%	52%	46%
14	North Central Prince of Wales	656,415	348,976	237,337	152,999	113,327	74%	63%	57%	67%	64%
15	Revilla Island/ Cleveland Peninsula	553,391	269,121	139,818	46,506	27,341	91%	86%	81%	69%	62%
16	Southern Outer Islands	129,891	61,801	44,041	17,807	12,997	86%	78%	74%	70%	65%
17	Dall Island and Vicinity	68,249	34,469	22,636	8,310	5,764	98%	97%	96%	95%	94%
18	South Prince of Wales	155,349	75,089	50,954	40,113	29,871	97%	96%	94%	97%	96%
19	North Misty Fiords	204,479	71,334	41,509	14,623	10,816	97%	93%	91%	87%	85%
20	South Misty Fiords	311,537	101,292	62,544	14,811	11,629	99%	98%	98%	95%	96%
21	Ice Fields	123,566	43,245	21,327	7,877	5,604	95%	88%	80%	75%	69%
Forest-wide		**5,463,379**	**2,453,537**	**1,540,877**	**672,481**	**487,571**	**92%**	**86%**	**82%**	**79%**	**77%**

[1]Original total POG acreages based on Forest Service GIS layer. To determine amount of high-volume POG, assumed 75% of total past harvest consisted of high-volume POG. To determine amount of large-tree POG (SD67 type), assumed 30 percent of total past harvest consisted of large-tree POG.

An intact, undeveloped landscape is assumed to be fully functional, maintaining rare and sensitive species, vegetation communities, and/or systems and their supporting ecological processes within their natural ranges of variability (Poiani et al. 2000). Thus, the intactness of a landscape is another measure of the degree to which biodiversity has been affected by human actions. Intact watersheds are defined as those having less than 5 percent of their POG harvested, which is consistent with a similar analysis conducted by Audubon Alaska and The Nature Conservancy (Albert and Schoen 2007). Based on this definition, a Value Comparison Unit (VCU), roughly equivalent to a large watershed, with at least 95 percent of the original POG remaining would be considered to be intact. VCUs are distinct geographic areas that generally encompass a drainage basin containing one or more large stream systems with boundaries that typically follow drainage basin divides (USDA Forest Service 2008a). Of the 947 VCUs on the Tongass National Forest 68 percent are considered intact (taking all landownerships into account) and are thus likely to maintain a high degree of biodiversity. Forest-wide approximately 12.7 million acres occur within intact watersheds, or 71 percent of all acreage (Table 3.9-7). Although landscapes with higher amounts of past harvest likely remain functional, this index represents areas that are in relatively pristine conditions and thus have the highest ecological integrity. Two biogeographic provinces have all VCUs intact (West Chichagoff Island and South Misty Fiords) and another two have 90 percent or more (Yakutat Uplands and North Misty Fiords). When acreage is considered, 16 of 21 biogeographic provinces have a majority (>50 percent) of the acreage within an intact watershed. Table 3.9-7 shows the distribution of intact VCUs by biogeographic province.

Table 3.9-7
Number and Acreage of Existing Intact[1] VCUs, Comparable to Large Watersheds, on the Tongass National Forest by Biogeographic Province (NFS and non-NFS lands)

	Biogeographic Province	Total number of VCUs	Percent of Intact Watersheds (VCUs)	Approximate Total Acreage in VCUs	Percent of Acreage in Intact Large Watersheds
1	Yakutat Forelands	24	88%	339,880	84%
2	Yakutat Uplands	26	96%	913,175	99%
3	East Chichagof Island	87	53%	1,134,726	49%
4	West Chichagof Island	31	100%	283,992	100%
5	East Baranof Island	22	55%	394,188	60%
6	West Baranof Island	43	65%	795,120	69%
7	Admiralty Island	60	87%	1,087,654	84%
8	Lynn Canal	50	76%	590,146	78%
9	North Coast Range	48	88%	911,106	92%
10	Kupreanof/Mitkof Island	35	40%	845,611	42%
11	Kuiu Island	30	73%	465,555	57%
12	Central Coast Range	28	86%	550,466	85%
13	Etolin Island	28	32%	519,357	30%
14	North Central Prince of Wales	117	22%	1,472,299	15%

Table 3.9-7 (continued)
Number and Acreage of Existing Intact[1] VCUs on the Tongass National Forest by Biogeographic Province (NFS and non-NFS lands)

	Biogeographic Province	Total number of VCUs	Percent of Intact Watersheds (VCUs)	Approximate Total Acreage in VCUs	Percent of Acreage in Intact Large Watersheds
15	Revilla Island/ Cleveland Peninsula	83	61%	1,262,389	63%
16	Southern Outer Islands	20	45%	214,933	57%
17	Dall Island and Vicinity	35	49%	200,936	34%
18	South Prince of Wales	36	71%	388,239	70%
19	North Misty Fiords	30	91%	892,125	88%
20	South Misty Fiords	54	100%	907,183	100%
21	Ice Fields	59	89%	2,769,480	90%
	Total	**947**	**68%**	**17,941,713**	**71%**

[1] Intact is defined here as those watersheds (VCUs) having less than 5 percent of their POG harvested.

The extent of fragmentation effects must be assessed in the context of an organism's ability to move between patches and the scale at which the organism interacts with the landscape (With 1999 as cited in D'eon et al. 2002). For example, species with limited dispersal capabilities (i.e., flying squirrel) appear to be more sensitive to habitat loss and resulting fragmentation than species with greater dispersal capabilities (i.e., goshawks; D'eon et al. 2002). Natural fragmentation of habitats can also affect the level of additional fragmentation that can be supported.

Landscape Connectivity and Fragmentation

The Tongass National Forest is characterized by an inherent level of fragmentation due to its island geography. The natural distribution of POG forest is also patchy and linear in many areas, as a result of the mosaic condition of our landscape created by muskeg, forested wetlands, alpine areas, other unproductive forest, and other non-forested habitats. This section provides an overview of the concepts of landscape connectivity and fragmentation and existing conditions on the Tongass National Forest.

Landscape connectivity has been defined as the degree to which the structure of a landscape helps or hinders the movement of wildlife species (Taylor et al. 1993). A landscape with a high degree of connectivity is one in which wildlife and other species can move readily between habitat patches over the long term (USDA Forest Service 2008a). On the Tongass, connectivity between areas of similar habitats (for example, between two patches of old-growth forest) or between high and low elevation habitats is important to maintaining well-distributed, viable wildlife populations and thus contributing to the ecological integrity of the landscape.

Landscape connectivity can be both structurally and functionally based. Structural connectivity refers to the physical connections between areas of habitat that facilitate movement of wildlife and other organisms. For example, intact stream buffers function as corridors providing structural connectivity between habitat patches. Likewise, the beach fringe may provide low elevation structural connectivity between watersheds and function as a transition zone between interior forest and saltwater influences (Julin 1997). Functional connectivity refers to the degree of movement or flow of organisms through broader linkage "zones" which contain an appropriate juxtaposition of habitats and land uses that facilitate movement across the landscape. On the Tongass National Forest, matrix lands may provide both structural and functional connectivity between old-growth reserves (OGRs) and other non-development LUDs.

Empirical studies to date suggest that habitat loss has large, consistently negative effects on biodiversity. Habitat fragmentation per se has much weaker effects on biodiversity that are at least as likely to be positive as negative (Fahrig 2003). Fragmentation, both natural (e.g., wind throw, landslides, insects and diseases, and avalanches) and human-caused (e.g., timber harvest, road building and powerline development), reduces landscape connectivity by breaking apart larger contiguous blocks of habitat into smaller patches. The value of residual old growth habitat patches may decline if they become too small to support species with minimum area requirements or to support a subpopulation of a particular organism (i.e., the functional unit of a metapopulation, or population made up of spatially separated local populations that interact with each other). In the latter case, interaction occurs via dispersal as individuals move among patches. Populations may become isolated, and therefore at greater risk of local extirpation, if fragmentation hinders movement of individuals between subpopulations (Wilcove et al.1986). The degree to which this occurs depends on species-specific dispersal capabilities, the distance between habitat patches, and conditions within the matrix between habitat patches.

When fragmentation occurs there is an increase in the amount of forest edge habitat and a decrease in the amount of interior old growth forest habitat, with which many wildlife species are associated (see Section 3.10 – *Wildlife*). Fragmentation is often accompanied by a decline in native species diversity because habitat conditions along the edge (edge effects) may favor some species over others. Edge effects may include changes to vegetation structure, species composition (both plants and animals), predation rates, and disturbance (Murcia 1995; Nilon et al. 1995; As 1999). Although the number of species may be higher along edges (often favoring invasive species), the number of habitat specialists (such as those associated with interior old growth forest conditions and those that tend to be more sensitive or at-risk) decreases (As 1999; Nilon et al. 1995; Kissling and Garton 2008).

The extent or "depth" of edge effects varies with the contrast in the structure and composition of adjacent vegetative communities, the width of the habitat fragment, and the stability of the remaining vegetation as it relates to other environmental effects such as windthrow, and may be species-dependent (Harper et al. 2005; Euskirchen et al. 2006). Edge effects related to vegetation structure and composition typically occur within 165 feet (50 meters) of created forest edges (Harper et al. 2005), whereas edge effects related to habitat functionality for wildlife extend farther (i.e., up to 1,640 feet [500 meters] for edge-related nest predation in migratory songbirds; Wilcove 1987). However, uncertainties remain regarding the spatial and temporal nature of edge effects. Edges are a dynamic component of the landscape. On harvested landscapes, edge contrast may decrease over time with the regeneration of disturbed areas, a process called "edge softening" (Matlack 1994; Euskirchen et al. 2006). Additionally, recent studies suggest that the presence of multiple edges (i.e., three or more adjacent patch types) may affect the magnitude and extent of edge effects (Euskirchen et al. 2006; Li et al. 2007).

Forested corridors along streams and between old-growth habitats at different elevations have been reduced in size by past harvest in many areas of the Tongass. Remaining patches of old-growth forest may serve as the only habitat in a landscape for many lichens, fungi, bryophytes, plants, and small-bodied animals, all of which contribute to the biodiversity and productivity of the old-growth forest ecosystem. These patches may be critical for species that are locally endemic, occur only in very specific conditions of forest structure or soil type, or have limited dispersal capabilities. Biogeographic provinces with the greatest levels of past timber harvest (Table 3.9-6) and fewest intact watersheds (Table 3.9-7) are at highest risk of not maintaining a full range of natural biodiversity (ecological integrity) and have the greatest reductions in landscape connectivity. Other biogeographic provinces are naturally fragmented by unproductive forest and non-forest habitats. Detailed analyses of landscape connectivity and fragmentation are typically conducted at the project level where individual patches of contiguous old-growth forest habitat and movement corridors can be identified. For this EIS, landscape connectivity and fragmentation are discussed qualitatively and with an overview by biogeographic province.

Tongass Forest Plan Conservation Strategy

The Tongass Forest Plan Conservation Strategy was developed to maintain the integrity of the old-growth forest ecosystem, and thereby conserve biodiversity across the Forest, by retaining intact, largely undisturbed habitat. This strategy, initially incorporated into the 1997 Forest Plan, was reviewed and amended for incorporation into the 2008 Forest Plan. The Conservation Strategy includes two major components: (1) a forest-wide network of variably sized OGRs allocated to the Old-growth Habitat LUD plus all small islands less than 1,000 acres, and (2) a series of standards and guidelines applicable to lands where timber harvest is permitted, also known as the matrix (USDA Forest Service 2008a, 2008b).

The reserve network was designed to maintain habitats of the species that have the highest viability concerns (USDA Forest Service 2008b), particularly those associated or dependent upon old growth forest characteristics. The reserve network also includes other non-development LUDs such as Wilderness, LUD II, Remote and Semi-Remote Recreation. These other non-development LUDs are comprised of representative habitat types found within the temperate rainforest of Southeast Alaska, including old-growth forest as well as other habitats. These non-development LUDs contribute to maintaining a variety of habitats important for species not necessarily dependent on old growth ecosystems. The intent of the reserve system is to help ensure the maintenance of well-distributed viable populations of all old-growth associated wildlife species across the Tongass, with focus on those species that are most sensitive to habitat loss and fragmentation. In general, the home range and dispersal capabilities of old-growth associated species of concern were considered in determining the size, number and spacing of reserves. . For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the OGR system, refer to Appendix D of the 2008 Forest Plan FEIS (USDA Forest Service 2008b).

The recent Sealaska conveyance (Public Law 113-291) directly affected OGRs in 15 VCUs (3610, 3620, 3630, 5450, 5460, 5560, 5570, 5600, 5872, 5900, 5940, 6180, 6190, 6200, and 6850) reducing the size, fragmenting, and in some cases eliminating them. A summary of the status of the resulting, existing OGRs (post-post-conveyance) and their consistency with Forest Plan minimum acreage requirements is provided in Appendix E. To compensate for effects to the Conservation Strategy, an interagency group of biologists from the Forest Service, U.S. Fish and Wildlife Service, and Alaska Department of Fish and Game convened in 2015 to identify new locations or boundary modifications for the affected OGRs. These "Biologically Preferred" OGRs are proposed as part of this Forest Plan amendment under Alternatives 2, 3, 4, and 5 and are discussed in the Interagency Old-growth Review report, included as Appendix E.

Within the matrix areas outside of reserves, components of the old-growth ecosystem are maintained through standards and guidelines designed to provide for important ecological functions such as dispersal of organisms, movement between forest stands, and maintenance of ecologically valuable structural components such as down logs, snags, and large trees. Matrix lands where commercial timber harvest occurs include Modified Landscape, Scenic Viewshed, and Timber Production LUDs.

Matrix management complements the reserve system by providing habitat at smaller spatial scales, increasing the effectiveness of reserves, and maintaining landscape connectivity (USDA Forest Service 2008b). Standards and guidelines applicable to these lands include maintenance of the 1,000-foot beach and estuary buffer, variable-width stream buffers, project-level legacy forest structure retention requirements, high-hazard soils, steep slopes, karst terrain, and visually sensitive travel routes and use areas, and requirements for connectivity. These are all considered contributing elements of the Conservation Strategy. Finally, a number of species-specific standards and guidelines, such as raptor nest and wolf den buffers, set aside old growth, sometimes temporarily, to avoid impacts to these species. These standards and guidelines are also addressed in the *Wildlife* section of this EIS. Additional detail on the rationale behind the standards and guidelines within the matrix is provided in Appendix D of the 2008 Forest Plan FEIS (USDA Forest Service 2008b). Table 3.9-8 shows the distribution of POG and young-growth forest within the reserve system and matrix lands.

Table 3.9-8
Distribution of Existing POG and Young Growth within the Reserve System and Matrix Lands (NFS Lands Only)

Biogeographic Province	Within Reserves (Non-Development LUDs; acres)				Within Matrix ((Development LUDs; acres)			
	Productive Old-growth				Productive Old-growth			
	Total	High-volume (SD 5N, 5S, 67)	Large-tree (SD 67)	Young-growth[1]	Total	High-volume (SD 5N, 5S, 67)	Large-tree (SD 67)	Young-growth[1]
1	74,371	42,876	30,916	24	20,691	15,806	13,171	3,569
2	43,193	13,850	3,185	254	821	455	237	1,119
3	230,146	94,783	23,185	10,341	169,060	64,079	11,064	33,694
4	72,639	18,480	2,021	-	5	-	-	-
5	53,694	16,444	1,214	1,767	34,974	13,654	785	11,648
6	181,273	47,481	3,551	6,323	33,184	8,185	543	10,529
7	595,432	301,706	97,582	8,823	-	-	-	-
8	116,162	44,024	8,650	1,093	41,827	17,010	3,302	4,277
9	215,920	90,802	14,521	354	106,763	46,508	7,824	323
10	135,284	49,737	9,467	5,992	172,467	56,544	10,120	31,392
11	197,425	105,819	17,633	4,672	94,414	57,193	16,894	22,799
12	163,813	72,362	12,305	662	82,340	37,214	7,721	5,858
13	102,207	37,434	6,067	4,192	118,848	43,113	6,416	33,824
14	257,676	121,130	55,795	29,811	228,483	100,154	46,128	140,445
15	344,679	160,998	21,401	9,384	160,148	71,700	10,536	39,180
16	89,536	36,703	8,468	4,155	22,498	11,706	3,982	13,701
17	57,671	29,772	7,557	1,269	9,279	3,723	363	30
18	105,567	49,825	27,651	1,667	45,507	22,058	11,179	2,608
19	184,661	61,354	11,542	5,265	13,549	5,278	1,201	1,004
20	309,132	99,488	14,089	2,405	0	-	-	-
21	99,184	33,666	5,634	4,476	17,709	4,574	241	2,197
Forest-wide	**3,629,686**	**1,528,738**	**382,437**	**102,928**	**1,372,569**	**578,956**	**151,706**	**358,196**

[1] Previously harvested young growth, which could help contribute to the transition to young-growth harvest.

Invasive Species

Invasive species are known to diminish the natural biodiversity of a landscape by outcompeting native species and thereby changing the ecosystem components (species composition, structure, function and connectivity) of an area. Alaska has, until recently, been relatively isolated from invasive species, due to climatic conditions, large undeveloped areas, limited transportation routes, and sparse human population centers (Fay 2002). Schrader and Hennon (2005) assessed the current status of invasive species in Alaska's ecosystems, which include non-native plants, fish, wildlife, and other species, emphasizing the Chugach and Tongass National Forests. More than 130 non-native plant species have been recorded in Alaska through 2005 (AKEPIC 2006). Eighty-eight species of non-natives have been recorded on the Tongass, 46 have been formally ranked according to their invasive characteristics and threat to Alaska, with 29 of those species identified as having a potential threat to Alaska. Fifteen of the species found on the Tongass are among the species that pose a potential threat (see the *Plant* section in this chapter for additional discussion on non-native plants).

Although many non-native wildlife species have been introduced or transplanted in Alaska, with the exception of rats in coastal ecosystems and possibly slugs in estuaries, none is considered invasive at the present. Additional discussion on terrestrial wildlife invasives are discussed in the *Wildlife* section of this chapter.

Schrader and Hennon (2005) identified 11 aquatic invasive species in their assessment. Six species have already established breeding populations in National Forest System lands and other areas in Alaska and include northern pike (*Esox lucius* Linnaeus), yellow perch (*Perca flavescens*), red-legged frog (*Rana aurora*), Pacific chorus frog (*Pseudacris regilla*), rainbow trout (*Oncorhynchus mykiss* Walbaum), and brook trout (*Salvelinus fontinalis*). The other five species are not established in Alaska yet, but cause widespread problems in the lower 48 states and could become problematic in Alaska. These species are the Atlantic salmon (*Salmo salar)*, Chinese mitten crab (*Eriocheir sinesis*), New Zealand mudsnail (*Potamopyrgus antipodarum* Gray), goldfish (*Carassius auratus*), and the signal crayfish (*Pacifacstacus leniusculus*). In Alaska, established populations of northern pike with the exception of Pike Lakes on the Yakutat Ranger District pose the greatest immediate concern, while the Atlantic salmon, Chinese mitten crab, and New Zealand mudsnail species are likely to invade Alaska in coming years (Fay 2002). Invasive tree pathogens are not currently damaging Alaskan ecosystems, but there are numerous species that could cause widespread tree mortality if introduced.

Four introduced insects are currently established in Alaska and are cause for concern: the larch sawfly, alder woolly aphid, spruce aphid, and amber-marked birch leafminer. These insects can cause widespread tree defoliation and mortality. A number of exotic insects pose a potential threat and are related primarily to transport of infested plant and wood products.

The Forest Service is addressing invasive plant management through the Alaska Region Invasive Plant Strategy (USDA Forest Service 2005) and the Tongass National Forest Invasive Plant Management Guides (Lerum and Krosse 2005). Within the Forest Service, various approaches are in place to address four action elements (prevention, early detection and rapid response, control, and restoration) in the National Strategy and Implementation Plan for Invasive Species Management (USDA Forest Service 2004b). See the *Plants* section in this chapter for more information on management of non-native plant species.

Environmental Consequences

Direct and Indirect Effects Common to All Alternatives

Effects to the Old-Growth Forest Ecosystem

A functional and interconnected old-growth ecosystem is essential to maintaining ecological integrity of several biodiversity components, including: structural complexity (within-stand and landscape level); connectivity (unfragmented contiguous blocks of old growth and well as functional connectivity within the matrix); stand age and species composition; and various ecological functions (tree establishment, disturbance, and nitrogen fixation [USDA Forest Service 2008b]). Timber harvest in POG may reduce biodiversity by shifting the age-structure of the forest by replacing old growth trees by younger t, Franklin et al. 1997); changing the composition of understory vegetation (Deal and Tappeiner 2002); and removing key habitat features such as large decadent trees, snags, and downed logs. The amount of POG remaining and its distribution across the landscape provide a method to estimate the effects of the alternatives on biodiversity. It can be assumed that the alternatives that harvest the most POG (and therefore result in the greatest changes in the natural distribution and composition of the old-growth ecosystem) would result in the greatest adverse direct effects to the biodiversity of old-growth ecosystems. It should be noted that many other cover types contribute to the overall biodiversity on the Tongass, but the focus throughout this section is placed on old-growth forest because this is the focus of the Conservation Strategy and the cover type that has been most affected by timber management activities on the Tongass. Maximum POG harvest under the alternatives would range from 32,609 acres under Alternative 2 to 62,815 acres under Alternative 1 (Table 3.9-9).

Table 3.9-9
Existing Productive Old-Growth Forest within Reserves[1] and Matrix[2] Lands (minimum protected vs. maximum harvested) by Alternative[3]

				Amount in Matrix[2]			
		Amount in Reserves[1]		Estimated Protected		Estimated Harvested[4]	
Alt.	POG Category	Acres	Percent	Acres	Percent	Acres	Percent
1	All POG	3,638,141	73%	1,301,262	26%	62,815	1%
	High-Volume POG	1,533,696	73%	546,533	26%	27,464	1%
	Large-Tree POG	385,498	72%	139,342	26%	9,303	2%
2	All POG	3,645,766	73%	1,323,880	26%	32,609	1%
	High-Volume POG	1,538,571	73%	555,101	26%	14,022	1%
	Large-Tree POG	388,688	73%	140,827	26%	4,629	1%
3	All POG	3,645,766	73%	1,320,921	26%	35,568	1%
	High-Volume POG	1,538,571	73%	555,407	26%	13,716	1%
	Large-Tree POG	388,688	73%	141,771	26%	4,629	1%
4	All POG	3,645,766	73%	1,313,892	26%	42,597	1%
	High-Volume POG	1,538,571	73%	550,875	26%	18,248	1%
	Large-Tree POG	388,688	73%	139,435	26%	6,021	1%
5	All POG	3,645,766	73%	1,314,009	26%	42,479	1%
	High-Volume POG	1,538,571	73%	551,307	26%	17,816	1%
	Large-Tree POG	388,688	73%	139,651	26%	5,805	1%

[1] Reserves include all Natural Setting and Wilderness Group LUDs (e.g., Old-Growth Habitat, Semi-Remote Recreation, Remote Recreation, Wilderness, National Monument, etc.). Roadless areas in Development LUDs are not included.

[2] Matrix includes all Development LUDs (Timber Production, Modified Landscape, Scenic Viewshed, and Experimental Forest). Roadless areas in matrix are included.

[3] Numbers may not appear to sum correctly due to rounding.

[4] Estimated harvest over 100 years.

Young-growth harvest, particularly if repeated over time (i.e., under short rotations) can have similar effects by maintaining early to mid-seral habitats instead of allowing these stands to mature to old-growth conditions. These changes may reduce the range of habitats that support diverse plant and animal communities and alter the ecological functions supported by the old-growth ecosystem. However, treatments such as pre-commercial and commercial thinning can result in benefits to biodiversity by increasing understory growth over the short-term, and by promoting the development of old-growth stands over the long-term when stands are allowed to mature. The extent of the effects is dependent on the type of young-growth treatment implemented and the time period over which young-growth harvest is implemented. The effects of young-growth harvest discussed throughout this section, as well as in Section 3.10-*Wildlife* represent the trade-off associated with the proposed transition young-growth harvest. The alternatives represent variations on this trade-off with those that propose quicker transition times, and therefore greater conservation of the POG ecosystem in a shorter time frame, requiring an expansion of the areas where young-growth harvest is permissible. The availability of suitable young-growth is currently limited, such that in order to achieved the desired volume additional areas would need to be made available for harvest over the first 10-15 years, after which time more of the current young-growth will become suitable for commercial harvest. In relation to the conservation of biodiversity, productive old-growth forests are some of the most biodiverse ecosystems in Southeast Alaska. Therefore, a transition to predominantly young-growth harvest would be expected to result in greater conservation of biodiversity than an old-growth-based timber program.

Alternatives 2, 3, 4, and 5 propose a transition from old-growth to young-growth timber harvest. The timing of the transition varies among the alternatives with some alternatives proposing a more aggressive transition by allowing young-growth harvest in non-development LUDs and other contributing elements of the conservation strategy (e.g., beach and estuary buffers and RMAs), and/or portions of Inventoried Roadless Areas (IRAs) (see Chapter 2 for a discussion of the transition to young-growth harvest and discussions below under each alternative). Young-growth forest stands are less structurally complex and do not support the full range of biodiversity found in old-growth forest stands. Therefore, a reduction in POG harvest over time in favor of young-growth harvest would have beneficial effects to old-growth dependent species on the Tongass. However, young-growth forests provide a range of functions that may be impacted by repeated harvest. These may include serving as dispersal corridors between old growth forest patches, providing buffers between areas of suitable habitat and human activity, softening edge effects, and serving as thermal cover which may be reduced by harvest.

Young-growth stands have the potential to return to old-growth conditions over the long term if left to mature on their own or managed with that end goal. Management of young-growth stands for timber production only (maintaining previously harvested stand in a perpetual young-growth state) would not allow a previously harvested stand to return to old-growth conditions and therefore would reduce the biodiversity of these stands. Maximum young-growth harvest under the alternatives would range from 209,882 acres under Alternative 1 to 335,334 acres under Alternative 2 (Table 3.9-10).

Table 3.9-10
Existing Young Growth[1] in Reserves[2] and in Matrix[3] Lands (minimum protected vs. maximum harvested) by Alternative[4]

	Amount in Reserves[2]				Amount in Matrix[3]			
	Estimated Protected		Estimated Future Harvest[5]		Estimated Protected		Estimated Future Harvest[5]	
Alt.	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
1	103,084	22%	0	0%	148,158	32%	209,882	46%
2	61,305	13%	43,281	9%	64,475	14%	292,063	63%
3	67,807	15%	36,779	8%	80,101	17%	276,437	60%
4	104,586	23%	0	0%	121,653	26%	234,885	51%
5	102,775	22%	1,811	<0.5%	74,205	16%	282,333	61%

[1] Young-growth in this table includes only young-growth originating from past timber harvest. It does not include natural young-growth (e.g., from blowdown).
[2] Reserves include all non-development LUDs (e.g., Old-Growth Habitat, Semi-Remote Recreation, Remote Recreation, Wilderness, National Monument, etc.); note under some alternatives limited harvesting of young-growth occurs in reserves.
[3] Matrix includes all development LUDs (Timber Production, Modified Landscape, Scenic Viewshed, and Experimental Forest).
[4] Numbers may not appear to sum correctly due to rounding.
[5] Estimated harvest over 100 years.

Alternatives that propose the greatest amounts of old-growth timber harvest would also result in the greatest effects to old-growth ecosystem biodiversity due to the associated fragmentation and loss of connectivity. Fragmentation may remove linkages between habitat patches, making it harder for organisms to move across the landscape. A continuously distributed population could become a series of small, subpopulations that rely on the ability of dispersing individuals for genetic interchange and recolonization in the event of local extirpation. Remaining patches would become smaller and less suitable for some species, for example those associated with interior forest conditions. The extent of these effects depends in part on the dispersal capabilities of the organism, its need for interior forest conditions, and the type of treatment implemented (e.g., creation of a harder edge by even-aged harvest or a softer edge through uneven-aged harvest).

However, these effects would be reduced to some extent under alternatives that propose the greatest amount of young-growth timber harvest (i.e., those with more rapid transition to young-growth harvest). These stands are intrinsically low in biodiversity particularly during the stem exclusion stage of stand development (Franklin et al. 2002)and as such, would remain so in perpetuity, at least in the development LUDs (because young-growth stands in non-development LUDs will be allowed to reach old-growth conditions after the transition period). However, young-growth harvest would still have some effects associated with fragmentation because older young-growth stands in particular provide connectivity and also can also buffer edge effects to old-growth stands (i.e., when located between areas of even-aged harvest and old-growth forest).

At the project level, where harvest units and roads can be identified, fragmentation and loss of connectivity can be evaluated in terms of changes in remnant forest patch size, spacing, or other physical characteristics. This is not possible at the forest planning level; therefore, in this analysis changes in the number of intact landscapes (VCUs maintaining at least 95 percent of the original POG; see the Affected Environment section above for discussion) provide an index of fragmentation.

Old-Growth Reserve Modifications

Appendix E includes an analysis of pre-conveyance, post-conveyance, and Biologically Preferred (identified by the Interagency Review Team) OGRs based on Forest Plan minimum acreage requirements included in Appendix K of the 2008 Forest plan, and design criteria in Appendix D of the 2008 Forest Plan FEIS. Proposed OGR modifications are the same under all of the alternatives. To the extent possible, the Biologically Preferred OGR locations were intended to compensate for reductions in the old-growth reserve acreage, connectivity between reserves and/or shoreline areas, and incorporate the best remaining habitats (e.g., the largest blocks of remaining POG forest, low elevation POG, etc.) available in the affected VCUs. The proposed OGR modifications would result in a net increase in 6,171 acres of OGR under the Conservation Strategy and a net increase of 7,148 acres of POG in the reserve system. Additional discussion of increases in other habitat components important to wildlife are included in the *Wildlife* section of this EIS.

Effects to the Tongass Conservation Strategy

Under all of the alternatives, long-term protection of POG would continue to occur under the Conservation Strategy. The system of OGRs and other non-development LUDs is intended to maintain the ecological integrity of the old-growth ecosystem. Within the matrix, old-growth between reserves is maintained through Forest-wide standards and guidelines for stream buffers, the beach and estuary fringe, legacy forest structure, and others that preclude or limit POG timber harvest for other resources under all alternatives. Collectively, these measures would facilitate organism dispersal and maintain the functionality and interconnectedness of the old-growth ecosystem (USDA Forest Service 2008b). Tables 3.9-9 and 3.9-10 show the current level of protection for POG and young-growth forest, both within the reserves and the matrix.

However, the alternatives differ in terms of the extent to which young growth may be harvested within the reserve system, non-development LUDs, and other elements of the Conservation Strategy, including beach and estuary buffers, RMAs, and in matrix management standards and guidelines. Table 3.9-11 shows the proposed acres of young-growth harvest within the beach fringe and estuary fringe, riparian management areas, Old-growth Habitat LUD, and other non-development LUDs. Alternatives 2 and 3 propose the most young-growth harvest within Conservation Strategy elements (Table 3.9-11). Young-growth harvest within the reserve system, beach and estuary fringe, or RMAs has the potential to affect the integrity of the Conservation Strategy. Effects can include reduced functionality of these areas, reduced or fragmented buffers, and increased edge effects. However, these effects would be localized, and in some instances temporary (Alternative 5 would have a one-time entry into the Old-growth Habitat LUD, beach and estuary fringe, and RMAs). Ultimately, the substantial reduction in old-growth harvest relative to what is allowed under the 2008 Forest Plan and the transition to young-growth harvest would enhance biodiversity and the functioning of the Conservation Strategy over the long-term under all alternatives. An analysis was developed to ascertain how well the overall integrity of the old-growth conservation strategy is maintained and was applied to each alternative. This analysis is included in Appendix D.

Table 3.9-11
Projected Harvest of Young-growth[1] and Old-growth in Beach Buffers, RMAs, Old-Growth Habitat LUD, other Non-Development LUDs, and 2001 Roadless Areas by Alternative

Conservation Strategy Component	Estimated Acres of Harvest over 100 Years									
	Alt 1		Alt 2[1]		Alt 3[2]		Alt 4[3]		Alt 5[4]	
	YG	OG	YG	OG	YG	OG	YG	OG	YG	OG
Harvest in Beach Buffer	0	0	21,871	0	30,769	0	11,114	0	3,903	0
Harvest in RMA	0	0	26,030	0	0	0	0	0	1,089	0
Harvest In OG Habitat LUD	0	0	31,640	0	26,186	0	0	0	1,811	0
Harvest in other Non-Development LUD	0	0	12,868	0	12,857	0	0	0	0	0
Maximum Harvest in 2001 Roadless Rule Inventoried Roadless Areas	0	0	9,118	2,171	11,810	17,037	0	0	0	0

[1] Alt 2 Prescriptions: Young Growth - Clearcutting is permitted in Beach Buffer for first 15 years; thereafter, only Commercial Thinning is permitted. Only Commercial Thinning is permitted in RMAs. Clearcutting is permitted in Old Growth Habitat LUD, Non-Development LUDs, and previously roaded Roadless Areas (this is inconsistent with the Roadless Rule for harvest to occur in these areas and the Roadless Rule would have to change to reflect the on-the-ground conditions), unless otherwise restricted. Old Growth - Clearcutting is permitted in previously roaded Roadless Areas.

[2] Alt 3 Prescriptions: Young Growth - Only Commercial Thinning is permitted in Beach Buffers. Clearcutting is permitted in OG Habitat LUD, Non-Development LUDs, and Roadless Areas (this is inconsistent with the Roadless Rule for harvest to occur in these areas and the Roadless Rule would have to change or the Tongass Roadless Rule exemption would need to be reinstated), unless otherwise restricted. Old Growth - Clearcutting is permitted in Roadless Areas.

[3] Alt 4 Prescriptions: Young Growth - Only Commercial Thinning is permitted in Beach Buffers.

[4] Alt 5 Prescriptions: Young Growth - Created openings of ≤ 10 acres and Commercial Thinning are permitted in Beach Buffers, OGRs, and RMAs for first 15 years and with maximum of 35% of the original stand harvested; thereafter, no harvest is permitted.

Invasive Species

None of the alternatives propose changes to the management framework of the Tongass in relation to invasive species. The Alaska Region of the Forest Service is currently updating an invasive species strategy that will apply the principles of prevention, early detection, control, and rehabilitation in cooperation with various agencies and partners to reduce or eliminate invasive species establishment (Stensvold 2015 - in progress). Under all alternatives, timber harvest, road construction, and development of renewable energy projects would contribute to additional opportunities for invasive species introduction and establishment. However, none of the alternatives propose increased old growth harvest and road development levels above the 2008 Forest Plan. Although the action alternatives propose varying levels of young growth harvest and changes to where that harvest would be allowed, the 2008 standards and guidelines for invasive species would apply. Therefore, no increase in invasive species risk is anticipated under any of the alternatives. See also the *Plants* section.

LUD Changes – Renewable Energy and Transportation

Under Alternatives 2, 3, 4, and 5 the existing Transportation and Utility System overlay LUD would be replaced by Forest-wide management direction for Renewable Energy and for Transportation Systems Corridors. This replacement would be to allow greater flexibility in renewable energy development and help Southeast Alaska communities reduce fossil fuel energy dependence. An overview of the existing LUD and proposed standards and guidelines is included in the Energy Resource Report (Tetra Tech 2015).

Renewable energy projects and associated infrastructure such as roads and utility lines have the potential to result in both temporary and long-term adverse localized effects to biodiversity. This may occur due to ground-disturbing activities (road construction, powerhouse construction, pipeline locations, etc.) or through inundation (water level increase associated with hydroelectric projects), which alter or remove vegetation communities, both forested and non-forested. The extent of these effects depends on the size and location of each project and the existing level of disturbance. The *Renewable Energy* section provides an overview of existing and foreseeable renewable energy projects in Southeast Alaska. Not all future project locations are known. Any renewable energy project proposed on NFS land or requiring Forest Service approval would undergo a separate, project-specific NEPA level review; therefore, individual projects are not addressed in detail here.

Ultimately, renewable energy projects would offset carbon dioxide emissions generated by facilities that burn fossil fuels, a primary contributor to climate change. Changes in temperature, precipitation, water availability, and sea level associated with climate change have the potential to affect ecosystems through habitat shifts, increased invasive species survival, enhanced competition for limited resources, and amplification of existing stressors, such as habitat fragmentation and pollution which can result in changes in biodiversity. Therefore, renewable energy development could have both a positive as well as negative contribution to old-growth ecosystems and overall forest biodiversity.

Direct and Indirect Effects Specific to Each Alternative

Alternative 1

Alternative 1 represents the 2008 Forest Plan. Under Alternative 1, there would be no effects related to additional or modified Forest Plan components because none are proposed.

Under Alternative 1, approximately 62,815 acres of POG forest including 27,464 acres of high-volume POG, of which 9,303 acres are large-tree POG, would be available for timber harvest (Table 3.9-9). Alternative 1 would maintain at least 99 percent of the existing total POG, 99 percent of the existing high-volume POG, and 98 percent of the existing large-tree POG Forest-wide. Approximately 73 percent of the existing total POG would be maintained within the reserve system and 26 percent within the matrix (Table 3.9-9).

Effects of Alternative 1 to biodiversity in the old-growth ecosystem associated with the removal of POG forest and fragmentation would be greatest in the East Chichagof Island, East Baranof Island, Kupreanof/Mitkof Islands, Kuiu Island, Etolin Island, and North Central Prince of Wales biogeographic provinces where 2 percent reductions in the amount of original total POG would occur. Reductions of 0 to 1 percent of the original total POG would occur all other biogeographic provinces.

Under Alternative 1 approximately 209,882 acres of young-growth would be available for harvest (Table 3.9-10). No young-growth harvest would occur in contributing elements of the Conservation Strategy including the beach and estuary fringe, OGRs, RMAs, or other non-development LUDs (Table 3.9-11), except for limited amounts of treatments aimed at improving habitat conditions as allowed under the 2008 Forest Plan. Another 251,242 acres of young-growth would be maintained within the reserve system or would be protected by matrix standards and guidelines (Table 3.9-10). These acres (approximately 5 percent of the original total POG) would be allowed to mature and eventually develop into POG forest.

Forest-wide and assuming maximum timber harvest over the planning horizon, approximately 90 percent of the original total POG, 85 percent of the original high-volume POG, and 78 percent of the original large-tree POG would be maintained under Alternative 1 (Tables 3.9-12, 3.9-13, and 3.9-14). By biogeographic province, 72 to 100 percent of the original total, 62 to 100 percent of the original high-volume, and 33 to 100 percent of the original large-tree POG would be maintained.

Alternative 1 would result in a reduction in the number of intact watersheds, and acreage within intact watersheds, over the planning horizon. After 100+ years, the percentage of intact watersheds would be reduced from 68 percent to 59 percent (Table 3.9-15).

Table 3.9-12
Estimated Percent of Original POG Remaining (Total and in Reserves) after 100 Years by Biogeographic Province and Alternative (NFS lands only)

		POG		% Original POG Remaining after 100+ Years (Total / In Reserves) by Alternative				
No.	Biogeographic Province	Original Acres	% Remaining in 2015	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1	Yakutat Forelands	98,656	96	95 / 75	96 / 75	96 / 75	96 / 75	96 / 75
2	Yakutat Uplands	45,387	97	97 / 95	97 / 95	97 / 95	97 / 95	97 / 95
3	East Chichagof Island	443,241	90	88 / 52	89 / 52	89 / 52	89 / 52	89 / 52
4	West Chichagof Island	72,643	100	100 / 100	100 / 100	100 / 100	100 / 100	100 / 100
5	East Baranof Island	102,083	87	85 / 53	86 / 53	86 / 53	86 / 53	86 / 53
6	West Baranof Island	231,308	93	92 / 78	93 / 78	92 / 78	93 / 78	93 / 78
7	Admiralty Island	604,254	99	99 / 99	99 / 99	99 / 99	99 / 99	99 / 99
8	Lynn Canal	163,358	97	96 / 67	96 / 67	96 / 67	96 / 67	96 / 67
9	North Coast Range	323,361	100	100 / 67	100 / 67	100 / 67	100 / 67	100 / 67
10	Kupreanof/Mitkof Island	345,136	89	87 / 39	88 / 39	87 / 39	88 / 39	87 / 39
11	Kuiu Island	319,310	91	89 / 63	90 / 63	91 / 63	90 / 63	91 / 63
12	Central Coast Range	252,672	97	97 / 68	97 / 68	97 / 68	97 / 68	97 / 68
13	Etolin Island & Vicinity	259,071	85	83 / 39	84 / 39	84 / 39	83 / 39	83 / 39
14	North Central Prince of Wales	656,415	74	72 / 40	73 / 41	73 / 41	72 / 41	72 / 41
15	Revilla Island/ Cleveland Pen.	553,391	91	90 / 62	91 / 62	90 / 62	90 / 62	90 / 62
16	Southern Outer Islands	129,891	86	85 / 69	86 / 69	86 / 69	85 / 69	85 / 69
17	Dall Island and Vicinity	68,249	98	98 / 84	98 / 84	98 / 84	98 / 84	98 / 84
18	South Prince of Wales	155,349	97	97 / 68	97 / 68	97 / 68	97 / 68	97 / 68
19	North Misty Fiords	204,479	97	97 / 90	97 / 90	97 / 90	97 / 90	97 / 90
20	South Misty Fiords	311,537	99	99 / 99	99 / 99	99 / 99	99 / 99	99 / 99
21	Ice Fields	123,566	95	94 / 79	95 / 79	95 / 79	95 / 79	95 / 79
	Forest-wide	**5,463,379**	**92**	**90 / 67**	**91 / 67**	**91 / 67**	**91 / 67**	**91 / 67**

[1] Numbers may not appear to sum correctly due to rounding.

Table 3.9-13
Estimated Percent of Original High-Volume POG Remaining (Total and in Reserves) after 100 Years by Biogeographic Province and Alternative (NFS lands only)[1]

		High-volume POG		% Original High-volume POG Remaining after 100+ Years (Total / In Reserves) by Alternative				
No.	**Biogeographic Province**	**Original Acres**	**% Remaining in 2015**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
1	Yakutat Forelands	61,377	96	94 / 70	95 / 70	96 / 70	96 / 70	96 / 70
2	Yakutat Uplands	15,335	93	93 / 90	93 / 90	93 / 90	93 / 90	93 / 90
3	East Chichagof Island	191,888	83	81 / 49	82 / 49	82 / 49	82 / 49	82 / 49
4	West Chichagof Island	18,480	100	100 / 100	100 / 100	100 / 100	100 / 100	100 / 100
5	East Baranof Island	40,159	75	73 / 41	74 / 41	74/ 41	74/ 41	74/ 41
6	West Baranof Island	68,304	81	81 / 70	81 / 70	81 / 70	81 / 70	81 / 70
7	Admiralty Island	308,323	98	98 / 98	98 / 98	98 / 98	98 / 98	98 / 98
8	Lynn Canal	65,061	94	93 / 63	93 / 63	93 / 63	93 / 63	93 / 63
9	North Coast Range	137,818	100	100 / 66	100 / 66	100 / 66	100 / 66	100 / 66
10	Kupreanof/Mitkof Island	134,319	79	77 / 37	78 / 37	78 / 37	78 / 37	78 / 37
11	Kuiu Island	183,616	89	86 / 59	88 / 59	88 / 59	87 / 59	88 / 59
12	Central Coast Range	114,465	96	95 / 67	96/ 67	95 / 67	95 / 67	96 / 67
13	Etolin Island & Vicinity	109,059	74	72 / 34	73 / 34	73 / 34	72 / 34	72 / 34
14	North Central Prince of Wales	348,976	63	62 / 35	62 / 37	63 / 37	62 / 37	62 / 37
15	Revilla Island/ Cleveland Pen.	269,121	86	85 / 60	86 / 60	86 / 60	86 / 60	86 / 60
16	Southern Outer Islands	61,801	78	77 / 59	78 / 59	78 / 59	77 / 59	77 / 59
17	Dall Island and Vicinity	34,469	97	97 / 86	97 / 86	97 / 86	97 / 86	97 / 86
18	South Prince of Wales	75,089	96	95 / 66	95 / 67	95 / 67	95 / 67	95 / 67
19	North Misty Fiords	71,334	93	93 / 86	93 / 86	93 / 86	93 / 86	93 / 86
20	South Misty Fiords	101,292	98	98 / 98	98 / 98	98 / 98	98 / 98	98 / 98
21	Ice Fields	43,245	88	88 / 76	88 / 76	88 / 76	88 / 76	88 / 76
	Forest-wide	**2,453,537**	**86**	**85 / 63**	**85 / 63**	**85 / 63**	**85/ 63**	**85 / 63**

[1] High-volume POG incudes SD5S, SD5N, and SD67 classes.

[2] Numbers may not appear to sum correctly due to rounding.

Table 3.9-14
Estimated Percent of Original Large-Tree POG Remaining (Total and in Reserves) after 100 Years by Biogeographic Province and Alternative (NFS lands only)[1]

		Large-tree POG		% Original Large-tree POG Remaining after 100+ Years (Total / In Reserves) by Alternative				
No.	Biogeographic Province	Original Acres	% Remaining in 2015	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1	Yakutat Forelands	45,164	98	95 / 68	97 / 68	98 / 68	98 / 68	98 / 68
2	Yakutat Uplands	3,834	89	89 / 83	89 / 83	89 / 83	89 / 83	89 / 83
3	East Chichagof Island	47,460	72	71 / 49	72 /49	72 / 49	72 / 49	71 / 49
4	West Chichagof Island	2,021	100	100 / 100	100 / 100	100 / 100	100 / 100	100 / 100
5	East Baranof Island	56,023	33	33 / 20	33 / 20	33 / 20	33 / 20	33 / 20
6	West Baranof Island	9,150	45	47 / 41	47 / 41	47 / 41	47 / 41	47 / 41
7	Admiralty Island	100,229	97	97 / 97	97 / 97	97 / 97	97 / 97	97 / 97
8	Lynn Canal	13,563	88	88 / 58	88 / 58	88 / 58	88 / 58	88 / 58
9	North Coast Range	22,549	99	99 / 64	99 / 64	99 / 64	99 / 64	99 / 64
10	Kupreanof/Mitkof Island	30,802	64	62 / 31	62 / 31	62 / 31	62 / 31	62 / 31
11	Kuiu Island	42,768	81	77 / 43	79 / 43	79 / 43	78 / 43	79 / 43
12	Central Coast Range	21,982	91	91 / 60	91 / 60	91 / 60	91 / 60	91 / 60
13	Etolin Island & Vicinity	23,888	52	51 / 25	51 / 25	51 / 25	51 / 25	51 / 25
14	North Central Prince of Wales	152,999	67	64 / 38	66 / 40	66 / 40	65 / 40	65 / 40
15	Revilla Island/ Cleveland Pen.	46,506	69	68 / 46	68 / 46	68 / 46	68 / 46	68 / 46
16	Southern Outer Islands	17,807	70	68 / 48	68 / 48	68 / 48	68 / 48	68 / 48
17	Dall Island and Vicinity	8,310	95	95 / 91	95 / 91	95 / 91	95 / 91	95 / 91
18	South Prince of Wales	40,113	97	96 / 69	96 / 69	96 / 69	96 / 69	96 / 69
19	North Misty Fiords	14,623	87	87 / 79	87 / 79	87 / 79	87 / 79	87 / 79
20	South Misty Fiords	14,811	95	95/ 95	95/ 95	95/ 95	95/ 95	95/ 95
21	Ice Fields	7,877	75	75/ 68	75/ 68	75/ 68	75/ 68	75/ 68
	Forest-wide	**672,481**	**79**	**78 / 57**	**79 / 58**	**79 / 58**	**79 / 58**	**79 / 58**

[1] Large tree POG is defined as the SD 67 classes (a subset of high-volume POG).

[2] Numbers may not appear to sum correctly due to rounding.

Table 3.9-15
Number and Acreage within Intact VCUs, Comparable to Large Watersheds , after 100+ Years by Biogeographic Province and Alternative (NFS and Non-NFS lands)[1]

No.	Biogeographic Province	Number of and Acreage within Large Watersheds No.	Acres	% of Watersheds/Percent of Acreage Existing	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1	Yakutat Forelands	24	339,880	88/84	63/73	71/77	75/82	75/82	75/82
2	Yakutat Uplands	26	913,175	96/99	93/99	93/99	93/99	93/99	93/99
3	East Chichagof Island	87	1,134,726	53/49	46/41	48/43	52/48	52/48	52/48
4	West Chichagof Island	31	283,992	100/100	100/100	100/100	100/100	100/100	100/100
5	East Baranof Island	22	394,188	55/60	45/50	45/50	45/50	45/50	45/50
6	West Baranof Island	43	795,120	65/69	51/59	51/59	51/59	51/59	51/59
7	Admiralty Island	60	1,087,654	87/84	80/79	80/79	80/79	80/79	80/79
8	Lynn Canal	50	590,146	76/78	57/60	59/62	59/62	59/62	59/62
9	North Coast Range	48	911,106	88/92	67/77	67/77	67/77	67/77	67/77
10	Kupreanof/Mitkof Island	35	845,611	40/42	34/37	34/37	29/27	34/38	34/38
11	Kuiu Island	30	465,555	73/57	67/52	70/55	73/57	73/57	73/57
12	Central Coast Range	28	550,466	86/85	75/69	75/69	75/69	75/69	79/74
13	Etolin Island & Vicinity	28	519,357	32/30	32/30	32/30	32/30	32/30	32/30
14	North Central Prince of Wales	117	1,472,299	22/15	19/12	19/12	19/12	19/12	19/12
15	Revilla Island/ Cleveland Pen.	83	1,262,389	61/63	51/52	51/52	48/51	51/52	51/52
16	Southern Outer Islands	20	214,933	45/57	40/53	45/57	40/53	40/53	40/53
17	Dall Island and Vicinity	35	200,936	49/34	31/19	31/19	31/19	31/19	31/19
18	South Prince of Wales	36	388,239	71/70	60/62	60/62	60/62	60/62	60/62
19	North Misty Fiords	30	892,125	91/88	84/83	84/83	84/83	84/83	84/83
20	South Misty Fiords	54	907,183	100/100	100/100	100/100	100/100	100/100	100/100
21	Ice Fields	59	2,769,480	89/90	86/89	86/89	86/89	86/89	86/89
	Forest-wide	**947**	**17,941,713**	**68/71**	**59/65**	**60/65**	**61/65**	**61/66**	**61/66**

[1] Large-watershed are defined here by VCUs.
[2] Intact is defined here has having less than 5 percent of original POG harvest.
[3] Numbers may not appear to sum correctly due to rounding.

Alternative 2

Alternative 2 proposes the most aggressive transition to young-growth harvest. POG harvest would be in Phase 1, 2, and 3 lands (same as 2008 Forest Plan) under Alternative 2. Alternative 2 would allow young-growth harvest in development LUDs including within the beach and estuary fringe and RMAs, and in some non-Development LUDs. Clearcutting of young-growth stands would be allowed within the beach and estuary fringe, although only during the first 15 years with only commercial thinning thereafter, and non-development LUDs under Alternative 2. Alternative 2 would also maintain a 1,000-foot buffer adjacent to even-aged (clearcut) harvest units within the beach and estuary fringe, effectively moving the buffer inland. Alternative 2 would also allow POG and young-growth harvest in the roaded roadless portions of IRAs (approximately 2,171 acres and 9,118 acres, respectively; Table 3.9-11), after new rulemaking to update the boundaries. Harvest in any portion of IRAs is inconsistent with the 2001 Roadless Rule and could not occur until there was a change in the 2001 Roadless Rule. Harvest in these areas would be deferred until there was a rule change.

Under Alternative 2, approximately 32,609 acres of POG forest including 14,022 acres of high-volume POG and 4,629 acres of large tree POG would be available for timber harvest (Table 3.9-9). Alternative 2 would maintain at least 99 percent of the existing total POG, 99 percent of the existing high-volume POG, and 99 percent of the existing large-tree POG Forest-wide. Approximately 73 percent of the POG forest would be maintained within the reserve system and 26 percent within the matrix (Table 3.9-9).

Effects of Alternative 2 to biodiversity in the old-growth ecosystem associated with the removal of POG forest and fragmentation would be comparable among biogeographic provinces. Reductions of 0 to 1 percent of the original total POG would occur in each biogeographic provinces (Table 3.9-12).

Assuming maximum timber harvest over the planning horizon, approximately 91 percent of the original total POG, 85 percent of the original high-volume POG, and 79 percent of the original large-tree POG would be maintained under Alternative 2. By biogeographic province, 73 to 99 percent of the original total, 62 to 100 percent of the original high-volume, and 33 to 100 percent of the original large-tree POG would be maintained (Tables 3.9-12, 3.9-13, and 3.9-14).

Alternative 2 would result in a reduction in the number of intact watersheds, and acreage within intact watersheds, over the planning horizon. After 100+ years the percentage of intact watersheds would be reduced from 68 percent to 60 percent (Table 3.9-15).

Under Alternative 2 approximately 335,344acres of young growth would be available for harvest (Table 3.9-10). This includes approximately 21,872 acres within the beach and estuary fringe, 26,030 acres within RMAs, 31,640 acres within Old-Growth Habitat LUD, and 12,868 acres within other non-development LUDs (Table 3.9-11). Another 125,780 acres of young growth would be maintained within the non-development LUDs which contribute to the Conservation Strategy or would be protected by matrix standards and guidelines (Table 3.9-10). These acres (approximately 2 percent of the original total POG) would be allowed to mature and eventually develop into POG forest.

Alternative 3

Alternative 3 proposes the second most aggressive transition to young-growth harvest. POG harvest would occur only in Phase 1, 2, and 3 lands (same as the 2008 Forest Plan) under Alternative 3. Alternative 3 would allow young-growth harvest in development LUDs, including within the beach and estuary fringe, and in some non-Development LUDs. However, only commercial thinning would be allowed in the beach and estuary fringe; no young-growth harvest would occur in RMAs. Both POG and young-growth harvest would be allowed in IRAs (11,810 acres and 17,037 acres, respectively; Table 3.9-11) if new rulemaking allowed for it. Harvest in IRAs is inconsistent with the 2001 Roadless Rule and could not occur until there was a change in the 2001 Roadless Rule. Harvest in these areas would be deferred until there was a rule change.

Under Alternative 3, approximately 35,568 acres of POG forest including 13,716 acres of high-volume POG and 4,629 acres of large tree POG would be available for timber harvest (Table 3.9-9). Alternative 3 would maintain at least 99 percent of the existing total POG, 99 percent of the existing high-volume POG, and 99 percent of the existing large-tree POG Forest-wide. Approximately 73 percent of the POG forest would be maintained within the reserve system and 26 percent within the matrix (Table 3.9-9).

Effects of Alternative 3 to old-growth ecosystem biodiversity associated with the removal of POG forest and fragmentation would be greatest in the Kupreanof/Mitkof Island biogeographic province where there would be a reduction of 2 percent of the original total POG; reductions of 0 to 1 percent of the original total POG would occur in all other biogeographic provinces (Table. 3.9-12).

Assuming maximum timber harvest over the planning horizon, approximately 91 percent of the original total POG, 85 percent of the original high-volume POG, and 79 percent of the original large-tree POG would be maintained under Alternative 3 (Tables 3.9-12, 3.9-13, and 3.9-14). By biogeographic province, 73 to 100 percent of the original total, 63 to 100 percent of the original high-volume, and 33 to 100 percent of the original large-tree POG would be maintained.

Alternative 3 would result in a reduction in the number of intact watersheds, and acreage within intact watersheds, over the planning horizon. After 100+ years the percentage of intact watersheds would be reduced from 68 percent to 61 percent (Table 3.9-15).

Under Alternative 3 approximately 313,216 acres of young growth would be available for harvest (Table 3.9-10). This includes approximately 30,769 acres within the beach and estuary fringe, 26,186 acres within OGRs, and 12,857 acres within other non-development LUDs; no young-growth harvest would occur in RMAs (Table 3.9-11). Another 147,902 acres of young growth would be maintained within the non-development LUDs that contribute to the Conservation Strategy or would be protected by matrix standards and guidelines. These acres (approximately 3 percent of the original total POG) would be allowed to mature and eventually develop into POG forest.

Alternative 4

Alternative 4 proposes the least aggressive transition to young-growth harvest. POG harvest under Alternative 4 would be allowed in only Phase I lands (less than the 2008 Forest Plan). Under Alternative 4 young-growth harvest would be limited to development LUDs, including the beach and estuary fringe. Only commercial thinning would be allowed in beach and estuary fringe. No POG or young-growth harvest would be allowed in RMAs, IRAs or non-development LUDs including OGRs under Alternative 4.

Under Alternative 4, approximately 42,597 acres of POG forest including 18,248 acres of high-volume POG and 6,021 acres of large tree POG would be available for timber harvest (Tables 3.9-9). Alternative 4 would maintain at least 99 percent of the existing total POG, 99 percent of the existing high-volume POG, and 99 percent of the existing large-tree POG Forest-wide. Approximately 73 percent would be maintained within the non-development LUDs and 26 percent within the matrix (Table 3.9-9).

Effects of Alternative 4 to old-growth ecosystem biodiversity associated with the removal of POG forest and fragmentation would be greatest in Etolin Island, and North Central Prince of Wales biogeographic provinces where reductions of 2 percent of the original total POG would occur (Table 3.9-12). Reductions of 0 to 1 percent of the original total POG would occur in all other biogeographic provinces.

Assuming maximum timber harvest over the planning horizon, approximately 91 percent of the original total POG, 85 percent of the original high-volume POG, and 79 percent of the original large-tree POG would be maintained under Alternative 4 (Tables 3.9-12, 3.9-13, and 3.9-14). By biogeographic province, 72 to 100 percent of the original total, 62 to 100 percent of the original high-volume, and 33 to 100 percent of the original large-tree POG would be maintained.

Alternative 4 would result in a reduction in the number of intact watersheds, and acreage within intact watersheds, over the planning horizon. After 100+ years the percentage of intact watersheds would be reduced from 68 percent to 61 percent (Table 3.9-15).

Under Alternative 4 approximately 234,885 acres of young growth would be available for harvest (Table 3.9-10). This includes approximately 11,114 acres within the beach and estuary fringe; no young-growth harvest would occur within RMAs, OG Habitat LUD, or other non-Development LUDs (Table 3.9-11). Another 226,239 acres would be maintained within the non-development LUDs or would be protected by matrix standards and guidelines (Table 3.9-10). These acres (approximately 4 percent of the original total POG) would be allowed to mature and eventually develop into POG forest.

Alternative 5

Alternative 5 proposes the third-most aggressive transition to young-growth harvest. POG harvest under Alternative 5 would occur in Phase 1, 2, and 3 lands (same as the 2008 Forest Plan). Under Alternative 5, young-growth harvest would be allowed in development LUDS, including in beach and estuary fringe (group selection with less than 10-acre openings or commercial thinning) outside of a 200-foot buffer and RMAs (group selection with less than 10-acre openings or commercial thinning), and in the Old-Growth Habitat LUD but not in other non-development LUDs. A one-time entry stipulation would be implemented for young-growth harvest in the Old-growth Habitat LUD, beach and estuary fringe and RMAs. No POG or young-growth harvest would occur in IRAs under Alternative 5.

Under Alternative 5, approximately 42,479 acres of POG forest including 17,816 acres of high-volume POG and 5,805 acres of large tree POG would be available for timber harvest (Table 3.9-9). Alternative 5 would maintain at least 99 percent of the existing total POG, 99 percent of the existing high-volume POG, and 99 percent of the existing large-tree POG Forest-wide. Approximately 73 percent would be maintained within the reserve system and 26 percent within the matrix (Table 3.9-9).

Effects of Alternative 5 to biodiversity in the old-growth ecosystem associated with the removal of POG forest and fragmentation would be greatest in the Kupreanof/Mitkof Island, Etolin Island, and North Central Prince of Wales biogeographic provinces where the amount of original POG remaining would be reduced by 2 percent. Reductions of 0 to 1 percent of the original total POG would occur in all other biogeographic provinces.

Assuming maximum timber harvest over the planning horizon, approximately 91 percent of the original total POG, 85 percent of the original high-volume POG, and 79 percent of the original large-tree POG would be maintained under Alternative 5 (Tables 3.9-12, 3.9-13, and 3.9-14). By biogeographic province, 72 to 100 percent of the original total, 62 to 100 percent of the original high-volume, and 33 to 100 percent of the original large-tree POG would be maintained.

Alternative 5 would result in a reduction in the number of intact watersheds, and acreage within intact watersheds, over the planning horizon. After 100+ years the percentage of intact watersheds would be reduced from 68 percent to 61 (Table 3.9-15).

Under Alternative 5 approximately 324,144 acres of young-growth would be available for harvest (Table 3.9-10). This includes approximately 3,903 acres within the beach and estuary fringe, 1,089 acres within RMAs, 1,811 acres in OGRs; no young-growth harvest would occur in other non-Development LUDs (Table 3.9-11). Another 176,980 acres of young-growth would be maintained within the non-development LUDs which contribute to the Conservation Strategy or would be protected by matrix standards and guidelines (Table 3.9-10). These acres (approximately 4 percent of the original total POG) would be allowed to mature and eventually develop into POG forest.

Cumulative Effects

Historically, harvest in Southeast Alaska has been more extensive on non-NFS lands than on NFS lands (Table 3.9-16). The cumulative effects analysis for old-growth ecosystem biodiversity takes into account all of Southeast Alaska, including all lands within the Tongass National Forest boundary from the Yakutat area to the south of Ketchikan, and the area of Glacier Bay National Park, and the areas around Haines and Skagway. To estimate the future harvest of POG on non-NFS lands, it was assumed that 75 percent of the remaining POG would be harvested on Native corporation lands and 50 percent of the remaining POG would be harvested on state lands, other private lands, and lands owned by municipalities, over the life of the Forest Plan (100 years). A list of all projects considered in the cumulative effects analysis is provided in Appendix C of this EIS.

Approximately 875,700 acres of POG have been harvested across the Tongass, including both NFS lands and non-NFS lands, resulting in a reduction to 86, 79, and 68 percent of the original total, high-volume, and large-tree POG in Southeast Alaska, respectively (Tables 3.9-16, 3.9-17, and 3.9-18). Approximately 83 percent of the original POG would remain on the Tongass after full implementation of the 2008 Forest Plan (Alternative 1) and future non-NFS harvest in 100+ years (Table 3.9-16). Future representation of high-volume POG and large-tree POG would be expected to be approximately 76 and 63 percent of the original amount, respectively, after 100+ years under the 2008 Forest Plan (Table 3.9-17 and 3.9-18). POG harvest on NFS lands under Alternatives 2, 3, 4, 5 would all be less than Alternative 1, but would also maintain approximately 83 percent of the total original POG remaining on the Tongass after implementation of alternatives and future non-NFS harvest (Table 3.9-16). Future representations of high-volume POG and large-tree POG under the alternatives would be expected to be approximately 76 percent and 63 percent of the original amounts, respectively, under Alternatives 2, 4, and 5 after 100+ years, and 76 percent and 64 percent of the original amounts, respectively under alternative 4 after 100+ years (Tables 3.9-17 and 3.9-18). This does not include maturing young growth that develops older forest characteristics during that time period (estimated to be approximately 2 to 5 percent of the original POG that would be represented by mature young- growth, in non-development LUDs, which would be beginning to take on older forest characteristics; Table 3.9-9).

All action alternatives would contribute to the cumulative reduction in POG and associated increase in fragmentation and loss of connectivity, which has the potential to reduce biodiversity. Timber harvest on NFS, including micro-sales and personal use, as well as on non-NFS lands would result in similar effects. Future land adjustments and remaining land conveyances would also be assumed to affect POG as these lands become available for harvest. Collectively, the implementation of the Forest Plan under all of the alternatives in combination with ongoing and foreseeable projects would increase in the number of smaller patches on the landscape, reducing the amount of interior forest and increasing the occurrence of forest edge habitat. Edge effects such as shifts in species composition may reduce natural biodiversity over time by favoring some species over others. These effects would be lessened by the action alternatives which propose a transition to young-growth harvest, which would reduce the long-term cumulative effects to old-growth ecosystem biodiversity by reducing the total amount of POG harvest and associated fragmentation. The actual amount of harvest that has occurred to date on the Tongass is far less than that projected under the 2008 Forest Plan FEIS, and would continue to be less under all of the alternatives (see Appendix D of this EIS for additional discussion).

Overall, biodiversity on the Tongass and in Southeast Alaska remains in good condition and the landscape continues to be dominated by old-growth forest ecosystems. As development continues through timber harvest and associated activities such as road building, and community expansion, particularly in areas where extensive development has already occurred (i.e., Prince of Wales Island), maintaining connectivity and roadless refugia will become increasingly important, particularly for wide-ranging species whose distribution depends on some level of connectivity across the landscape. In addition, the management of human resources will continue to play a role in maintaining biodiversity across the Tongass. Within the Tongass National Forest boundary, the Conservation Strategy was designed to address the more extensive harvest on non-NFS lands through the old-growth reserve system and Forest-wide standards and guidelines, both of which were intended to maintain ecological components needed to maintain the ecological integrity important to a variety of organisms and maintain connectivity across the landscape, with or without much contribution from non-NFS lands.

Table 3.9-16
Cumulative Percent of Original Total POG Remaining on All Landownerships after 100 Years of Forest Plan Implementation by Biogeographic Province and Alternative (NFS and Non-NFS Lands)

No.	Biogeographic Province	Estimated Original Total POG (Acres)	Percent Original Total POG Remaining	Percent Total POG Remaining after 100+ Years[1,2]				
				Alternative				
				1	2	3	4	5
1	Yakutat Forelands	123,675	85%	79%	79%	80%	80%	80%
2	Yakutat Uplands	45,426	97%	97%	97%	97%	97%	97%
3	East Chichagof Island	507,958	84%	79%	80%	80%	80%	80%
4	West Chichagof Island	72,958	100%	100%	100%	100%	100%	100%
5	East Baranof Island	103,046	87%	84%	85%	85%	85%	86%
6	West Baranof Island	247,420	92%	88%	89%	89%	89%	89%
7	Admiralty Island	634,873	95%	94%	94%	94%	94%	94%
8	Lynn Canal	180,172	97%	90%	91%	91%	91%	91%
9	North Coast Range	382,583	94%	88%	88%	88%	88%	88%
10	Kupreanof/Mitkof Island	406,907	82%	76%	77%	77%	77%	77%
11	Kuiu Island	327,703	91%	88%	89%	90%	89%	89%
12	Central Coast Range	259,558	97%	95%	96%	95%	95%	95%
13	Etolin Island	275,571	85%	80%	82%	81%	81%	81%
14	North Central Prince of Wales	906,143	63%	56%	57%	57%	56%	56%
15	Revilla Island/ Cleveland Peninsula	648,823	88%	81%	82%	81%	81%	81%
16	Southern Outer Islands	141,131	83%	79%	80%	80%	79%	80%
17	Dall Island and Vicinity	135,765	68%	57%	57%	57%	57%	57%
18	South Prince of Wales	192,458	88%	82%	82%	82%	82%	82%

Table 3.9-16 (continued)
Cumulative Percent of Original Total POG Remaining on All Landownerships after 100 Years of Forest Plan Implementation by Biogeographic Province and Alternative (NFS and Non-NFS Lands)

No.	Biogeographic Province	Estimated Original Total POG (Acres)	Percent Original Total POG Remaining	Percent Total POG Remaining after 100+ Years[1,2] Alternative 1	2	3	4	5
19	North Misty Fiords	207,657	96%	96%	96%	96%	96%	96%
20	South Misty Fiords	311,823	99%	99%	99%	99%	99%	99%
21	Ice Fields	123,674	95%	94%	94%	95%	95%	95%
	Total for Southeast Alaska[3]	**6,235,343**	**86%**	**83%**	**83%**	**83%**	**83%**	**83%**

[1] The estimate assumes all scheduled suitable POG is harvested; does not account for Model Implementation Reduction Factor (MIRF).
[2] Based on an inventory of existing harvest on non-NFS lands and the estimation of future harvest by major landowner category. To estimate the future harvest of POG on non-NFS lands, it was assumed that 75 percent of the remaining POG would be harvested on Native corporation lands and 50 percent of the remaining POG would be harvested on state lands, other private lands, and lands owned by municipalities, over the life of the Forest Plan (100 years).
[3] Does not include land area in biogeographic provinces 22 and 23 which are almost exclusively non-NFS land.

Table 3.9-17
Cumulative Percent of Original High-Volume POG Remaining on All Landownerships after 100 Years of Forest Plan Implementation by Biogeographic Province and Alternative (NFS and Non-NFS Lands)

No.	Biogeographic Province	Estimated Original High-Volume POG (Acres)	Percent Original High-Volume POG Remaining	Percent Original High-Volume POG Remaining after 100+ Years[1,2] Alternative 1	2	3	4	5
1	Yakutat Forelands	74,753	83%	79%	80%	81%	81%	81%
2	Yakutat Uplands	15,384	93%	93%	93%	93%	93%	93%
3	East Chichagof Island	225,290	75%	72%	72%	72%	72%	72%
4	West Chichagof Island	18,598	100%	100%	100%	100%	100%	100%
5	East Baranof Island	40,496	75%	73%	74%	74%	73%	74%
6	West Baranof Island	74,710	81%	78%	78%	78%	78%	78%
7	Admiralty Island	325,440	94%	93%	93%	93%	93%	93%
8	Lynn Canal	71,127	94%	89%	90%	90%	90%	90%
9	North Coast Range	165,343	91%	86%	87%	87%	87%	87%
10	Kupreanof/Mitkof Island	166,887	69%	65%	66%	65%	66%	65%
11	Kuiu Island	186,894	89%	85%	87%	87%	86%	87%
12	Central Coast Range	117,349	95%	94%	94%	94%	94%	94%
13	Etolin Island	116,073	73%	70%	70%	70%	70%	70%
14	North Central Prince of Wales	485,130	52%	48%	49%	49%	48%	48%
15	Revilla Island/ Cleveland Peninsula	310,772	83%	78%	78%	78%	78%	78%
16	Southern Outer Islands	67,773	74%	71%	72%	72%	71%	72%
17	Dall Island and Vicinity	70,553	60%	55%	55%	55%	55%	55%
18	South Prince of Wales	93,875	83%	80%	80%	80%	80%	80%
19	North Misty Fiords	72,780	93%	92%	92%	92%	92%	92%

Table 3.9-17 (continued)
Cumulative Percent of Original High-Volume POG Remaining on All Landownerships after 100 Years of Forest Plan Implementation by Biogeographic Province and Alternative (NFS and Non-NFS Lands)

No.	Biogeographic Province	Estimated Original High-Volume POG (Acres)	Percent Original High-Volume POG Remaining	Percent Original High-Volume POG Remaining after 100+ Years[1,2] Alternative 1	2	3	4	5
20	South Misty Fiords	101,392	98%	98%	98%	98%	98%	98%
21	Ice Fields	43,282	88%	88%	88%	88%	90%	88%
Total for Southeast Alaska[3]		**2,845,053**	**79%**	**76%**	**76%**	**76%**	**76%**	**76%**

[1] The estimate assumes all scheduled suitable POG is harvested; does not account for Model Implementation Reduction Factor (MIRF).
[2] Based on an inventory of existing harvest on non-NFS lands and the estimation of future harvest.
[3] Does not include land area in biogeographic provinces 22 and 23 which are almost exclusively non-NFS land.

Table 3.9-18
Cumulative Percent of Original Large-tree POG Remaining on All Landownerships after 100 Years of Forest Plan Implementation by Biogeographic Province and Alternative (NFS and Non-NFS Lands)

No.	Biogeographic Province	Estimated Original SD67 POG (Acres)	Percent Original SD67 POG Remaining	Percent SD67 POG Remaining after 100+ Years[1,2] Alternative 1	2	3	4	5
1	Yakutat Forelands	52,545	87%	84%	85%	86%	86%	86%
2	Yakutat Uplands	3,841	89%	89%	89%	89%	89%	89%
3	East Chichagof Island	65,774	60%	55%	56%	56%	55%	55%
4	West Chichagof Island	2,079	100%	97%	98%	98%	97%	98%
5	East Baranof Island	6,192	35%	33%	33%	34%	33%	33%
6	West Baranof Island	12,468	52%	42%	42%	42%	42%	42%
7	Admiralty Island	109,747	90%	90%	90%	90%	90%	90%
8	Lynn Canal	16,623	89%	78%	79%	78%	78%	78%
9	North Coast Range	37,331	77%	64%	66%	67%	65%	66%
10	Kupreanof/Mitkof Island	48,728	49%	44%	45%	45%	45%	45%
11	Kuiu Island	44,459	81%	78%	79%	79%	78%	78%
12	Central Coast Range	23,494	89%	72%	80%	81%	76%	75%
13	Etolin Island	27,581	53%	48%	48%	48%	48%	48%
14	North Central Prince of Wales	228,389	51%	48%	48%	48%	48%	48%
15	Revilla Island/ Cleveland Peninsula	68,569	64%	55%	55%	55%	55%	55%
16	Southern Outer Islands	21,098	63%	9%	60%	60%	59%	59%
17	Dall Island and Vicinity	28,220	44%	36%	36%	36%	36%	36%
18	South Prince of Wales	50,376	83%	80%	80%	80%	80%	80%

Table 3.9-18 (continued)
Cumulative Percent of Original Large-tree POG Remaining on All Landownerships after 100 Years of Forest Plan Implementation by Biogeographic Province and Alternative (NFS and Non-NFS Lands)

No.	Biogeographic Province	Estimated Original SD67 POG (Acres)	Percent Original SD67 POG Remaining	Percent SD67 POG Remaining after 100+ Years[1,2] Alternative 1	2	3	4	5
19	North Misty Fiords	15,397	85%	84%	84%	84%	84%	84%
20	South Misty Fiords	14,861	95%	95%	95%	95%	95%	95%
21	Ice Fields	7,896	75%	75%	75%	75%	75%	75%
Total for Southeast Alaska		**886,260**	**68%**	**63%**	**63%**	**64%**	**63%**	**63%**

[1] The estimate assumes all scheduled suitable POG is harvested; does not account for Model Implementation Reduction Factor (MIRF).
[2] Based on an inventory of existing harvest on non-NFS lands and the estimation of future harvest by major landowner category.
[3] Does not include land area in biogeographic provinces 22 and 23 which are almost exclusively non-NFS land.

Wildlife

Affected Environment

This section describes the wildlife resources on the Tongass National Forest. The following subsections address the old-growth habitat conservation strategy; threatened, endangered, and candidate species; Management Indicator Species (MIS); Alaska Region Sensitive Species; migratory birds; endemic species; and invasive species. Consumptive uses of wildlife on the Tongass National Forest are discussed in the *Subsistence* section.

Old-Growth Habitat and the Conservation Strategy

Typical of Southeast Alaska, vegetation on the Tongass National Forest is dominated by temperate coastal rain forests at lower elevations (less than 2,000 feet elevation), with interspersed muskegs, other wetlands, and other non-forest types. At higher elevations, alpine vegetation, rock, glaciers, and snowfields dominate. Although many wildlife species on the Tongass are associated with more than one habitat type, most inhabit old-growth forests or prey on species that inhabit old-growth forests. Therefore, this analysis focuses on the old-growth ecosystem. In Southeast Alaska, old-growth forests are typically greater than 150 years old, and are characterized by complex canopies; an interspersion of trees of multiple age classes; the presence of snags, decadent trees, and fallen trees; and a variation in the amounts and distribution of live trees. These features create intricate habitat niches that support many wildlife species (Spies 2004).

The 1997 Tongass Forest Plan established a comprehensive, science-based Conservation Strategy to provide for wildlife sustainability and viability across the Tongass (USDA Forest Service 1997a, 1997b). The Conservation Strategy was developed to maintain the integrity of a functional and interconnected old-growth ecosystem on the Tongass by retaining intact, largely undisturbed habitat well-distributed across the Forest. The Conservation Strategy includes two major components: (1) a forest-wide network of large, medium, and small OGRs allocated to the Old-Growth Land Use Designation (LUD) and other non-development LUDs plus all small islands less than 1,000 acres, and (2) a series of standards and guidelines applicable to lands where timber harvest is permitted (the matrix; USDA Forest Service 2008a, 2008b).

The OGR system was designed to maintain habitats of the old-growth associated and dependent species (USDA Forest Service 2008a). The forested areas of other non-development LUDs such as Wilderness, LUD II, Remote and Semi-Remote Recreation also maintain the old-growth ecosystem. The intent of the reserve system was to help ensure the maintenance of well-distributed viable populations of old-growth associated wildlife species across the Tongass, with focus on those species that are most sensitive to habitat loss and fragmentation. For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the OGR system, refer to Appendix D of the 2008 Forest Plan Final Environmental Impact Statement (FEIS; USDA Forest Service 2008a).

Within the matrix (areas outside of reserves), components of the old-growth ecosystem are maintained through a series of standards and guidelines designed to provide for important ecological functions such as dispersal of organisms, movement between forest stands, and maintenance of ecologically valuable structural components such as down logs, snags, and large trees (USDA Forest Service 2008a). Matrix lands include Modified Landscape, Scenic Viewshed, and Timber Production LUDs; Experimental Forest is also a development LUD, however timber harvest occurs only for research purposes. Standards and guidelines applicable to these lands include the 1,000-foot beach and estuary buffer, Riparian Management Areas (RMAs), legacy forest structure standards and guidelines, and a number of species-specific standards and guidelines (e.g., raptor nest buffers and wolf den buffers). A more detailed description of the Tongass Conservation Strategy, and the basis for its development, is provided in the *Biodiversity* section.

There are currently approximately 5.0 million acres of POG forest on the Tongass National Forest, of which 2.1 million acres are high-volume POG and half a million acres are large-tree POG, representing 92, 84, and 82 percent of these forest types estimated to have been originally existing in 1954 prior to the beginning of commercial timber harvest (Tables 3.9-3 and 3.9-6). There are approximately half a million acres of young-growth forest on the Tongass National Forest, of which 84 percent are a result of past harvest and 16 percent are natural young-growth (Table 3.9-5). The *Biodiversity* Section provides a description POG forest and other cover types and a discussion of past timber harvest on the Tongass National Forest.

Landscape Connectivity and Fragmentation

Landscape connectivity is defined as the degree to which the structure of a landscape helps or hinders the movement of wildlife species (Taylor et al. 1993). A landscape with a high degree of connectivity is one in which wildlife move readily between habitat patches over the long term (USDA Forest Service 2008a). On the Tongass, connectivity between areas of similar habitats (i.e., old-growth forest) or between high and low elevation habitats is important to maintaining well-distributed, viable wildlife populations of some species.

Fragmentation by both natural and human-caused actions reduces landscape connectivity by breaking apart larger contiguous blocks of habitat into smaller patches. Populations may become isolated, and therefore at greater risk of local extirpation, if fragmentation hinders movement of individuals between subpopulations (Wilcove et al. 1986). The degree to which this occurs depends on species-specific dispersal capabilities, the distance between habitat patches, and conditions within the matrix between habitat patches. Empirical studies to date suggest that habitat loss has large, consistently negative effects on biodiversity. Habitat fragmentation per se has much weaker effects on biodiversity that are at least as likely to be positive as negative (Fahrig 2003). The concepts of landscape connectivity and fragmentation are described in the *Biodiversity* section.

Wildlife Species

The following sections describe threatened and endangered species, candidates for listing, management indicator species (MIS; 1982 planning rule), Alaska Region sensitive species, and other species of interest. Table 3.10-1 provides a comprehensive list of these species and identifies those carried forward in the analysis based on known occurrences or the presence of suitable habitat in the planning area.

Threatened, Endangered, and Candidate Species

Federally listed threatened and endangered species are those plant and animal species formally listed by the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) under authority of the Endangered Species Act (ESA) of 1973, as amended. An endangered species is defined as one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is defined as one that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

The federally listed threatened and endangered wildlife species known to occur within the boundary of the Tongass National Forest include the humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), sperm whale (*Physeter microcephalus*), short-tailed albatross (*Phoebastria albatrus*), and Steller sea lion (*Eumetopias jubata;* western Distinct Population Segment [DPS]). There are also several listed fish species which are addressed in the *Fish* section of this EIS. Pursuant to Section 7 of the ESA, a Biological Assessment (BA) evaluating the effects of the selected alternative of this Forest Plan amendment on these species was prepared; one BA for the marine mammals and fish species was submitted to the NMFS and another containing the short-tailed albatross was submitted to the USFWS for review and concurrence. The remaining federally listed species are not addressed further because the Tongass is outside of their known range or suitable habitat is not present (Table 3.10-1). Currently, no candidates for federal listing occur within the boundary of the Tongass National Forest (Table 3.10-1). In accordance with Forest Service Manual 2670, a Biological Evaluation (BE) covering federally listed threatened and endangered wildlife species and Region 10 sensitive species was also prepared; this BE contains an evaluation and comparison of all alternatives. The BA and BEs for this Forest Plan Amendment are included in the project record.

Short-tailed Albatross

The short-tailed albatross was federally listed as endangered throughout its range on July 31, 2000 (65 Federal Register [FR] 147:46643-46654). It is a pelagic seabird species that forages offshore and in shelf-break waters throughout the North Pacific Ocean and Bering Sea. The short-tailed albatross primarily breeds in Japan but single nest sites have been documented on Midway Island, Hawaii. Outside of the breeding season, it occurs in the waters of the Bering Sea, Aleutian Islands, and Gulf of Alaska (USFWS 2012). Primary threats to this species include loss of nesting habitat as well as interactions with fishing operations (e.g., entanglement with gear), ingestion of plastic debris, contamination from oil spills, and predation at breeding colonies.

Based on the most recent USFWS 5-year review for the species (USFWS 2014), the short-tailed albatross population is making progress toward recovery. Data from breeding colony surveys, suggest a total population of estimate of 4,454 individuals at the end of the 2013-2014 breeding season.

Previously the waters adjacent to the Tongass National Forest were thought to be outside of the range of this species (USFWS 2008b); however, more recent satellite tracking of adult (in 2006-2008) and juvenile (in 2008-2012) albatrosses has helped to provide a more complete picture of the marine distribution of this species (USFWS 2014). The satellite tracking data indicates that there are marked differences in the marine distribution of juvenile and adult albatrosses, with juvenile and sub-adult birds (up to 2 years old) traveling to the west coast of North America (including Southeast Alaska), and more extensively between Hawaii and Alaska, than adult birds. This species may forage in nearshore waters adjacent to the outer coast of the Tongass, particularly where the continental shelf break is close to shore. Therefore, it could be exposed to water quality effects associated with land management activities on the Tongass National Forest.

Table 3.10-1
Federally Listed Threatened and Endangered Species, Candidate Species Under the ESA, and Forest Service Alaska Region Sensitive Species and Potential for Occurrence on the Tongass National Forest

Common Name	Scientific Name	Habitat Association	Potential for Occurrence in the Planning Area	Status1
ESA Species Under USFWS Jurisdiction				
Eskimo curlew	*Numenius borealis*	Arctic tundra.	No, outside of species' range.	E
Short-tailed albatross	*Phoebastria albatrus*	Winters in waters of the Bering Sea, Aleutian Islands, and Gulf of Alaska; breeds in Japan (USFWS 2012a).	Yes, may occur in nearshore waters near islands and mainland coastlines of southeast Alaska.	E
Spectacled eider	*Somateria fischeri*	Coastal waters in northern and western Alaska (USFWS 2012b).	No, outside of species' range.	T
Steller's eider	*Polysticta stelleri*	Occurs in northern and western Alaska (USFWS 2012c).	No, outside of species' range.	T
Polar bear	*Ursus maritimus*	Sea ice and coastlines of western Alaska and along the North Slope.	No, outside of the species' range.	T
Pacific walrus	*Odobenus rosmarus divergens*	Continental shelf waters of Bering and Chukchi seas.	No, outside of the species' range.	C
ESA Species Under NMFS Jurisdiction				
Blue whale	*Balaenoptera musculus*	Off-shore (pelagic) marine waters of the Bering Sea, Chukchi Sea, North Pacific Ocean and/or Gulf of Alaska (NMFS 2009a). Critical habitat designated for North Pacific right whales in the Bering Sea and the Gulf of Alaska (NMFS 2009a).	No, very rarely observed in Southeast Alaska.	E
Beluga whale	*Delphinapterus leucas*			
Bowhead whale	*Blaena mysticetus*			
Northern Pacific right whale	*Eubalaena japonica*			
Sei whale	*Balaenoptera borealis*			
Humpback Whale	*Megaptera novaeangliae*	Common in the inside waters of the Alexander Archipelago and are regularly sighted in the Inside Passage and coastal waters of the Southeast Alaska panhandle (NMFS 1991).	Yes, likely to occupy marine waters surrounding the Tongass. May occur in shallow coastal areas.	E
Fin whale	*Balaenoptera physalus*	Typically off-shore (pelagic) marine waters of the Bering Sea, Chukchi Sea, North Pacific Ocean and/or Gulf of Alaska (NMFS 2009a); two more recent sightings in lower Clarence Strait (Dahlheim et al. 2009).	Yes, may occur seasonally in marine waters surrounding the Tongass, but in proximity to the open ocean.	E
Sperm whale	*Physeter macrocephalus*	Typically off-shore marine waters of the Bering Sea, Gulf of AK, Southeast AK and Aleutian Islands (Allend and Angliss 2014).	Yes, may occur seasonally in marine waters around Tongass, but in proximity to the open ocean.	E

Table 3.10-1 (continued)
Federally Listed Threatened and Endangered Species, Candidate Species Under the ESA, and Forest Service Alaska Region Sensitive Species and Potential for Occurrence on the Tongass National Forest (continued)

Common Name	Scientific Name	Habitat Association	Potential for Occurrence in the Planning Area	Status[1]
Bearded seal Ringed Seal	*Erignathus barbatus* *Phoca hispida*	Sea-ice habitats in Bering Sea, Chukchi Sea, Beaufort seas (77 FR 76740-76768, 77 FR 76706-76738).	No, outside of species' range.	C – bearded seal; T – ringed seal
Northern sea otter, SW Alaska population	*Enhydra lutris kenyoni*	Coastal marine habitats.	No, outside of species range.	T
Steller sea lion – Western AK DPS[2]	*Eumetopias jubatus*	Marine and terrestrial areas from Prince William Sound westward (west of 144° west longitude).	Yes, DPS occurs in waters surrounding the Tongass. Critical habitat has also been designated.	E
Green sea turtle	*Chelonia mydas*	Occur in the Gulf of Alaska and some species are found as far west as the Aleutian Islands. Adults are highly migratory, but the details and locations of migrations are largely unknown (NMFS 2009b).	No, only rarely observed in Southeast Alaska.	T
Loggerhead sea turtle	*Caretta*			T
Olive Ridley sea turtle	*Lepidochelys olivacea*			T
Leatherback sea turtle	*Dermochelys coriacea*			E
Forest Service Alaska Region Sensitive Species[3]				
Steller sea lion – Eastern AK DPS[3]	*Eumetopias jubatus*	Marine and terrestrial areas in Southeast Alaska (east of 144° west longitude).	Yes, occurs in waters surrounding the Tongass.	S
Queen Charlotte goshawk	*Accipiter gentiles laingi*	Mature/old-growth forests.	Yes, known to occur on the Tongass.	S
Aleutian Tern	*Sterna aleutica*	Nests on islands, shrub-tundra, grass or sedge meadows and freshwater and coastal marshes.	Yes, known to occur on the Tongass.	S
Black oystercatcher	*Haematopus bachmani*	Rocky shorelines along the coast; forages in sheltered areas where low-sloping gravel or rock beaches with abundant prey occur.	Yes, known to occur on the Tongass.	S
Kittlitz's murrelet	*Brachyramphus brevirostris*	Breeds in the vicinity of glaciers and cirques in high elevation alpine areas with little or no vegetative cover; northern Gulf of Alaska and Bering Sea coast (Day et al. 1999).	Yes, known to occur on the Tongass.	S

[1] T = Federally threatened; E = Federally endangered; C = candidate for Federal listing; S = Alaska Region Sensitive Species
[2] DPS = Distinct Population Segment.
[3] Regional Forester's Sensitive Species List (February 2009). The Steller sea lion Eastern DPS was added as a sensitive species afte federal ESA delisting. The Western DPS remains federally endangered.

Alaska Region Sensitive Species

The Alaska Region Sensitive Species list was updated in 2009 and supersedes previous lists (USDA Forest Service 2009b). The following summarizes the 2009 updates to the Alaska Region Sensitive Species list for animal species that occur on the Tongass National Forest. Three animal species were removed from the list and include the Trumpeter swan, American osprey, and Peale's peregrine falcon. Two animal species were added to the list and include Black Oystercatcher and Aleutian tern. Two animal species were retained on the list and include the Kittlitz's murrelet and Queen Charlotte goshawk.

Although not on the 2009 list, the Steller sea lion (eastern DPS) is now an Alaska Region Sensitive Species. A species removed from listing under the ESA because recovery criteria have been met will automatically be added to the sensitive species list for at least 5 years (FSM 2672.11, R-10 2600-2005-1). On November 4, 2013, the NMFS issued a final rule (78 FR 66140) to remove the eastern DPS of Steller sea lion from the List of Endangered and Threatened Wildlife and therefore will be analyzed as a sensitive species through at least 2018.

Species that are candidates for listing under the ESA are also automatically considered an Alaska Region Sensitive Species. Pacific walrus is a USFWS candidate for listing, but this species does not occur on the Tongass and is not considered further here (Table 3.10-1).

Queen Charlotte Goshawk

The Queen Charlotte goshawk (*Accipiter gentilis laingi*) is included by Stenhouse and Senner (2005) on Audubon's Alaska WatchList. The Queen Charlotte goshawk is recognized as a distinct subspecies of the northern goshawk (*Accipiter gentilis*) that occurs only in coastal areas of British Columbia and in Southeast Alaska. In 2007, in response to a court-ordered remand on a petition to list the species, the USFWS updated a 1997 status review for the Queen Charlotte goshawk, and concluded that Alaska supports a DPS of this species though listing of this DPS was not warranted (USFWS 2007). On August 1, 2012, the British Columbia DPS of the Queen Charlotte goshawk was listed as threatened under the ESA (FR 45870-45893). The Alaska DPS was not listed in part due to the protections provided by the Tongass Forest Plan Conservation Strategy.

The goshawk is a year-round resident in Southeast Alaska and may occupy different or overlapping breeding and winter territories. Goshawk breeding territories can be described hierarchically in terms of the nest site, the nest area, post-fledging area, and foraging area (see Reynolds et al. 1992 and USDA Forest Service 2008b). Goshawks in Southeast Alaska typically nest in large patches of tall, mature, and old trees with dense canopies. When mature and old-growth habitats are not available, they will nest in maturing young growth with sufficient structure (Reynolds et al. 2006; Boyce et al. 2006). Nesting in mature young growth is less common, and occurs in proportion to the amount of this habitat available on the landscape, suggesting goshawks neither prefer nor avoid its use (USFWS 2007).

Goshawk foraging areas typically consist of mature and old-growth forest stands, though they will also forage in young forest as well as along edges and in openings as long as suitable perches from which to observe and attack prey are present (Iverson et al. 1996; Bosakowski et al. 1999; McClaren 2004; Boyce et al. 2006; Reynolds et al. 2006). Prey species vary geographically, and include blue grouse, red squirrels, and a variety of forest-dwelling birds (spruce grouse, Steller's jay, and ptarmigan; Lewis 2001). High-volume POG represents optimal nesting and foraging habitat for goshawks due to the presence of large trees and snags. Existing amounts of this forest type on the Tongass are discussed in the *Biodiversity* section. Approximately 84 percent of the original high-volume POG existing in 1954, the time at which commercial timber harvest began on the Tongass National Forest, remains (Table 3.9-6).

Timber harvest in both old-growth and mature young-growth forest may locally limit the availability of nest sites through removal of suitable nest trees, or through removal of forest surrounding these trees. Nest trees optimally should be surrounded by patches of mature or old-growth forest large enough to include several alternate nests and provide post-fledging habitat. Timber harvest may also decrease foraging habitat quality through reductions in prey abundance and availability. Dense young growth stands are difficult for goshawks to hunt, reducing availability of prey, even where prey populations may otherwise be adequate. The availability of adequate prey resources has been linked to goshawk territory occupancy and breeding success (Doyle and Smith 1994; Salafsky et al. 2005; Keane et al. 2006; Salafsky et al. 2007). Conservation measures for this species include requirements for project surveys for nesting goshawks, retention of confirmed or probable nest stands, and retention of legacy old-growth forest structure in old-growth harvest units larger than 20 acres, where logging has been most intensive (USDA Forest Service 2008a). The system of OGRs and other non-development LUDs also maintains habitat for this species, although a recent study suggests that some uncertainty remains with respect to the ability of Forest Plan conservation measures to contribute sufficient habitat to sustain well-distributed, viable populations of northern goshawks throughout Southeast Alaska (Smith 2013). Continued inventories and monitoring of established nest protection buffers will help to inform future decisions.

Kittlitz's Murrelet

The Kittlitz's murrelet (*Brachyramphus brevirostris*) was retained as a 2009 sensitive species because it was a USFWS candidate (USDA Forest Service 2009b). On October 3, 2013, the USFWS issued a 12-month finding (78 FR 61763) that listing the Kittlitz's murrelet is not warranted. However, until the Alaska Region Sensitive Species list has been updated, the Kittlitz's murrelet will continue to be analyzed as a sensitive species. During its 2013 review, the USFWS concluded that the rangewide Kittlitz's murrelet population declined by approximately 30 percent per year between 1989 and 2000, but since then appears to have stabilized or may be declining at a much slower rate (USDI 2013). Declines have been attributed to glacial retreat and changes in the ocean environment which may alter foraging habitat and prey populations; other factors include predation, oil pollution, gill-net by-catch, disturbance by commercial and recreational boaters, and flightseeing operations (USFWS 2006b).

More than 95 percent of the global population is estimated to breed in Alaska, with the remainder occurring in the Russian Far East. The largest breeding populations are believed to be in Glacier Bay National Park and Preserve, Prince William Sound, Kenai Fjords, and Icy Bay (Kendall and Agler 1998 as cited in Day et al. 2000). Breeding season core population centers adjacent to the Tongass include Icy Bay, Malaspina Forelands, and Yakutat Bay where the species is closely associated with glacial habitats (Kissling et al. 2011). The Forest Plan contains direction to "provide for the protection and maintenance of known Kittlitz's murrelet nesting habitat."

Black Oystercatcher

The black oystercatcher (*Haematopus bachmani*) was added to the Alaska Region Sensitive Species list in 2009. The Alaska Shorebird Conservation Plan also notes it as a species of high concern due to concerns with population size, breeding and nonbreeding threats, and nonbreeding distribution (Alaska Shorebird Group 2008). It is also a Bird of Conservation Concern, and is on the Audubon Society's Watch List (Tessler et al. 2007).

The black oystercatcher occurs along the North American Pacific coast from the Aleutian Islands to Baja California (Andres and Falxa 1995), with over half of the global population residing in Alaska primarily in Prince William Sound and the Kodiak Archipelago (Tessler et al. 2007). They favor rocky shorelines and forage exclusively on intertidal macroinvertebrates (e.g., limpets and mussels) found in sheltered areas of high tidal variation (Tessler et al. 2007).

Breeding oystercatchers are highly territorial and breeding pairs tend to be widely distributed (Tessler et al. 2007). After breeding, black oystercatchers aggregate into winter flocks ranging from tens to hundreds of individuals. Winter flocks typically concentrate on protected, ice-free tidal flats or rocky islets with dense mussel beds.

Because black oystercatchers solely use the intertidal zone, where they may congregate in large numbers, they are especially vulnerable to disturbance from marine industrial pollution and human disturbance from tourism and fishing. Threats include predation, recreational disturbances, flooding, vessel wakes, and shoreline contamination (Tessler et al. 2007).

Surveys specifically targeting black oystercatchers in Alaska are limited and the Northern Pacific Pelagic Seabird Database (NPPDS) serves as one of the largest data sources, although it may underestimate the number of birds because it is not specific to oystercatcher (Tessler et al. 2007). Kodiak Island is currently the only documented area in Alaska that supports large concentrations of black oystercatchers (Tessler et al. 2007), but they have been observed and are known to nest in low densities along shorelines and use intertidal areas adjacent to the Tongass National Forest. Historically, they have been documented in Sitka Sound/Necker Islands, the Myriad Islands, the outer coast of Baranof Island, and the Forrester Island group but breeding birds are generally sparsely distributed (Tessler et al. 2007). From Baranof Island south to the Canadian border, the NPPSD shows only 57 incidental observations of black oystercatchers between 1972 and 2003, most (65 percent) of which are from the Forrester Island group (Tessler et al. 2007). There is no specific 2008 Forest Plan direction for this species because it was added to the sensitive species list after the 2008 Forest Plan was approved.

Aleutian Tern

The Aleutian tern (*Sterna aleutica*) is a migratory seabird that breeds exclusively in Alaska and eastern Siberia. It is a USFWS Bird of Conservation Concern and is protected under the Migratory Bird Treaty Act (MBTA) and is listed as an Alaska Region sensitive species by the Forest Service. In Alaska, Aleutian tern colonies are located throughout the Aleutian Islands, north to the southeastern Chukchi Sea and east to the Alaska Peninsula, Yakutat, and Glacier Bay (USFWS 2012d).

Aleutian terns breed in loose colonies, often in association with Arctic terns, in coastal sites located at the heads of bays, reefs, island, estuaries, and river mouths (USFWS 2012d). Nests are located on the ground in a variety of habitats including shrub tundra, grass or sedge meadows, and freshwater and coastal marshes (USFWS 2006b). One of the largest breeding colonies of Aleutian terns occurs on Black Sand Spit in the Yakutat Forelands, which supports approximately one third of Alaska's population. Due to its importance as a breeding colony, Black Sand has been identified as an Audubon Important Bird Area. Most other known occurrences of Aleutian terns are not located on the Tongass. Little is known about this species outside of the breeding season; however, it is known to winter in the eastern Pacific.

Threats to this species include human disturbance at nest sites, marine oil spills, and change in forage fish populations (USFWS 2012d). Timber harvest associated activities (i.e., log transport, use of log transfer facilities [LTFs], and helicopter activity) could have the potential to affect this species through disturbance to nesting colonies or through water quality impacts to prey species. Although most known colonies are in remote sites, some do exist in areas where Forest Service permitting may have the potential to cause disturbance (USDA Forest Service 2009b). There is no specific Forest Plan direction for this species but the standards and guidelines for Seabird Colonies apply (USDA Forest Service 2008a).

Steller Sea Lion Eastern DPS

The Steller sea lion (*Eumetopias jubatus*) was emergency-listed as threatened under the ESA in April 1990 by NMFS due to rapid population declines in the western portion of its range (55 FR 12645). In 1997, the NMFS designated two DPS, occurring west and east of 144 degrees west longitude, respectively. Due to persistent decline, the western DPS was reclassified as endangered, while the increasing eastern DPS was delisted in November 2013. On November 4, 2013, NMFS issued a final rule (78 FR 66140) to remove the eastern DPS of Steller sea lion from the List of Endangered and Threatened Wildlife. A species removed from listing under the ESA because of recovery criteria have been met will be automatically added to the Alaska Region Sensitive Species list for at least 5 years (FSM 2672.11, R-10 2600-2005-1). The western DPS is analyzed in the BA. Steller sea lions are also protected by the Marine Mammal Protection Act (MMPA) under which they are designated as “depleted” (NMFS 2013a, 2013b).

Steller sea lions are widely distributed over the continental shelf and throughout the coastal waters of the Gulf of Alaska. The eastern DPS is known to occur in the waters surrounding the Tongass, although intermigration between the eastern and western populations has been documented, particularly north of Frederick Sound.

Steller sea lions forage in nearshore and pelagic waters where they are opportunistic predators. They feed primarily on a wide variety of fishes and cephalopods (squid and octopus). Steller sea lions use terrestrial haulout sites to rest and take refuge. They also gather on well-defined, traditionally used rookeries to pup and breed. These habitats are typically gravel, rocky, or sand beaches; ledges; or rocky reefs (NMFS 2013b).

Critical habitat was designated for the Steller sea lion by NMFS in 1993 and represents areas considered essential for the continued survival and recovery of this species (NMFS 1993). 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. These rookeries, as well as haulouts, have been officially designated as critical habitat in Southeast Alaska (NMFS 2001).

NMFS defines critical habitat for Southeast Alaska to include a “terrestrial zone, aquatic zone, and an air zone, that extend 3,000 feet landward, seaward, and above, respectively, for each major rookery and major haulout in Southeast Alaska.” Critical habitat provides notice to federal agencies that a listed species is dependent on these areas for its continued existence and that any federal action that may affect these areas is subject to the consultation requirements of Section 7 of the ESA. To date, 3 major rookeries and 11 major haulouts have been identified as critical habitat on or adjacent to the Tongass. Two additional haulouts have been identified in Southeast Alaska (Cape Fairweather and

Graves Rock) but these locations are within Glacier Bay National Park. In light of the delisting of the Eastern DPS and listing of the Western DPS as endangered, as well as availability of new science, NMFS is currently conducting a review of critical habitat for this species.

Steller sea lions are sensitive to disturbance and harassment or displacement from haulouts and rookeries. Human activities such as boating, recreation, aircraft, LTFs, and log raft towing are concerns related to the long-term conservation of the sea lion in Southeast Alaska. Forest Plan standards and guidelines for Steller sea lions provide protection to sea lion habitats and regulate activities in proximity to this species.

Former Management Indicator Species

The 1982 Planning Rule directed the use of Management Indicator Species (MIS) in forest planning to help display the effects of forest management. The 1997 Forest Plan selected 13 wildlife MIS which carried through to the 2008 Forest Plan Amendment. Because this EIS is analyzing an amendment to the 2008 Forest Plan done under the 1982 Planning Rule, these species are analyzed here even though the 2012 Planning Rule does not use MIS for evaluating effects. Most of these species are associated with POG forests of Southeast Alaska either directly or rely on prey species associated with these habitats.

A series of workshops were held in 2011 with representatives from the Alaska Department of Fish and Game (ADF&G), NMFS, USFWS, and the Forest Service to evaluate the current Tongass MIS and develop a set of proposed MIS that would more effectively serve the Tongass. After following a structured process used to revise MIS elsewhere on National Forest System (NFS) lands (Hayward et al 2001), the group recommended retaining deer, marten, brown bear, black bear, mountain goat, and bald eagle on the wildlife species MIS list (Hayward and Jacobson 2011); however, all original MIS are discussed below.

Sitka Black-Tailed Deer

Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) are indigenous to the coastal regions of Southeast Alaska and northwest British Columbia. They are an important game hunting and subsistence species. They are also an important prey species for the Alexander Archipelago wolf (discussed below).

Sitka black-tailed deer use lower elevation (below 800 feet elevation) POG forest habitats during the winter period. The quantity, quality, distribution and arrangement of winter habitat are considered the most important limiting factors for Sitka black-tailed deer in Southeast Alaska. However, spring, summer, and fall habitats (non-winter) are also important for deer reproduction and population recovery following severe winters, and for building up pre-winter body reserves. During these seasons, and during mild winters, deer will forage in young-growth stands less than about 25 years old and other open non-forested habitats.

For consistency with the 1997 Forest Plan revision FEIS and 2008 Forest Plan Amendment FEIS, the interagency deer habitat capability model was used to assess existing habitat capability within the planning area (USDA Forest Service 1997b, 2008b). This model has a number of limitations, which are described in the 2008 Forest Plan FEIS (USDA Forest Service 2008b). In particular, the model does not account for the biological value of young-growth stands or young-growth management in providing summer forage for deer because it assigns one value to all young growth (and one value to all types of timber harvest, whether even-aged or uneven-aged harvest). That is, it does not reflect any benefits from commercial thinning, precommercial thinning, development of canopy gaps, or other treatments. Table 3.10-2 presents modeled deer habitat capability by biogeographic provinces. Forest-wide, approximately 89 percent of the original (1954) habitat capability remains, ranging from 72 to 100 percent depending on the biogeographic province. The greatest reductions in deer habitat capability have occurred in provinces where timber harvest has been concentrated (the North Central Prince of Wales, East Baranof, and Etolin Island biogeographic provinces).

The Forage Resources Evaluation System for Habitat (FRESH) model developed by the USDA Forest Service Pacific Northwest Research Station (Hanley et al. 2012; http://cervid.uaa.alaska.edu/deer/Home.aspx) was also used to quantify the relative value of available deer forage under different alternatives in the planning area.

The FRESH model is a food-based model that takes into account the quantity (biomass) and quality (digestible energy and digestible protein, two of the most common nutritional limiting factors for deer) of the estimated food resources in relation to user-specified metabolic requirements of deer (which depend on age, sex, season, and reproductive status). The model uses a linear algorithm to determine the suitable forage that can sustain deer at this metabolic requirement, and produces the number of deer days per unit area that the available food resources (within the habitat patch or landscape) are capable of supporting. One deer day represents the food required to support one animal for one day at the specified level of nutritional requirements. The output of the model is a “snapshot” of habitat conditions based on estimated food availability and quality at one point in time which can be used to make a relative comparison of conditions within a habitat patch or landscape under different conditions (i.e., before and after implementation of a management activity).

Table 3.10-2
Existing Forest-wide Deer Habitat Capability Using the Interagency Deer Model (NFS Lands Only)

	Biological Province	Existing Habitat Capability 2015 (Deer per Square Mile)	Original (1954) Habitat Capability (Deer per Square Mile)	% Original Habitat Capability Remaining	No. WAAs with Modeled Deer Density of at least 18 Deer per Square Mile[1/]
1	Yakutat Forelands	13.3	13.7	97%	2
2	Yakutat Uplands	2.3	2.4	98%	0
3	East Chichagof Island	11.7	13.7	86%	1
4	West Chichagof Island	14.5	14.5	100%	1
5	East Baranof Island	7.0	8.5	82%	0
6	West Baranof Island	12.2	13.7	89%	4
7	Admiralty Island	17.6	17.9	98%	10
8	Lynn Canal	5.5	5.8	95%	1
9	North Coast Range	6.2	6.2	100%	0
10	Kupreanof/Mitkof Island	16.9	19.2	88%	7
11	Kuiu Island	25.5	28.1	91%	7
12	Central Coast Range	9.0	9.5	96%	1
13	Etolin Island	15.7	18.9	83%	3
14	North Central Prince of Wales	17.7	24.5	72%	11
15	Revilla Island/Cleveland Peninsula	13.5	15.0	90%	7
16	Southern Outer Islands	28.1	32.1	88%	9
17	Dall Island and Vicinity	30.4	30.6	99%	3

Table 3.10-2 (continued)
Existing Forest-wide Deer Habitat Capability Using the Interagency Deer Model (NFS Lands Only)

	Biological Province	Existing Habitat Capability 2015 (Deer per Square Mile)	Original (1954) Habitat Capability (Deer per Square Mile)	% Original Habitat Capability Remaining	No. WAAs with Modeled Deer Density of at least 18 Deer per Square Mile[1/]
18	South Prince of Wales	21.8	22.2	98%	5
19	North Misty Fiords	3.7	3.8	99%	2
20	South Misty Fiords	8.4	8.4	100%	0
21	Ice Fields	0.7	0.8	94%	0
	Forest-wide	**10.1**	**11.3**	**89%**	**57**

[1] For WAAs that overlap a biological province boundary only the overlapping portion counted toward the total.

[2] Note that the model treats harvested stands in the stem exclusion stage (25 years old or older) the same value regardless of thinning treatments that are implemented.[3] Note that wolves very rarely occur on Admiralty, Baranof, and Chichagof Islands.

The FRESH model has not yet been reviewed by an interagency team for widespread use; however, it does provide a supplemental way to compare management activities for possible effects to deer. As with any model, it has a number of limitations, which are that (1) it is a calculator, rather than a simulation model, providing a snapshot analysis of habitat quality at a user specified point in time (i.e., habitat quality values do not represent annual or seasonal averages), (2) it does not take into account other factors on the landscape that affect habitat quality beyond forage (i.e., it assumes all habitat is available to the animal), and (3) it does not account for the more complex relationships between plants and herbivores such as mineral and micronutrient requirements or the effects of plant secondary chemistry (such as tannins) which may affect forage palatability and the preference/avoidance of certain forages (Hanley et al. 2012).

Values for the available forage biomass and its nutritional quality (digestible energy and digestible protein concentrations) on the Tongass were based on a variety of sources including the Tongass Wide Young-Growth Study (2007, 2008, 2010, 2011, 2012, 2013), Prince of Wales Commercial Thin Study (Forest Sciences Lab Juneau 2014, unpublished), 2011 Tongass Young-growth Inventory (2011), Second Growth Management Project, Size-Density Accuracy Assessment and other unpublished studies from southeast Alaska (see the Project Record for more information). It is assumed that all available vegetation is potential food, and there is no accounting for long-term herbivore-plant dynamics (i.e., the effects of overbrowsing; Hanley et al. 2012). Thinning and logging slash have the potential to inhibit deer access; however, the current body of literature does not provide sufficient information for making adjustments to FRESH model output to reflect these limitations.

For this analysis, forage resources were analyzed with the GIS-based model application for a doe in the winter season. Deer metabolic requirements for winter were the following: dry matter digestibility 48 percent, digestible protein 1.8 percent, and dry matter intake 525 grams/day (see Hanley et al. 2012 for rationale and sources).

The FRESH model requires an estimate of snow depth on February 1 at sea level in a level open area. To reflect the geographic variation in snow depth in Southeast Alaska, the planning area was divided into six snow zones with average snow depth estimated for each under current climate conditions. Climate data from 1981-2010 were used to model PRISM-based “precipitation as snow” which was then converted to snow depth using the relationship of snow depth and elevation in the FRESH model snow sub-model (see metadata in the project record for additional information). The FRESH model then reduces the biomass of each forage in proportion to its height profile that is "buried" in snow (see Hanley et al. 2012 for details).

Table 3.10-3 provides the existing habitat conditions on the Tongass based on FRESH model output. Existing habitat quality on NFS lands ranges from 3.0 deer days per hectare in the Ice Fields biogeographic province to 153.9 deer days per hectare in the South Prince of Wales Island biogeographic province (Table 3.10-3). In the North Central Prince of Wales biogeographic province, where past harvest has been concentrated, existing habitat quality is 137.0 deer days per hectare.

The effects of timber harvest on deer may not be fully realized for decades. During the first 25 years or so (stand initiation), openings created by even-aged timber harvest (both old-growth and young-growth) provide abundant forage for deer as sunlight is allowed to penetrate to the forest floor enhancing growth of understory vegetation (Farmer and Kirchhoff 2007); however, access to forage may be limited during winter in moderate to high snow years, without the canopy of old-growth forest. However, as the forest grows, a dense canopy can form that shades out understory vegetation (stem exclusion) thereby reducing foraging habitat—a period which may last up to 150 years after harvest. Deer abundance has been shown to be lower in these forage-poor habitats (Brinkman 2009; Person 2010). Long-term young-growth management that includes intermediate treatments, which would maintain managed stands with more open canopies than unmanaged young-growth stands, may prolong the short-term beneficial effects of shrub and forb production used as forage.

Table 3.10-3
Existing Habitat Conditions Using the FRESH Deer Model (NFS Lands Only)

	Biological Province	Existing Habitat Conditions in 2015 (Average Deer Days/Hectare)[1/]	Range of Habitat Conditions Within Individual WAAs (Average Deer Days/Hectare)[1/]
1	Yakutat Forelands	0.0	0.0-0.0
2	Yakutat Uplands	0.0	0.0-0.0
3	East Chichagof Island	35.7	0.0-127.4
4	West Chichagof Island	89.1	0.0-93.9
5	East Baranof Island	30.6	0.0-62.6
6	West Baranof Island	56.9	0.0-114.7
7	Admiralty Island	50.6	14.2-130.4
8	Lynn Canal	24.4	1.4-74.6
9	North Coast Range	19.3	0.0-20.5
10	Kupreanof/Mitkof Island	96.8	0.0-146.7
11	Kuiu Island	64.8	0.0-119.9
12	Central Coast Range	31.8	0.0-78.7
13	Etolin Island	72.9	0.0-85.6
14	North Central Prince of Wales	137.0	0.0-133.0
15	Revilla Island/ Cleveland Peninsula	68.8	0.0-232.3
16	Southern Outer Islands	126.1	0.0-121.0
17	Dall Island and Vicinity	130.3	7.0-130.3
18	South Prince of Wales	153.9	6.9-126.5
19	North Misty Fiords	21.6	0.0-34.3
20	South Misty Fiords	56.3	0.0-88.9
21	Ice Fields	3.0	0.0-6.8
	Forest-wide[2/]	**46.9**	**NA**

[1] Calculated as weighted averages based on WAA area (total or portion coinciding with the biogeographic province)
[2] No snow zone was assigned to biogeographic provinces 1 and 2 due to very low use by deer; therefore, model not run

Mountain Goat

Mountain goats (*Oreamnos americanus*) inhabit alpine and subalpine areas and adjacent POG forests on the mainland portions of the Tongass and have been introduced to several islands. Steep glacial valleys and peaks provide escape terrain from predation by wolves and bears. Adjacent meadows provide forage and, at lower elevations, POG forests provide cover as well as evergreen shrubs and forbs for winter forage (Porter 2010).

Mountain goats are sensitive to human disturbance, which can cause the temporary or permanent abandonment of habitat, increased stress, altered behaviors, and potentially excess energy expenditure (Goldstein et al. 2005; Olliff et al.1999). Prolonged exposure to disturbance may have demographic consequences (e.g., effects to vital rates such as survival and reproduction), though this relationship is not completely understood. Industrial activities such as timber harvest, mining, road construction and hydroelectric development have the potential to have adverse effects on mountain goat populations through disturbance or removal of habitat. However, this species spend much of its time outside of areas where timber harvest has occurred or are likely to occur in the future. Existing Forest Plan standards and guidelines were developed to reduce the impacts of other activities (e.g., helicopter over-flights for recreation) and impacts associated with facilities.

Black Bear

Black bears are an important species for hunting, recreation and tourism. In Southeast Alaska, black bears are present throughout the mainland and on the islands south of Frederick Sound. Black bears in Southeast Alaska are part of a population (Alexander Archipelago black bears) endemic to coastal British Columbia and Southeast Alaska, except Admiralty, Baranof, and Chichagof islands (Stone and Cook 2000; Peacock et al. 2007).

Black bears will use habitats from sea level to the alpine but appear to prefer estuarine, riparian, and forested coastal habitats (USDA Forest Service 2008b). Black bears use small openings, and areas such as wetlands, clearcuts, and subalpine meadows for foraging.

Past timber harvest, especially in areas adjacent to salmon streams, has decreased black bear habitat suitability through the removal of POG forest. While early successional habitats may provide abundant food (berries), over the long term dense young-growth stands provide poor habitat for black bears due to the lack of forage and large hollow trees for denning. Also, over the long term, reduction of den sites may result from a lack of availability of large tree root structures (Davis et al. 2012). There are approximately 43,300 acres of young-growth within the beach and estuary fringe and 38,320 acres of young-growth within RMAs due to past timber harvest on the Tongass (Table 3.9-5). Small OGRs and other Non-development LUDs provide some connectivity on a local scale to shoreline and riparian habitats preferred by black bears.

Timber harvest may also impact black bears through increased human access on roads. This can result in increased harvest-related mortality; however it should be noted that black bear harvest risk is not tied to a particular road density level.

River Otter

River otter (*Lutra canadensis*) are associated with coastal and freshwater aquatic environments and the immediately adjacent (within 100 to 500 feet) upland habitats. River otters are distributed throughout Southeast Alaska, and across the Tongass National Forest, along coastal and inland waters (MacDonald and Cook 2007).

Old-growth forests have the highest habitat value for river otters, providing canopy cover, large-diameter trees and snags, and burrow and den sites. River otters rest in cavities or beneath the roots of large conifers or snags in POG forests with open understories (high-volume POG forest; Ben-David et al. 1996; Bowyer et al. 2003). Young-growth forests provide lower quality habitat. There are approximately 2.1 million acres of high-volume POG forest on the Tongass (Table 3.9-3). There are 43,300 acres of young-growth forest within the beach and estuary fringe and 38,320 acres of young-growth within RMAs (excluding TTRA buffers) resulting from past timber harvest on the Tongass (Table 3.9-5). Protection under the Forest Plan is provided through standards and guidelines for beaches, estuaries, and riparian areas (USDA Forest Service 2008a).

American Marten

The American marten (*Martes americana*) is an important furbearer that is associated with old-growth forests. Although only one species of marten is formally recognized in Southeast Alaska two distinct lineages exist. Although there is some uncertainty, recent taxonomic evidence suggests the potential existence of two species (Dawson and Cook 2012). Within the Alexander Archipelago, the coastal form *caurina* is thought to occur only on Kuiu and Admiralty Islands, though a preliminarily identified specimen of this subspecies has been collected on Dall Island (USDA Forest Service unpublished data). The continental form occurs elsewhere in their range (Cook et al. 2006).

Coastal habitats (beach fringe) and riparian areas have the highest habitat value for marten, followed by upland forested habitats below 1,500 feet in elevation (USDA Forest Service 2008a). Marten favor large- and medium-sized old-growth forests because they intercept snow, provide cover and denning sites, and provide habitat for marten prey species (Flynn and Schumacher 2001; Flynn et al. 2004). These forests are also used by deer during winter, and winter-kill carcasses of deer represented a significant portion of marten diet in winter (Ben-David et al. 1997). These forests have also experienced past timber harvest. Consequently, the quantity and quality of winter habitat is a limiting factor for marten in Southeast Alaska. Therefore, the availability of deep-snow marten habitat, defined as high-volume POG below 800 feet in elevation, provides a measure of habitat quality for marten. There are approximately 3 million acres of high-volume POG forest below 800 feet elevation on the Tongass National Forest (Table 3.9-4). Young-growth forests provide lower habitat value but may be used if they support abundant forage and small mammal populations (Flynn et al. 2004). More recent research indicates more prevalent use of young-growth forests than once thought (Goldstein 2013), emphasizing these forest in the matrix and within the reserve system for providing structural connectivity for movement and dispersal.

Marten populations fluctuate greatly over time in response to habitat conditions, prey densities, and trapping pressure. Marten are easily trapped and can be overharvested. The ADF&G currently permits unlimited trapping of marten in all of the Game Management Units (GMUs) covering the Tongass National Forest (GMUs 1, 2, 3, 4, and 5) with the exception of Kuiu Island, which is currently closed.

Old-growth timber harvest reduces habitat quality for marten through the removal of forest cover, fragmentation of old-growth habitat (reductions in travel corridors and/or functional connectivity between spatially isolated populations), and reductions in habitat for some prey species. Increased human access associated with new roads may result in increased marten harvest-related mortality. Although closed roads still facilitate access (e.g., off-highway vehicle, pedestrian), open roads that receive the highest and most consistent use are likely to have the greatest effect on marten. Existing road densities (all elevations included) on the Tongass are listed in Table 3.10-4.

Table 3.10-4
Existing Estimated Average Road Densities and Percentage of WAAs in Road Density Categories on NFS Lands and All Lands Combined for All Roads and Open Roads Only within the Tongass National Forest Boundary (All Elevations)

Road Density Category (miles per square mile)	Existing Road Densities (percentage of WAAs)	
	NFS Lands	All Lands[1]
All Roads		
0	47.6%	43.5%
0 to 0.7	37.7%	35.1%
0.7 to 1.0	6.3%	5.8%
1.0 to 2.0	7.9%	12.6%
2.0 to 3.0	0.5%	3.1%
>3.0	0.0%	0.0%
Total	**100%**	**100%**
Average Total Road Density – All WAAs	**0.195**	**0.334**
Open Roads[2]		
0	57.1%	49.7%
0 to 0.7	39.3%	37.7%
0.7 to 1.0	2.6%	4.7%
1.0 to 2.0	1.0%	6.3%
2.0 to 3.0	0.0%	1.6%
>3.0	0.0%	0.0%
Total	**100%**	**100%**
Average Open Road Density – All WAAs	**0.089**	**0.218**

[1] Percentages are based on all 191 WAAs inside the Forest boundary, including Annette Island; includes roads and streets within municipalities
[2] Open roads on NFS land were calculated using Maintenance Levels 2, 3, 4, and 5 (see Transportation section for maintenance level description)

Roadless areas and OGRs and other non-development LUDs provide refugia for marten from trapping pressure. However, marten home ranges are well distributed across the landscape and include areas with timber harvest and roads, emphasizing the importance of habitat within matrix lands. Legacy Forest Structure standards and guidelines, in combination with the beach fringe and riparian buffers, aid in providing habitat and connectivity for marten on NFS lands (USDA Forest Service 2008a).

Brown Bear

Southeast Alaska is home to one of the highest concentrations of brown bears (*Ursus arctos*) in the world (ADF&G 2000). Brown bears are present on the mainland and on most the islands north of Frederick Sound. They are occasionally reported on Mitkof, Etolin, Revillagigedo, and Wrangell Islands south of Frederick Sound, but are not found on any of the other islands in Southeast Alaska. Admiralty, Baranof, Chichagof, Kruzof, Yakobi, and neighboring islands consistently support the highest densities of brown bears on the Tongass National Forest (GMU 4).

Brown bears are important both for hunting (including both outfitter guided and non-guided hunting) and to the recreation and tourism industry of Southeast Alaska. On the Tongass, ADF&G permits harvest of brown bears in GMUs 1, 3, 4, and 5. As tourism grows in Southeast Alaska, there is increasing demand for more bear viewing opportunities such as those provided by Pack Creek and Anan Creek.

Brown bears use areas from sea level to the alpine and are habitat generalists. The late-summer season has been identified as the most critical or limiting period for brown bears when they must build up energy reserves that are adequate to survive the winter and successfully reproduce (Hilderbrand et al. 1999). During this season, many brown bears concentrate along low elevation valley bottoms and salmon streams, with most use occurring within 500 feet of streams (Schoen and Beier 1990; Titus and Beier 1999), where their efforts focus on consuming large quantities of fish in order rebuild their body condition and lay on essential fat reserves. These are often the same areas of highest human use and most intense resource development activities (Flynn et al. 2007).

Flynn et al. (2007) found bears, particularly females, in heavily altered watersheds (i.e., with more road building and timber harvest) tended to occur farther away from salmon streams than bears in watersheds with more intact streamside vegetation suggesting that bears are not making optimal use of available salmon resources in heavily altered landscapes. A study on the Kenai Peninsula reported that female brown bears with cubs tended to avoid areas used by other bears and by humans, apparently in an effort to increase offspring survival, and used less productive salmon spawning areas despite having high nutritional requirements (Suring et al. 2006). Thus, even less productive streams may be important to brown bear population productivity (Wielgus and Bunnell 1995).

Roads and other human developments can also be detrimental to bears because they increase the opportunity for human-induced mortality of bears through legal hunting, defense of life or property kills, and illegal killing. Additionally, poorly maintained or constructed roads can affect water quality and productivity of salmon streams.

Alexander Archipelago Wolf

The Alexander Archipelago wolf (*Canis lupus ligoni*) is thought to be a subspecies of gray wolf endemic to Southeast Alaska and British Columbia. It inhabits the mainland of Southeast Alaska and coastal British Columbia west of the Coast Mountain Range, and larger islands (those south of Frederick Sound) except Admiralty, Baranof, Chichagof islands, and on all of the Haida Gwaii or the Queen Charlotte Islands (USFWS 2015). Approximately 38 percent of the range-wide population of Alexander Archipelago wolves inhabits Southeast Alaska, where population trends are largely unknown, except for the population on Prince of Wales Island and the surrounding islands (collectively GMU 2), which appeared to decline in abundance in the past 20 years. A portion of Prince of Wales Island was sampled and estimates expanded to the entire GMU 2 suggesting an apparent decline of potentially 75 percent. Uncertainty in the apparent decline is most effectively considered through 95 percent confidence intervals on the 1994 (CI=148-564) and 2014 (CI=50-159) estimates (USFWS 2015). However, because GMU 2 constitutes approximately four percent of the range of the Alexander Archipelago wolf and six percent of the range-wide population, negative population impacts in GMU 2 likely do not affect the range-wide population significantly (USFWS 2015).The majority (62 percent) of the Alexander Archipelago wolf population occurs in coastal British Columbia and is thought to be stable (USFWS 2015). Although some research suggests that wolves inhabiting Prince of Wales Island may be genetically isolated from other populations in Southeast Alaska (Person 2001; Weckworth et al. 2005, 2010, 2011), there remains uncertainty about the degree of isolation (see the Alexander Archipelago Wolf Species Status Assessment (USFWS 2015) for more information).

In August 2011, the USFWS received a petition to list the subspecies as threatened or endangered, and to recognize Prince of Wales Island as a significant portion of its range (Center for Biological Diversity and Greenpeace 2011). The petition also requested that the USFWS consider those wolves found on Prince of Wales Island and adjacent islands (including Kosciusko, Tuxekan, Heceta, Suemez, Dall, and others proximate to Prince of Wales) as a DPS based on unique genetic, physical, and ecological characteristics. In March 2014, the USFWS issued a 90-day finding that the petition to list the subspecies presented substantial information indicating that listing may be warranted (79 FR 17993). A status review of the Alexander Archipelago wolf to determine if listing is warranted was published in November 2015.In January 2016, the USFWS published a 12-Month Finding that listing of the subspecies was not warranted.

Wolves feed primarily on deer in certain areas, though waterfowl, beaver, spawning salmon, and marine mammals represent important prey when available (Lafferty et al. 2014; Darimont and Reimchen 2002; Szepanski et al. 1999). Wolves in Southeast Alaska also prey on moose and elk where available. Suitable habitats for wolves are those capable of supporting this prey base. Therefore, wolves in Southeast Alaska use a wide variety of prey habitats but spend most of their time in productive and unproductive old-growth forests at low elevations (below 270 feet); young-growth forests and clearcuts are typically avoided (Person 2001). Dens on Prince of Wales Island are located in root wads of large living or dead trees within old-growth forest stands less than 495 feet (150 meters) from freshwater (Person and Russell 2009).

Deer winter habitat was considered by Person et al. (1996) and Person (2001) to be a good measure of habitat quality for wolves in southern Southeast Alaska. Black-tailed deer are present in all Southeast Alaska GMUs where wolves occur. Forest Plan standards and guidelines state that where possible, the provision of sufficient deer habitat capability to first maintain sustainable wolf populations, and then to consider meeting estimated human deer harvest demands. This is generally considered to equate to the habitat capability to support a minimum of 18 deer per square mile (using interagency deer habitat capability model outputs; USDA Forest Service 2008a). However, other factors (e.g., local knowledge of habitat conditions, inherent capability of the landscape, spatial extent of the analysis) are to be considered by the biologist, as well, rather than solely relying upon model outputs (USDA Forest Service 1997b, Appendix N).

As required under the Forest Plan, the interagency deer habitat capability model was used to evaluate wolf habitat capability based on modeled deer habitat capabilities (see the 2008 Forest Plan FEIS for discussion of model limitations and assumptions). Table 3.10-5 summarizes existing conditions by biogeographic province. Forest-wide approximately 89 percent of the original (1954) habitat capability remains, ranging from 72 to 100 by biogeographic province.

Wolves are also a furbearer in Southeast Alaska. Harvesting of wolves is regulated by the Federal Subsistence Board and the State of Alaska Board of Game. Harvest regulations, both subsistence and sport, are intended to help ensure sustainable wolf populations. The ADF&G works cooperatively with the Alaska Board of Game and with federal land managers, including the Forest Service, to identify and address conservation concerns and propose regulation changes as needed for all wildlife in Southeast Alaska, including wolves.

Although wolves are often harvested by hunters and trappers working from boats (approximately 59 percent of harvest in GMU 2) harvest-related wolf mortality (both legal and illegal) is correlated with roads and other habitat features, which influence their vulnerability to harvest (Person and Russell 2008; Person and Logan 2012). Wolf mortality analyses (e.g., Person and Russell 2008, Person and Logan 2012) document the strong positive relationship between wolf mortality and road density. Person and Russell (2008) found that rate of harvest of both resident and non-resident (e.g., those dispersing or moving through unfamiliar territory) wolves increased with density of roads, which provide access to hunters and trappers; however, total road densities above 1.5 miles per square

Table 3.10-5
Modeled Deer Habitat Capability Using the Interagency Deer Model for Comparison to Forest Plan 18 Deer per Square Mile Standard and Guideline (NFS Lands Only)

	Biological Province	Existing Habitat Capability 2015 (Deer per Square Mile)	Original (1954) Habitat Capability (Deer per Square Mile)	% Original Habitat Capability Remaining	No. WAAs with Modeled Deer Density of at least 18 Deer per Square Mile[1/]
1	Yakutat Forelands	13.3	13.7	97%	2
2	Yakutat Uplands	2.3	2.4	98%	0
3	East Chichagof Island	11.7	13.7	86%	1
4	West Chichagof Island	14.5	14.5	100%	1
5	East Baranof Island	7.0	8.5	82%	0
6	West Baranof Island	12.2	13.7	89%	4
7	Admiralty Island	17.6	17.9	98%	10
8	Lynn Canal	5.5	5.8	95%	1
9	North Coast Range	6.2	6.2	100%	0
10	Kupreanof/Mitkof Island	16.9	19.2	88%	7
11	Kuiu Island	25.5	28.1	91%	7
12	Central Coast Range	9.0	9.5	96%	1
13	Etolin Island	15.7	18.9	83%	3
14	North Central Prince of Wales	17.7	24.5	72%	11
15	Revilla Island/Cleveland Peninsula	13.5	15.0	90%	7
16	Southern Outer Islands	28.1	32.1	88%	9
17	Dall Island and Vicinity	30.4	30.6	99%	3
18	South Prince of Wales	21.8	22.2	98%	5
19	North Misty Fiords	3.7	3.8	99%	2
20	South Misty Fiords	8.4	8.4	100%	0
21	Ice Fields	0.7	0.8	94%	0
	Forest-wide	**10.1**	**11.3**	**89%**	**57**

[1] For WAAs that overlap a biological province boundary only the overlapping portion counted toward the total.
[2] Note that the model treats harvested stands in the stem exclusion stage (25 years old or older) the same value regardless of thinning treatments that are implemented.[3] Note that wolves very rarely occur on Admiralty, Baranof, and Chichagof Islands.

mile had little additional effect on harvest rates. This study did not differentiate between open and closed roads though the authors stated that road status likely had an important influence on wolf mortality. Similarly, wolves are more easily observed in open habitats such as muskegs, meadows, and young clearcuts; therefore, use of these habitats, particularly in areas accessible to humans (i.e., the beach and roaded areas), increases the risk of harvest-related mortality (Person and Russell 2008). Harvest vulnerability may limit dispersal, and thus the ability of wolves to recolonize territories that have been vacated by trapping and hunting or may diminish genetic interchange between separate populations.

The 2008 Forest Plan states that a road density of 0.7 to 1.0 mile per square mile or less may be necessary to reduce harvest-related mortality risk where locally unsustainable wolf mortality has been identified through interagency analysis (USDA Forest Service 2008, p. 4-95; Person 1996). Existing road densities are presented in Table 3.10-4. Approximately 15.8 percent of Wildlife Analysis Areas (WAAs) exceed this guideline (all roads included), and approximately 7 percent exceed 1.5 mile per square mile.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is associated with beach, estuary fringe, and riparian habitats. Bald eagles typically nest in large trees in spruce-hemlock forest, and over 90 percent of the nests are within 500 feet of a saltwater beach. Nests are located within beach, estuary fringe, and riparian habitats. Since 1967, the USFWS has monitored, via aerial surveys, bald eagle populations along the north Pacific coast from southern British Columbia to the Alaska Peninsula (Hodges 2011). In Southeast Alaska, the population increased until the 1980s, but since then has remained stable, with an adult population of approximately 13,000-26,000 birds (Hodges 2011).

Bald eagles are especially sensitive to disturbance early in the breeding season. Activities associated with timber harvest can result in reproductive failure or cause bald eagles to abandon their nests completely (Fraser et al. 1985 as cited in Isaacs et al. 2005). They are also susceptible to water quality impacts that adversely impact their prey populations (e.g., herring, flounder, pollock, and salmon). Under the 2008 Forest Plan, the availability of nesting habitat is not seen as a significant limiting factor, in part due to the current protection of the 1,000-foot shoreline beach buffer on the Tongass National Forest (Hodges 2011). Further protection to bald eagles is afforded by Forest-wide standards and guidelines that require the maintenance of estuarine and riparian buffers and the raptor standards and guidelines (USDA Forest Service 2008a). Bald eagles are managed by the USFWS under the National Bald and Golden Eagle Protection Act and through the Bald Eagle Take Permit Program (USFWS 2009b).

Red Squirrel

The red squirrel is an important prey species for American marten and goshawk and is a management indicator species because of its preference for cone-producing trees and tree cavities and snags, which they use for denning and nesting (USDA Forest Service 2008b). It is one of only two arboreal rodents in Southeast Alaska. Red squirrels are also a small game species. Red squirrels are abundant on many of the islands in the Alexander Archipelago and the mainland.

Red squirrels use POG forests, but may also use young-growth stands once cone production begins about 40 years after timber harvest (USDA Forest Service 2008a). There are approximately 9.9 million acres of forested land (including all age classes and types of conifer forests) on the Tongass National Forest that provide potential habitat for red squirrels (Table 3.9-2).

Old-growth timber harvest reduces habitat quality for red squirrels through the removal of forest cover and fragmentation of forest habitats. However, recovery of habitat capability after timber harvest is much faster for red squirrels than other species because although post-harvest formation of structures favored for nesting and food storage (cavities) takes longer, the majority of habitat capability (food availability) is restored quickly as cone production typically begins 40 years after harvest. Commercial even-aged young-growth harvest would return stands to an early seral condition so would delay development of habitat capability for red squirrels. Forest Plan Reserve Tree/Cavity-Nesting Habitat and Legacy Forest Structure standards and guidelines maintain habitat for this species (USDA Forest Service 2008a).

Red-breasted Sapsucker, Hairy Woodpecker, and Brown Creeper

The red-breasted sapsucker (*Sphyrapicus ruber*), hairy woodpecker (*Leuconotopicus villosus*), and brown creeper (*Certhia americana*) are old-growth associated and snag dependent species. Hairy woodpeckers and red-breasted sapsuckers are primary cavity excavators that require snags and dying trees for foraging and nesting. Although they may be found in a variety of forested habitats, the brown creeper prefers large diameter old-growth trees (Hejl et al. 2002). Although no historic population estimates exist, it is likely that timber harvest and associated activities have reduced populations from historic levels (Raphael 1988; Hejl et al. 2002). North American Breeding Bird Survey data collected between 2003 and 2013 suggest populations of all three species are increasing within the Northern Pacific Rainforest region, though none of the trends were statistically significant (Sauer et al. 2014).

The hairy woodpecker is an uncommon, permanent resident throughout southeast Alaska. The hairy woodpecker is typically associated with high-volume POG. They generally feed on insects on the surfaces of snags, the dead parts of live trees, and occasionally live trees during the summer. Hairy woodpeckers nest in large dead and live trees.

Red-breasted sapsuckers are the most common primary cavity excavators in southeast Alaska (Suring 1988 as cited in USDA Forest Service 2008b), and provide obligatory habitat for secondary cavity nesters including other birds and northern flying squirrels who are unable to create their own cavities (Wagner 2011). However, red-breasted sapsuckers are weak excavators and therefore require rotted or soft substrates in order to create cavities for nesting and roosting. The red-breasted sapsucker inhabits all of southeast Alaska during spring, summer, and fall but typically winters in the coastal portions of its breeding range. The red-breasted sapsucker is an interior old-growth forest species typically associated with low-volume POG. Nest sites contain a lower volume of trees, trees intermediate in size, increased incidence of fungal infection, and older decay classes of coarse woody debris (Wagner 2011).

Brown creepers are considered uncommon, permanent residents throughout southeast Alaska. They are an interior old-growth forest species and have been shown to abandon sites that have been subjected to even light tree clearing if it includes the removal of large, mature trees (Wiggins 2005).

All three species are associated with interior old-growth forest conditions (Kissling and Garton 2008). In a study of the responses of forest-dwelling birds to varying forested beach buffer widths in southeast Alaska, hairy woodpeckers and brown creepers were absent from forest buffers less than 830 feet wide (250 meters wide), indicating that these species may avoid edge habitats; 83 percent of brown creepers were detected in undisturbed control plots (Kissling 2003; Kissling and Garton 2007). Densities of red-breasted sapsuckers were positively correlated with buffer width, with the greatest densities occurring in buffers at least 1,000 feet wide (300 meters wide; Kissling 2003).

Old-growth timber harvest activities that remove large, live trees and dead or dying trees reduce nesting and foraging habitat for these species (Hejl et al. 2002). Timber harvest may also reduce local habitat quality by creating fragmented forest patches, reducing the amount of interior old-growth forest habitat with which these species are associated. Brown creeper and hairy woodpecker would be most affected by harvest activities that reduce the number of large diameter trees and snags. Commercial thinning activities as well as commercial young growth harvest may result in increased openness, tree "wounding," and slash, creating habitats that could be used by these species for foraging (James 1984; Hagar et al. 1996, 1994). Hagar and Friesen (2009) found that the positive influence of thinning persisted for at least 10 years for some species including the red-breasted sapsucker.

Past timber harvest has reduced and altered the habitat used by the red-breasted sapsucker, hairy woodpecker, and brown creeper. Of the 5.0 million acres of POG forest on the Tongass National Forest, approximately 2.1 million acres are high-volume POG, and 790,000 acres are low-volume POG that provide potential habitat for these species (Table 3.9-3). Maintenance of habitat for these species under the Forest Plan is provided in the reserve tree and legacy standards and guidelines, beach and riparian buffers, and the OGR system (USDA Forest Service 2008a).

Vancouver Canada Goose

The Vancouver Canada goose (*Branta canadensis fulva*) is associated with wetlands (both forested and non-forested) in the estuary, riparian, and upland areas of the Forest (USDA Forest Service 2008b). The Vancouver Canada goose is primarily a non-migratory subspecies of Canada goose that occurs year-round throughout Southeast Alaska, with an estimated resident population of 25,000 birds (Hupp et al. 2010). However, geese do move locally between nesting, brood rearing, molting, and wintering grounds. This species nests in forested habitats associated with beach and estuary buffers, and riparian habitats. Hupp et al. (2010) documented nests in forests adjacent to muskegs. During winter, marine grasses and salt marsh plants commonly found in intertidal areas are important forage resources, and Vancouver Canada geese exhibit strong fidelity, returning repeatedly to such winter sites.

Potential habitats for Vancouver Canada geese are located along the shorelines of lakes as well as in the forested riparian and estuarine areas. There are approximately 1.3 million acres of forested wetlands on the Tongass National Forest (see the *Wetlands* section for additional discussion).

Timber harvest activities may result in disturbance to geese, particularly if they occur in the vicinity of nest sites or brood rearing areas, and habitat removal. However, timber harvest in these areas has generally been minimal because these sites are fairly unproductive. However, modifications to shoreline and riparian habitats can occur in association with young-growth harvest and roads and utility corridors if these habitats are crossed. Protection from direct impact to habitat is provided by Forest Plan Standards and Guidelines for waterfowl and shorebird, wetland, and riparian standards and guidelines; overall goose habitat is provided by the Forest Plan Conservation Strategy (USDA Forest Service 2008a).

Other Species

Migratory Birds

Executive Order 13186 provides for the conservation of migratory birds and their habitats and requires the evaluation of the effects of Federal actions on migratory birds, with an emphasis on species of concern. The Executive Order directs agencies to take certain actions to further comply with the migratory bird conventions, the MBTA, the Bald and Golden Eagle Protection Act, and other pertinent statutes. 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 resources when conducting agency actions.

Birds protected under the MBTA include all common songbirds, waterfowl, shorebirds, hawks, owls, eagles, ravens, crows, native doves and pigeons, swifts, martins, swallows, and others, including their body parts (e.g., feathers, plumes), nests, and eggs. The Tongass National Forest is located in the Northern Pacific Rainforest Bird Conservation Region (BCR 5). The Northern Pacific Rainforest BCR is one of five BCRs designated in Alaska to provide a framework to facilitate coordinated conservation efforts (U.S. NABCI Committee, September 2000; Rich et al. 2004).

Priority migratory bird species identified in the Landbird Conservation Plan (BPIF 1999; Rich et al. 2004) for Southeast Alaska with the potential to occur on the Tongass National Forest are listed in Table 3.10-6. Of these species, 14 use hemlock/spruce/cedar forest (both old-growth and young-growth) as primary habitat for known or probable breeding; the remaining 6 use this forest as secondary habitat. These species include ground-nesting birds (blue grouse), cavity- and bark-nesting birds (woodpeckers, the brown creeper, swallows, forest owls, and wrens), tree- and shrub-nesting birds (flycatchers, warblers, forest raptors, crossbills, thrushes, kinglets, and corvids), and specialized nesters (dippers). Migratory birds are likely to be present in upland forest, riparian, and coastal habitat. There are 5.0 million acres of POG on the Tongass National Forest that provide primary or secondary habitats for these species (note that many of these species are also shrub nesters; Table 3.9-3).

The main management issue for migratory birds in BCR 5 is the harvest of old-growth coniferous forests. Timber harvest directly removes perching, foraging, and nesting habitat and results in habitat fragmentation, which may reduce the suitability of remaining forest for species associated with old-growth interior forest conditions, such as the Pacific-slope flycatcher, varied thrush, golden-crowned kinglet, Townsend's warbler, and brown creeper (BPIF 1999, Kissling 2003; Sperry 2006). Fragmentation may increase the exposure of birds to edge-related predators and parasites, though there remain many unknowns about the effects of fragmentation on landbird populations in Alaska (Robinson 1992; Hoover et al. 1995; BPIF 1999). As the landscape becomes more fragmented, forest buffers become increasingly important for migratory birds to mitigate the effects of habitat loss (Kissling 2003). There is already an existing level of fragmentation on the Tongass, both natural in association with the distribution of forested and non-forested cover types, and in association with past timber harvest and other development activities. Riparian forests are also important for many species, such as the American dipper, western screech owl, western wood-pewee, and Hammond's flycatcher. This habitat has been altered by road construction and other human activities; however, the Forest Plan Conservation Strategy maintains these areas mitigating some of these effects. Timber harvest and related activities may also directly impact migratory birds through disturbances of adults or young through the removal of active bird nests or by causing nest abandonment. Protection under the Forest Plan is provided by beach fringe and riparian buffers and standards and guidelines for waterfowl, shorebirds, raptors, and legacy forest structure.

Table 3.10-6
Migratory and Resident Birds Identified as Species of Concern in Southeast Alaska[1]

Common Name	Scientific Name	General Habitat	Preferred Habitat[2]	Abundance and Occurrence
Sooty Grouse	*Dendragapus fuliginosus*	Habitat affinities vary by season and region. Coastal birds tend to remain in old-growth or recently logged forests all year. Inland birds prefer forest edges in summer, coniferous forests in winter (Kaufman 1996). Found in coniferous and mixed forests in Southeastern Alaska; also in dwarf conifer forests at treeline.	2, 3	Rare; breeding, winter
Western Screech-Owl	*Megascops kennicottii*	Open coniferous and deciduous forests and along rivers, creeks, ponds and bogs. Also forest edges and in suburban areas in parks, orchards and gardens. Often nest near water (Campbell et al. 1990). In southern part of range in mesquite groves and saguaros (Kaufman 1996). Probably non-migratory in Alaska due to sufficient habitat to meet year-round requirements (P. Schempf, pers. commun.). In Yakutat, appears to favor riparian spruce (B. Andres, pers. commun.).	2	Uncommon; breeding, winter
Black Swift	*Cypseloides niger (borealis)*	Appear to be restricted to river valleys with steep unvegetated cliffs. Although nesting has not been confirmed in Southeastern Alaska, summer sightings in adequate habitat suggest Black Swifts are a probable breeder.	5	Rare; breeding
Vaux's Swift	*Chaetura vauxi*	Nests in coniferous and mixed forests, especially old growth. Often observed foraging over lakes, rivers, open country and clearcuts. Many records from Southeastern Alaska are along rivers and estuaries.	2	Uncommon; migration, breeding
Rufous Hummingbird	*Selasphorus rufus*	Found in a variety of habitats throughout breeding range including old growth, young growth, thickets, and shrubby hillsides	2	Common; migration, breeding
Red-Breasted Sapsucker	*Sphyrapicus ruber*	Often associated with mature stands, especially hemlock and/or spruce in Pacific Northwest and Southeastern Alaska, but may not be an obligate old-growth species.	2	Abundant; breeding
Olive-sided Flycatcher	*Contopus cooperi*	In Central Alaska, most often found in open conifer forest. Usually associated with openings (muskegs, meadows, burns, and logged areas) and water (streams, beaver ponds, bogs, and lakes). Apparently requires an uneven canopy or openings for aerial hawking, and wet areas productive of insect prey.	3	Uncommon; breeding
Western Wood-Pewee	*Contopus sordidulus*	In Southeastern Alaska, occurs along large mainland rivers, much less common on islands.	3	Uncommon; breeding
Hammond's Flycatcher	*Empidonax hammondii*	In Southeastern Alaska, found in riparian deciduous forests.	2, 3	Uncommon; breeding
Pacific-slope Flycatcher	*Empidonax difficilis*	Prefers old-growth coniferous forests, especially near streams.	2, 3	Common; breeding
Steller's Jay	*Cyanocitta stelleri*	In Alaska, found predominately in coniferous forests	2	Abundant; breeding, winter

Table 3.10-6 (continued)
Migratory and Resident Birds Identified as Species of Concern in Southeast Alaska[1]

Common Name	Scientific Name	General Habitat	Preferred Habitat[2]	Abundance and Occurrence
Northwestern Crow	*Corvus caurinus*	Coastal beaches, rocky shores, estuaries, coastal ponds and inshore islands.	2, 6, 7, 8	Abundant; breeding, winter
Chestnut-backed Chickadee	*Poecile rufescens*	In Southeastern Alaska, common in mature hemlock/spruce forests and also in pole and sawtimber stages of successional forests	2	Abundant; breeding, winter
American Dipper	*Cinclus mexicanus*	Dippers are a riparian-obligate species and are totally dependent on the productivity of streams and rivers.	4, 5	Fairly common; breeding
Varied Thrush	*Ixoreus naevius*	Found mostly in thick, wet, coniferous forests of the coast.	1, 2, 3	Abundant; migration, breeding, winter
Townsend's Warbler	*Dendroica townsendi*	Largely restricted to mature forests with tall coniferous trees throughout its breeding range. Most abundant in large undisturbed tracts of contiguous forest, but will also use forests in late successional stages.	2, 3	Common; breeding
Blackpoll Warbler	*Dendroica striata*	Habitat preference variable, but usually found in tall shrubs (riparian woodland) or in coniferous or deciduous forest or woodland	2	Rare; migration
MacGillivray's Warbler	*Oporornis tolmiei*	In southeastern Alaska, it is found in shrubs along hemlock/spruce edges, deciduous woodlands with shrubs, clearcuts, and riparian shrubs.	1	Uncommon; breeding
Golden-crowned Sparrow	*Regulus satrapa*	Prefers low to tall alder and willow scrub on hillsides and near tundra. Commonly found in proximity to lakes, streams, and bogs. In winter prefers uninterrupted brushland, streamside thickets, and chaparral.	1	Fairly common; breeding, winter
Golden-crowned kinglet	*Zonotrichia atricapilla*	Found in coniferous forests (spruce, fir, and hemlock) all times of year; also in mixed forests in south coastal and central Alaska. In winter and migration, can be found in other trees and shrubs.	1, 3	Common; breeding, winter

[1] Source: Boreal Partners in Flight Landbird Conservation Plan for Alaska Biogeographic Regions (1999)
[2] 1=shrub thicket; 2=hemlock/Sitka spruce/cedar forest; 3=mixed deciduous/spruce woodland; 4=fluvial waters; 5=cliffs, bluffs, and screes; 6=moraines, alluvia, and barrier islands; 7=beaches and tidal flats; 8=rocky shores and reefs.

Bats

There are seven species of bats that are known to occur in Alaska (Parker et al. 1997, Olson et al. 2014). Little is known about the distribution, migration, habitat associations, and population status of these species (Loeb et al. 2014; Boland et al. 2009). ADF&G has established a network of year-round acoustic monitoring stations across Southeast Alaska to learn more about their seasonal activity patterns across the region. Of the bat species that occur in Southeast Alaska, the little brown bat (*Myotis lucifugus*) is the most common and wide spread. Others include the silver-haired bat (*Lasionycteris noctivagans*), Keen's myotis (*M. keenii)*, California myotis (*M. californicus*), the long-legged myotis (*M. californicus*), Yuma myotis (*M. yumanensis*), and the big brown bat (*Eptesicus fuscus*). All species are associated with mature forested habitats which provide roosting, breeding, and foraging sites, and bat activity appears rare, for most species, in second-growth forest (Tessler et al. 2014; Walton et al. 2013a-e; Parker et al. 1996). Tree-roosting species, such as the Keen's myotis and silver-haired bat often roost in mature forest patches with large numbers of suitable cavity trees. Other species, such as the little brown bat, roost in caves associated with the karst system. Foraging activities vary depending on vegetation density, and studies have found higher foraging activity from bats in intact forest patches and along the patch edges, with less activity in clear-cut areas (Patriquin and Barclay 2003). Throughout its range, the little brown bat has undergone dramatic declines due to white-nose syndrome (a fungal infection that affects bats while in hibernation), and is of particular management interest as white-nose syndrome has not yet been detected in Alaska. Bats are generally relatively rare in Alaska and reproductive rates for bats in higher latitudes are generally lower than farther south. These factors may make these species more susceptible to habitat loss and other factors, however further research is needed to better understand current bat populations and how they respond to habitat loss and other factors (Boland et al. 2009). Timber harvest, particularly even-aged harvest, has the potential to remove roosting and foraging habitat for bats.

Marbled Murrelet

In March 2006, a status review for the marbled murrelet was initiated by the USFWS for the northern part of the species range to support ESA deliberations over the listing of the species as threatened in the southern part of its range (California, Oregon, and Washington; Piatt et al. 2007). Genetic analysis conducted as part of the review identified three distinct population segments: one in the central and western Aleutian Islands; one ranging from the eastern Aleutians to northern California; and one in central California.

Marbled murrelets are widely distributed across marine waters in Southeast Alaska. They spend the majority of their lives at sea, but travel inland up to 50 miles to nest in old-growth forest stands (Piatt et al. 2007). Marbled murrelets typically nest on mossy-limbed branches of large, mature coniferous trees within stands of structurally complex, coastal high-volume old-growth forest (DeGange 1996; Kuletz et al. 1995; Ralph and Miller 1995). However, on some treeless islands in Southeast Alaska marbled murrelets lay eggs on bare talus slopes in mountainous areas (Piatt et al. 2007).

Timber harvest, through the removal of POG forest, can directly remove nest trees, and also increases habitat fragmentation and associated edge effects, such as increased rates of nest predation (Andren 1994; Chalfoun et al. 2002). Some avian predators of murrelets, especially corvids (i.e., ravens, crows, jays), are known to increase both with forest fragmentation and proximity to human activity (Burger 2002). In a study of the edge effects and nest predation risk on marbled murrelets, Malt and Lank (2007) found that disturbances by avian predators at nests were significantly more frequent at hard edges (clearcuts) relative to interiors, but less frequent at soft edges (regenerating forest); there were no edge effects at natural-edged (riparian) sites. Thus, edge-associated predation risk may subside with the progression of forest succession. Forest Plan standards and guidelines pertaining to marbled murrelets include maintaining a 600-foot radius no-cut buffer zone around identified murrelet nests (Forest Service 2008a).

Amphibians

There are eight species of amphibians known to occur in Southeast Alaska; two of which, the Pacific chorus frog *(Pseudacris regilla)* and the red-legged frog *(Rana Aurora),* are introduced (MacDonald and Cook 2007). Native species include the western toad (*Bufo boreas*), wood frog (*Rana sylvatica*), Columbia spotted frog (*Rana luteiventris*), rough-skinned newt (*Taricha granulosa*), long-toed salamander (*Ambystoma macrodactylum*), and northwestern salamander

(*Ambystoma gracile*). Within Alaska, most of these species are confined to the southeast, with the exception of the western toad which ranges as far north as Prince William Sound (MacDonald and Cook 2007), and the wood frog, which is widespread throughout Alaska, and persists north of the arctic circle (Lee-Yaw et al. 2008). Amphibians have specific requirements for both aquatic and terrestrial habitats in order to complete their life-cycle. This makes them useful indicator taxa of forest change and effects on habitat elements such as canopy shade, soil moisture, and coarse woody material. All factors that can be critical for maintaining populations within a forest stand (Olsen et al. 2014; Semlitch et al. 2009; Bunnel et al. 1999). Clearing of trees can result in increased solar radiation to the forest floor, resulting in changes in moisture and soil temperatures; these effects can be reduced using selective thinning (Verschuyl et al. 2011). Amphibians are often vulnerable to road construction and increased road traffic as many species migrate from streams and other waterbodies to upland habitats. This often involves crossing of roads, and amphibians are often slow moving and behaviorally susceptible to vehicular mortalities (Trombulak and Frissel 2000). In addition, contaminants from roads, run-off and habitat changes (such as changes in hydrology and drier soils along the edge of the road) from construction can have deleterious effects on amphibian physiology and behavior, such as changes in migration (Jochimsen et al. 2004; Reeves et al. 2010). Climate change has the potential to disproportionately affect amphibians due to their limited range sizes, dependence on both moist terrestrial and aquatic habitats, and ectothermic physiology (affecting larval development, oxygen availability in water, resistance to diseases and parasites, and general physiology) (Wake and Vredenburg 2008).

Endemism

The USFWS defines endemic as “a species native and confined to a certain region; having comparatively restricted distribution” (http://www.fws.gov/endangered/about/glossary.html). The 2008 Forest Plan standards and guidelines for endemic mammals direct the Forest to “maintain habitat to support viable populations and improve knowledge of habitat relationships of rare or endemic terrestrial mammals that may represent unique populations with restricted ranges.” Likewise, the NFMA directs that management prescriptions “shall preserve and enhance the diversity of plant and animal communities, including endemic(s).”

Due to its archipelago geography and highly dynamic glacial history, southeast Alaska has been found to be a region with an especially high degree of endemism (Demboski et al. 1998). Approximately 20 percent of the small mammal taxa (species and subspecies) known to occur in Southeast Alaska are endemic to an island or a group of islands (Dawson et al. 2007). There remain many uncertainties about the extent of endemism in Southeast Alaska because research to date has primarily focused on mammals, thus the level of endemism in other organisms such as plants, birds, amphibians, and invertebrates is largely unknown. Centers of endemism (areas with the presence of a high number of endemic species) have been identified in Southeast Alaska which are thought to have been refugia during the last glacial event (Cook et al. 2001, 2006). Some of these locations coincide with areas that have also experienced high levels of timber harvest and which may be ready for YG harvest.

Due to their restricted ranges, specific habitat requirements, and sensitivity to human activity, insular endemic species (i.e., those restricted to islands or groups of islands) are highly susceptible to extirpation and eventually extinction (Soule 1983; Reid and Miller 1989; Burkey 1995). Species tied to island archipelagos are more sensitive to the effects of introduced non-natives, including pathogens and disease, and natural events, such as climate change, than other managed landscapes due to their limited mobility and isolation from other subpopulations

(Cook et al. 2006). The 2008 Forest Plan FEIS (USDA Forest Service 2008b) provides a detailed discussion on endemism and its implications on the Tongass National Forest.

There are 24 known endemic wildlife species (mammals and birds) on the Tongass National Forest (Table 3.10-7; ISLES 2013). The Alaska Natural Heritage Program (ANHP) is currently working on compiling a list of endemic species for Alaska and associated range maps. This information will be incorporated into the EIS if it becomes available. Two of the more well-studied species, the Prince of Wales flying squirrel and Prince of Wales spruce grouse, are endemic to portions of the Tongass National Forest where much of the past timber harvest has been concentrated and are described in more detail below. Other species such as the Coronation Island long-tailed vole, Admiralty Island ermine and vole, and the Warren Island red-backed vole occur where little to no past harvest has occurred. The Alexander Archipelago wolf and Alexander Archipelago black bear are also thought to be endemic taxa and are described above.

Table 3.10-7
Endemic Wildlife Species Documented on the Tongass National Forest

Species	Known Distribution
Prince of Wales spruce grouse (*Falcipennis canadensis isleibi*)	Prince of Wales Island and nearby island including Heceta, Suemez, Warren, Kosciusko, Zarembo, and Mitkof
Admiralty Island beaver (*Castor canadensis phaeus*)	Admiralty Island
Prince of Wales flying squirrel (*Glaucomys sabrinus griseifrons*)	Prince of Wales Archipelago
Pacific marten (*Martes caurina*)	In Southeast Alaska, restricted to Admiralty and Kuiu islands
Coronation Island long-tailed vole (*Microtus longicaudus coronarius*)	Coronation, Warren, and Forrester islands
Sitka root vole (*Microtus oeconomus sitkensis*)	Baranof and Chichagof islands complex
Admiralty Island meadow vole (*Microtus pennsylvanicus admiraltiae*)	Admiralty Island
Baranof Island ermine (*Mustela ermine initis*)	Baranof and Chichagof islands
Admiralty Island ermine (*Mustela erminea salva*)	Admiralty Island
Revillagigedo Island red-backed vole (*Myodes gapperi solus*)	Revillagigedo Island
Warren Island red-backed vole (*Myodes gapperi wrangeli*)	Wrangell and Sergief islands
Keen's myotis (*Myotis keenii*)	Records from Juneau south
Alexander Archipelago mink (*Neovison vison nesolestes*)	Admiralty Island
Forrester Island deermouse (*Peromyscus keeni oceanicus*)	Forrester Island
Sitka deermouse (*Peromyscus keeni sitkensis*)	Baranof, Chichagof, Warren, Coronation, and Duke islands
Insular dusky shrew (*Sorex monticolus elassodon*)	Alexander Archipelago and Haida Gwaii
Warren Island dusky shrew (*Sorex monticolus malitiosus*)	Warren Island
Alexander Archipelago black bear (*Ursus americanus pugnax*)	Throughout Southeast Alaska, except Admiralty, Baranof, and Chichagoff islands

Table 3.10-7 (continued)
Endemic Wildlife Species Documented on the Tongass National Forest

Species	Known Distribution
"Glacier bear" (*Ursus americanus emmonsii*)	Yakutat/Glacier Bay region
Yakutat brown bear (*Ursus arctos dallli*)	North mainland from Yakutat to Glacier Bay
Sitka brown bear (*Ursus arctos sitkensis*)	Alexander Archipelago and northern mainland

Source: ISLES 2013

Old-growth timber harvest has the potential to remove habitat used by some endemic species, such as snags and hollow trees used by the Keen's myotis and the Prince of Wales flying squirrel, but may also create habitat for some species e.g., regenerating forest stands for spruce grouse. Fragmentation of habitat patches could limit the ability of some species, e.g., flying squirrels, to disperse between areas of suitable habitat. In addition, for those species that are hunted, roads have the potential to increase hunter access and thus may increase harvest rates along the road system and the areas that these roads access (note that there are no known road thresholds relative to road density for these species).

Prince of Wales Flying Squirrel

The Prince of Wales flying squirrel is endemic to the Prince of Wales Island complex (Demboski et al. 1998; Smith 2005). The flying squirrel plays an important role in the dynamics of coniferous forest ecosystems (Carey 2000a) because it, along with other animals, disperses ectomycorrhizal fungi (Maser and Maser 1988), a food source that is lacking in young-growth forest (Flaherty et al. 2008). Due to its close association with old-growth forest structure and processes and because of its specific habitat requirements for efficient movement, some authors have expressed concern about the long-term viability of this species because much of its range overlaps areas that have been affected by old-growth timber harvest (Carey 2000a; Scheibe et al. 2006; Shanley et al. 2013).

Prince of Wales flying squirrels are associated with POG forest and den sites are typically located in areas with lower levels of fragmentation than elsewhere on the landscape (Pyare et al. 2010). The Prince of Wales flying squirrel is capable of crossing open areas such as meadows or riparian zones; however, this subspecies has a limited gliding range (approximately 250 feet), a distance substantially less than the average clearcut width (Flaherty et al. 2008). Recent research also indicates that the Prince of Wales flying squirrel relies on its sense of smell, hearing, and vision for movement. These movements are limited in clearcuts and young-growth forests; Flaherty et al. 2008). Flaherty et al. (2008) speculated that Prince of Wales flying squirrels are unlikely to venture beyond their perceptual (i.e., smell, hearing, and vision abilities) ranges, and thus may become isolated by large clearings (i.e., those that exceed 250 feet). Thus, successful dispersal of the species depends on the functional connectivity of the landscape (Smith et al. 2005).

Under the Forest Plan Conservation Strategy, the system of small OGRs was designed to provide for the distribution of flying squirrels in every major watershed and facilitate functional connectivity between larger reserves (USDA Forest Service 1997a). However, some biologists suggest that many reserves on Prince of Wales Island may be too small or spaced too far apart to support populations of Prince of Wales flying squirrels over the long term or maintain functional connectivity to support a back-and-forth exchange between flying squirrel populations (Pyare and Smith 2005; Smith et al. 2011). In addition to the system of OGRs, connectivity between reserves for flying squirrels is also provided by the legacy forest structure, stream, estuary, lake, and beach buffer standards and guidelines. These features represent significant structural elements providing functional connectivity among landscape elements.

Prince of Wales Spruce Grouse

The Prince of Wales spruce grouse (spruce grouse) is a subspecies endemic to Prince of Wales and nearby islands in southern Southeast Alaska. The spruce grouse is associated with muskegs, high-volume POG, and mixed conifer (scrub) habitats but will also use young-growth forest (15-30 years following timber harvest) with a well-developed middle story; they avoid clearcuts (Russell 1999). Though they are closely associated with conifer forests, the highest densities of spruce grouse are supported by areas with a mosaic of older coniferous habitats interspersed with regenerating patches of dense trees. Spruce grouse are poor long-distance flyers and are generally sedentary, with some limited migratory movement (typically less than a mile; Dickerman and Gustafson 1996) between summer and winter habitats (Boag and Schroeder 1992; Williamson et al. 2008).

Spruce grouse are an important prey species for goshawks and marten. Forest birds, including spruce grouse, comprised a larger proportion of goshawk diets during the breeding season on Prince of Wales Island than elsewhere in Southeast Alaska (Lewis et al. 2006). Thus, impacts to spruce grouse could also impact goshawk and marten populations. Spruce grouse are managed as a game species by ADF&G.

Timber harvest and associated fragmentation may lead to population declines if open areas are too large or forested patches are spread too far apart to enable spruce grouse to move between them (greater than 1 mile). Clearcuts may also present a dispersal barrier to this species due to the thick logging debris often present which could inhibit walking, this species preferred method of movement (Russell 1999).

Spruce grouse are a small game species that are particularly vulnerable to hunting along road systems, and thus are susceptible to overexploitation near roads and human populations (Williamson et al. 2008; Rabe 2009). Existing total road densities are provided in Table 3.10-4. The current season for grouse is August 1 through May 15 with a bag limit of five per day in GMU 2 (ADF&G 2015d). The Forest Plan Conservation Strategy maintains connectivity within matrix lands that will help facilitate dispersal and interchange between spruce grouse populations.

Invasive Species

Species are considered invasive if they are not native to an ecosystem, and are likely to cause harm to human health, the economy, or the environment (Executive Order 13112). Due to its remote landscape and climate, Alaska has relatively few invasive species compared to the rest of the United States. However, factors such as altered disturbance patterns, climate change, and the expansion of the transportation network in Alaska are expected to increase the prevalence of invasive species. Global climate change also creates conditions suitable for new invasive by altering geographic range limits and by making habitats no longer suitable for native species.

Invasive species can affect native species by preying on them, competing with them, hybridizing with them, disrupting or destroying their habitat, or introducing pathogens or parasites that sicken or kill them. At least eight terrestrial species have been introduced into coastal Alaska habitats: Norway rat (*Rattus norvegicus*), European black slug (*Arion atter*), garden slug (*Arion* spp.), leopard slug (*Limax maximus*), elk (*Cervus elaphus*), house mouse (*Mus musculus*), starling (*Sturnus vulgaris*), and rock dove (*Columba livia*). Raccoons and snowshoe hares have also been introduced; however, due to their small population size and limited distribution, these species are not currently considered a threat to coastal Alaska ecosystems (Schrader and Hennon 2005). At this time, only rats are considered to be causing substantial ecological harm in coastal ecosystems and thus invasive, though there is concern about the expanding elk population (Schrader and Hennon 2005). With the exception of elk, which were introduced intentionally as part of a collaborative effort between ADF&G and the USDA Forest Service and are a desired non-native in some areas, all other species were unintentionally introduced.

Norway rats likely became established along the Alaska coast following shipwrecks of early European explorers and now occur in areas of human habitation and along coastal islands where food supplies are abundant (Schrader and Hennon 2005). The primary concern with this species is the adverse effects it may have on ground-nesting birds, as evidenced by rat populations on the Aleutian and Queen Charlotte Islands that prey on bird nests and have substantially impacted breeding bird colonies.

Elk were introduced to Alaska to develop additional hunting opportunities. As recently as 1987, ADF&G introduced elk on Etolin Island. Since then, elk have spread to other islands and areas in the Southeast. A population occurs on Zarembo Island, and there have been reports of elk on other nearby islands including Onslow, Wrangel, Mitkof, Kupreanof, Kashevaroff, Prince of Wales, Brushy, Shrubby, and Farm islands. They have also been spotted on the mainland as far north as Cape Fanshaw, and one of the original transplanted and radio-collared elk was located at the mouth of the Stikine River (J. Brainard, retired USDA Forest Service biologist, Petersburg District, personal communication). Elk are considered a desired non-native species on Etolin and Zarembo islands, but there are still many unknowns about their presence and potential ecological effects elsewhere. The ADF&G Division of Wildlife Conservation has prepared a draft elk management plan for Southeast Alaska to manage and better understand the elk population and its potential effect on native plants and animals (ADF&G 1999). The main concern is competition with native Sitka black-tailed deer due to the high degree of dietary overlap of the two species (ADF&G 1999). This is primarily an issue on deer winter range, where deer are most limited by resource availability. Elk may reduce the available winter forage for deer through browsing, physically displace deer, alter predator-prey dynamics, and directly compete for food. The degree of dietary overlap between the species is the highest reported in the literature, indicating a high potential for direct competition (Kirchhoff and Larsen 1998). Pellet-count surveys on Etolin Island between 1991 and 1998 documented a doubling of the elk population while deer population declined by 56 percent (ADF&G 1999). An associated issue is that a decline in deer numbers could lead to fewer deer hunting opportunities. One recommendation for managing the elk population outside Etolin and Zarembo islands is to increase harvest pressure on elk.

There are also two invasive aquatic amphibian species that are present in coastal Alaska. The red-legged frog (*Rana aurora*), which is native to the Pacific Northwest, has established populations in several drainages on Chichagof Island and the Juneau area and recent surveys suggest that its range is expanding (MacDonald 2003). Effects of this species are currently unknown but potentially include the displacement of the endemic boreal toad (*Bufo borealis*) and wood frogs (*Rana sylvatica*) (MacDonald 2003). The Pacific chorus frog (*Pseudacris regilla*) has an established breeding population on Revillagigedo Island (MacDonald 2003). Currently, this population is thought to be having little effect on native amphibian species, as boreal toads and rough-skinned newts (*Taricha granulose*) have successfully reproduced in the same pond complex (Schrader and Hennon 2005).

Environmental Consequences

This section describes effects to wildlife resources in the planning area. The NFMA, as interpreted in the context of the Tongass Forest Plan Conservation Strategy, directs the Forest to manage wildlife habitat to maintain viable and well distributed populations to ensure continued existence in the planning area. Quantitative criteria for viability are not specified by the NFMA or associated regulations. For this analysis, the evaluation of viability includes considerations of the island archipelago environment as well as the best available science related to each species.

This section begins with an analysis of effects to the overall Tongass Conservation Strategy, which is addressed in detail in Appendix D to this EIS. The use of the word "wildlife" occurs frequently in this discussion without referencing a particular species because the intent is to consider each of the contributing elements of the conservation strategy and their ability to function as intended with respect to old-growth associated species under the alternatives. Following this discussion, impacts to individual species are addressed.

Direct and Indirect Effects

Old-growth Conservation Strategy

The Tongass Conservation Strategy was designed to maintain well-distributed, viable wildlife populations across the Forest in the context of past and anticipated old-growth timber harvest. Since 1997 timber harvest rates have been far below those assumed in the 1997 Forest Plan FEIS and 2008 Forest Plan Amendment FEIS (USDA Forest Service 1997a, 2008a). The transition from old-growth harvest to young-growth harvest under Alternatives 2, 3, 4, and 5 would further reduce old-growth harvest levels, with the greatest amounts of POG maintained under Alternative 2, followed by Alternatives 3, 5, 4, and 1. Tables 3.10-8 and 3.10-9 present the amount of POG forest and young-growth forest protected and scheduled for timber harvest under each of the alternatives. Ultimately, all of the action alternatives would enhance the Conservation Strategy as a whole over the long term compared to the current Forest Plan by reducing POG harvest and thus maintaining habitat for old growth-associated or -dependent wildlife species. The total area and spatial distribution of POG forest on the landscape in the planning area are the foundation of the conservation strategy.

Table 3.10-8
Productive Old-Growth Acreage in Reserves, Protected/Unscheduled in the Matrix, and Scheduled for Timber Harvest over 100 years (NFS lands only)

Alternative	POG in Reserves	POG in Matrix – Protected or Unscheduled: Protected by Beach Fringe, Riparian, & Other Standards and Guidelines	POG in Matrix – Protected or Unscheduled: Suitable, But Not Scheduled for Harvest[1]	Total Protected POG	Total POG Scheduled for Harvest[2]
1	3,638,141	1,035,499	265,764	4,939,404	**62,851**
2	3,645,766	1,007,109	316,771	4,969,646	**32,609**
3	3,645,766	839,922	480,999	4,966,687	**35,568**
4	3,645,766	1,087,353	226,539	4,959,658	**42,597**
5	3,645,766	1,127,428	186,581	4,959,775	**42,479**

[1] Productive old growth (POG) that is suitable, but is not estimated to be needed to achieve the old-gro portion of PTSQ over the next 100 years.
[2] Represents the POG that would be harvested assuming harvest takes place at the full estimated rate 100 years.

Table 3.10-9
Young-Growth Acreage in Reserves, Protected/Unscheduled in the Matrix, and Scheduled for Timber Harvest over 100 Years (NFS Lands Only)

Alternative	Protected YG in Reserves	YG in Matrix – Protected or Unscheduled: Protected by Beach Fringe, Riparian, & Other Standards and Guidelines	YG in Matrix – Protected or Unscheduled: Suitable, But Not Scheduled for Harvest[1]	Total Protected YG	Total YG Scheduled for Harvest[2]
1	103,091	94,129	54,022	251,242	**209,882**
2	53,515	32,895	39,370	125,780	**335,343**
3	56,557	54,695	36,656	147,908	**313,216**
4	104,586	92,828	28,825	226,239	**234,885**
5	69,049	53,102	54,829	176,980	**284,144**

[1] Young growth that is suitable, but is not estimated to be needed to achieve the young-growth portion c PTSQ over the next 100 years.
[2] Represents the young growth that would be harvested assuming harvest takes place at the full estima rate over 100 years.

However, the alternatives differ in terms of how aggressively they approach the transition, and thus their effects on wildlife, by allowing young-growth harvest in OGRs, non-development LUDs, the beach and estuary fringe, and/or RMAs, all of which are contributing elements of the Forest Plan Conservation Strategy (see Table 3.9-11 in the *Biodiversity* section for a summary). The consequences of the differences in approach are two-fold. They influence the total area of old-growth forest harvested in the future and they influence the extent of harvest of young-growth in OGRs, non-development LUDs, the beach and estuary fringe, and/or RMAs. Appendix F provides a detailed comparison of Forest Plan direction proposed under each alternative. These contributing elements of the

Conservation Strategy (the overall extent of old-growth and integrity of OGRs, non-development LUDs, the beach and estuary fringe, and/or RMAs) maintain wildlife habitat and provide connectivity across the landscape. Thus, young-growth timber harvest proposed in these areas has the potential to affect the integrity of the Conservation Strategy. The Conservation Strategy is addressed specifically in Appendix D.

Alternatives that would allow young-growth harvest in the Old-growth Habitat LUD (Alternatives 2, 3, and 5; Table 3.9-11) and other non-development LUDs (Alternatives 2 and 3) would delay the amount of young-growth allowed to mature to old-growth conditions by maintaining them in a managed state at least over the short term. Alternative 5 is intended to emulate the natural scale and distribution of disturbance patterns on the landscape, and over the long term would promote the development of old-growth characteristics in harvested young-growth stands in Old-growth Habitat LUD, RMA, and beach fringe. This is because Alternative 5 limits the size of created openings to 10 acres, includes stand retention limits (maximum removal of 35 percent of original harvest stand acres, and includes a one-time entry stipulation (i.e., young-growth stands would only be harvested once) in these areas. After harvest, young-growth stands would be allowed to return old-growth conditions. In contrast, under Alternatives 2 and 3 the size of created openings is limited only by Scenery standards and multiple entries into stands are allowed in all non-development LUDs. Some wildlife species would benefit in the short term from increased forage availability associated with growth of vegetation following young-growth timber harvest (e.g., deer and bears) under Alternatives 2 and 3; however, the nutritional value of forage in clearcuts may be reduced due to the greater amount of tannins compared to forage in old-growth which reduces the amount of digestible protein (Happe et al. 1990); however, harvested stands would not develop the characteristics of POG forest such as snags, downed logs, diverse tree canopy layers that most POG-associated species (e.g., marten, goshawks, flying squirrels) prefer if reentered multiple times. Alternative 2 would harvest the most young-growth in the Old-growth Habitat LUD and other non-development LUDs (45,684 acres), followed by Alternatives 3 (41,671 acres) and 5 (1,796 acres); no harvest, except potentially salvage and personal use and habitat restoration projects, would occur in any non-development LUDs under Alternatives 1 and 4.

Young-growth stands within the beach and estuary fringe and RMAs provide lower value to wildlife than old-growth stands; however, they can provide structural connectivity for movement and dispersal of some wildlife and serve as buffers between areas of suitable habitat and human activity. Alternatives 2, 3, 4, and 5 would allow young-growth harvest within the beach and estuary fringe; Alternatives 2 and 5 would also allow young-growth harvest within RMAs. Young-growth harvest may decrease buffer width in some places, potentially reducing the effectiveness for wildlife species that are negatively affected by edge. Additionally, alternatives that allow even-aged management in the beach and estuary fringe (Alternative 2 and 5) and RMAs (Alternative 5) may increase habitat perforation and limit movements of some wildlife if openings are too large to be crossed by species with limited dispersal capabilities and snow interception is decreased in the openings. Commercial thinning in these areas, which could occur under all of the action alternatives, have the potential to improve wildlife habitat quality over time by promoting the development of fewer, larger trees in thinned stands and increasing forage availability (Hanley et al. 2005). Although research has shown that the removal of commercial-sized trees can promote tree growth and understory vegetation development, there remains some uncertainty about the effectiveness of young-growth treatments in benefiting wildlife. Thus, the discussion of commercial thinning and its benefits here and below should be interpreted in the context of the remaining uncertainty associated with its benefits to wildlife. Additionally, young-growth harvest in these areas has the potential to disturb species such as river otters, black bears, bald eagles and migratory bird that use riparian and estuarine areas.

Alternative 3 would harvest the most young growth in the beach and estuary fringe (41,489 acres), followed by Alternatives 2 (30,892 acres), 4 (14,865 acres), and 5 (3,546 acres); no harvest in the beach and estuary fringe would occur under Alternative 1 (Table 3.9-11). Alternatives 2 and 5 incorporate measures to maintain wildlife habitat and connectivity in the beach and estuary fringe through maintenance of a 1,000-foot-wide corridor adjacent to even-aged harvest units (i.e., effectively shifting the beach and estuary buffer inland; Alternative 2) and maintenance of a 200-foot-wide buffer from the shoreline (Alternative 5) which could provide some continued connectivity and reduce the impacts of commercial young growth harvest. Effects would be further reduced under Alternative 5, which limits clearcutting to the first 15 years after plan approval, limits the size of created openings to 10 acres, and includes a one-time entry stipulation (i.e., young-growth stands would only be harvested once). Alternative 2 is less conservative in that the size of created openings is limited only by Scenery standards and multiple entries into harvested young-growth stands would be allowed; however even-aged harvest would be limited to the first 15 years after plan approval (commercial thinning would be allowed thereafter). Commercial thinning would be allowed under Alternatives 3 and 4, but would occur through the life of the Forest Plan.

Alternative 2 would harvest the most young-growth in RMAs (36,092 acres), followed by Alternative 5 (882 acres); no harvest in RMAs would occur under Alternatives 1, 3, and 4 (Table 3.9-11). Effects to wildlife habitat and connectivity would be minimized under Alternative 5 by limiting timber harvest to the first 15 years after plan approval, limiting the size of created openings to 10 acres, and including a one-time entry stipulation (i.e., young-growth stands would only be harvested once). Commercial thinning would be allowed under Alternative 2, but would occur through the life of the Forest Plan.

Alternatives 2, 3, and 5 would also lower the Scenic Integrity Objective (SIO) standard for young-growth stands, which would allow the removal of more trees from these stands. This would reduce the amount of trees retained that could provide habitat for wildlife.

Under Alternatives 2, 3, 4, and 5, young-growth harvest in the beach and estuary fringe and RMAs, as well as the reduction in SIOs, would result in long-term, minor, localized reductions in habitat for wildlife. Effects would last for decades in association with even-aged harvest, as treatments would effectively restart the forest successional process in harvested units, taking decades to return to their current state, and likewise the potential beneficial effects of thinning would occur over decades as stand development toward old-growth conditions is promoted. Protective corridors and other limitations on harvest would maintain wildlife habitat and connectivity in these areas over the long term. Additionally, over the long term, young-growth management would accelerate the development of old-growth characteristics in these areas.

Although IRAs were not part of the original 1997 Conservation Strategy, they add value by providing large expanses of roadless refugia, which are important to wide-ranging wildlife species such as wolves, brown bears, marten, and less mobile species such as flying squirrels and amphibians. Under Alternative 2, no harvest would occur in IRAs that have not been roaded; however, the portions of IRAs that were roaded before the 2001 Roadless Rule and during the 2001

Roadless Rule exemption period for the Tongass would be available for young-growth and old-growth harvest after rulemaking. Alternative 3 would permit old-growth and young-growth harvest in 2001 Roadless Areas, but only if the Roadless Rule changed or the Tongass Roadless Rule Exemption were reinstated. No harvest in Roadless Areas would occur under Alternatives 1, 4, and 5 (Table 3.9-11). Timber harvest in these areas and associated road construction or reconstruction has the potential to decrease the value of these roadless areas to wildlife through increased habitat fragmentation and reduce landscape connectivity. Additionally, species that are vulnerable to overharvest (e.g., wolf, marten, and spruce grouse) would be affected by potential increased hunter access along new or reconstructed roads, whether for young-growth harvest or renewable energy projects. (Note that new roads would only occur in currently roaded areas where reconstruction is not feasible and that in unroaded areas helicopters would be used to extract logs; see the *Transportation* section of this EIS for additional discussion on roads.)

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance. The land conveyance removed portions of OGRs, decreasing the amount of wildlife habitats (e.g., POG forest, streams, and low elevation forest) within the reserve system. An interagency team reviewed these affected OGRs and proposed modified locations to meet Appendix K criteria for OGRs (see the *Biodiversity* section and Appendix E for additional discussion of the Biologically Preferred OGR locations proposed by the Interagency Review Team). The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in the following net changes within the reserve system:

- Net increase in 6,171 acres of OGR;
- Net increase of 7,148 acres of POG forest;
- Net increase of 31 stream miles;
- Net increase of 3,066 acres of rare/underrepresented features (large tree POG);
- Net increase of 3,648 acres of deep snow deer and marten habitat (high-volume POG below 800 feet elevation);
- Net increase of 4,466 acres of goshawk and murrelet nesting habitat (high-volume POG); and
- Net increase of 6,696 acres of low-elevation POG (indicative of important areas of landscape connectivity).

These OGR modifications would result in greater protection of wildlife habitats and connectivity under the Conservation Strategy, than would occur as a result of the land conveyance without these changes. These OGR modifications would also result in a net increase in road miles (9 miles) and early seral habitat (2,408 acres) included in the reserve system relative to post-conveyance OGRs, but these areas are distributed across the forest and were a tradeoff made in the interest of selecting the only available areas to add to the reserve system or increasing connectivity or inclusion of ecologically important features within the reserve system.

Species-specific Effects

The following sections describe impacts to threatened and endangered species, former MIS, Alaska Region sensitive species, migratory birds, endemic species, and invasive species.

Threatened, Endangered, and Candidate Species

Impacts from the Proposed Action to Threatened and Endangered species potentially occurring within the boundary of the Tongass are addressed in the BA, which is included in the planning record. All alternatives would require adherence to the MMPA, ESA, and NMFS guidelines for approaching sea lions and other marine mammals. The amount of human activity in the marine environment associated with Forest management activities is only a fraction of the total amount of human activity occurring in the marine environment. Some of the other activities include commercial fishing, sport fishing, hunting, subsistence, tourism, and mariculture. Many of these activities are not regulated by the Forest Service. The effect of such recreational activity on marine mammals would depend on many factors such as size of the bay, depth of the waters in the bay, number of boats, individual behavior responses to disturbance. At the present time, there is not a quantifiable way to estimate these possible effects. Forest-wide standards and guidelines that have been developed for application on all Forest Service permitted or approved activities to minimize or eliminate adverse impacts on marine mammals.

Humpback Whale, Fin Whale, Sperm Whale, and Steller Sea Lion Western DPS

These species could be exposed to disturbance and noise associated with LTF activity, potential collisions with vessels, and fuel or oil spills associated with vessel traffic particularly if these activities occur in the vicinity of nearshore areas used by whales and major haul-outs or rookeries used by sea lions. Harassment or displacement of whales and Steller sea lions from preferred habitats by human activities such as boating, recreation, aircraft, log transfer facilities, and log raft towing, was identified as a concern with regard to long-term conservation in the Biological Assessment conducted for the 2008 Forest Plan Amendment (USDA Forest Service 2008b). Exposure of whales and Steller sea lions to these impacts would be unchanged under all of the alternatives because a much greater volume of old-growth timber harvest was assumed to occur compared to the actual amount (see Appendix D); therefore, any of these nearshore activities associated with proposed young-growth timber harvest have been accounted for no increases in these uses are anticipated under this Amendment. All alternatives would require adherence to the MMPA, ESA, and NMFS guidelines for approaching sea lions and other marine mammals, as currently required under the Forest Plan. Young-growth timber harvest within the beach fringe, and potentially removal of timber for renewable energy development in these areas, has the potential to result in very localized, minor, temporary reductions in water quality to which whales and Steller sea lions could be exposed. For these reasons, the Forest Plan Amendment (all alternatives considered) may affect, but is not likely to adversely affect whales and Steller sea lions.

Short-tailed albatross

Short-tailed albatross occur in nearshore areas along the outer coast. Short-tailed albatross could be affected by reduced marine water quality due to activities in the nearshore environment, including LTF use, log raft towing, vessel traffic, and timber harvest within the beach fringe. However, vessel traffic, log raft towing, and LTF use are expected to remain comparable to that anticipated under the current forest plan with use occurring periodically over the planning horizon. Moreover, the 2008 Forest Plan assumed a considerably greater amount of old-growth harvest than has actually occurred (see Appendix D) and therefore, any use associated with future young-growth harvest has been accounted for. Young-growth timber harvest, or removal of trees in association with renewable energy development, within the beach and estuary fringe also has the potential to reduce marine water quality (see the Fisheries section for additional discussion). However, effects would be minor and effects would likely be limited to nearshore areas. Therefore, the Forest Plan Amendment (all alternatives considered) may affect but is not likely to adversely affect the short-tailed albatross. Alaska Region Sensitive Species

In accordance with Forest Service Manual 2670, a BE covering federally listed threatened and endangered wildlife species and Region 10 sensitive species was prepared; this BE contains an evaluation and comparison of all alternatives on these species. The project record contains one BE for wildlife and fish, and a separate BE for plants.

Queen Charlotte Goshawk

Impacts to goshawks are assessed in terms of the reduction in total and high-volume POG, which provides potential high quality nesting and foraging habitat. High-volume POG represents optimal nesting habitat due to the presence of large-trees and snags. Reductions in forest cover, and the subsequent progression of forest succession in young-growth stands, also have the potential to affect the abundance and availability of prey. At a landscape level, reductions in the amount of POG and mature young-growth forest may result in portions of the landscape becoming marginal or unsuitable for goshawks. Therefore, alternatives under which harvest of the most POG is proposed would be expected to have the greatest effect on goshawks (Tables 3.10-8 and 3.10-9). The greatest amount of POG harvest would occur under Alternative 1 (62,851 acres total; 26,275 acres high-volume), followed by Alternative 4 (42,597 acres total; 18,031 high-volume), Alternative 5 (42,479 acres total; 18,173 high-volume), Alternative 3 (35,568 acres total; 13,134 high-volume) and Alternative 2 (32,609 acres total, 12,636 high-volume). Refer to the *Biodiversity* section for a discussion of effects to POG by biogeographic province (Tables 3.9-12 and 3.9-13).

Young-growth forest provides marginal goshawk habitat, but over the long term if unharvested or thinned with an objective of accelerating old growth conditions would return to old-growth conditions. Young-growth stands ready for commercial harvest may be reaching an age to provide some benefits to goshawk (foraging, occasional nesting, post-fledging areas) if adequate structure is developed (typically 45 to 100 years following harvest, depending on site productivity). The most young-growth harvest would occur under Alternative 2, followed by Alternatives 3, 5, 4, and 1 (Table 3.10-9). Impacts to goshawks would be greatest in the North Central Prince of Wales, Kupreanof/Mitkof Island, East Chichagof Island, and Revilla Island/Cleveland Peninsula biogeographic provinces where the most suitable young-growth forest is located (See Suitable Land maps in the Map Packet that accompanies this EIS). Of course, evaluation of the consequences of young-growth harvest must be considered in light of associated changes in harvest of old growth.

The beach and estuary fringe and RMAs provide connectivity for goshawks between reserve areas, and old-growth forest near beach, estuary, and riparian habitats generally support greater prey diversity and net prey productivity for goshawk foraging (USDA 1996). Thus, young-growth stands in these areas have the potential to develop into highly productive habitats for goshawks. Pre-commercial and commercial thinning of young-growth stands, which would occur under all of the alternatives, would promote the development of stand conditions that provide foraging habitat for goshawks. However, even-aged harvest or group-selection of young-growth in the beach and estuary fringe (Alternatives 2, 3, 4, and 5), RMAs (Alternatives 2 and 5), and non-development LUDs (Alternatives 2, 3, and 5) would setback the stand development process (returning harvest units to the stand initiation stage). The creation of gaps several acres in size or more could result in localized reductions in goshawk foraging habitat quality, and would delay the development of old-growth habitat capable of providing higher quality foraging, nesting, and post-fledging habitat. Effects to connectivity for goshawks would be lessened under Alternatives 2 and 5, which maintain a 1,000 foot buffer immediately inland of the beach and estuary fringe young-growth units and a 200-foot buffer along the shoreline, respectively.

Despite these localized effects, the transition to young-growth proposed under the action alternatives is likely to benefit goshawks by reducing the amount of POG harvest that would occur over the planning horizon, thereby maintaining more old-growth forest that provides potential foraging, nesting, and post-fledging habitat, compared to the current forest plan. Given the localized nature and extent of young-growth harvest in the beach and estuary fringe, RMAs, and non-development LUDS (see Appendix D for a detailed discussion of effects to the Conservation Strategy), all of the action alternatives would be expected maintain the long-term viability of goshawks in the planning area and increase the probability of maintaining viability relative to Alternative 1.

Alternatives 1, 2, 3, 4, and 5 include the Legacy Forest Structure standard and guideline that protect habitat features that are important for goshawks on a stand level. The Legacy Forest Structure standard and guideline applies only to old-growth harvest, and is clarified under Alternatives 3 and 4 to indicate that in VCUs that have received concentrated past old-growth harvest the management approach would be to retain young-growth stand acres when implementing young-growth timber harvest projects greater than 20 acres to retain residual trees to diversity structural characteristics and promote future recruitment of snags. The proposed clarifications to the Legacy Forest Structure standard and guideline would continue to provide protection of forest structure in harvest units, maintaining foraging habitat and connectivity for goshawks (USDA Forest Service 2008b).

Alternatives 2, 3, 4, and 5 also propose a revision to the Goshawk standards and guidelines which address nesting habitat. These standards and guidelines expand the requirement to maintain 100 acres of POG forest surrounding a nest tree or nest site to include the largest diameter young-growth forest if POG alone is not sufficient. Therefore, the proposed modification would provide greater protection to goshawk nest sites.

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of goshawk habitat (total POG) within the reserve system. The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase of 4,466 acres of goshawk nesting habitat included in the reserve system (Appendix E). These modifications would result in greater protection of goshawk habitat under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Renewable energy and transportation project development can affect goshawks directly during construction through disturbance and through habitat removal or alteration. During operation, electrocution with powerlines and/or collisions with project structures is a potential risk. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance (e.g., APLIC guidelines; EEI et al. 2006), and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to goshawks and their habitats during project construction and operation.

Collectively all of the action alternatives would reduce the amount of old-growth timber harvest that would occur over the planning horizon which would maintain more suitable habitat for the goshawk than anticipated under the 2008 Forest Plan. This would offset to some extent the potential for loss of high quality habitat associated with young-growth harvest within the beach and estuary fringe, RMAs, and old-growth reserves. Added measures under Alternatives 2 (the 1,000-foot inland buffer) and 5 (the 200-foot no-harvest shoreline buffer) would further reduce effects to goshawks. Individual projects would be required to conduct goshawk surveys and implement the goshawk standards and guidelines which would minimize impacts to this species at the project level. For these reasons, the Forest Plan Amendment (all alternatives considered) may impact individuals but would not result in loss of viability of this species or a trend toward federal listing.

Kittlitz's Murrelet

The Kittlitz's murrelet is associated with glacial habitat and occupies areas outside of where timber harvest and associated activities and renewable energy development have occurred or are likely to occur. Consequently, implementing any of the alternatives would not directly or indirectly affect the Kittlitz's murrelet. No changes are proposed to the 2008 Forest Plan standard and guideline to "provide for the protection and maintenance of known Kittlitz's murrelet nesting habitats." Moreover, none of the activities proposed under the Forest Plan Amendment would occur within the upland scree slope nesting habitat used by this species. If young-growth timber harvest within the beach fringe, or renewable energy development in these areas, were to occur with in the vicinity of tidewater glaciers on the Tongass where this species occurs (Yakutat District), foraging Kittlitz's murrelets could be exposed to very minor, localized, temporary reductions in water quality. Therefore, the Forest Plan Amendment (all alternatives considered) may impact individual Kittlitz's murrelets but would not result in loss of viability of this species or a trend toward federal listing.

Black Oystercatcher

The black oystercatcher is associated with rocky shorelines and tidal mudflats along the coast. They could be affected by oil or fuel spills associated with vessels in the vicinity of the LTFs and the transport of logs from harvested areas under all of the alternatives. They could also be affected by disturbance associated with management activities within the beach fringe. Effects would be greatest under the action alternatives that allow harvest within the beach and estuary fringe (Alternatives 2, 3, 4 and 5). Effects would be least under Alternative 5, which limits harvest in these areas to the first 15 years after plan approval and maintains a 200-foot-wide no harvest buffer along the shoreline. Alternative 5 is anticipated to have 3,546 acres of young-growth harvest within the beach fringe over a 100 year timeframe. Alternative 2 would allow even-aged harvest for the first 15 years, and then commercial thinning thereafter; it is anticipated to harvest 30,892 acres of young growth in the beach fringe. Alternatives 3 and 4 would allow commercial thinning only with no time limit. Alternative 3 estimates 41,489 acres while Alternative 4 estimates 14,865 acres of young-growth harvest in the beach fringe. Therefore, the alternatives would differ slightly in the intensity and time frame of harvest allowed near areas used by black oystercatchers.

However, black oystercatchers occur at low densities across the Tongass and the habitats it uses (intertidal areas) do not typically coincide with management activities, although there is the potential for ongoing effects associated with recreation and tourism activities on the Tongass and disturbance associated with young-growth harvest in the each fringe under Alternatives 2, 3, 4, and 5. A Forest-wide standard was added to the Forest Plan to provide a minimum 330-foot buffer from human activities and concentration or nesting areas. Therefore, this species is unlikely to be affected by the activities proposed under the alternatives.

Renewable energy and transportation development would have the potential to affect this species directly through disturbance or through loss or removal of habitat if facilities are proposed along the shoreline. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts and the new Forest-wide 330-foot buffer for nesting areas would also apply. These measures would minimize impacts to black oystercatchers and their habitats during project construction and operation.

Young-growth timber harvest and/or renewable energy development within the beach and estuary fringe and RMAs could impact nesting or foraging black oystercatchers due to disturbance or displacement or habitat degradation or loss within the intertidal areas used by this species. However, effects would be minor, localized, and temporary given the limited areas across the Tongass where black oyster catcher occur and where these proposed activities could occur, the mobile nature of the species, and the BMPs and other measures in place for maintain water quality. Therefore, the Forest Plan Amendment (all alternatives considered) may impact individual black oystercatchers but would not result in loss of viability of this species or a trend toward federal listing.

Aleutian Tern

Management activities proposed under all the alternatives would have the potential to affect this species through disturbance to nesting colonies or through water quality impacts to prey species. However, none of the alternatives propose young-growth or old-growth harvest or other management activities in the vicinity of Black Sand Spit, in the Yakutat Ranger District, where the largest known breeding colony occurs. Should renewable energy development be proposed in this area, adherence to the USFWS Land-based Wind Energy Guidelines (USFWS 2012d) and APLIC guidelines (EEI et al. 2006) would minimize impacts to this species.

It is unlikely that any of the areas identified as habitat will be impacted by the currently proposed activities; if impacts do occur which create noise and disturbance (e.g., helicopter) the potential resulting disturbance would likely be minor and temporary. Additionally, this species would be afforded protection by standards and guidelines for shorebird colonies. Therefore, the Forest Plan Amendment (all alternatives considered) may impact individual Aleutian terns but would not result in loss of viability of this species or a trend toward federal listing.

Steller Sea Lion Eastern DPS

Steller sea lions may occur in the nearshore and pelagic waters throughout the Tongass. Steller sea lions have the potential to be exposed to disturbance and noise associated with LTF activity, potential collisions with vessels, and fuel or oil spills associated with vessel traffic particularly if these activities occur in the vicinity of major haul-outs or rookeries. All of the identified rookery sites occur in the outside waters of the Tongass and none are located near any proposed activities. One site, Forrester Island, is a designated National Wildlife Refuge and is under the jurisdiction of the USFWS. Most of the known haulouts (Biali Rock, Cape Cross, Biorka Island, Cape Ommaney, Coronation Island, Timbered Island, and Cape Addington) occur in the outside waters of the Tongass and will not likely be impacted by any proposed activities. Of the known haulout sites, only Gran Point, Benjamin Island, Sunset Island, and Lull Point occur in the inside waters of the Tongass. Gran Point is an area in Chilkoot Inlet near Haines; Benjamin Island is a small island in Lynn Canal north of Juneau; Sunset Island is a small island located in Stephens Passage between Hobart and Windham Bay; and Lull Point located on the south end of Catherine Island on the east side of Baranof Island. It is unlikely that any of the areas identified as critical habitat would be impacted by the currently proposed activities; if impacts do occur that create noise and disturbance (e.g., boating), the potential resulting disturbance would likely be minor and temporary.

The amount of human activity in the marine environment associated with Forest management activities is only a fraction of the total amount of human activity occurring in the marine environment. Some of the other activities include commercial fishing, sport fishing, hunting, subsistence, tourism, and mariculture. Most of these activities are not regulated by the Forest Service. Harassment or displacement of sea lions from preferred habitats by human activities such as boating, recreation, aircraft, LTFs, and log raft towing was identified as a concern with regard to long-term conservation in the BA conducted for the 2008 Forest Plan Amendment (USDA Forest Service 2008b). Exposure of Steller sea lions to these impacts would be unchanged under all of the alternatives because a much greater volume of old-growth timber harvest was assumed to occur compared to the actual amount (see Appendix D); therefore, any of these nearshore activities associated with proposed young-growth timber harvest have been accounted for no increases in these uses are anticipated under this Amendment. All alternatives would require adherence to the MMPA, ESA, and NMFS guidelines for approaching sea lions, as currently required under the Forest Plan. Young-growth timber harvest within the beach fringe, and potentially removal of timber for renewable energy development in these areas, has the potential to result in very localized, minor, temporary reductions in water quality to which Steller sea lions could be exposed. Therefore, the Forest Plan Amendment (all alternatives considered) may impact individual Steller sea lions but would not result in loss of viability of this species or a trend toward federal listing.

Sitka Black-Tailed Deer

Extensive analysis on deer was done for the 1997 Forest Plan and subsequent 2008 Forest Plan Amendment. Analyses included information on summer and winter forage and effects of roadbuilding. The expected ecological response of deer to old-growth and mature young-growth timber harvest , road building, and vegetation succession will be similar to those predicted in those analyses; however, the extent of future impacts would be expected to be reduced by the Forest Plan amendment because lower levels of old-growth harvest are proposed in all action alternatives.

All of the alternatives would reduce deer habitat capability (based on Interagency Deer Habitat Capability model output) from existing conditions due to the harvest of mature young-growth and POG forest (Table 3.10-10). Model output by WAA is available in the project record. Immediately following young-growth and old-growth timber harvest there is an increase in the amount of forage available to deer during the summer and mild winter months in response to increased understory growth responding to sunlight associated with opening the forest canopy, although it is may be of lesser quality compared to the same species of plants grown in the shade (Person and Brinkman 2013; Happe et al. 1990). Therefore, reductions in deer habitat capability in summer and mild winters would not be realized immediately after timber harvest due to the short-term increase in forage, but would be greatest in heavy snow winters during years immediately following harvest and after about 25 years, as forest succession progresses and harvested stands reach the stem exclusion stage. Under all alternatives, this would occur to some extent due to natural succession of previously harvested stands. Over the long term, reductions in habitat capability would reduce carrying capacity, or the numbers of deer an area is capable of supporting given the available resources. This could lead to a decline in the deer population, particularly following severe winters, if the demand for resources (e.g., food or habitat) exceeds that which is available. Uneven-aged and two-aged harvest prescriptions (which would be determined at the project-level) would maintain both some overstory cover to capture snow and understory forage in harvested stands resulting in fewer negative effects than even-aged management. Potential declines in the deer population resulting from reduced habitat capability may decrease the availability of deer to wolves (Person 2001; Farmer et al. 2006; Brinkman et al. 2009). Likewise, reductions in deer habitat capability over the long term may reduce the access to and availability of deer to wolves (see discussion below) and subsistence hunters (see the *Subsistence* section).

The transition to young-growth harvest under Alternatives 2, 3, 4, and 5 would dampen the long-term decrease in deer habitat capability predicted for Alternative 1 because fewer acres of POG forest would be harvested over the planning horizon, thereby maintaining more quality winter habitat for deer (Table 3.10-10). This is illustrated in the Interagency Deer Habitat Capability model results at both the 25-year and 100-year time steps, where Alternatives 2, 3, 4, and 5 maintain approximately 1 to 4 percent more of the existing habitat capability than Alternative 1 (the current Forest Plan). At the forest scale, all alternatives would maintain 99 percent of the existing deer habitat capability over the long term.

Additionally, intermediate stand treatments (pre-commercial and commercial thinning) in young-growth forest would result in increased understory growth which would improve forage resources for deer over the first 15-25 years following harvest. These treatments are not reflected in the Interagency Deer Habitat Capability model results, which only assign one value to harvested stands (i.e., this model does not account for the benefit of young-growth harvest which would convert stands currently in the stem exclusion stage back into the stand initiation stage, or account for thinning treatments which open the forest canopy and promote the development of old-growth stand characteristics and understory plant growth). In contrast, the FRESH deer model (Table 3.10-11) accounts for, and assigns different biomass values (indicative of habitat quality) to, multiple young-growth forest age classes. Therefore, FRESH model results reflect the potential benefits to deer associated with young-growth management as well as the progression of older young-growth stands to POG forest. The results of the FRESH deer model indicate that all of the action alternatives would either maintain the level of habitat quality anticipated under the current Forest Plan (Alternative 1) or improve it by 1 to 2 percent at 25 years; 100 years after plan approval the action alternatives would maintain or result in an additional decline of 1 percent of the level of habitat quality anticipated under the current Forest Plan (Table 3.10-11). At the forest scale, all alternatives maintaining 100 percent of existing habitat quality in 25 years and 99 percent of the existing deer habitat quality in 100 years (Table 3.10-11). Details on model inputs are provided in the Deer subsection under Affected Environment and also included in the project record.

Table 3.10-10
Relative Changes in Deer Habitat Capability (DHC) by Biogeographic Province by Alternative in 25 years and 100 years based on the Interagency Deer Habitat Capability Model (NFS Lands Only)

	Biogeographic Province	Existing Deer Habitat Capability (Deer Habitat Capability Units)	Deer Habitat Capability By Alternative (% Existing Habitat Quality Remaining)									
			Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
			25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs
1	Yakutat Forelands	6,187	98	94	100	94	100	100	100	100	100	100
2	Yakutat Uplands	3,259	100	100	100	100	100	100	100	100	100	100
3	East Chichagof Island	18,919	99	98	100	99	100	99	100	98	99	98
4	West Chichagof Island	6,172	100	100	100	100	100	100	100	100	100	100
5	East Baranof Island	4,167	99	100	101	100	100	100	101	100	100	100
6	West Baranof Island	14,085	100	101	102	101	101	101	101	101	101	100
7	Admiralty Island	28,416	100	100	100	100	100	100	100	100	100	100
8	Lynn Canal	5,461	100	100	100	100	100	100	100	100	100	100
9	North Coast Range	9,520	100	100	100	100	100	100	100	100	100	100
10	Kupreanof/Mitkof Island	19,823	99	98	101	99	101	99	100	99	100	99
11	Kuiu Island	18,861	100	101	100	100	100	100	100	100	100	100
12	Central Coast Range	9,910	101	100	101	100	101	100	101	100	101	100
13	Etolin Island	11,968	99	97	100	99	100	98	99	97	99	97
14	North Central Prince of Wales	31,134	97	95	101	97	101	97	100	96	100	96
15	Revilla Island/ Cleveland Peninsula	23,700	99	99	100	99	100	99	99	99	100	98
16	Southern Outer Islands	9,043	99	98	101	100	101	100	101	98	101	99
17	Dall Island and Vicinity	5,272	100	100	101	100	101	100	100	100	100	100
18	South Prince of Wales	11,358	100	100	100	100	100	100	100	100	100	100
19	North Misty Fiords	5,562	100	100	100	100	100	100	100	100	100	100
20	South Misty Fiords	11,612	100	100	100	100	100	100	100	100	100	100
21	Ice Fields	3,401	100	100	100	100	100	100	100	100	100	100
	Forest-wide	257,830	99	99	101	99	100	99	100	99	100	99

[1] Deer habitat capability model output by WAA, including habitat capability units, is available in the project record.

Table 3.10-11
Habitat Conditions Resulting from Each Alternative Using the FRESH Deer Model in 25 years and 100 years (NFS Lands Only)

No.	Biogeographic Province	Existing Habitat Quality (Deer Days Per Hectare)	Percent of Existing Habitat Quality Remaining									
			Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
			25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs
1	Yakutat Forelands	0.0	--	--	--	--	--	--	--	--	--	--
2	Yakutat Uplands	0.0	--	--	--	--	--	--	--	--	--	--
3	East Chichagof Island	35.7	99	98	99	97	99	97	99	98	99	97
4	West Chichagof Island	89.1	100	100	100	100	100	100	100	100	100	100
5	East Baranof Island	30.6	99	99	100	100	100	99	100	99	100	99
6	West Baranof Island	56.9	100	100	101	100	101	100	100	100	100	100
7	Admiralty Island	50.6	100	100	100	100	100	100	100	100	100	100
8	Lynn Canal	24.4	100	100	102	100	100	100	100	100	100	100
9	North Coast Range	19.3	100	100	100	100	100	100	100	100	100	100
10	Kupreanof/Mitkof Island	96.8	99	99	100	99	100	99	99	99	99	99
11	Kuiu Island	64.8	99	99	99	98	99	98	99	98	99	98
12	Central Coast Range	31.8	101	100	102	100	102	100	101	100	101	100
13	Etolin Island	72.9	99	98	100	98	100	98	99	98	99	98
14	North Central Prince of Wales	79.1	99	98	101	98	101	98	100	98	100	97
15	Revilla Island/ Cleveland Peninsula	68.8	100	99	100	99	100	99	100	99	100	99
16	Southern Outer Islands	96.4	99	99	100	99	100	99	100	99	100	99
17	Dall Island and Vicinity	76.5	100	100	100	100	100	100	100	100	100	100
18	South Prince of Wales	95.1	100	100	100	100	100	100	100	100	100	100
19	North Misty Fiords	21.6	100	100	100	100	101	100	100	100	100	100
20	South Misty Fiords	56.3	100	100	100	100	100	100	100	100	100	100
21	Ice Fields	3.0	100	100	101	100	101	100	100	101	100	100
	Forest-wide	**40.9**	**100**	**99**	**100**	**99**	**100**	**99**	**100**	**99**	**100**	**99**

Note: No snow zone assigned to Biogeographic Province 1 and 2 due to very low use by deer; therefore, model not run.

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of deer winter habitat (high-volume POG less than 800 feet elevation) within the reserve system. The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase of 3,648 acres of deep snow deer winter habitat included in the reserve system (Appendix E). These modifications would result in greater protection of deer habitat under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Alternatives 2, 3, 4, and 5 propose to eliminate the TUS LUD, and implement a new series of Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines. Renewable energy and transportation project development can affect deer during construction through disturbance and through habitat removal or alteration. Operational impacts due to disturbance would expected to be minimal. The proposed standards and guidelines include consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to deer and/or areas of important deer habitat during construction and operation.

Mountain Goat

Mountain goats are associated with old-growth forest and are susceptible to over-hunting if road access is increased or improved, though most roads are located a long distance (both vertically and horizontally) from mountain goat habitat. The greatest amount of POG harvest would occur under Alternative 1 (62,851 acres), followed by Alternatives 4 (42,597 acres), 5 (42,479 acres), 3 (35,568 acres) and 2 (32,609 acres; Table 3.10-8).

The amount of road access, quantified in terms of the amount of road construction and reconstruction proposed under each alternative, is representative of the potential for over-hunting. New road construction on NFS lands after full implementation of the Forest Plan (100 years) for each alternative ranges from 871 miles (Alternative 4) to 1,056 miles (Alternative 2) (See Table 3.12a-1 in the Transportation Section). The greatest amount of road to be constructed over decommissioned roadbeds or reconstruction would occur under Alternative 2 (1,191 miles), followed by Alternatives 3 (1, 129 miles), 5 (1,058 miles), 4 (900 miles), and 1 (887 miles). However, most of the roads, particularly accessing young-growth units, would be below 1,500 feet in elevation and outside of mountain goat habitat. Additionally, note that many new or reconstructed roads would be closed or decommissioned after use, further reducing effects on mountain goats. Risk of over-harvest due to human access along roads is mitigated to some extent by Transportation Forest-wide standards and guidelines that require travel access road objectives to be developed for all roads, and mountain goat standards and guidelines that would be implemented under all of the alternatives.

Mountain goats are also susceptible to disturbance and displacement from helicopter overflights and landings. There are Forest Plan standards and guidelines in place that address helicopter use at the project level that would be maintained under all of the alternatives.

Renewable energy and transportation projects could affect mountain goats through direct disturbance or through removal or modification of habitats. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines proposed under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to mountain goats and their habitat during project construction and operation.

Black Bear

Preferred habitats for black bears, which include coastal, estuarine, and riparian areas, are protected by the Forest Plan Conservation Strategy. All of the alternatives maintain these measures, although Alternatives 2, 3, 4, and 5 propose guidelines for young-growth harvest that allow harvest in the beach and estuary fringe and RMAs (Alternatives 2 and 5 only; see discussion above under Tongass Conservation Strategy). Alternative 2 would result in the greatest amount of young-growth harvest in these black bear habitats (66,984 acres), followed by Alternatives 3 (41,489 acres), Alternative 4 (14,865 acres) and Alternative 5 (4,428 acres); no harvest in beach and estuary buffers or RMAs would occur under Alternative 1 (Table 3.9-11 in the *Biodiversity* section).

Harvest of mature young-growth and old-growth timber (both even aged as well as thinning) would increase forage availability (berries) for black bears over the short term in the resulting early-successional plant communities. However, this food source typically lasts only about 25 years post-logging and decreases over time in association with canopy closure. Over the long-term, old-growth harvest would decrease habitat suitability for black bears, due to the reduced understory forage in young-growth stands and loss of denning habitat in upland areas (e.g., large woody structures such as hollow logs and hollow living trees; Davis et al. 2012). This effect would be greatest under continued POG harvest (Alternative 1). The transition to young-growth harvest under Alternatives 2, 3, 4, and 5 would increase forage availability over the long term by reverting young-growth stand in the stem exclusion stage back to the stand initiation stage; however, development of old-growth stand characteristics used by bears for denning would be delayed. However, effects to the contributing elements of the Conservation Strategy would be localized, with the maximum proposed young-growth harvest affecting 2.4 percent, 3.3 percent, 1.2 percent, and 0.4 percent of forest land in the beach and estuary fringe under alternative 2, 3, 4, and 5, respectively; 6.7 percent and 0.3 percent of the forest land within RMAs under Alternatives 2 and 5, respectively; up to 3 percent of the forest land within old-growth reserves and other non-development LUDs (Alternatives 2, 3, and 5) within the planning area (see Appendix D for additional discussion of the Conservation Strategy). Therefore, these areas would continue to function as habitat for black bears.

Reductions in deer habitat capability resulting from timber harvest (both old-growth and young-growth) could reduce fawn productivity, and therefore the prey base for bears in the spring in some portions of the Tongass. However, as discussed above over the long term the transition to young-growth harvest is expected to maintain or increase deer habitat capability and habitat quality over the long term under Alternatives 2, 3, 4, and 5 minimizing this effect to black bears.

Timber harvest (both old-growth and young-growth) may also indirectly increase the susceptibility of black bears to over-harvest if road access is increased or improved. An increase in open roads, particularly in open habitats such as clearcuts and muskegs, where bears forage and are easier to see, can increase the potential for human-bear interactions. The amount of road access, quantified in terms of the amount of road construction and reconstruction proposed under each alternative, is representative of the potential for over-hunting (USDA Forest Service 2008b; see discussion above under Mountain Goat for a comparison of the alternatives). Average total road density on NFS lands (across all WAAs) in 100 years would be approximately 0.2 mile per square mile under all of the alternatives, an increase of 0.03 to 0.04 mile per square mile above existing average road density; Table 3.10-12). Therefore, any potential increase in hunter access and risk of over harvest would be localized, and no measureable increase would be expected at the forest scale under any of the alternatives.

Alternatives 1, 2, 3, 4, and 5 would incorporate the Legacy Forest Structure standards and guidelines, which are intended to maintain old-growth structure in areas that are already highly developed, as well as areas that will experience increased harvest levels over the life of the Forest Plan. These components (large trees and snags) may provide potential den sites for black bears. Alternatives 2, 3, 4, and 5 include a proposed clarification that the list of VCUs where the Legacy Forest Structure standards and guidelines apply should be verified during project-specific planning and analysis. Alternatives 3 and 4 also include a new management approach for this standard and guideline to indicate that when implementing young-growth harvest projects larger than 20 acres in VCUs that have received concentrated past old-growth harvest it is intended that 30 percent of the young-growth stand acres should be left to retain residual trees to diversify structural characteristics and promote future recruitment of snags. Therefore, the proposed clarification would provide greater protection of black bear denning habitat.

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of shoreline and riparian habitats included in the reserve system. The proposed modifications to existing (i.e., post-conveyance) OGRs would help maintain connectivity to shoreline and protect riparian habitats preferred by black bears. Proposed OGR modifications would result in a net increase of 31 miles of Class I streams and 6,696 acres of low-elevation POG included in reserve system (Appendix E). These modifications would provide greater protection of black bear foraging habitat under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Renewable energy and transportation projects could affect black bears through direct disturbance or through removal or modification of habitats. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to black bears and their habitats during project construction and operation.

Table 3.10-12
Estimated Average Road Density and Percent of WAAs in Road Density Categories on NFS Lands and All Lands Combined[1] for All Roads and for Open Roads Only within the Tongass National Forest Boundary by Alternative after 100 Years

	Percentage of WAAs											
	Existing		Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
Road Density Category (miles per sq. mi.)	**NFS Lands Only**	**All Lands**	**NFS Lands Only**	**All Lands**	**NFS Lands Only**	**All Lands**	**NFS Lands Only**	**All Lands**	**NFS Lands Only**	**All Lands**	**NFS Lands Only**	**All Lands**
All Roads												
0	47.6%	43.5%	35.1%	32.5%	33.5%	32.5%	35.6%	32.5%	43.5%	33.0%	39.3%	32.5%
0 to 0.7	37.7%	35.1%	47.6%	39.8%	49.2%	39.8%	47.1%	39.8%	40.3%	39.8%	43.5%	39.8%
0.7 to 1.0	6.3%	5.8%	6.3%	7.3%	5.2%	5.8%	5.2%	5.8%	5.2%	5.8%	5.2%	5.8%
1.0 to 2.0	7.9%	12.6%	7.9%	13.1%	8.9%	14.1%	8.9%	14.7%	7.9%	14.1%	8.9%	14.7%
2.0 to 3.0	0.5%	3.1%	3.1%	5.8%	3.1%	6.3%	3.1%	5.8%	3.1%	5.8%	3.1%	5.8%
>3.0	0.0%	0.0%	0.0%	1.6%	0.0%	1.6%	0.0%	1.6%	0.0%	1.6%	0.0%	1.6%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Average Total Road Density – All WAAs	0.195	0.334	0.231	0.450	0.235	0.454	0.233	0.453	0.228	0.448	0.232	0.452
Open Roads												
0	57.1%	49.7%	37.7%	33.5%	35.6%	33.5%	37.7%	33.5%	46.6%	34.0%	41.4%	33.5%
0 to 0.7	39.3%	37.7%	58.6%	51.3%	60.2%	51.3%	58.1%	51.3%	49.2%	50.8%	54.5%	51.3%
0.7 to 1.0	2.6%	4.7%	1.6%	5.8%	2.1%	5.2%	2.1%	5.2%	2.1%	5.8%	2.1%	5.8%
1.0 to 2.0	1.0%	6.3%	2.1%	8.9%	2.1%	9.4%	2.1%	9.4%	2.1%	8.9%	2.1%	8.9%
2.0 to 3.0	0.0%	1.6%	0.0%	0.5%	0.0%	0.5%	0.0%	0.5%	0.0%	0.5%	0.0%	0.5%
>3.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Average Open Road Density – All WAAs	0.089	0.218	0.094	0.238	0.095	0.239	0.095	0.239	0.094	0.238	0.094	0.239

[1] Percentages are based on all 191 WAAs inside the Forest boundary, including Annette Island

River Otter
River otters prefer habitats, especially POG forest, immediately adjacent to coastal and fresh water aquatic environments, with most use occurring within 500 feet of the these areas. These old-growth habitats are protected by Forest Plan standards and guidelines for the beach and estuary fringe, riparian areas, and lakes which would be implemented under all alternatives. Alternatives that propose young-growth harvest within habitats used by river otters would be expected to have the greatest effects to these species. Young-growth harvest within beach and estuary fringe (Alternatives 2, 3, 4, and 5) and RMAs (Alternatives 2 and 5 only) are presented in Table 3.9-11 and discussed above under Black Bear. Alternative 2 would result in the greatest amount of young-growth harvest in these river otter habitats (66,984 acres), followed by Alternative 3 (41,489 acres), Alternative 4 (14,865 acres), and Alternative 5 (4,428 acres); no harvest in the beach and estuary fringe or RMAs would occur under Alternative 1 (Table 3.9-11 in the *Biodiversity* section).

Renewable energy and transportation projects could affect river otters through direct disturbance or through removal or modification of habitats, particularly if activities affect water bodies. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to river otters and their habitats during project construction and operation.

American Marten
Through the removal of forest cover and old-growth ecosystem features such as decadent live trees and snags, timber harvest (POG harvest and young-growth harvest) would reduce the vertical and horizontal structural complexity important to marten in relation to prey access, denning and resting sites, escape from predation, and thermoregulation (Buskirk and Zielinski 1997; Hargis et al. 1999; Flynn and Schumacher 2001). Forest fragmentation resulting from timber harvest may also alter patterns of occupancy by marten (Thompson and Harestad 1994; Bissonette et al. 1997; Chapin et al. 1998). Although more recent research indicates that marten use all forested stands relative to their ability, including young-growth stands mixed conifer and deciduous stands less than 40 years of age (Goldstein 2013), alternatives that result in the greatest reduction in deep snow marten habitat (high-volume POG at or below 800 feet elevation) would be expected to have the greatest negative effects to marten. Reductions in deep snow marten habitat may result in localized reductions in the capability of the remaining habitat to support marten. The greatest amount of deep snow marten habitat is scheduled to be harvested in the next 100 years under Alternative 1 (16,116 acres), followed by Alternatives 4 (9,921 acres), 5 (9,844 acres), 2 (8,120 acres), and 3 (6,297 acres; Table 3.10-13).

Table 3.10-13
Estimated Harvest (acres) of High-Volume (SD5N, SD5S, and SD67) and Large-Tree (SD67) Productive Old-Growth by Elevation Category and Alternative after 100 years (NFS lands only)

Elevation Category	Alternative				
	1	2	3	4	5
High-Volume POG					
< 800 feet	16,116	8,120	6,297	9,921	9,844
> 800 feet	11,349	5,901	7,420	8,328	7,972
Total	**27,464**	**14,022**	**13,716**	**18,248**	**17,816**
Large-Tree POG					
< 800 feet	6,076	2,989	1,937	3,542	3,594
> 800 feet	3,227	1,640	1,748	2,478	2,211
Total	**9,303**	**4,629**	**3,685**	**6,021**	**5,805**

Alternatives 1, 2, 3, 4, and 5 would incorporate the Legacy Forest Structure standards and guidelines which are intended to maintain old-growth structure in areas that are already highly developed, as well as areas that will experience increased harvest levels over the life of the Forest Plan. These components (large trees and snags) may provide potential den sites and foraging habitat for marten. Alternatives 2, 3, 4, and 5 include a proposed clarification that the list of VCUs where the Legacy Forest Structure standards and guidelines apply should be verified during project-specific planning and analysis. Alternatives 3 and 4 also include a new management approach for these standards and guidelines to indicate that when implementing young-growth harvest projects larger than 20 acres in VCUs that have received concentrated past old-growth harvest it is intended that 30 percent of the young-growth stand acres should be left to retain residual trees to diversify structural characteristics and promote future recruitment of snags. Therefore, the proposed clarification would provide greater protection of marten habitat in managed forest stands.

Increased human access associated with new roads may result in increased marten vulnerability to harvest, particularly along open roads (Flynn et al. 2004). All alternatives would result in minor increased average total road densities; however, the proportion of WAAs within various road density categories would not change under any of the alternatives (see the discussion under Black Bear; Table 3.10-12). Increased road densities have the potential to indirectly increase hunter access and associated trapping pressure; however these effects would be minor and would not differ among alternatives.

Marten were chosen as one of the design species in the development of 1997 Forest Plan Conservation Strategy (USDA Forest Service 1997b) because they exhibit a consistent close association with mature forests throughout their distributional range (Sturtevant et al. 1996). Under the current Forest Plan, the marten populations are supported by the Conservation Strategy which works to maintain old-growth forest cover and coarse woody debris to provide structure important to marten for resting, denning, escape from predators, trapping refugia, and facilitate marten dispersal. The beach and estuary fringe and RMAs provide travel corridors for marten, and old-growth reserves and other non-development LUDs provide refugia from trapping. Pre-commercial and commercial thinning of young-growth stands in these areas, which would occur under all of the alternatives, would promote the development of stand conditions that provide habitat structure for marten. However, even-aged harvest or group-selection of young-growth in the beach and estuary fringe (Alternatives 2, 3, 4, and 5), RMAs (Alternatives 2 and 5), and non-development LUDs (Alternatives 2, 3, and 5) would setback the stand development process (returning harvest units to the stand initiation stage). The creation of gaps several acres in size or more could result in localized reductions in marten movement, local reductions in prey availability, and would delay the development of old-growth habitat conditions in harvested stands. Effects to connectivity for marten would be lessened under Alternatives 2 and 5, which maintain a 1,000 foot buffer immediately inland of young-growth harvest units in the beach and estuary fringe and a 200-foot buffer along the shoreline, respectively. Additionally, Alternative 5 includes a one-time entry stipulation for young-growth harvest in each of these areas (See the discussion above under Conservation Strategy and the analysis of effects to the Conservation strategy in Appendix D for more detail).

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of marten habitat (high-volume POG below 800 feet elevation) within the reserve system. The proposed modifications to the existing (post-conveyance) OGRs would result in a net increase of 3,648 acres of deep snow marten habitat included in the reserve system. Overall, these modifications would increase the amount of marten habitat protected by the Conservation Strategy, compared to the amount of protection that would occur as a result of the land conveyance without these changes.

Renewable energy and transportation projects could affect marten through direct disturbance or through removal or modification of habitat. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to marten and their habitats during project construction and operation.

Brown Bear

Brown bears are associated with low-elevation POG forests, particularly along Class I salmon streams. These habitats are protected to some extent by Forest-wide Standards and Guidelines for beach and estuary fringe and RMAs. However, young-growth harvest would occur in these areas under Alternatives 2, 3, and 5. It can be assumed that the alternatives with the greatest amount of young-growth harvest in the beach and estuary fringe and RMAs would have the greatest effect to brown bears. Young-growth harvest within beach and estuary fringe and RMAs are presented in Table 3.9-13 and discussed above under Black Bear. Alternative 2 would have the greatest effects to habitats used by brown bears, followed by Alternatives 3, 4, and 5; no harvest in the beach and estuary fringe or RMAs would occur under Alternative 1 (Table 3.9-11 in the *Biodiversity* section).

Road densities are another measure of the potential impact of the alternatives on brown bears. Primary concerns include increased hunting or poaching, and disturbance during critical life stages (e.g., late-summer feeding periods for bear). Habitat fragmentation, as well as habitat loss secondary to activities that are facilitated by vehicular access (e.g., timber harvest, mining, residential development, and renewable energy development) are other potential impacts. Open roads, which receive the highest and most consistent use, are likely to have the greatest effect on brown bears, although closed roads still facilitate access (e.g., off-highway vehicle, pedestrian) to roadless areas. There is no road density guideline for brown bears; however, it can be assumed that increased road density elevates the potential for human-bear interactions. All alternatives would result in minor changes in total road density (see the discussion under Black Bear; Table 3.10-12). Increased road densities have the potential to indirectly increase human-bear interactions; however, these effects would be minor and would not differ among alternatives.

The reserve system serves as an important source of roadless refugia for brown bears, reducing the possibility of human-bear interactions. Alternatives 2, 3 and 5 allow young-growth harvest in old-growth reserves and other non-development LUDs (Alternatives 2 and 3 only). Under Alternatives 2, 3, and 5, maximum estimated young-growth harvest acres within these areas comprise less than 3 percent of Old-growth Habitat LUD acres Forest-wide and less than 1 percent of other non-development LUD acres Forest-wide (see Appendix D for an analysis of the Conservation Strategy). Suitable young-growth stands within OGRs and other non-development LUDS are typically located along the shoreline or inland under existing road systems. These easily accessible stands, particularly when located near other suitable young-growth stands in development LUDs, would be selected to avoid effects to intact, relatively undisturbed POG forest within OGRs and other non-development LUDs. Therefore, young-growth harvest within the reserve system under Alternatives 2, 3, and 5 would not be expected to reduce the functioning of these areas as refugia for brown bears.

Renewable energy and transportation projects could affect brown bears through direct disturbance or through removal or modification of habitat, particularly if developments affect Class I salmon streams. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to brown bears and their habitats during project construction and operation.

Alexander Archipelago Wolf

The 1997 and 2008 Forest Plan analyses contain extensive information on wolf ecology building on the wolf assessment (Person et al. 1996). As outlined in the 1997 and 2008 plans and associated documents, scheduled harvest of POG forest has the potential to result in the reduction of the wolf prey base (deer through decreased deer habitat capability) and increased human access along project roads, which could reduce the wolf population through increased legal and illegal hunting and trapping. It is assumed that a decline in the deer population would likely result in a decline in the wolf population (USDA Forest Service 2008b). Resonating effects could include reductions in opportunities to hunt or trap wolves (see Subsistence section). These effects are of particular concern on Prince of Wales Island where the population has apparently undergone substantial declines over the last several decades; however, this population represents a small proportion (approximately 4 percent) of the overall Alexander Archipelago wolf population and this decline is not anticipated to affect the status of the population at large (USFWS 2015).

One approach to examining potential effects of alternatives on wolves is evaluating the reduction in modeled deer habitat capability (based on Interagency Deer Habitat Capability model outputs in terms of calculated deer density) in each biogeographic area and by WAA. Note that deer density expressed by the habitat capability model does not represent actual population numbers but represents a consensus at the time the model was developed regarding deer habitat capability at different structural / successional stages which can be used to compare alternatives. Model assumptions, based on recent direction provided by the Forest Service include:

- For the direct and indirect effects analysis, deer habitat capability by WAA (including only NFS lands) was divided by the total square miles of NFS lands (all elevations included, but with acres above 1,500 feet elevation receiving a zero value) in the WAA.
- For the cumulative effects analysis, deer habitat capability from all land ownerships (NFS and non-NFS lands) was divided by the total square miles of all lands (all elevations included, but habitats on non-NFS land and land above 1,500 feet elevation receiving a zero value) in the WAA.

Evaluation of potential effects of timber harvest on wolves based on the Interagency Deer Habitat Capability Model relies on an understanding of the complex interactions between forest management and deer habitat, roads, snowpack, deer populations, deer hunters, wolves (as predators of deer), and wolf trappers/hunters. Particularly important is the idea that winter deer habitat (old growth forest, which intercepts snow and provides forage) is reduced through timber harvest to the point where a severe winter (or series of such winters) with deep snow results in high deer mortality.

Evaluation employing the Interagency Deer Carrying Capacity Model suggests that harvest of POG forest will decrease carrying capacity for deer over the long term because of reductions in the amount of available winter habitat due to the ultimate development of forest in stem-exclusion (Table 3.10-11; see also discussion of effects to deer). However, this long-term decline in carrying capacity is less under Alternatives 2, 3, 4, and 5 than Alternative 1 due to the transition to young growth,. Current deer habitat capability based on the interagency habitat capability model is below the Forest Plan guideline of 18 deer per square mile in many WAAs. This results from several factors and varies among landscapes. Contributing factors include lower inherent capability of some landscapes and habitats, reduced habitat capability from past timber harvest and associated succession, and the static nature of how the model expresses habitat capability during succession (such as one value for young growth from 25 to 150 years of age). Model results suggest that continued harvest of POG forest in some areas would result in higher risk that there will be insufficient deer to sustain predation by wolves and human deer harvest over the long-term (see existing modeled deer densities in Table 3.10-2). That concern exists despite the availability of alternative prey and current abundance of deer in some parts of the forest.

Alternative 1 would reduce the existing percentage of WAAs with deer habitat capability of at least 18 deer per square mile by 14 percent at stem exclusion in approximately 25 years; there would be no change in the percentage of WAAs with at least 18 deer per square mile habitat capability over this time period under Alternatives 2, 3, or 4, but the decrease in number of WAAs would be 11 percent under Alternative 5 (Table 3.10-14)., After 100 years of Forest Plan implementation all alternatives would reduce the percentage of WAAs with at least 18 deer per square mile by 14 percent. WAAs with the greatest potential impacts are located in South Prince of Wales, North Central Prince of Wales, Kupreanof/Mitkof Islands, Revillagigedo Island, and Chichagof Island biogeographic provinces (Table 3.10-14). Deer Habitat Capability model output by WAA is included in the project record. Reductions in habitat capability are due to both timber harvest as well as natural succession of stands harvested in the past.

Table 3.10-14

Comparison of Alternatives in terms of their Long-term Ability to Meet the Wolf Guideline of Providing Sufficient Habitat to Support 18 Deer per Square Mile after 25 and 100+ Years of Forest Plan Implementation 1 (NFS Lands Only)

No.	Biogeographic Province	Existing Habitat Capability 2015 (Deer per Square Mile)	Existing No. WAAs with Modeled Deer Density of at least 18 Deer per Square Mile[1/]	Model-generated Habitat Capability by Alternative (Deer Per Square Mile and Number of WAAs with Modeled Deer Density of at least 18 Deer per Square Mile)[2]									
				Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
				25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs
1	Yakutat Forelands	13.3	2	12.4(2)	11.9(2)	12.6(2)	11.9(2)	12.7(2)	12.7(2)	12.7(2)	12.7(2)	12.7(2)	12.7(2)
2	Yakutat Uplands	2.3	0	2.3(0)	2.3(0)	2.3(0)	2.3(0)	2.3(0)	2.3(0)	2.3(0)	2.3(0)	2.3(0)	2.3(0)
3	East Chichagof Island	11.7	1	11.4(1)	11.3(1)	11.6(1)	11.4(1)	11.5(1)	11.4(1)	11.5(1)	11.3(1)	11.5(1)	11.4(1)
4	West Chichagof Island	14.5	1	14.0(0)	14.0(0)	14.0(0)	14.0(0)	14.0(0)	14.0(0)	14.0(0)	14.0(0)	14.0(0)	14.0(0)
5	East Baranof Island	7.0	0	6.8(0)	6.8(0)	6.9(0)	6.8(0)	6.8(0)	6.8(0)	6.9(0)	6.8(0)	6.8(0)	6.8(0)
6	West Baranof Island	12.2	4	11.9(4)	11.9(4)	12.1(4)	12.0(4)	12.0(4)	11.9(4)	11.9(4)	11.9(4)	11.9(4)	11.9(4)
7	Admiralty Island	17.6	10	17.3(10)	17.3(10)	17.3(10)	17.3(10)	17.3(10)	17.3(10)	17.3(10)	17.3(10)	17.3(10)	17.3(10)
8	Lynn Canal	5.5	1	5.4(1)	5.4(1)	5.4(1)	5.4(1)	5.5(1)	5.4(1)	5.4(1)	5.4(1)	5.4(1)	5.4(1)
9	North Coast Range	6.2	0	6.1(0)	6.1(0)	6.1(0)	6.1(0)	6.1(0)	6.1(0)	6.1(0)	6.1(0)	6.1(10)	6.1(0)
10	Kupreanof/Mitkof Island	16.9	7	16.5(3)	16.4(3)	16.8(3)	16.6(3)	16.8(3)	16.6(3)	16.6(3)	16.5(3)	16.7(3)	16.4(3)
11	Kuiu Island	25.5	7	25.0(7)	25.1(7)	25.1(7)	25.1(7)	25.1(7)	25.1(7)	25.1(7)	25.1(7)	25.1(7)	25.0(7)
12	Central Coast Range	9.0	1	8.9(1)	8.8(1)	8.9(1)	8.8(1)	8.9(1)	8.8(1)	8.9(1)	8.8(1)	8.9(1)	8.8(1)
13	Etolin Island	15.7	3	15.2(2)	14.9(2)	15.5(1)	15.1(1)	15.5(1)	15.0(1)	15.4(2)	14.9(1)	15.3(2)	14.9(1)
14	North Central Prince of Wales	17.7	11	16.8(9)	16.5(9)	17.4(11)	16.7(10)	17.4(11)	16.7(10)	17.3(11)	16.6(10)	17.2(11)	16.6(10)
15	Revilla Island/ Cleveland Peninsula	13.5	7	12.9(6)	12.9(6)	13.1(6)	12.9(6)	13.1(6)	12.9(6)	13.0(6)	12.9(6)	13.0(6)	12.8(6)
16	Southern Outer Islands	28.1	9	27.4(9)	27.0(9)	27.8(9)	27.4(9)	27.8(9)	27.3(9)	27.9(9)	26.9(9)	27.9(9)	27.1(9)
17	Dall Island and Vicinity	30.4	3	29.5(3)	29.5(3)	29.5(3)	29.5(3)	29.5(3)	29.5(3)	29.5(3)	29.5(3)	29.5(3)	29.5(3)
18	South Prince of Wales	21.8	5	20.9(5)	20.8(5)	21.0(5)	20.9(5)	20.9(5)	20.9(5)	20.9(5)	20.8(5)	20.9(5)	20.8(5)
19	North Misty Fiords	3.7	2	3.7(1)	3.7(1)	3.7(1)	3.7(1)	3.7(1)	3.7(1)	3.7(1)	3.7(1)	3.7(1)	3.7(1)
20	South Misty Fiords	8.4	0	8.2(0)	8.2(0)	8.2(0)	8.2(0)	8.2(0)	8.2(0)	8.2(0)	8.2(0)	8.2(0)	8.2(0)
21	Ice Fields	0.7	0	0.7(0)	0.7(0)	0.7(0)	0.7(0)	0.7(0)	0.7(0)	0.7(0)	0.7(0)	0.7(0)	0.7(0)
	Forest-wide	**10.1**	**74**	**9.8(64)**	**9.7(64)**	**9.9(65)**	**9.8(64)**	**9.9(65)**	**9.8(64)**	**9.9(66)**	**9.8(64)**	**9.9(66)**	**9.8(64)**

1 For WAAs that overlap a biological province boundary only the overlapping portion counted toward the total.

2 Note that the model treats harvested stands in the stem exclusion stage (25 years old or older) the same value regardless of thinning treatments that are implemented.3 Note that wolves very rarely occur on Admiralty, Baranof, and Chichagof Islands.

The transition to young-growth harvest under the action alternatives is not fully reflected in the interagency deer model results because the model does not assign different values to stands that have been pre-commercially or commercially thinned (i.e., it still treats them as stands in the stem exclusion phase with limited value for deer), or young-growth stands beyond the stem exclusion phase which become more suitable for deer. Harvest of young-growth stands would increase summer and low-snow winter forage availability for deer over the short term, providing temporary increases in habitat capability during most years, but reduced winter habitat capability in high-snow years. Over the long term as young-growth stands re-enter the stem exclusion phase, habitat capability for deer (and thus potential prey availability for wolves) would be expected to decrease (due to reduced forage availability) until the next stand treatment.

The transition to young growth would revert stands in the stem exclusion stage back to the stand initiation stage, and therefore would extent the period of short-term benefits to deer (in summer and low-snow winters) associated with increased habitat capability and thus also benefiting wolves. Ultimately, the continued harvest of old-growth and young-growth forest under all the alternatives has the potential to result in localized reductions in deer habitat capability which may reduce prey availability for wolves in portions of the Tongass where deer are their primary prey (e.g., Prince of Wales Island and surrounding islands [GMU 2]).

All action alternatives involve the construction or reconstruction of roads. The roads associated with timber harvest (old-growth and young-growth) may also increase the risk of both legal and illegal hunting and trapping related wolf mortality by increasing human access. Estimated total road densities below 1,200 feet (representative of low elevation habitats used by wolves and deer) would increase by 0.07 to 0.08 miles per square mile (NFS lands only) under all of the alternatives. Estimated open road densities would increase by 0.01 miles per square mile under all action alternatives (Table 3.10-15). Therefore, at most, localized increases in hunter access would be expected under the action alternatives with no substantial increase across the Tongass. Relative to Alternative 1, the action alternatives would result in a minor increase in open road miles below 1,200 feet under Alternatives 2, 3, and 5 (an increase of 26 miles, 20 miles, and 14 miles, respectively) and a minor decrease under Alternative 4 (5 miles; Table 3.10-15). These effects would be lessened through road closures after use, through storage or decommissioning. The effectiveness of closure and storage, or decommissioning and ultimately the extent of mitigation will depend on both enforcement and the approach to closure. These decisions are made at the island, district, and project level through Access Travel Management Plans based on an evaluation of all resources.

The old-growth reserve system of the Conservation Strategy serves as an important source of roadless refugia for wolves. Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of deer winter habitat and areas identified as being important for landscape connectivity (low-elevation POG) in the reserve system. The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase in the of 3,6,48 acres of deep snow deer winter habitat and 6,696 acres of low-elevation POG the reserve system, thus indirectly benefiting wolves (see the discussion under Deer above and Appendix E).

Table 3.10-15
Estimated Road Miles and Average Road Density below 1,200 ft. in Elevation on NFS Lands and All Lands Combined for All Roads and for Open Roads by Alternative after 100 Years

	Existing		Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
Category	NFS Lands Only	All Lands	NFS Lands Only	All Lands	NFS Lands Only	All Lands	NFS Lands Only	All Lands	NFS Lands Only	All Lands	NFS Lands Only	All Lands
Road Miles												
All Roads	4,858	8,900	5,726	11,917	5,830	12,020	5,796	11,987	5,659	11,850	5,772	11,963
Open Roads	2,201	5,777	2,327	6,264	2,353	6,290	2,347	6,283	2,322	6,259	2,341	6,277
Road Density (mi/mi²)												
All Roads	0.39	0.63	0.46	0.85	0.47	0.86	0.47	0.85	0.46	0.84	0.46	0.85
Open Roads	0.18	0.41	0.19	0.45	0.19	0.45	0.19	0.45	0.19	0.45	0.19	0.45

These modifications would result in greater protection of the wolf prey base and potential wolf travel corridors under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Renewable energy and transportation project development can affect wolves directly during construction through disturbance at den and rendezvous sites and indirectly through effects to deer habitat and increased vulnerability to harvest. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to wolves, their habitats, and their prey base during project construction and operation. Additionally, it is assumed that all projects would implement existing Forest Plan standards and guidelines for wolves to further minimize impacts.

Bald Eagle

Timber harvest (both old-growth and young-growth) and associated activities which create noise and disturbance (e.g., blasting and helicopter logging) have the potential to result in minor, temporary disturbance to individual bald eagles. As required by the Forest Plan, all alternatives would be conducted implemented in accordance with the Bald and Golden Eagle Protection Act, including maintaining appropriate distances from active bald eagle nests. Riparian and beach and estuary standards and guidelines, as well as OGRs and other non-development LUDs, protect bald eagle habitat on the Tongass. Alternatives 2, 3, 4, and 5 propose young-growth harvest to varying extents in the beach and estuary fringe and/or RMAs (Alternatives 2 and 5 only). Management activities in these areas could disturb eagles and reduce the protection afforded to suitable bald eagle habitat. Alternative 5 allows commercial management of young growth (up to 10-acre openings) in the beach and estuary fringe and RMAs for the first 15 years after plan approval, so would delay development of future trees/snags suitable for eagle nesting, perching, and roosting; it includes a minimum 200-foot forested buffer along the shore (beach) that would continue to protect some eagle perching or roosting trees during that time. Alternatives 2, 3, and 4 allow commercial thinning of young growth in the beach buffer to continue into the future, beyond 15 years, so could have longer term effects on eagle habitat. In addition, Alternative 2 allows even-aged management for up to 15 years (harvest opening size limited by Scenery standards only) in the beach and estuary fringe and commercial thinning in RMAs (no time limit specified). Alternatives 3 and 4 would not allow even-aged management in the beach and estuary fringe and do not propose harvest in RMAs and would therefore have less impact on eagles than Alternatives 2 and 5. No harvesting in the beach and estuary fringe or RMAs would occur under Alternative 1.

Many of young growth trees harvested would be of insufficient size to be suitable for nesting or preferable for roosting. Harvest of young growth has potential to disturb eagles, especially if helicopter harvest methods are used. Timing restrictions would apply near active eagle nests in the vicinity of harvest activities to minimize disturbance to eagles or the abandonment of nests.

Renewable energy and transportation project development can affect bald eagles directly during construction through disturbance and through habitat removal or alteration. During operation, electrocution with powerlines and/or collisions with project structures are a potential risk. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. This would include adherence to the MBTA, Bald and Golden Eagle Protection Act, and guidelines such as APLIC standards for transmission lines (EEI et al. 2006). These measures would minimize impacts to bald eagles and their habitats during project construction and operation.

Red Squirrel, Red-breasted Sapsucker, Hairy Woodpecker, and Brown Creeper

These species are associated with old-growth forest and extensive quality habitat is protected through the conservation system, particularly old-growth reserves and non-development LUDs. In the matrix, these species rely on legacy components (e.g., large diameter trees, snags) of the old-growth forest ecosystem for nesting and foraging. All of the alternatives would result in the removal of nesting and foraging habitat (POG forest; Tables 3.9-12, 3.9-13, and 3.9-14). Red-breasted sapsuckers are most closely associated with low-volume old-growth; whereas hairy woodpeckers and brown creepers are associated with high-volume and large-tree, respectively. Red squirrels are more versatile and will use young-growth stands as young as 40 years of age. Indirect effects to these species would be associated with fragmentation and the reduction in POG patch sizes. Fragmentation reduces the amount and effectiveness of interior old-growth forest habitat by creating habitat edges along which there may be increased rates of nest predation by avian predators (Kissling and Garton 2008). It is assumed that alternatives that harvest more POG would have greater effects to these species. The greatest amount of POG harvest would occur under Alternative 1, followed by Alternatives 5, 4, 3, and 2 (Table 3.9-9). Harvest of young-growth stands would have minimal fragmentation-related effects to these species because old-growth interior forest conditions preferred by these species would not be affected. However, connectivity for red squirrels could be locally reduced because this species may use mature young-growth stands that are suitable for commercial harvest.

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of red squirrel, red-breasted sapsucker, hairy woodpecker, and brown creeper habitat (total POG) within the reserve system. The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase of 7,148 acres of POG forest included in the reserve system (Appendix E). These modifications would result in greater protection of habitats used by these species under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Alternatives 1, 2, 3, 4, and 5 would incorporate the Legacy Forest Structure standards and guidelines which are intended to maintain old-growth structure in areas that are already highly developed, as well as areas that will experience increased harvest levels over the life of the Forest Plan. These components (large trees and snags) may provide nesting and foraging habitat for the red-squirrels, red-breasted sapsuckers, hairy woodpeckers, and brown creepers. Alternatives 2, 3, 4, and 5 include a proposed clarification that the list of VCUs where the Legacy Forest Structure standards and guidelines apply should be verified during project-specific planning and analysis. Alternatives 3 and 4 also include a new management approach for these standards and guidelines to indicate that when implementing young-growth harvest projects larger than 20 acres in VCUs that have received concentrated past old-growth harvest it is intended that 30 percent of the young-growth stand acres should be left to retain residual trees to diversify structural characteristics and promote future recruitment of snags. Therefore, the proposed clarification would provide greater protection of habitats used by these species in managed forest stands

Renewable energy and transportation projects could affect red squirrels, red-breasted sapsuckers, hairy woodpeckers, and brown creepers during construction through direct disturbance or through removal or modification of habitats. During operation, the potential for collision with project structures is a risk. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address these species; however, they do specify consideration of the most current science, guidance (e.g., APLIC guidelines; EEI et al. 2006), and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to these species and their habitats during project construction and operation.

Vancouver Canada Goose

Vancouver Canada geese use wetlands (forested and non-forested) in the estuary, riparian, and uplands areas of the forest. Habitat needs for this subspecies are specifically provided for under the waterfowl standards and guidelines, which apply to specific sites, and a 100-foot buffer around lakes or streams. The beach, estuary, and riparian Forest-wide standards and guidelines provide additional protection to habitats used by Vancouver Canada geese. Alternatives that propose the most harvest of forested wetlands and that would allow young-growth harvest within the beach and estuary fringe and RMAs would result in the greatest loss of suitable habitat for this species. After full implementation of the Forest Plan (100 years), the greatest effects to forested wetlands would occur under Alternative 1 (28,923 acres), followed by Alternatives 2 (28,681 acres), 5 (28,265 acres), 3 (28,142 acres), and 4 (26,305 acres); see *Wetlands* section for additional discussion. Young-growth harvest within beach and estuary fringe and RMAs are presented in Table 3.9-13 and discussed above under Black Bear. Alternative 2 would have the greatest effects to habitats used by geese, followed by Alternatives 3, 4, and 5; no harvest in the beach and estuary fringe or RMAs would occur under Alternative 1.

Renewable energy and transportation projects could affect the Vancouver Canada goose during construction through direct disturbance or through removal or modification of habitats. During operation electrocution and collision with project structures is a risk. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance (e.g., APLIC guidelines; EEI et al. 2006), and methodologies related to avoiding and minimizing wildlife impacts. This would include adherence to the MBTA. These measures would minimize impacts to Vancouver Canada geese and their habitats during project construction and operation.

Other Species

Migratory Birds

All of the alternatives would result in a reduction of perching, foraging, and potential nesting habitat and the increase in fragmentation associated with timber harvest and road building. After timber harvest, there would be a short-term increase in the habitat for species associated with early successional habitats and forest edges, which may result in short-term population growth for these species. However, extended local reductions in available habitat would be expected as forest succession progresses. Habitat removal would reduce the effectiveness of interior forest habitat, and increase the potential for nest predation and nest parasitism for some species, which can ultimately reduce reproductive success (Robinson et al. 1995). Migratory birds would be most susceptible to impacts from harvest activities occurring in suitable nesting habitat during the nesting/fledging period, which generally begins in mid-April and ends about mid-July, when young birds have fledged.

The migratory bird species most likely to be adversely affected by the harvest of POG forest under all of the alternatives are those that primarily nest in POG forests, including the Western screech-owl, rufous hummingbird, red-breasted sapsucker, Pacific-slope flycatcher, Steller’s jay, northwestern crow, chestnut-backed chickadee, golden-crowned kinglet, varied thrush, Townsend's warbler, blackpoll warbler, northern goshawk and marbled murrelet. Alternatives that harvest more POG and result in greater increases in the number of POG patches on the landscape would be expected to have greater effects to these migratory bird species. The greatest amount of POG harvest would occur under Alternative 1, followed by Alternatives 4, 5, 3, and 2 (Tables 3.10-8, 3.9-12, 3.9-13, and 3.9-14). However, species associated with early successional or scrub habitats such as the MacGillivray’s warbler, golden-crowned sparrow, and golden-crowned kinglet would benefit through increases in suitable habitat over the short- to mid-term from timber harvest. All migratory bird species would benefit from the transition to young-growth harvest proposed under the action alternatives due to the reduced long-term scheduling of POG harvest.

At the project level, effects to migratory birds can be minimized by altering the season of activity, retaining snags, maintaining the integrity of breeding sites, considering key winter and migration areas, and minimizing pollution or detrimental alteration of habitats (USDA Forest Service 2008c). Under all alternatives, migratory bird habitat would be maintained by the Forest Plan Conservation Strategy. Alternatives 1, 2, 3, 4, and 5 include the Legacy Forest Structure standard and guideline that protect habitat features that are important for migratory birds on a stand level. Alternatives 2, 3, 4, and 5 include a proposed clarification that the list of VCUs where the Legacy Forest Structure standards and guidelines apply should be verified during project-specific planning and analysis. Alternatives 3 and 4 also include a new management approach for these standards and guidelines to indicate that when implementing young-growth harvest projects larger than 20 acres in VCUs that have received concentrated past old-growth harvest it is intended that 30 percent of the young-growth stand acres should be left to retain residual trees to diversify structural characteristics and promote future recruitment of snags. These clarifications would benefit migratory birds by maintaining forest structural components (dead trees and snags) in managed stands.

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of POG forest within the reserve system and used by many species of migratory bird species for nesting and foraging. The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase of 7,148 acres of POG forest included in the reserve system (Appendix E). These modifications would result in greater protection of habitats used by migratory birds under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Renewable energy and transportation projects could affect migratory during construction through direct disturbance or through removal or modification of nesting habitats. During operation collision with project structures is a risk. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address migratory birds; however, they do specify consideration of the most current science, guidance (e.g., APLIC guidelines; EEI et al. 2006), and methodologies related to avoiding and minimizing wildlife impacts. This would include adherence to the MBTA. These measures would minimize impacts to migratory birds and their habitats during project construction and operation.

Marbled Murrelets

Marbled murrelets nest in structurally complex old-growth forest stands (Piatt et al. 2007). As a result, timber harvesting and road construction within POG forest stands (especially high-volume POG) can remove nest trees or disturb nesting birds. Indirectly, timber harvest and road building increase fragmentation, reducing the effectiveness of interior forest habitat and creating habitat edges along which there may be increased rates of nest predation by avian predators. Alternatives that harvest the most POG forest would be expected to have the greatest direct and indirect effects to marbled murrelets (Tables 3.9-12, 3.9-13, and 3.9-14). The greatest amount of POG harvest would occur under Alternative 1, followed by Alternatives 5, 4, 3, and 2 (Table 3.9-9). Under all alternatives, marbled murrelet nesting habitat would be protected by the Forest Plan conservation strategy.

The transition to young-growth harvest would benefit this species through the retention of a greater amount of POG forest on the landscape over the planning horizon. Moreover, many of young-growth trees harvested would be of insufficient size to be suitable for nesting. Additionally, harvest of young-growth stands would have minimal fragmentation-related effects to this species because old-growth interior forest conditions preferred by this species for nesting would not be affected.

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the Biodiversity section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, decreasing the amount of marbled murrelet habitat (total POG) within the reserve system. The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase of 7,148 acres of POG forest included in the reserve system (Appendix E). These modifications would result in greater protection of habitats used by marbled murrelets under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Alternatives 1, 2, 3, 4, and 5 would incorporate the Legacy Forest Structure standards and guidelines which are intended to maintain old-growth structure in areas that are already highly developed, as well as areas that will experience increased harvest levels over the life of the Forest Plan. These components (large trees and snags) may provide nesting habitat for marbled murrelets. Alternatives 2, 3, 4, and 5 include a proposed clarification that the list of VCUs where the Legacy Forest Structure standards and guidelines apply should be verified during project-specific planning and analysis. The proposed clarification would provide greater protection of habitats used by marbled murrelets in managed forest stands

Renewable energy and transportation projects could affect marbled murrelets during construction through direct disturbance or through removal or modification of habitat. During operation, the potential for collision with project structures is a risk. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address this species; however, they do specify consideration of the most current science, guidance (e.g., APLIC guidelines; EEI et al. 2006), and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to marbled murrelets and their habitats during project construction and operation.

Bats

All bat species known to occur in southeast Alaska are associated with mature forested habitats which provide roosting, breeding, and foraging sites, and bat activity appears rare in young-growth forest (ACCS 2016). Old-growth timber harvest would remove POG, thereby reducing the number of potential day-roosts available to tree-roosting bats and foraging habitat. Indirectly, timber harvest may also reduce the suitability remaining roosting habitat through increased fragmentation (and decreased patch sizes) as day-roosts are more likely to be selected for some species (e.g., Keen's myotis and silver-haired bat) if they are located in stands with a higher number of trees in early to late decay stages (Boland et al. 2009).

Therefore, alternatives that harvest the most POG would be expected to have the greatest effect to the bats. The greatest amount of POG harvest would occur under Alternative 1, followed by Alternatives 4, 5, 3, and 2 (Tables 3.10-8, 3.9-12, 3.9-13, and 3.9-14). However, it should be noted tree-roosting species may choose a large-diameter tree for roosting regardless of whether or not it is located in an area with past timber harvest (Boland et al. 2009). Habitat and landscape connectivity would be provided for these species by the Forest Plan conservation strategy.

Amphibians

Amphibians require both aquatic and terrestrial habitats in order to complete their life-cycle. Ponds, streams, and wetlands used by amphibians for breeding are protected by Forest Plan Riparian and Wetland standards and guidelines. However, increased sedimentation and the entry of contaminated run-off from roads resulting from timber harvest (both young-growth and old-growth) can reduce the quality of these habitats. Under all alternatives, standard BMPs for water quality would be implemented to minimize these effects (see the Fisheries section for additional discussion).

Amphibians have very limited physiological mechanisms for preventing water loss, and therefore require relatively cool, moist forested habitats, in conjunction with underground refuges or coarse woody debris to maintain high moisture levels (Semlitsch et al 2009). Timber harvest (both old-growth and young-growth) has the potential to result in the loss and/or degradation of terrestrial habitats through changes in microclimates, soil compaction, and leaf litter disturbance. Tree canopy removal increases solar radiation to the forest floor, resulting in changes in moisture and soil temperatures which can make terrestrial habitats unsuitable for amphibians. Thinning or uneven-aged harvest techniques may reduce these effects.

Amphibians also possess small home ranges and relatively limited dispersal capabilities compared to other wildlife species. Therefore, timber harvest (both old-growth and young-growth) can affect the interchange between populations if harvest units do possess suitable microclimates or habitat features (e.g., course woody debris) for amphibians to cross. Likewise, road development can preclude amphibian movement and can also result in direct mortality to adults moving between breeding and upland terrestrial habitats.

The effects of specific harvest treatments on amphibians is complex. Some amphibians in the aquatic stage may be affected positively by even-aged harvest techniques (clearcutting), whereas effects of these treatments on juvenile and adult terrestrial stages are mostly negative (Semlitsch et al. 2009). Moreover, uneven-aged (partial) harvest treatments have been shown to produce both positive and weaker negative responses than even-aged treatments. Therefore, it is assumed here that alternatives that propose the most total POG harvest, regardless of treatment, would have the greatest potential for adverse effects to amphibians, as these forest stands provide optimal habitat conditions for amphibians. The greatest amount of POG harvest would occur under Alternative 1, followed by Alternatives 4, 5, 3, and 2 (Tables 3.10-8, 3.9-12, 3.9-13, and 3.9-14).

Renewable energy and transportation projects could affect amphibians through direct disturbance or through removal or modification of habitats, particular if activities affect water bodies. The proposed Forest-wide Renewable Energy and Transportation Systems Corridors standards and guidelines under Alternatives 2, 3, 4, and 5 do not directly address these species; however, they do specify consideration of the most current science, guidance, and methodologies related to avoiding and minimizing wildlife impacts. These measures would minimize impacts to amphibians and their habitats during project construction and operation.

Endemism

By definition, endemic species occur in isolated populations and many have limited mobility or specific habitat requirements. Thus, they are vulnerable to the effects of habitat loss and fragmentation, introduced non-natives, pathogens and disease, natural events (i.e., climate change), and overharvesting (Dawson et al. 2007). Therefore, the ability to disperse and recolonize is an important factor in how endemic species are able to respond to environmental changes.

Timber harvest and road construction/reconstruction proposed under all alternatives would directly affect endemic species through habitat loss (POG) and fragmentation (reduced patch size), and by altering the distribution of habitats across the landscape. This may inhibit the ability of individuals to move between patches of suitable habitat, and therefore may further limit the distribution of a population or reduce genetic interchange between subpopulations. These effects would occur to a less extent in association with young-growth harvest as these stands provide lower quality habitat to most endemic species. Timber harvest by alternative is presented in Tables 3.10-8 and 3.10-9; landscape connectivity and fragmentation are discussed in detail in the *Biodiversity* section. Most endemic species would benefit from the transition to young-growth harvest proposed under the alternatives due to the reduced amount of scheduled POG harvest over the long term. Effects would be greatest under Alternative 1, followed by Alternatives 4, 5, 3, and 2 (ranging from most to least POG harvest over 100 years of Forest Plan implementation).

Alternatives 2, 3, 4, and 5 propose modifications to OGRs that compensate for effects associated with the Sealaska land conveyance (see the *Biodiversity* section and Appendix E for additional discussion). The land conveyance removed portions of OGRs, reducing connectivity between reserves and decreasing the amount of POG forest and other important habitat features (e.g., streams, low elevation POG forest, and large-tree POG stands) within the reserve system and used by endemic species (Appendix E). The proposed modifications to the existing (i.e., post-conveyance) OGRs would result in a net increase of 7,148 acres of total POG (including 6,696 acres of low-elevation POG and 3,066 acres of large-tree POG) and 31 Class I stream miles included in the reserve system (Appendix E). These modifications would result in greater protection of habitats used by endemic species, as well as greater connectivity between reserves and to the shoreline, under the Conservation Strategy than would occur as a result of the land conveyance without these changes.

Prince of Wales Flying Squirrel

A thorough analysis of this species occurred during the 1997 and 2008 Forest Plan efforts and results documented that the conservation strategy was functioning adequately to maintain the viability of this species in the planning area (USDA Forest Service 1997b, Appendix N; 2008b, Appendix D). Prince of Wales flying squirrels are closely associated with old-growth structural characteristics and are limited by their dispersal capabilities. Densities of flying squirrels are linked to structural features common in POG forests such as large-diameter downed woody debris, snags, and tall trees (Smith et al. 2004) and abundance has been shown to be reduced by forestry practices that influenced the structure or age of residual stands (Smith et al. 2011). Additionally, due to their gliding locomotion, forest openings resulting from timber harvest can act as dispersal barriers if flying squirrels are not able to traverse openings (Flaherty et al. 2008, 2010; Smith et al. 2011). This subspecies has a limited gliding range (approximately 250 feet), a distance substantially less than the average clearcut width (Flaherty et al. 2008). Fragmentation resulting from old-growth timber harvest has the potential to reduce the value of residual patches of old growth in the matrix if they become isolated from adjacent patches either by distance or habitat type (young growth). Old-growth timber harvest under all alternatives would reduce the quality and quantity of flying squirrel nesting, foraging, and denning habitat but effects would be expected to be greatest under alternatives that propose the most POG harvest (Table 3.10-8). Alternatives that harvest the most POG and result in the greatest increase in the fragmentation be expected to have the greatest effect to the Prince of Wales flying squirrel due to their limited dispersal capabilities. The greatest amount of POG harvest (and thus the greatest effects to this species) would occur under Alternative 1, followed by Alternatives 4, 5, 3, and 2. The Forest Plan Conservation Strategy would continue to maintain suitable old-growth habitat and provide landscape connectivity for flying squirrels.

Young-growth management proposed under Alternatives 2, 3, 4, and 5 (particularly commercial thinning) could benefit flying squirrels over the short-term by increasing canopy height and creating more open space in the midstory -

conditions which facilitate efficient gliding (Scheib et al. 2006). Over the long-term, commercial thinning would promote stand development toward conditions capable of supporting breeding flying squirrels and improve the functional connectivity between old-growth reserves (Smith et al. 2011).

Prince of Wales Spruce Grouse

Prince of Wales spruce grouse are associated with muskegs, high-volume POG, and mixed conifer (scrub) habitats but will also use young-growth forest (15-30 years following timber harvest) with a well-developed middle story. Because they are associated with microhabitats within POG forests, old-growth timber harvest would alter habitat availability for this species, though effects would change over time. Prince of Wales spruce grouse avoid young (less than 5 years) clearcuts presumably due to the presence of large amounts of debris that inhibit movement, increased exposure to predators, and lack of food. However, as the understory vegetation develops, peaking after 15 to 30 years, grouse likely benefit from increased berry production and cover for chicks (Russell 1999). After this, forest conditions become unfavorable to spruce grouse, characterized by canopy closure, high stem densities, and little understory vegetation due to reduced light which reduces the overall structural and horizontal diversity of the stand (USFWS 2010). These conditions can persist up to 150 years after even-aged timber harvest. Thus, old-growth timber harvest under all action alternatives would have a short-term benefit to grouse due to increased forage availability, followed by an extended period in which habitat conditions in harvested units would not be suitable. Young-growth harvest would provide similar short-term benefits to this species in the years following stand treatments. However, even-aged harvest of both old-growth and young-growth forest would initially (i.e., within the first 5 years after harvest) result in habitat patches unsuitable for spruce grouse, which may result in local impediments to movement. Due to their generally sedentary nature and preference for walking rather than flying, fragmentation due to old-growth and young-growth even-aged timber harvest can result in the isolation of local spruce grouse populations (i.e., if open areas are too large or forested patches are spread too far apart to enable spruce grouse to move between them). However, thinning and group selection treatments can promote the development of structural and horizontal diversity beneficial to grouse (Russell 1999).

Increased road densities associated with timber harvest (both young-growth and POG forest) could also adversely affect spruce grouse by increasing hunter access (USFWS 2010). None of the alternatives propose measurable increases in average WAA road densities and therefore would not be expected to result in increased harvest risk at the forest level. Localized increases in road densities would be managed through road closures and storage or decommissioning which would minimize the potential for increased harvest risk for spruce grouse over the long term.

Alternatives that harvest the most POG and result in the greatest increase in the fragmentation be expected to have the greatest effect to the Prince of Wales spruce grouse, due to their limited dispersal capabilities. The greatest amount of POG harvest, and thus the greatest effects to this species, would occur under Alternative 1, followed by Alternatives 4, 5, 3, and 2. The Forest Plan Conservation Strategy would continue to suitable habitat and provide landscape connectivity for spruce grouse.

Invasive Species

Although a number of non-native wildlife species have been accidentally introduced or deliberately transplanted in Southeast Alaska, the only species considered invasive (i.e., based on the definition that they cause harm to the economy, environment, or humans) at the present time is the Norway rat. Elk in Southeast Alaska may be considered invasive in certain geographic areas due to their effects on habitat and competition with native species in areas where they were not intentionally introduced. None of the alternatives propose changes to the management of the Tongass in relation to invasive species and no invasive wildlife species are addressed under the Forest Plan Monitoring section or standards and guidelines. However, the Alaska Region of the Forest Service is currently developing an invasive species strategy that will apply the principles of prevention, early detection, control, and rehabilitation in cooperation with various agencies and partners.

Activities that create or enhance the habitats preferred by invasive species may facilitate range expansion. Timber harvest and associated management activities would occur under all alternatives, but would have no effect on the spread of Norway rats or elk.

Cumulative Effects

Activities that occur on other land ownerships within and adjacent to the Tongass have the potential to affect the overall context within which effects to wildlife are considered. Appendix C of this EIS provides a full list of all the projects considered in the cumulative effects analysis. Such reasonably foreseeable activities include, but are not limited to, timber harvest, residential development, mining, recreation and tourism, and road construction. Typically these activities have the potential to negatively impact wildlife populations through habitat conversion, fragmentation, and disturbance associated with road building, though some activities can have short-term or long-term beneficial impacts, depending on the species. Prediction of the future extent and intensity of such activities has a high degree of uncertainty associated with it on a Forest-wide basis over a broad time scale. This analysis is conservative in that it assumes harvest of all non-NFS lands over the planning horizon.

Many private lands in Southeast Alaska are already highly developed in terms of roading and timber harvest and are likely to experience a continuing decline in old-growth forest in the future. Therefore, the cumulative long-term trend within the Forest boundary under all alternatives is likely to be a decline in optimum habitat for most old-growth associated species, with non-NFS land contributing to this trend. Additionally, future land exchanges and conveyances (e.g., Mental Health Trust) have the potential to remove some lands from protection under the Conservation Strategy. The Forest Service would continue to evaluate opportunities to compensate for these losses by evaluating additional OGR modifications when these land exchanges or conveyances are implemented.

The transition to young-growth harvest on the Tongass would benefit wildlife species by reducing the overall amount of POG forest harvested over the planning horizon. Activities such as pre-commercial and commercial thinning would have both short-term (increased forage availability) and long-term (promotion of the development of old-growth forest stand characteristics) to wildlife species that use POG forests on the Tongass. The young-growth harvest proposed under Alternatives 2, 3, 4, and 5 would contribute to similar beneficial effects of ongoing young-growth management activities (e.g., restoration efforts and other forest thinning activities) on the Tongass, although effects under alternatives that allow commercial thinning would be delayed if stands are actively managed throughout the life of the Forest Plan. The following discussion addresses the effects of cumulative old-growth harvest resulting under the alternatives, with the transition to young-growth harvest proposed more aggressively under the action alternatives.

When combined with other management activities occurring on non-NFS lands, all alternatives would produce additional impacts (noted above) associated with continued old-growth harvest to species for which this forest type is optimal habitat, such as goshawks, marten, mountain goats, red squirrel, red-breasted sapsucker, hairy woodpecker, brown creeper, marbled murrelets, and bat species. However, these declines in habitat (and associated effects such as fragmentation) would be lessened to some extent through the transition to young-growth harvest on NFS lands under Alternatives 2, 3, 4, and 5. Cumulative effects are anticipated to be the greatest under Alternative 1, which proposes the highest amount of POG timber harvest, followed by Alternatives 4, 5, 3, and 2 (i.e., cumulative effects would be least under the alternatives that propose the shortest transition from old-growth to young-growth harvest), and would be most evident in areas where timber harvest is concentrated. Tables 3.9-16, 3.9-17, and 3.9-18 in the *Biodiversity* section summarize the maximum long-term cumulative percent of the original total, high-volume, and large-tree POG that would be harvested in Southeast Alaska on all ownerships by biogeographic province by alternative. After 100 years of Forest Plan implementation, cumulative POG harvest levels on all lands of Southeast Alaska would maintain approximately 83 percent of the original (1954) total POG under Alternative 1. Cumulative harvest levels would be less under Alternatives 2, 3, 4, and 5 but would also maintain approximately 83 percent of the original total POG (Table 3.9-16).

Cumulative effects to modeled deer habitat capability under the alternatives would range from maintenance of 78 percent of the original level under Alternatives 1, 4, and 5 and slight increase to 79 percent of the original level under Alternatives 2 and 3 in 25 years; at 100 years, the current Forest Plan would maintain 77 percent of the original level whereas the alternatives would result in a slight increase, maintaining 78 percent of original levels (Table 3.10-16). WAAs with the greatest impacts under the alternatives are located in GMU 2 (Prince of Wales and surrounding island) where concentrated past timber harvest has occurred (see the Project Record for detailed information on interagency deer model analysis results by WAA). Thus each of the alternatives may result in local declines in the deer population, due to reduced habitat capability which could affect wolves and thus hunters and trappers, but less so than under the current Forest Plan due to the reduction in old-growth harvest. However, commercial thinning proposed under the action alternatives, in combination with ongoing and foreseeable thinning conducted various watershed restoration plans would mitigate these effects to some extent. The USFWS Alexander Archipelago wolf species status assessment concluded that assuming continuation of current land use trends, the GMU 2 wolf population is anticipated to decline by another roughly 8 to 14 percent of current levels over the next 30 years (USFWS 2015). Although this could result in gaps in wolf distribution within GMU 2, given that it comprises just 6 percent of the population range wide, impacts to the overall distribution in Southeast Alaska or to species viability are not expected (USFWS 2015).

Table 3.10-16
Relative Changes in Deer Habitat Capability (DHC) by Biogeographic Province by Alternative in 25 years and 100 years based on the Interagency Deer Habitat Capability Model (All Lands)

	Biogeographic Province	Original Deer Habitat Capability (Deer/mi^2)	Existing Deer Habitat Capability as % Original	Deer Habitat Capability By Alternative (% Original Habitat Quality Remaining)									
				Alt 1		Alt 2		Alt 3		Alt 4		Alt 5	
				25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs	25 yrs	100 yrs
1	Yakutat Forelands	13.6	84%	82%	79%	84%	79%	84%	84%	84%	84%	84%	84%
2	Yakutat Uplands	2.3	98%	97%	97%	98%	97%	98%	98%	98%	98%	98%	98%
3	East Chichagof Island	14.4	74%	73%	72%	74%	73%	74%	73%	74%	73%	73%	73%
4	West Chichagof Island	14.0	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%	99%
5	East Baranof Island	8.3	81%	81%	81%	82%	81%	81%	81%	82%	81%	81%	81%
6	West Baranof Island	13.7	83%	83%	84%	84%	84%	84%	84%	83%	83%	84%	83%
7	Admiralty Island	18.3	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%	92%
8	Lynn Canal	6.2	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%
9	North Coast Range	7.2	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%
10	Kupreanof/Mitkof Island	19.6	76%	76%	75%	77%	76%	77%	76%	76%	76%	76%	75%
11	Kuiu Island	27.7	88%	88%	89%	88%	88%	88%	88%	88%	88%	88%	88%
12	Central Coast Range	9.5	92%	92%	92%	93%	92%	93%	92%	92%	92%	92%	92%
13	Etolin Island	18.7	79%	77%	76%	79%	78%	79%	77%	78%	76%	78%	76%
14	North Central Prince of Wales	24.7	54%	53%	52%	55%	53%	55%	53%	54%	52%	54%	52%
15	Revilla Island/ Cleveland Peninsula	13.6	79%	79%	78%	79%	79%	79%	78%	79%	78%	79%	78%
16	Southern Outer Islands	31.8	81%	81%	80%	82%	81%	82%	81%	82%	80%	82%	80%
17	Dall Island and Vicinity	25.4	66%	66%	66%	66%	66%	66%	66%	66%	66%	66%	66%
18	South Prince of Wales	22.6	82%	82%	81%	82%	82%	82%	82%	82%	81%	82%	81%
19	North Misty Fiords	3.8	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%	97%
20	South Misty Fiords	8.2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
21	Ice Fields	0.8	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%	93%
	Forest-wide	**11.8**	**78%**	**78%**	**77%**	**79%**	**78%**	**79%**	**78%**	**78%**	**78%**	**78%**	**78%**

Populations are threatened with extinction for a variety of reasons and habitat loss is recognized as an important threat (Pimm et al 1988; Wilcove et al. 1998). When habitat conditions represent the primary threat to persistence, the likelihood of a wildlife population persisting over time has been suggested to be related to some threshold level of habitat loss on the landscape (Fahrig 1997, 1999, 2003; Flather et al. 2002; Andren 1994). After reaching this threshold, the rate of population decline, and thus the likelihood of extinction, may increase (Haufler 2006). Reported threshold levels (percentage of habitat maintained on the landscape) range from 20 percent (Fahrig 1997) to 50 percent (Soule and Sanjayan 1998), depending in part on the dispersal capability of the species under consideration. No specific threshold has been determined for the Tongass; however, all of the biogeographic provinces on the Tongass would maintain at least 57 percent of the original (1954) POG after 100 years of Forest Plan implementation. Moreover, all of the action alternatives would maintain 80 percent or more of the original (1954) total POG forest in 18 of 21 biogeographic provinces over this period (Table 3.9-16).

However, there are portions of the Tongass where cumulative effects become more important due to the level of past harvest that has occurred. Specifically, the North Central Prince of Wales and Kupreanof/Mitkof Islands biogeographic provinces have experienced some of the highest reductions in original (1954) POG forest on the Tongass and are also where much of the young-growth suitable for commercial timber production is located (see the Suitable Land maps in the Map Packet that accompanies this EIS). Additional timber harvest (young-growth and POG forest), particularly when located adjacent to previously harvested areas, has a greater potential to result in localized reductions in landscape connectivity and gaps in species distributions in these more heavily harvested areas compared to portions of the Tongass that have less cumulative past timber harvest. These cumulative effects would be most likely to occur for species with very limited ranges (endemic species limited to individual islands or island groups such as the Prince of Wales flying squirrel, Prince of Wales spruce grouse) or with limited dispersal capabilities or dispersal capabilities that are dependent on certain mature forest structural characteristics (e.g., goshawks, amphibians, flying squirrels, spruce grouse).

Species with limited dispersal capabilities (i.e., flying squirrels and spruce grouse, which are also endemic species) are likely to be more sensitive to habitat loss and fragmentation than species with greater dispersal capabilities (i.e., goshawks, wolves, and brown bears; D'eon et al. 2002). Natural fragmentation of habitats can also affect the level of additional fragmentation that can be supported. The Forest Plan Conservation Strategy would continue to provide for extensive areas in reserves, distributed across the Forest. The Legacy Forest Structure and other standards and guidelines that retain POG forest in harvested areas (e.g., beach and estuary fringe, RMAs, and Scenic Integrity Objectives) would also ensure the maintenance of a functional and interconnected old-growth ecosystem on the Tongass. These features are important for species associated with shoreline and riparian habitats such as river otters, black bears, brown bears, bald eagles, and Vancouver Canada geese, These measures, particularly when implemented in areas that have experienced concentrated past harvest increase the likelihood that these landscapes will continue to provide the full range of matrix functions that support viable and well-distributed populations of wildlife species.

As discussed in detail in Appendix D, the alternatives that propose young-growth harvest in the beach and estuary fringes (Alternatives 2, 3, 4, and 5), RMAs (Alternatives 2 and 5), and old-growth reserves and/or other non-development LUDs (Alternatives 2, 3, and 5) all have the potential to affect the functioning of these contributing elements of the Conservation Strategy. However, due to the scale and distribution of suitable young growth in these areas (see Appendix D and the Suitable Land maps in the Map Packet that accompanies this EIS) all of the alternatives have the potential to result in localized reductions in intactness and effectiveness of these areas in providing habitat and facilitating movement of wildlife across the landscape; however, all alternatives are expected to maintain the integrity of the conservation strategy as a whole and its ability to maintain viable and well-distributed wildlife populations across the Tongass. Viability associated with individual wildlife species is discussed in more detail below.

Additional effects, associated with the cumulative timber harvest described above, include road construction, which has the potential to impact wildlife species through habitat fragmentation especially migratory birds, amphibians, and other interior-forest associated species, and access-related disturbance (increased harvest risk especially for wolves, marten, and spruce grouse) and human-bear conflicts. Table 3.10-12 summarizes existing and proposed total (open and closed roads) cumulative road densities (all land ownerships included) by the proportion of WAAs within road density categories. Generally road densities on non-NFS lands are greater than those found on adjacent NFS lands. In addition, there are no road closure/access management restrictions in place on these lands to reduce effects to species sensitive to access provided by roads. Forest-wide cumulative total and open road densities (NFS and non-NFS lands) would increase by 0.11 to 0.12 miles per square mile above current conditions (Table 3.10-12). When taking only lands below 1,200 feet elevation into account, representative of low elevation habitats used be wolves and deer, Under the action alternatives Forest-wide cumulative total and open road densities (NFS and non-NFS lands) would increase by 0.04 miles per square mile, and between 0.21 and 0.23 miles per square mile above current conditions, respectively (Table 3.10-15).

All of the alternatives would result in vessel traffic and marine activity associated with LTF use and log transport, which would occur irregularly over the life of the Forest Plan (in association with individual old-growth and young-growth timber harvest projects as they are proposed). Therefore all of the alternatives would make a minor contribution to the existing potential for oil or fuel spills associated with existing vessel activity and bark accumulations near the LTFs to which marine and shoreline-associated species such as black oystercatchers, Aleutian terns, short-tailed albatrosses, humpback whales, and Steller's sea lions would be exposed. However, levels of marine activity are expected to remain within levels anticipated for the current Forest Plan (Alternative 1) under all of the action alternatives given that the 2008 Forest Plan assumed a level of old-growth timber harvest far greater than what has occurred (see Appendix D). Therefore, any marine activities associated with young-growth harvest have been accounted for. Furthermore, all activities at the project level would be conducted in accordance with Alaska Water Quality Standards under Section 401 of the Clean Water Act for log transfer facilities (ADEC 2011). These standards place restrictions on the types, quantities, and extent of discharges (including bark) to the marine environment and would limit the effects of the project on water quality. Therefore, very minor contributions to cumulative effects in the marine environment are anticipated under all of the alternatives.

Climate change may also contribute to cumulative effects. Warmer temperatures and decreased precipitation are anticipated to result in changes to vegetation and thus, the suitability of wildlife habitat, among other impacts (Haufler et al. 2010, Shanley et al. 2015; see *Climate and Air* section). Although many species may benefit (e.g., greater overwinter survival of deer, and thus a greater prey base for wolves, resulting from warmer winter temperatures during normal years), habitat changes resulting from a longer growing season, wind, fires, insect infestations, and disease may have variable effects on others. The greatest concerns for wildlife populations in relation to climate change, however, are the weather extremes that can be expected to occur periodically (Haufler et al. 2010). Periodic severe winter snowfalls, which may seem counterintuitive given the general warming trend, are anticipated (SNAP 2010). These stochastic events would be of greatest concern for populations that are limited in number or distribution. The Forest Plan Conservation Strategy was designed to maintain a resilient old-growth forest ecosystem in the face of this uncertainty. The potential for contributions to climate change from continued old-growth timber harvest on the Tongass, which could indirectly affect wildlife species such as the Kittlitz's murrelet, is described in detail in Section 3.1 – *Climate and Air Quality*.

Wildlife Viability

A series of wildlife panel assessments were conducted to evaluate the likelihood that plan alternatives for the 1997 Forest Plan would maintain habitat sufficient to support viable and well-distributed populations of select wildlife species across the planning area over a 100-year horizon. Panel assessments were conducted for goshawks, wolves, marten, brown bears, marbled murrelets, and "other terrestrial mammals" (including endemic species such as the Prince of Wales flying squirrel). These species or species groups were selected because collectively their ecologies were thought to incorporate the breadth of forest habitat features and other attributes of environmental variation represented across the Forest (Shaw 1999). They were also thought to be representative of species that are sensitive to disturbance and potentially at risk of either becoming locally extirpated or jeopardizing cultural or subsistence uses.

The 1997 Forest Plan wildlife panel assessments were conducted under the 1982 Planning Rule. Federal regulations for implementing the National Forest Management Act (USDA Forest Service 1982 [36 CFR 219.19:43048]) state: "Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." A viable population was defined for planning purposes as "one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area." Furthermore, "habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that individuals can interact with others in the planning area (USDA Forest Service 1997b, Appendix N).

The panel assessment process was designed to provide the context for, and guide the development of, the Forest Plan Conservation Strategy. Through each panel's evaluation, habitat conditions and/or management components (e.g., reserves, beach buffers) emerged as being important to providing sufficient habitat to maintain well-distributed, viable populations of each species or species group. The results of the panel assessments are included in Appendix N to the 1997 Forest Plan FEIS (USDA Forest Service 1997b) and summarized (and supplemented with new information) in Appendix D of the 2008 Forest Plan FEIS (USDA Forest Service 2008b).

Although the panel assessments do not directly address the alternatives evaluated in this EIS, the ability of the proposed Forest Plan Amendment to continue to maintain viable, well-distributed wildlife populations can be assessed based on two related premises. First, it can be assumed that if the integrity of the Forest Plan Conservation Strategy is maintained, there is a high likelihood that the Forest Plan Amendment would continue to provide habitat sufficient to support viable well-distributed wildlife populations and therefore maintain the diversity of plant and animal communities. Second, if the Forest Plan Amendment maintains the key habitat factors identified as important to maintaining viability by the panel assessments for each species or species group, then there is a high likelihood that the Forest Plan Amendment would be at least as likely as the current Forest Plan to maintain viable, well-distributed populations of these species or species groups in the planning area.

A detailed analysis of the Forest Plan Conservation Strategy, indicating that none of the alternatives would compromise its integrity, is included in Appendix D of this EIS. Therefore, this topic is not discussed further here. The following discussion focuses on the key factors that formed the basis for the conclusions drawn in the 1997 Forest Plan panel assessments in relation to the proposed Forest Plan Amendment.

The transition to young-growth harvest proposed in the action alternatives would have a beneficial effect to wildlife species associated with old-growth forest by reducing the amount of old-growth timber harvest that would occur over the planning horizon. When developed for the 1997 Forest Plan, the Conservation Strategy was based on an assumed initial old-growth timber harvest rate of about 83,400 acres per decade. Over a period of 100 years (1996 to 2095), approximately 474,000 acres would be harvested. In contrast, the actual area harvested from 1996 to 2015 plus the projected harvest of old-growth through 2095 under each of the alternatives would result in a total of 70,300 to 100,500 acres of old-growth harvest. Thus, the transition to young-growth harvest, together with other changes to Tongass forest management (especially the 2001 Roadless Rule), would result in between 373,500 and 403,700 acres of old-growth forest remaining in 2095 that was projected to have been harvested by the panels assessing viability for the 1997 plan (see Appendix D for additional discussion). Therefore, many OGRs and non-Development LUDs would be surrounded by additional unharvested areas of POG forest and matrix lands would contain a substantially greater amount of POG forest than the amounts assumed during the development of the Forest Plan Conservation Strategy. Thus, panel assessment conclusions were based on assumptions that the Tongass would support far less old-growth forest than will be realized under the no action or any of the action alternatives.

For goshawks, the following were highlighted as important factors in maintaining a viable well-distributed population on the Tongass (2008 Forest Plan FEIS Appendix D, p. D-55-58; Iverson 1996a, 1997a)

- the amount and distribution of old-growth forest resulting from the reserve system together with the matrix, that is retained under maximum assumed harvest levels, was determined to be important for maintaining the distribution, persistence and habitat suitability for goshawks than the reserve system by itself, due to the wide-ranging nature of the species;
- the implementation of longer harvest rotations (100-200 years) to maintain forest structure sufficient to support prey populations and goshawk foraging (this is replaced by the substantial amount of unharvested POG under the current plan and alternatives);
- the implementation of additional measures for retaining POG in VCUs where more than 33 percent of the original POG had been harvested and where goshawk habitat had been highly fragmented (e.g., currently the Legacy standard and guideline); and

- the maintenance of POG within the beach and estuary buffers and RMAs to provide foraging and nesting habitat in the matrix, to support well-distributed populations across the planning area.

As noted above, all of the alternatives would maintain more POG within the matrix than the 1997 Forest Plan. This would likely outweigh the effects of increasing the harvest rotation (less than 100 years) in commercial young-growth stands, particularly because the harvested land base under these alternatives would be much less than assumed during development of the Conservation Strategy. Additionally, commercial young-growth harvest within the beach and estuary fringe (Alternatives 2, 3, 4, and 5) and RMAs (Alternatives 2 and 5) would be minor and localized. Forest-wide approximately 2.4 percent, 3.3 percent, 1.2 percent, and 0.4 percent of the forest land within the beach fringe consists of young-growth that would be harvested, under Alternatives 2, 3, 4, and 5, respectively (Table 6 in Appendix D of this EIS). Likewise, Forest-wide 0.3 to 6.7 percent of forest land within RMAs consist of young-growth that would be harvested, under Alternatives 2 and 5, respectively (Table 8 in Appendix D of this EIS). Moreover, the retention of TTRA buffers along streams, the provision under Alternative 2 to maintain a 1,000-foot corridor inland adjacent to shoreline harvest units, and the provision under Alternative 5 to maintain a 200-foot buffer along the shoreline would provide alternate low-elevation forested corridors which would maintain goshawk foraging habitat and reduce the likelihood of creating gaps in goshawk population distribution. At the project level, the extent of localized effects to goshawk habitat would be minimized through the implementation of Goshawk, Landscape Connectivity, and Legacy standards and guidelines which would help ensure that habitat components important to goshawks are maintained. For these reasons, all of the action alternatives would be expected to be at least as likely as the current Forest Plan to maintain a viable, well-distributed goshawk population on the Tongass.

For wolves, the following were highlighted as important factors in maintaining a viable well-distributed population on the Tongass (2008 Forest Plan FEIS Appendix D, p. D-63-65 Iverson 1996b, 1997b):

- the presence of large reserves to maintain roadless refugia (as a means of providing deer habitat capability and minimizing mortality risk by managing human access);
- the maintenance of deer habitat capability, particularly during winter, given its close link to wolf persistence; and
- the maintenance of demographic interchange among wolf packs to avoid gaps in distribution.

Large reserves (Old-growth Habitat and other non-development LUDs) would continue to function as roadless refugia for wolves under all action alternatives. None of the alternatives propose changes in the size or spacing of the reserve system or POG forest management (thereby maintaining deer habitat capability) within these areas. Although some alternatives propose young-growth harvest in the Old-growth Habitat LUD (Alternatives 2, 3, and 5) or other non-development LUDs (alternatives 2 and 3), these suitable young-growth stands are typically located along the shoreline or adjacent to existing road systems. Therefore, little change in wolf mortality risk due to increased road access in non-development LUDs is anticipated. Additionally, road densities (all LUDs considered) would remain comparable under all alternatives (see Wolf discussion above); therefore, at most, localized increases in hunter access would be expected under the action alternatives with no substantial increase across the Tongass.

Another important factor is related to the road development that was projected under the 1997 Forest Plan vs. what is projected under the current no action and action alternatives (see Appendix D). Under any of the alternatives, total road development on NFS lands is expected to be more than 2,000 miles less than that was projected to have been developed by the panels assessing viability for the 1997 Plan.

Under the current Forest Plan there would be a continued decline in deer habitat capability in some biogeographic provinces as a result of future POG harvest. However, this decline would be reduced under Alternatives 2, 3, 4, and 5 due to the transition to young-growth harvest. Therefore, the action alternatives would not be expected to affect the likelihood of wolf population persistence in the planning area. In GMU 2 where past harvest has been concentrated and where there are already concerns about wolf viability, any decline in deer habitat capability could result in localized gaps in wolf distribution. However, the recent USFWS Alexander Archipelago Wolf Species Status Assessment notes that, even with the anticipated continued decline in the GMU 2 wolf population, a viable population is still expected to be maintained in Southeast Alaska (USFWS 2015). With the transition to young-growth harvest, the likelihood of creating gaps in the wolf population in GMU 2 under the action alternatives is less than under the current Forest Plan. Therefore, all of the Action Alternatives would be expected to be at least as likely as the 2008 Forest Plan to maintain a viable, well-distributed wolf population on the Tongass.

For marten, the following were highlighted as important factors in maintaining a viable, well-distributed population on the Tongass (2008 Forest Plan FEIS Appendix D, p. D-59-63; Iverson 1996c, DeGayner 1997):

- The maintenance of late-seral forest and POG within beach and riparian zones for connectivity and prey diversity;
- The presences of large and medium reserves to provide roadless refugia for marten; and
- The implementation of other management measures to maintain habitat for marten within the matrix.

As noted above, all of the Action Alternatives would maintain more POG forest on the landscape than the current Forest Plan. Although commercial young-growth harvest within the beach and estuary fringe (alternatives 2 through 5) and RMAs (Alternatives 2 and 5) has the potential to reduce prey diversity and landscape connectivity for marten, effects would be minor and localized and would not be expected to result in gaps in the marten distribution (see discussion above for goshawks). Provisions under the alternatives including the retention of TTRA buffers along streams, a 1,000-foot corridor inland adjacent to shoreline harvest units (Alternative 2 only), and a 200-foot buffer along the shoreline (Alternative 5 only) would provide alternate low-elevation forested corridors which would maintain marten prey diversity and facilitate connectivity between reserves. At the project level, the extent of localized effects to marten habitat would be minimized through the implementation of Landscape Connectivity and Legacy standards and guidelines which would help ensure that connectivity and habitat components important to marten are maintained.

The effects of young-growth harvest within the reserve system (Alternatives 2, 3, and/or 5) would also be minor and localized. Forest-wide under all alternatives less than 3 percent of Old-growth Habitat LUD acres consist of projected young-growth harvest under all action alternatives. Likewise, Forest-wide less than 1 percent of other non-development LUD acres consist of projected young-growth harvest (Tables 3 and 4 in Appendix D of this EIS). Moreover, suitable young-growth stands within the reserve system are typically located along the shoreline or adjacent existing road systems. Therefore, no change in the ability of the reserve system to provide roadless refugia from trapping for marten is anticipated under any of the action alternatives. For these reasons, all of the action alternatives would be expected to be at least as likely as the current Forest Plan to maintain a viable, well-distributed marten population on the Tongass.

The Prince of Wales flying squirrel was identified by the panel assessment as the greatest viability concern among endemic species and is representative of species with limited ranges and dispersal capabilities. The following were highlighted as important factors in maintaining viable, well-distributed populations of Prince of Wales flying squirrels and other endemic species on the Tongass (2008 Forest Plan FEIS Appendix D, p. D-68-73; Julin 1995, Iverson 1997c):

- the overall level of old-growth timber harvest proposed,
- the presence of a reserve system (particularly medium and large reserves) to support individual populations of flying squirrels;
- the maintenance of POG within the beach and estuary fringe and RMAs to retain structural components used by flying squirrels (e.g., snags and logs) and facilitate dispersal through the matrix, allowing flying squirrel populations within reserves to function as a metapopulation; and
- the removal of islands less than 1,000 acres from the timber base and the requirement to conduct surveys for endemic species on islands less than 50,000 acres (or in areas with a high likelihood of species presence).

None of the alternatives propose changes in the size or spacing of the reserve system or the management of POG forest within these areas, and as noted above under goshawks, young-growth harvest within the Old-growth Habitat LUD (Alternatives 2, 3, and 5) and other non-development LUDs (Alternatives 2 and 3) would have minor, localized effects. However, research suggests that many reserves on Prince of Wales Island may be too small or spaced too far apart to support populations of Prince of Wales flying squirrels over the long term, or maintain functional connectivity to support a back-and-forth exchange between flying squirrel populations (Pyare and Smith 2005, Smith et al. 2011). These findings emphasize the importance of matrix management in maintaining viable, well-distributed Prince of Wales flying squirrel populations under all alternatives.

Prince of Wales flying squirrel movement capabilities can be limited by localized matrix conditions and harvested stands (both young-growth and old-growth) can preclude the movement of individuals across the landscape. The current Forest Plan and the action alternatives would continue to allow some level of POG harvest, although as noted above the amount projected over the planning horizon is far less than the amount anticipated during the development of the Conservation Strategy, retaining more POG forest adjacent to and connecting reserves. Projected POG harvest would be further reduced under the action alternatives through the transition to young-growth harvest. On Prince of Wales Island where past timber harvest has been concentrated, any additional old-growth and commercial young-growth harvest has the potential to result in localized gaps in distribution if clearings are too large or too dense for flying squirrels to cross. However, with the transition to young-growth harvest, the likelihood of creating such gaps in the Prince of Wales flying squirrel population is less than under the current Forest Plan due to the overall reduction in old-growth harvest. Therefore, all of the Action Alternatives would be expected to be at least as likely as the current Forest Plan to maintain a viable, well-distributed Prince of Wales flying squirrel population on the Tongass.

For brown bears, the following were highlighted as important factors in maintaining a viable, well-distributed population on the Tongass (2008 Forest Plan FEIS Appendix D, p. D-65-67; Iverson 1996d, Meade 1997):

- the overall level of old-growth timber harvest proposed (due to the presence of clearcuts, road construction, and risks to salmon populations);
- the presence of large reserves for providing roadless refugia to brown bears (due to risks associated with hunting and defense of life and property mortality); and
- the maintenance of riparian habitat capable of sustaining salmon habitat and populations over time and providing sufficient forest cover to maintain important brown bear foraging and loafing areas.

As noted above, all of the Action Alternatives would maintain more POG forest on the landscape than the current Forest Plan, and none of the alternatives proposed changes in the size or distribution of reserves. As noted above under the discussion of marten, young-growth harvest within old-growth habitat reserves and other non-development LUDs would have minor, localized effects to habitat and would not preclude these areas from providing roadless refugia. Although commercial young-growth harvest in RMAs (Alternatives 2 and 5) would remove riparian habitats potentially used by brown bears, effects would be minor and localized (see the discussion under goshawks regarding the scale of effects) and the retention of TTRA buffers along streams would maintain salmon habitat as well as brown bear foraging and loafing sites. For these reasons all of the action alternatives would be expected to be at least as likely as the current Forest Plan to maintain a viable, well-distributed brown bear population on the Tongass.

For marbled murrelets, the following were highlighted as important factors in maintaining a viable, well-distributed population on the Tongass (2008 Forest Plan FEIS Appendix D, p. D-73-76; Smith 1996):

- the presence of large, contiguous blocks of high-volume, low-elevation old-growth forest to provide nesting habitat (interior forest habitat) and provide protection from predation (along forest edges); and
- the implementation of long forest rotations (more than 200 years) to allow the development of suitable marbled murrelets habitat.

As noted above, all of the action alternatives would maintain more high-volume old-growth forest within the matrix, and thus more interior forest nesting habitat suitable for marbled murrelets, than the current Forest Plan. This would likely outweigh the effects of increasing the harvest rotation (less than 100 years) in commercial young-growth stands which would delay the development of suitable marbled murrelets habitat, particularly because the harvested land base under these alternatives would be much less than assumed during development of the Conservation Strategy. Therefore, all of the action alternatives would be expected to be at least as likely as the current Forest Plan to maintain a viable, well-distributed marbled murrelet population on the Tongass.

Human Uses and Land Management

Lands Uses, Ownership, and Adjustments

Affected Environment

This section addresses land ownership administration and adjustments and special uses of Tongass National Forest System (NFS) lands. Transportation and mineral uses are discussed in other sections. Adjustment of land ownership within the Tongass boundaries can occur through congressionally mandated conveyances, exchanges, and acquisitions, or through Forest Service administrative activities. Authorized non-recreation special uses on the Tongass include industrial and commercial uses, such as commercial fishing camps, powerlines, communications sites, and a variety of other uses. The *Recreation* section of this Final Environmental Impact Statement (FEIS) addresses recreation special uses. Appendix E in the Tongass Land and Resource Management Plan (Forest Plan) lists approved communications sites on the Tongass.

The exterior boundary of the Tongass National Forest established by Congress includes varied land ownership patterns of non-federal ownership. Table 3.11-1 shows the acreage by ownership type within the exterior boundary.

Table 3.11-1
Land Ownership Distribution, Tongass National Forest[1]

Ownership Type	Acres	Percent of Total
Federal/Forest Service administered[2]	16,720,000	93.4
State of Alaska[3]	296,000	1.7
Local Governments	45,000	0.3
Native Regional Corporation (Sealaska)	363,000	2.0
Native Village Corporations	292,000	1.6
Private Owners and Unknown	190,000	1.1
Total	17,906,000	100

[1] Table indicates calculated ownership of total acreage within the exterior boundary of the Tongass National Forest. Acreages have changed since 2008 due to land adjustments, refinement of GIS mapping, the Sealaska land conveyance, and other transfers.
[2] Figure includes 296 acres administered by other federal agencies. Figure includes lakes surrounded by NFS lands.
[3] Figure does not include lakes surrounded by NFS lands.
Source: USDA Forest Service 2015 GIS data.

Land Ownership Adjustment

A number of land adjustments have occurred since the 2008 Forest Plan. Some lands have been conveyed from federal to other ownership, and these adjustments are documented on the Forest Plan Land Use Designation (LUD) map. Some lands have been acquired and become National Forest System lands during this period.

Most of these land adjustments were conveyances to the State of Alaska and Native corporations as authorized by the Statehood Act and the Alaska Native Claims Settlement Act of 1971 (ANCSA), as amended, and conveyances of Alaska Native Allotments as authorized by the Alaska Native Allotment Act of May 17, 1906 (43 Code of Federal Regulations [CFR] 1634, 34 Stat. 197, as amended). Parcels conveyed through land exchanges, a Small Tracts Act sale, and the disposal of two lighthouse reserves have also modified the Forest. Through land exchanges, purchases, and donations, the United States also acquired new lands for inclusion within the Tongass.

Legislated Alaska Conveyances

Land ownership status within the Tongass is complicated by ongoing land conveyances created under various federal legislation.

The Alaska Native Allotment Act of May 17, 1906, provided for Native individuals who had occupied lands prior to their designation as national forest to apply for conveyance of up to 160 acres, under conditions prescribed by the Act and federal regulations. As of August 2015, approximately 45 Native allotment cases on the Forest are pending adjudication by the Bureau of Land Management (BLM). This number could change by unknown circumstances by either quite title action, re-instatement applications, or new legislation proposals.

The Alaska Statehood Act of July 7, 1958 (Public Law 85–508, 72 Stat. 339, as amended) authorized the State of Alaska to select 400,000 acres of vacant and unappropriated land from within the Tongass and Chugach National Forests in Alaska, to further the development and expansion of Alaskan communities. To date, under this provision of the Statehood Act, the state has received title to approximately 256,150 acres located in the Tongass National Forest. Approximately 12,000 acres remain to be conveyed to the state on the Tongass National Forest.

The Alaska Native Claims Settlement Act of December 18, 1971 (ANCSA), (Public Law 92-203, 43 United State Code [USC] 1601, et seq.) as amended, was legislated, in part, to extinguish aboriginal land claims in Alaska in exchange for monetary compensation and conveyance of specified land entitlements to eligible Native Corporations and individuals. Thirteen (13) Regional Corporations were created and two hundred thirteen (213) Village Corporations. Section 16 of ANCSA, as amended, also known as the “Tlingit-Haida Settlement,” identified ten (10) villages entitled to select land entitlements of 23,040 acres each in Southeast Alaska across the Tongass National Forest. As of 2015, only four village corporations have not yet received land entitlements under Section 16 of ANCSA.

As of the current day, only four ANCSA Village Corporations on the Tongass have remaining entitlements under ANCSA, pending adjudication by the BLM. Those village entitlements are:

- Kake Tribal Corporation (Kake, AK) – Approximately 100 acres
- Kootznoowoo (Angoon, AK) – Approximately 20 acres under Section 506(a) of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) and 54 acres under Section 506(a)(5) of ANILCA
- Cape Fox (Saxman) – Approximately 180 acres
- Yak-Tat Kwaan (Yakutat, AK) – Approximately 40 acres

ANCSA also provided that the subsurface estate for any village or urban entitlement would be conveyed to the regional corporation.

In addition to the remaining village land entitlements depicted above, Section 14(h)(1) of ANCSA allows regional corporations fee title to existing cemetery, cultural, and historic sites. There are three remaining original 14(h)(1) applications pending adjudication by BLM on the Tongass under ANCSA. Title XXX, subtitle A, sec. 3002 of the Carl Levin and Howard P 'Buck' McKeon National Defense Authorization Act for Fiscal Year 2015 (Public Law 113-291) (hereafter referred to as the National Defense Authorization Act for Fiscal Year 2015), will allow Sealaska Regional Corporation an additional land entitlement of not more than 490 acres for cemetery sites and historical places under Section 14(h)(1) of ANCSA.

Section 14(h)(3) of ANCSA established four urban corporations, including Sitka and Juneau on the Tongass. Section 14(h)(8) of ANCSA established land entitlements and allocations to the regional Corporations. Only Sealaska Regional Corporation had a Section 14(h)(8) land entitlement in Southeast Alaska. Sealaska Regional Corporations' final land entitlement under Section 14(h)(8) of ANCSA was fulfilled in 2014; with the passage of the National Defense Authorization Act for Fiscal Year 2015.

The National Defense Authorization Act for Fiscal Year 2015 , amended ANCSA and provided Sealaska Regional Corporation final land entitlement under Section 14(h)(8) ANCSA entitlement. On March 9, 2015, Sealaska Corporation received its final ANCSA entitlement and conveyance of 69,585 acres. This law also amended Section 508 of ANILCA by adding eight LUD II areas, containing 152,000 acres. Additional actions to be finalized under the National Defense Authorization Act for Fiscal Year 2015 include negotiations with Sealaska Regional Corporation regarding reservations for public access under section 17(b) of ANCSA and road use agreements.

Potential Future Conveyances

In recent years there have been other formal and informal proposals that, if authorized, might result in the transfer of Tongass National Forest System (NFS) lands out of federal ownership. Several of these conveyance proposals are summarized below:

- **Unrecognized Southeast Alaska Native Communities Recognition and Compensation Act.** In March 2015, United States Senator Lisa Murkowski re-introduced a bill for the "Unrecognized Southeast Alaska Native Communities Recognition and Compensation Act." An Identical bill was introduced by House Representative Don Young in May 2015. This proposed legislation would amend ANCSA to permit the Native residents of each of the Native Villages of Haines, Ketchikan, Petersburg, Tenakee, and Wrangell to organize as Urban Corporations and to receive certain settlement land pursuant to this Act. The entitlement would consist of one township of land (23,040 acres) for each Alaska Native community (115,000 total acres), and require the conveyance of all roads, trails, log transfer facilities, leases, and appurtenances on or related to the land conveyed to the new urban corporations.

- **Alaska Natives Veterans Land Allotment Equity Act.** In May 2015, House Representative Don Young introduced the "Alaska Veteran Native Allotment Land Equity Act." An Identical bill was introduced in the Senate by Senator Dan Sullivan in August 2015. The proposed legislation includes a clause regarding approval of formerly rejected Native Allotment Cases (*Shields v. USA*, 698 F.2d 987, United States Court of Appeals, Ninth Circuit, 1983). If this were to become law, approximately 200 closed Native allotment cases applied for under the 1906 Native Allotment Act could be approved, including many allotments on the Tongass. Native Allotment applications are 160 acres each. These allotments would become the private property of the original applicants or their heirs.

- **Alaska State Forest Proposal.** State officials or interests have at times advocated the establishment of an additional Alaska State Forest to be managed to provide income for state government programs. To date, no federal legislation to implement such a proposal has been introduced in Congress.

Land Disposal

Federal agencies responsible for administering public lands sometimes dispose of lands to other governments or private parties. Such disposals typically involve relatively small land parcels that have been determined to be “surplus” or “excess” property under federal property regulations.

The Forest Service Facility Realignment and Enhancement Act of 2005 (Public Law 109-54), as amended, authorizes a program for the conveyance of a limited number of excess Forest Service structures and associated administrative lands. The Tongass has used this program to excess and dispose of facilities and lands to reduce administration costs.

Additional real property disposal authorities include those under the Small Tracts Act and Townsite Act, and other special authorities.

Land Exchanges

Administrative land exchanges, in which NFS lands can be conveyed to another entity in exchange for lands of equal value, are another form of land ownership adjustment. Complex land exchanges are sometimes authorized by Congress through special legislation. In addition to the conveyances discussed above, the Forest Service has completed several land exchanges involving Tongass NFS lands. These adjustments are summarized below:

- Under the Kake Tribal Corporation Land Transfer Act of October 6, 2000, (Public Law 106-283), amended ANSCA directing the Forest Service to convey 1,389 acres of Tongass NFS lands (which had previously been selected by the State of Alaska) in the Jenny Creek area near Kake to the Kake Tribal Corporation. Public Law 106-283 also provided for transfer of 1,430 acres of land owned by the Kake Tribal Corporation and Sealaska Regional Corporation to the City of Kake, an exchange of the subsurface estate (mineral rights) for two areas (each of over 1,100 acres) between the Forest Service and Sealaska. Public Law 106-283 was enacted to provide protection and management of the Kake municipal watershed.
- Under the Hood Bay Land Exchange, the Forest Service received a 54-acre parcel that had formerly been a private inholding within Admiralty Island National Monument and the Kootznoowoo Wilderness (USDA Forest Service 2006b). The United States conveyed and relinquished all reversionary interests on 144 acres of land at Sitka to the Alaska Pulp Corporation.
- Through an exchange with the Kennecott Greens Creek Mining Company, Inc., the Forest Service received one 50-acre parcel within the Misty Fiords National Monument Wilderness and two parcels totaling approximately 139 acres within Admiralty Island National Monument Kootznoowoo Wilderness

(USDA Forest Service 2006b). The United States conveyed the subsurface mineral estate on 7,301 acres at Hawk Inlet/Young Bay on Admiralty Island.

In 2007, the Alaska Mental Health Trust Authority proposed an equal value land exchange with the Forest Service. The proposal included approximately 18,000 acres of non-federal lands in scenic backdrops surrounding the communities of Juneau, Sitka, Petersburg, Wrangell, Meyers Chuck, and Ketchikan in exchange for NFS lands on Prince of Wales Island near Naukati and Hollis, and Shelter Cove near Ketchikan, Alaska. In April 2015, a Feasibility Analysis and Study was completed by Forest Service. On June 30, 2015, an Agreement to Initiate was signed by both parties. The agreement provides a roadmap to exchange land and is one of the first steps in a multi-year process.

Alaska's unique land laws and land patterns continually change the landscape, and stimulate discussions regarding potential future land exchanges between the Forest Service, Tribal and Native corporations, and other local entities on the Tongass.

Land Acquisition

Land ownership adjustments can also occur through the outright purchase of lands or the acceptance of land donations for inclusion in the Forest. Purchases typically involve small inholdings, always involve a willing seller, and usually involve parcels surrounded by designated wilderness or other sensitive resource lands.

In 2012, the Secretary of Agriculture announced that the Forest Service will dedicate funds from the Land and Water Conservation Fund to acquire the surface estate at Cube Cove, which is almost entirely surrounded by Admiralty National Monument and Kootznoowoo Wilderness. The 22,890-acre surface estate within the Admiralty Island National Monument and Kootznoowoo Wilderness would be purchased from Shee Atiká, Incorporated. The purpose of this acquisition is to conserve and enhance significant scenic, recreation, cultural, wildlife, and plant resources within National Monument and Wilderness and to protect wilderness values from development.

In addition to the acquisition of the surface estate at Cube Cove between the Forest Service and Shee Atiká Incorporated, the subsurface estate owner, Sealaska Regional Corporation, has expressed interest in exchanging the underlying subsurface estate at Cube Cove for other surface estate on the Tongass National Forest.

Withdrawals/Encumbered Areas

Withdrawals and encumbrances are other key aspects of land ownership administration. Withdrawal is the withholding of an area of federal land from settlement, sale, mineral location, or entry under some or all of the general land laws for the purpose of limiting activities under those laws in order to maintain public values in the area. In general, an encumbrance is a claim, lien, charge, or liability attached to and binding real property (Black 1979, as cited in USDA Forest Service 2003b). In the context of the Tongass, an encumbrance is a land claim of some type that removes NFS lands from the full range of Forest Service administrative functions.

The largest withdrawal action applies to the more than 5.7 million acres in designated wilderness areas, which are withdrawn from entry under the mining laws. Many of the administrative withdrawals date back several decades and include withdrawals around lighthouse and light station sites, and a large number of power site withdrawals intended to preserve options for hydroelectric development.

The land conveyance processes established by ANCSA delineated areas of federal lands within which Native village corporation land selections were to be located. These areas, totaling an estimated 1.8 million acres (on the Tongass, were withdrawn and will likely remain encumbered in the land status records until all lands to which the Native corporations are entitled have been conveyed The BLM is still processing several thousand acres of NFS lands that were over-selected by Sealaska Regional Corporation, and Southeast village corporations.

Approximately 1,000 additional acres of NFS lands will be conveyed to non-federal parties under the Native Allotment Act, ANCSA, and ANILCA. The adjudication process and conveyances are initiated by the BLM, Alaska State Office.

Land Use Authorizations

Uses of NFS lands by individuals or entities other than the Forest Service can be authorized under a special use authorization, subject to applicable regulations found in 36 CFR 251. Generally, permits are issued for 10 years or less. Complex authorizations for uses such as hydroelectric projects may be issued for up to 50 years.

The demand for uses of NFS land within the planning area has grown since 2008 and is expected to continue to grow over the life of the approved Plan. The challenge for the Forest Service would be to accommodate lands and realty needs for community development, rights-of-way, easements, leases, and other permitted uses while minimizing adverse effects on, or conflicts with, other resources.

The number of permits fluctuates between 700 and 750. In August 2015, there were about 720 special use authorizations issued on the Forest. About 380 of these are land uses such as, but not limited to, communications sites, roads, certain cabins, aquatic farming activities, research, military training areas, and fish camps. About 235 of these are outfitting and guiding permits, and about 105 are other recreational uses, such as organizational camps, isolated cabins, and recreation events.

Communications and Other Electronic Sites

A communications or electronic site is an area of National Forest System land designated for telecommunication uses. These sites are characterized by antennas, electronic transmitters, equipment shelters, passive microwave reflectors, and a wide variety of electronic communication support equipment such as those listed in Forest Service Handbook 2709.11, Chapter 90. These uses of federal land are authorized by the Federal Land Policy and Management Act of 1976 (FLPMA) and the Telecommunications Act of 1996.

As of May 2015, there were 75 approved communications sites on the Tongass (see Appendix E of the Forest Plan). Most of the sites are authorized to private and public entities (such as Alaska Power & Telephone, and the City of Wrangell). Some sites are operated by other federal agencies, such as the United States Coast Guard, the Federal Aviation Administration, and the Forest Service.

The majority of sites are occupied by a single user but some sites have multiple users. All sites are currently open to more than one user if the need arises. Applicants for new communications uses will be encouraged to co-locate their facilities at approved sites. This approach to communication site development could reduce the impacts associated with the proliferation of sites by reducing the number of sites.

Roads, Trails, and Rights-of-Way

Landowners are allowed reasonable access across NFS lands to their land under provisions of ANILCA and other federal laws. Easements are issued to the State of Alaska, Department of Transportation & Public Facilities (ADOT&PF) for state-managed highways. The Forest Service administered about 40 road, trail, and rights-of-way authorizations in 2015. The types include one railroad right-of-way, one ADOT&PF easement, 14 Forest Road and Trail Act easements, three FLPMA easements, and 21 FLPMA right-of-way permits.

In August 2005, Congress enacted Section 4407 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU) (Public Law 109-59), which states: "Notwithstanding any other provision of law, the reciprocal rights-of-way and easements identified on the map numbered 92337 and dated June 15, 2005, are hereby enacted into law." Public Law 109-59 is presented in the *Transportation* section.

In December 2015, the President signed a transportation bill (Fixing America's Surface Transportation Act, or "FAST Act") that amended Section 4407 of SAFETEA-LU to now read:

> "Notwithstanding any other provision of law, the reciprocal rights-of-way and easements identified on the map numbered 92337 and dated June 15, 2005, are hereby granted."

Hydroelectric Projects

There are 22 operating hydropower projects on or adjacent to the Tongass (Table 3.12b-1). Fifteen of those are under license from the Federal Energy Regulatory Commission (FERC), with most of those also under special use permit from the Forest Service and authorized under the FLPMA. As of September 2015, there are an additional 11 proposed renewable energy projects (Table 3.12b-3). Six of the 11 projects are FERC hydroelectric projects. The remaining five projects consist of three non-FERC projects (Angoon Hydroelectric, Tenakee Springs/Indian River, and Little Port Walter), one wave project (Yakutat Wave), and one geothermal project (Bell Island Geothermal). See the *Renewable Energy* section for additional information.

Recreation Permits

As of August 2015, the Forest Service administers 341 special use permits for recreation uses. These include 234 outfitter/guide permits, 63 isolated cabins, and 14 recreation residences. Isolated cabins and recreation residences, although similar in many ways, are managed differently because of the different authorities used to grant use and occupancy. Construction of new cabins is regulated by ANILCA. New cabins can only be permitted for administration of the unit or continuing an authorized use. Over time, national policy, in combination with the provisions of ANILCA (section 1303), will result in a decrease in the number of privately owned cabins on the public lands in Alaska.

Environmental Consequences

Direct and Indirect Effects

No significant environmental consequences within the Lands category are anticipated for any of the alternatives. The NFS land base is the same for all five alternatives, at just over 16.7 million acres. The five alternatives would not change the Forest boundary or how the Forest Service acquires or disposes of land. Changes to the land base may occur as a result of ongoing conveyance processes, or from future land exchange, disposal, and acquisition actions. If future changes to the land base are not legislated (i.e., legislated land conveyances or exchanges) and are deemed major federal actions, they would require preparation of an environmental impact statement. None of the alternatives incorporate any specific land adjustment that is unique to the alternative.

The Forest Service would continue land use and land adjustment activities under the Forest-wide standards and guidelines presented in Chapter 4 of the Forest Plan. Only administrative changes were made to Chapter 4 direction to correct clerical errors, to address conformance of the Forest Plan to new statutory or regulatory requirements, or to delete repeated direction where standards and guidelines referenced directives (Forest Service Handbook or Manual) and repeated the existing direction. .

The only material change in the standards and guidelines as they relate to lands is the removal of the Transportation and Utility System LUD under the action alternatives and creation of the new direction for Renewable Energy and Transportation Systems Corridors to be applied to existing LUDs. See the *Renewable Energy* and *Transportation* sections in this chapter. As presented in Chapter 2, lands suitable for timber production vary by alternative and new young-growth direction has been developed. While these changes and variations between the alternatives would affect how the land is managed, the boundaries of the Forest would not be affected.

Administration of special use authorizations would continue under all alternatives. The number of communications and other electronic sites on NFS lands under special use authorization has increased in recent years, and additional sites may be authorized. Increases in land uses for recreation purposes, rights-of-way, and other special uses are possible.

Each request for a special use authorization receives individual consideration and evaluation. Special use authorizations may be granted in the future, and the environmental impacts of those actions would be evaluated through site-specific project analyses. The Forest Service can assign terms and conditions to an authorization to address impacts. Special use authorizations generally apply to small, specific areas and activities that have limited impacts. Impacts from permitted activities cannot be predicted at a Forest wide level, would not vary among the alternatives, and are not likely to be significant. The addition of communication sites could help improve electronic signal coverage Forest-wide improving health and safety for all forest users.

Cumulative Effects

Appendix C in this FEIS describes the existing, proposed, and reasonably foreseeable future land adjustments considered in the cumulative effects analysis. Forest Service land use and land adjustment activities under the Forest Plan do not have the potential to create or contribute to significant cumulative effects. To the extent that special use authorizations increase in number and affected acreage, environmental effects from future authorizations would add to those of use and occupancies already in effect. As noted above, however, those effects are not likely to be significant.

In general, land ownership adjustments executed by the Forest Service are made in response to direction from others, primarily Congress through legislated land conveyances or exchanges. There have been transfers of federal lands in Southeast Alaska to other ownership since statehood (Public Law 85–508, 72 Stat. 339, enacted July 7, 1958). Most recently are the 70,075 acres transferred to Sealaska under Public Law 113-291.

No land ownership adjustments are proposed under any of the Forest Plan alternatives. The proposed Alaska Mental Health Trust land exchange, the Cube Cove land acquisition, and possible land exchange of the underlying subsurface estate at Cube Cove for other surface estate with the Sealaska Regional Corporation are considered reasonably foreseeable actions (see Appendix C for a complete list of past, present, and reasonably foreseeable actions considered.) Each of these actions would have a cumulative effect on the NFS land base within the Tongass if they were to occur.

This page is intentionally left blank.

Transportation

Affected Environment

There are three principal types of travel in Southeast Alaska: air, water, and ground. Historically, marine transportation has been the major method of moving freight and passengers; however, during the last several decades, air services have developed to serve the growing demand for rapid transportation between communities within Alaska and to the contiguous United States. Residents of the region are dependent on air and water transportation for travel between most communities, rather than roads or rail. A roaded transportation system has developed on National Forest System (NFS) lands, largely in support of timber harvesting but for the most part does not connect communities except on Prince of Wales Island.

Currently, air carriers are the primary transporter of long distance passenger traffic in the Southeast. Commercial jet service connects the communities of Juneau, Ketchikan, Sitka, Petersburg, Wrangell, and Yakutat (and Gustavus in the summer) and provides service outside of Southeast Alaska. Other communities are connected by air through air taxis, scheduled commuter flights and chartered flights. Angoon is the largest community in the state without a land airport (Alaska Department of Transportation & Public Facilities [ADOT&PF] 2014). A Draft Environmental Impact Statement (DEIS) evaluating development of an airport in Angoon was published in January 2015, and the Federal Aviation Administration is working internally through comments received from the public and agencies.

Regional Transportation System

Southeast Alaska relies on a "marine highway system" to augment its limited roads and highways. The ADOT&PF issued the Final Southeast Alaska Transportation Plan (SATP) in 2004 (ADOT&PF 2004). The 2004 SATP called for transitioning away from the long line ferries to a system of expanded roads and shuttle ferries to fill the gaps in the road network. The 2004 SATP also identifies 34 essential highway and utility corridors and requested they be reserved and incorporated into the Tongass Land and Resource Management Plan (Forest Plan). These corridors were incorporated into the Forest Plan in 2008.

A Draft SATP was published in June 2014 (ADOT&PF 2014). The Draft SATP includes the same 34 essential corridors and identifies two priority highway transportation projects which could be developed within the next 20 years: East Lynn Canal Highway (Juneau Access Project) and a road (with ferry segment) between Kake and Petersburg. The Draft SATP also identifies a road between Sitka and Warm Spring Bay on the east side of Baranof Island as a priority, but not likely to be developed within the next 20 years.

Three cities in Southeast Alaska are connected to the continental road system: Haines, Skagway, and Hyder. Several cities in Southeast Alaska are linked to Bellingham, Washington, via the Alaska Marine Highway and the Canadian community of Prince Rupert, British Columbia. In addition, several ferries connect communities on a daily, weekly or twice-weekly basis. Prince of Wales Island has the only road system in Southeast Alaska that interconnects island communities. Several possibilities exist for state highways that could connect some communities of Southeast Alaska to the continental road system. Several new internal corridors are also possible.

Because the ADOT&PF's Southeast Region lies largely within the Tongass National Forest's boundaries, many of the proposed road projects cross National Forest System (NFS) lands and require Forest Service easements. The proposed linkages for the East Lynn Canal Highway (Juneau Access Improvement Project), the Kake to Petersburg road, and the Sitka to Warm Spring Bay road cross NFS land.

In August 2005, Congress enacted Section 4407 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act - A Legacy for Users (SAFETEA-LU; Public Law 109-59), which states: "Notwithstanding any other provision of law, the reciprocal rights-of-way and easements identified on the map numbered 92337 and dated June 15, 2005, are hereby enacted into law."

The ADOT&PF and Alaska Department of Natural Resources entered into a Memorandum of Understanding (MOU) with the Forest Service that established a framework and process for granting the reciprocal rights-of-way and easements.

The MOU provides for two types of easements to be granted by the Forest Service to the State. The first is an easement for highway and utility planning purposes (the D-1 easement). Attachment D of the MOU identifies 19 transportation and utility corridors, all but one of which is also in the 2004 SATP. The Whale Pass to Exchange Cove corridor on Prince of Wales Island is not included in the 2004 SATP. The Forest Service has granted the State's D-1 planning easements, with one exception, the Lynn Canal East easement involved in the Juneau Access Improvement Project litigation. The second easement is for the actual construction, operation, and maintenance of a highway and utility system (the D-2 easement) to be issued once the planning and permitting is complete.

On December 4, 2015, the President signed into law Public Law 114-94, Fixing America's Surface Transportation Act, or the FAST Act. This law amended Section 4407 of SAFETEA-LU by striking "hereby enacted into law" and inserting "granted". The Forest Service and the State of Alaska are in discussions as to how this may affect the MOU.

The State grants to the United States tideland easements for the 126 log transfer facilities identified in the MOU. These easements are necessary to ensure appropriate infrastructure and access exists to support the Forest Service timber program in Southeast Alaska. The Forest Service has received 66 out of 126 easements from the State thus far.

In the MOU, the State agreed that the United States, as an upland landowner, may, without written authorization from the State, construct, operate, and maintain 231 marine access points identified through the map numbered 92337. These marine access points allow the Forest Service and its permittees to provide public access to NFS lands and facilities without obtaining a permit or written authorization from the State. Marine access points may include facilities such as docks, boat ramps, floats, buoys, anchors, breakwaters, boat haulouts, and similar improvements and facilities.

The Federal Highway Administration (FHWA) issued a Record of Decision (ROD) in 2006 approving a road on the east side of Lynn Canal from the current terminus of State Highway 7 to the Katzehin River. From there, shuttle ferries would continue to Haines and Skagway. Following legal challenges, the District Court found that the Environmental Impact Statement (EIS) was not valid and this decision was upheld by the Court of Appeals. In September 2014, the FHWA published a Draft Supplemental Environmental Impact Statement (SEIS) for the Juneau Access Improvement Project and is currently reviewing the comments received on the draft.

Other transportation facilities within Southeast Alaska include more than 300 marine facilities (docks, small boat harbors, refuge floats, and boat launch ramps), 12 major airports, approximately 35 seaplane bases or floats, and numerous heliports and airstrips (ADOT&PF 2004).

National Forest System Roads

NFS roads are constructed to provide access to NFS lands and are included in the Forest Development Transportation Plan (see Transportation Standards and Guidelines in Chapter 4 of the Forest Plan [USDA Forest Service 2008a]). They are NFS roads, as are other roads that are wholly or partially on NFS lands and are intended to be maintained for the long term. They are functionally classified as arterial (serving large land areas and usually connecting to public highways), collector (serving smaller areas, usually connecting to arterials or public highways), and local (terminal roads, may connect to any other type).

NFS roads are also managed by a system of maintenance levels, depending on their intended use and suitability for various types of vehicles. These levels range between level 1 (closed), level 2 (suitable for high-clearance vehicles), level 3 (suitable for passenger vehicles, rough surface), level 4 (suitable for passenger vehicles, smooth surface), and level 5 (suitable for passenger cars, dust free, possibly paved). Maintenance can include reconditioning the original road grading the road surface, cleaning roadside ditches, and removing vegetation that may encroach upon the road or block vision. Grading and other maintenance would generally take place more often on a maintenance level 4 road than on a level 3 road, and would be expected to occur less often on a level 2 road. Level 1 roads are left to a self-maintaining condition that requires little or no maintenance.

With the exception of a few administrative sites and campgrounds, most NFS roads are single lane, constructed with blasted quarry rock, and designed for off-highway loads. Typical collector and local roads are 14 feet wide with a rough gravel surface. Higher standard arterial roads are normally 16 feet wide, may have a smooth gravel surface, and are designed for speeds of up to 30 miles per hour. Travel speed on lower standard roads is often controlled more by surface roughness than by horizontal alignment or road gradient.

On the Tongass, the demand for roads has primarily been for access to timber resources. The maintenance and reconstruction requirements of the existing system depend mainly on the volume of timber hauled and, to a lesser extent, on recreational use. Future construction is anticipated to continue to be largely determined by the need to access timber resources. Currently, there are approximately 5,000 miles of roads on NFS lands, approximately 3,100 miles of which are not maintained for highway vehicles (maintenance level 1 and 2). There are another 3,660 miles of roads that are on non-NFS lands. Over half of the roads suitable for highway vehicles are connected to communities.

The steep, densely vegetated terrain of Southeast Alaska limits the use of typical off-highway vehicles (OHVs) such as four-wheelers and all-terrain vehicles to beaches, communities, road systems, braided river channels, and frozen or snow-covered areas. Most trails in Southeast Alaska do not lend themselves well to the use of such vehicles because of wet ground conditions that often necessitate the use of boardwalks. With the exception of a few specific areas, the Tongass has not experienced the kinds of resource damage typically associated with OHVs elsewhere.

In 2001, the Forest Service adopted a road management policy that requires the agency to maintain a safe, environmentally sound road network that is responsive to public needs and affordable to manage. The policy includes a science-based roads analysis process designed to help managers make better decisions on roads. The Forest completed a Forest-wide roads analysis for maintenance level 3, 4, and 5 roads in 2003.

Prior to 2005, the Forest was designated open to OHVs except for Wilderness, National Monuments, and Research Natural Areas. Site-specific closures were considered in specific locations where conflicts with other uses, public safety problems, or damage to resources could occur. The goal of OHV management is to ensure resource protection and public safety, minimize user conflicts, and provide diverse opportunities for Forest users.

In November 2005, the Forest Service adopted a final rule for managing motor vehicle use, including OHV use, on national forests throughout the United States (36 Code of Federal Regulations 212). Under this rule, the travel management plans designate a system of roads and trails for OHV use, and identify areas for cross country travel that are appropriate and do not cause resource damage. Annually, each unit prepares an updated Motor Vehicle Use Map (MVUM). The MVUM displays NFS routes (roads and trails) or areas designated as open to motorized travel. The MVUM also displays allowed uses by vehicle class (ex. highway-legal vehicles, vehicles less than 50 inches wide and motorcycles), seasonal allowances, and distance allowances, and provides information on other travel rules and regulations. Routes not shown on the MVUM are not open to public motor vehicle travel. Driving off of routes designated on the current MVUMs is prohibited with limited exceptions. District and Monument Access and Travel Management Plans were completed between November 2007 and September 2009. These Plans determined which unauthorized roads were incorporated into the Forest transportation system and which would be closed as funding became available.

Log Transfer Facilities

The transport of harvested timber from isolated islands in Southeast Alaska requires both land and water routes to reach processing facilities. Log transfer facilities (LTFs) are used to transfer logs to barges or rafts for towing. Over 100 LTFs exist on the Tongass. The MOU discussed above grants the Forest Service easements to use the 126 LTFs on state lands listed on Map 92337. Currently, there are 55 LTFs with active permits.

Transportation and Utility Systems in the Current Forest Plan

The 2008 Forest Plan applies the Transportation and Utility Systems (TUS) Land Use Designation (LUD) to the potential right-of-way corridors and associated uses for selected potential and existing transportation systems and utility corridors. These systems include state and federal highways, power lines of 66 kilovolt capacity or greater, and pipelines 10 inches or more in diameter, if they are a public utility. This LUD was intended to minimize potential conflicts, such as over-determining the appropriate visual quality objective, should development of any of these projects occur. With minimal exceptions, transportation and utility systems are allowed throughout the Tongass.

The 2008 Forest Plan identifies three types of areas related to TUS on the Tongass based on the existing LUDs: windows, which represent areas potentially available for energy development; avoidance areas; and exclusion areas. Avoidance areas are those LUDs in which development of energy projects is allowed when there is no feasible alternative. Exclusion areas preclude TUS. There are no exclusion areas on the Forest due to special authorities provided in Alaska National Interest Lands Conservation Act, Title XI.

Environmental Consequences

Direct, Indirect, Effects

The following discussions address the direct, indirect, and cumulative effects of the alternatives on the transportation infrastructure of Southeast Alaska. Analyses examine both the existing system and reasonably foreseeable changes.

Effects on the National Forest Transportation Road System

The total number of existing roads on NFS lands tend to overestimate total road miles because they include unauthorized roads, most of which are either decommissioned or are likely to be decommissioned. New road construction estimates are directly related to proposed timber harvesting; they are based on the maximum harvest levels projected for each alternative. These estimates are primarily based on the logging system and transportation analysis (LSTA) completed in 2007 for the majority of the mapped suitable lands on the Tongass (refer to the *Timber* section). Where suitable lands were not covered by the LSTA (primarily in portions of Alternatives 2, 3, and 4 where harvest would occur in LUDs that are currently considered not suitable), they were estimated using the ratio of road miles to suitable acres based on the LSTA by Value Comparison Unit. As shown in Table 3.12a-1, which displays the existing road miles and maximum anticipated road construction by alternative over the next 100 or more years, new road construction on NFS lands for each alternative ranges from 871 miles (Alternative 4) to 1,056 miles (Alternative 2).

Table 3.12a-1
Estimated Number of Road Miles (includes Decommissioned Roads) on All Lands within the Tongass Forest Boundary for Each Alternative after Full Implementation of the Forest Plan for 100 Years[1]

	Alternative					
Road Categories	**Existing**	**1**	**2**	**3**	**4**	**5**
Total New Miles on NFS Lands	0	944	1,056	1,020	871	994
Total Miles on NFS Lands	5,093	6,036	6,148	6,113	5,964	6,086
Total Miles on Non-NFS Lands[2]	4,258	6,593	6,593	6,593	6,593	6,593
Total Miles on All Lands	**9,351**	**12,629**	**12,741**	**12,705**	**12,556**	**12,679**

[1] Assumes full implementation of Forest Plan plus future non-NFS harvest.
[2] Assumes an increase of 2,335 road miles on non-NFS lands by state, private, and municipality interests, over 100 years. Annette Island is included because it is surrounded by areas within the Forest boundary.

Roads have the potential to affect fish habitat, soils, and water quality by increasing erosion and landslide potential, changing recreation settings and opportunities, altering scenery, and increasing wildlife harvest. These types of effects are discussed in the subject resource sections of this chapter, as applicable. Under all alternatives, Best Management Practices would be implemented to protect water quality (see USDA Forest Service 2012b and 2006a).

Based on current practices, most new roads would be closed to motorized traffic once their initial use is over. These roads are built for silvicultural purposes under exemptions granted under Section 404(f)(1) of the Clean Water Act. The construction or maintenance of forest roads used for established silvicultural activities is exempt from regulation under Section 404 of the Clean Water Act. Roads constructed and maintained specifically for recreation or other uses do not qualify under this exemption (USACE 2004). Roads built under the Section 404 exemption should be closed following completion of silvicultural activities. The roads would either be decommissioned or placed in storage. Bridges and culverts may be removed (or culverts may be bypassed), erosion control measures would be applied as needed, and the roadbeds would be allowed to revegetate naturally.

In addition to typical maintenance that would accompany all alternatives, each alternative would result in reconstruction of a portion of the existing road system in each decade, primarily roads that have been placed in storage (maintenance level 1) or reconstructed roads. Estimates range from 1,315 miles under Alternative 1 to 1,790 miles under Alternative 2 (Table 3.12a-2). Reconstruction of a road maintains the original investment and makes the road suitable and safe for intended use. Reconstruction involves the rehabilitation of the original roadbed, and can include cleaning ditches, replacing drainage structures, re-installing bridges, and grading and shaping.

Table 3.12a-2
Estimated Miles of Road Construction and Reconstruction by Alternative after 100 Years[1]

	Alternative				
	1	2	3	4	5
New Road Construction	944	1,056	1,020	871	994
Roads Constructed over Decom. Roadbeds	428	600	566	445	527
Road Reconstruction[2]	887	1,191	1,129	900	1,058
Total Road Work (includes reconstruction)	**2,259**	**2,846**	**2,716**	**2,216**	**2,579**

[1] Assumes full implementation of Forest Plan at PTSQ levels. Includes adjusted road miles estimated to needed to harvest all scheduled timber in the alternative
[2] Estimated existing road miles that would need to be reconstructed.

Effects on Log Transfer Facilities

The effects of operation at LTFs are likely to be similar under all alternatives. Generally, effects would be somewhat proportional to the amount of harvest under each alternative, with Alternative 2 having the greatest volume of harvest over the next 25 years followed by Alternatives 3, 5, 4, and 1 with the least volume of harvest during this period. Guidelines for LTF siting, construction and operation, and monitoring are provided in Appendix G of the Forest Plan.

See the *Fish* section for a discussion of the effects of LTFs.

Effects on Off-Highway Vehicle Access

Access and travel management plans designate roads and trails for OHV use, and identify if any areas for cross country travel are appropriate and do not cause resource damage. The proposed alternatives would not affect this process. Alternatives 1, 2, 4, and 5 include only the roaded land base. Where young growth would be harvested in roadless areas under Alternative 3, access would be by helicopter or from the beach; no new roads would be developed in these roadless areas that would affect OHV access, unless the Tongass exemption to the Roadless Rule is reinstated.

Effects on Regional Transportation Opportunities

None of the alternatives would affect other regional transportation opportunities. No new Wilderness or LUD II areas are proposed under any of the alternatives. None of the alternatives proposes changing any of the currently roaded areas to LUDs that would not allow road construction, or road expansion.

Alternative 1

The existing TUS LUD included in the current Forest Plan would be maintained. This includes the transportation corridors covered by Public Law 109-59 and the subsequent MOU with the State. There would be no difference in how these corridors are currently managed. Under Alternative 1, the TUS LUD would be given priority over all underlying LUDs, including LUDs that do not typically allow road construction.

Wilderness, Non-wilderness National Monument, Research Natural Areas, Special Interest Area, Remote Recreation, Municipal Watershed, Old-Growth Habitat, Wild River, Scenic River, Recreational River, Experimental Forest, Minerals, and LUD II lands are identified in the current Forest Plan as TUS "Avoidance Areas."

Alternatives 2, 3, 4, and 5

Under Alternatives 2, 3, 4, and 5, the existing TUS LUD would be removed from the Forest Plan. Proposed new plan components for Transportation Systems Corridors (TSC) would replace the direction currently found in the Transportation and Utility System LUD. TSC plan components apply only to major road systems such as state and federal highways, railroads, and those identified by the State of Alaska in the current version of the SATP and applicable laws (for example, Section 4407 of Public Law 109-59, Title XI of the Alaska National Interest Lands Conservation Act, Public Law 96-487).

The purpose of the plan direction for TSC is to facilitate the availability of NFS land for the development of existing and future transportation systems. These components would apply to existing and proposed major transportation developments. When planning future transportation projects, these plan components would apply. Prior to this, all other applicable Forest Plan LUD direction would remain in effect. Proposed new plan direction includes goals, objectives, standards, guidelines, and management approaches for the protection of forest resources. With this amendment, the existing transportation and utility LUD and avoidance areas would be removed from the Forest Plan. TSC plan components (e.g., standards and guidelines to the Forest Plan) would take precedence over other Forest-wide and LUD-specific standards and guidelines (subject to applicable laws) where TSC are proposed or exist.

Cumulative Effects

Cumulative road miles projected for the next 100 years for each alternative are displayed in Table 3.12a-1, which includes roads on state land, lands owned by Native corporations, and other lands (including towns and cities) within the Forest boundary; and Table 3.12a-2, which includes roads that would be constructed over decommissioned roadbeds and reconstructed roads over the same period. The total road miles are likely to be an over-estimate because these numbers include existing unauthorized roads on NFS lands, most of which are expected to be decommissioned.

The road construction projected for non-NFS lands primarily includes roads needed for timber harvest, but also includes roads likely built to serve communities, such as the road on the east side of Lynn Canal from the current terminus of State Highway 7 to the Katzehin River. This road and other road corridors covered by Public Law 109-59 would, if developed, connect additional areas in Southeast Alaska to the continental highway system and improve transportation between communities.

There is considerable uncertainty concerning the future development of Southeast Alaska's road system. As stated above, the ADOT&PF has prepared a Draft SATP, and a Draft SEIS has been prepared for the Juneau Access Improvement Project. New roads linking communities and linking Southeast Alaska to the continental highway system would be expensive to build and maintain, and funds have yet to be approved for their construction. The 2004 SATP estimated in 2004 that the cost would be $1.8 billion over 20 years. Most of the funding was anticipated to come from the federal government. To date, there has been no commitment for this level of funding from either the state or federal governments.

Roads associated with timber harvest are based on the projected harvest for each alternative; therefore, they represent a maximum estimate. If new wood processing facilities and markets are not developed, especially for young-growth products, these levels of harvest are unlikely to occur and new road construction would be less than projected in Table 3.12a-1. There is also uncertainty concerning the funds to maintain the existing forest road network, to place existing roads into storage status, and to decommission roads that are no longer needed. Risks associated with inadequate funding include adverse effects to fish, water quality, and wildlife and increased safety hazards as older roads and stream crossings deteriorate.

Appendix C in this EIS describes of all the past, present, and reasonably foreseeable future actions considered in the cumulative effects analysis.

Renewable Energy

Affected Environment

Water is everywhere in the Tongass National Forest, originating as rainfall and melting snow and ice. Increasingly, it is this plentiful water that is the focus of communities, utility companies, and developers. The water resources of the Tongass are a potential source of reliable and relatively inexpensive renewable energy.

Twenty-two operating hydroelectric projects are located either on National Forest System (NFS) lands or on adjacent state or private land. These projects have a total installed capacity of 216.9 megawatts (MW) and range in size from less than 1 MW to 78 MW in size (Table 3.12b-1).

Project proponents have filed permit applications with the Federal Energy Regulatory Commission (FERC) for about seven new or amended hydroelectric projects on the Forest, such as Sweetheart Lake, Soule River, Crooked Creek/Jim's Lake, and Swan Lake. Each of these new hydroelectric projects is within inventoried roadless areas (IRAs), with one located in Wilderness. Three additional projects (Little Port Walter, Tenakee Springs/Indian River, and Angoon Hydroelectric) are not under FERC jurisdiction. The Forest Service special use permit will be the authorizing document for these three proposed projects.

Other active proposed renewable projects on the Forest consist of a wave energy project (Yakutat Wave) and one geothermal project (Bell Island Geothermal).

In addition to proposals for new energy projects, there is ongoing work associated with existing hydroelectric projects. Forest Service involvement continues throughout the life of these projects with the implementation and monitoring of license terms and conditions and annual coordination meetings. Examples of existing operating projects on NFS lands include the Black Bear Lake, Blue Lake, and Goat Lake projects.

Table 3.12b-1
Existing Renewable Energy Projects

No. [1]	Name	Type	Capacity (MW)	Date Online	Community Served
1	Goat Lake	Hydropower (Storage)	4.0	1997	Skagway and Haines
2	Dewey Lakes	Hydropower (Run-of-the-River)	0.9	1902	Skagway
3	Kasidaya Creek	Hydropower (Run-of-the-River)	3.0	2008	Upper Lynn Canal
4	Salmon Creek	Hydropower (Storage)	6.7	1913	Juneau
5	Gold Creek	Hydropower (Run-of-the-River)	1.6	1914	Juneau
6	Annex Creek	Hydropower (Dam/Reservoir)	3.6	1915	Juneau
7	Lake Dorothy	Hydropower (Dam/Reservoir)	14.3	2009	Juneau
8	Snettisham	Hydropower (Dam/Reservoir)	78.0	1979	Juneau and Douglas
9	Falls Creek	Hydropower (Run-of-the-River)	0.8	2009	Gustavus
10	Pelican	Hydropower (Run-of-the-River)	0.7	1941	Pelican
11	Blue Lake	Hydropower (Dam/Reservoir)	16.9	1961	Sitka
12	Green Lake	Hydropower (Dam/Reservoir)	18.6	1979	Sitka
13	Crystal Lake	Hydropower (Dam/Reservoir)	2.0	1920s	Petersburg
14	Tyee Lake	Hydropower (Lake tap)	20.0	1984	Wrangell, Petersburg, Ketchikan
15	Black Bear Lake	Hydropower (Lake tap)	4.5	1995	Prince of Wales Island
16	South Fork Black Bear	Hydropower (Run-of-the-River)	2.0	2005	Prince of Wales Island
17	Ketchikan Lakes	Hydropower (Dam/Reservoir)	4.3	2000	Ketchikan
18	Beaver Falls	Hydropower (Dam/Reservoir)	5.4	1947	Ketchikan
19	Silvis Lake	Hydropower (Dam/Reservoir)	2.1	1968	Ketchikan
20	Swan Lake	Hydropower (Dam/Reservoir)	22.4	1983	Ketchikan, Wrangell, Petersburg
21	Whitman Lake	Hydropower (Dam/Reservoir)	4.6	2014	Ketchikan, Wrangell, Petersburg
22	Gartina Falls	Hydropower (Run-of-the-River)	0.5	2015	Hoonah
		Total Installed Capacity	**216.9**		

[1] Four other hydropower projects – Hidden Falls Hatchery, Jetty Lake, Betty Lake, and Burnett Inlet Hatchery – on NFS lands supply power to fish hatcheries and are not included.
Notes: Prince of Wales Island includes the communities of Craig, Klawock, Hydaburg, Hollis, Kasaan, and Thorne Bay
Upper Lynn Canal includes the communities of Haines, Skagway, Klukwan, and Chilkat Valley
Sources: USDA Forest Service 2010; AEA and REAP 2013; AEA 2014; AEL&P 2014; AP&T 2014; Leavitt et al. 2008; SEAPA 2014

The existing transmission system in Southeast Alaska is limited. The electric systems in a few communities are currently interconnected. These may be summarized by region, as follows:

- Southeast Alaska Power Agency (SEAPA) Region—The SEAPA system connects Ketchikan, Petersburg, and Wrangell.
- Juneau Area—The Alaska Electric Light & Power (AEL&P) system connects Juneau, Douglas Island, Auke Bay, and Greens Creek.
- Prince of Wales Island—The Alaska Power & Telephone (AP&T) system connects the communities of Coffman Cove, Craig, Hollis, Hydaburg, Kasaan, Klawock, and Thorne Bay.
- Upper Lynn Canal Region—A separate AP&T system connects Haines and Skagway in the Upper Lynn Canal Region and is connected via an intertie to the existing Inside Passage Electrical Cooperative (IPEC) system that serves Klukwan and Chilkat Valley.

Many of the proposed projects include transmission lines that cross NFS lands. These include the Swan Lake-Lake Tyee Intertie Project, completed in 2009, and the Kake to Petersburg Transmission Line Intertie Project, which is undergoing National Environmental Policy Act (NEPA) review; the Draft Environmental Impact Statement (DEIS) was released in December 2014 and a Final EIS (FEIS) and Draft Record of Decision (ROD) are anticipated in June 2016.

Others are still in the early conceptual planning stage and applications have not been submitted to the Forest Service.

Tongass National Forest Land and Resource Management Plan

The 2008 Forest Plan includes a Transportation and Utility System (TUS) Land Use Designation that "provide(s) for, and/or facilitate(s) the development of existing and future major public Transportation and Utility Systems" (USDA Forest Service 2008a). Major systems are defined as "state and federal highways, railroads, public hydroelectric power projects and associated facilities, powerlines 66 kV or greater, and pipelines 10 inches or greater in diameter." Four types of transportation and utility corridors are identified on the 2008 Forest Plan LUD map. These corridors are: Existing Power Transmission Corridor, Potential Power Transmission Corridor, Existing State Road Corridor, and Proposed State Road Corridor. The TUS LUD applies to existing or new transportation and utility systems once a project is approved and construction is initiated. Prior to construction, the management prescriptions of the underlying LUDs remain applicable.

The Forest-wide Standards and Guidelines for Lands address special use administration for right-of-way grants, including those related to the TUS LUD. Three types of Transportation and Utility System areas are identified based on the LUD's emphasis: TUS "windows," TUS "avoidance areas," and TUS "exclusion areas." These areas are defined in the 2008 Forest Plan in Chapter 4 (USDA Forest Service 2008a, pp. 32-33) as follows:

1. TUS "window" is an area potentially available for the location of transportation or utility corridors and sites. Windows represent areas of future opportunity where the applied management direction will not conflict with future designation of a TUS. A site-specific analysis is still required during project-level planning, to identify resource protection needs within these areas.

2. A TUS "avoidance area" is an area where the establishment and use of transportation or utility corridors and sites is not desirable given the LUD emphasis. A search for "windows" should be exhausted before TUS facilities are considered in avoidance areas. When feasible, these areas should be avoided through site-specific analysis during project-level planning. Avoidance areas often include congressionally and administratively designated areas. Although special environmental or procedural considerations may be required for these areas, they do not preclude consideration and use as a TUS. Avoidance areas are designated through the allocation of lands to LUDs specifically identified as TUS avoidance areas in their standards and guidelines. In cases where proposed or potential corridors are allocated to the TUS LUD that traverse other LUDs identified as TUS "avoidance areas," treat the corridors within such LUDs the same as TUS "windows" (subject to applicable laws).

3. A TUS "exclusion area" is a large area (large enough to cause significant barriers) that legislatively precludes TUS. There will be no exclusion areas on the Tongass National Forest due to special authorities provided in the Alaska National Interest Lands Conservation Act (ANILCA), Title XI (USDA Forest Service 2008a, p. 4-32 to 4-33).

The 19 LUDs on the Tongass include two overlay LUDs: the Transportation and Utility LUD and the Minerals LUD. The remaining 17 LUDs are either designated TUS windows or TUS avoidance areas. Four of the 17 non-overlay LUDs are TUS windows and together account for 6,342,405 acres, approximately 38 percent of the Forest. The remaining 13 non-overlay LUDs, which comprise

10,413,279 acres or 62 percent of the Forest, are TUS avoidance areas. The distribution of the TUS windows and TUS avoidance areas are shown in Table 3-12b-2. The assignment of TUS windows and TUS avoidance areas is discussed further in this section, and additional information, including map figures, is provided in the Energy Resource Report (Tetra Tech 2016).

Table 3.12b-2
Transportation and Utility System Window and Avoidance Areas by LUD (acres)

TUS "Window"	Acres	TUS "Avoidance Areas"	Acres
Natural Setting LUD Group		**Wilderness LUD**	
Semi-Remote Recreation	3,010,933	Wilderness	2,641,042
Development LUD Group		Wilderness National Monument	3,113,807
Modified Landscape	726,224	Non-Wilderness National Monument	167,282
Scenic Viewshed	308,950	**Natural Setting LUD Group**	
Timber Production	2,296,298	LUD II	878,694
Total Window Areas	**6,342,405**	Remote Recreation	2,005,891
		Old Growth Habitat	1,194,080
		Municipal Watershed	45,208
		Research Natural Area	21,682
		Special Interest Area	206,370
		Wild River, Scenic & Rec. River	102,130
		Development LUD Group	
		Experimental Forest	36,264
		Unmapped areas GIS Slivers	829
		Total Avoidance Areas	**10,413,279**

Inventoried Roadless Areas

As noted earlier, project proponents have filed permit applications with the Federal Energy Regulatory Commission (FERC) for seven new or amended hydroelectric projects on the Tongass National Forest that require Forest Service review and/or responses during various stages in the permitting and FERC licensing process. Forest Service involvement includes the permitting of investigative studies, reviewing and commenting on project documents, reviewing study plans and results, participating in project development and resource mitigation, developing Federal Power Act section 4(e) terms and conditions, and issuing an authorization after the project is licensed by FERC. Three additional proposed projects (Little Port Walter, Tenakee Springs/Indian River, and Angoon Hydroelectric) are not under FERC jurisdiction. The Forest Service special use permit will be the authorizing document for these three projects. Of the 11 new or unconstructed projects proposed for development, 8 are in inventoried roadless areas (see Table 3.12b-3 in the Proposed Renewable Energy Projects section below).

In addition, proposed transmission lines serving as power interties among Southeast Alaska communities also cross inventoried roadless areas.

The Federal Power Act (FPA) grants FERC the authority to issue and administer licenses for hydropower projects. For projects located on National Forest System lands, Section 4(e) of the FPA requires FERC to determine whether the project is consistent with National Forest purposes and the land management plan. Section 4(e) also gives the Forest Service authority to impose mandatory conditions in the FERC license to ensure the adequate protection and use of NFS land and resources.

Prohibitions on road construction and timber removal in inventoried roadless areas are considered conditions necessary for the protection and use of NFS land and resources.

If sited and designed properly, hydroelectric projects provide an environmentally and economically preferred source of power due to the near elimination of hydrocarbon emissions from diesel fuels and reduce the risk of catastrophic diesel fuel spills associated with shipping, handling, and storing activities.

Section 4(e) can be used to mitigate the impacts of any project including the location and size of a dam, associated project works (pipelines, roads, and facilities), reasonable access, and mitigation measures. The Forest Service may develop conditions necessary to protect NFS lands and resources, such as limiting or prohibiting certain roads, preserving remote characteristics, defining the size of facilities, project operations (run-of-river vs. large storage reservoirs, etc.) so long as the conditions do not constitute a veto and thereby usurp FERC's role in deciding to license a hydropower facility.

Current Trends

Viewed from an electric generation and transmission perspective, Southeast Alaska consists mainly of multiple, small load centers, separated from one another by mountainous terrain and marine waters. Regional planning efforts have included development of the 2012 Southeast Alaska Integrated Resource Plan (IRP). Developed in response to direction from the Alaska Legislature, the Alaska Energy Authority (AEA) was the lead agency for this plan, which explored the current status of energy resources in the region, as well as options for minimizing future power supply and space heating costs, while maintaining or improving power supply reliability (Black & Veatch 2012). The 2012 IRP describes the region's electric transmission grid as limited in terms of the number of communities connected and notes that the grid is very different from the integrated, interconnected, and redundant grids that are in place throughout the lower 48 states (Black & Veatch 2012).

Southeast Alaska has a wet, relatively temperate climate, and the combination of high precipitation rates and mountainous terrain provides considerable opportunity for hydroelectric generation. Although hydroelectric generation accounts for most of the region's net power generation, hydroelectric power is not evenly distributed among the region's communities. As communities moved toward electrification, hydropower projects were developed in locations near the region's main load centers (i.e., the larger communities). Diesel generation was developed to supplement and backup hydroelectric generation, where it existed, and for communities that could not economically access hydroelectric power. Diesel generation is the main alternate source of energy because of the availability of diesel fuel, the ease of installing diesel generators in a wide range of capacities, and relatively low initial costs. However, in the period leading up to the 2012 Southeast Alaska IRP, the Southeast region saw a large increase in the number of conversions from fuel oil to electric space heating in those communities where hydroelectric power is available. This trend has led to unplanned growth in electric loads and reductions in the excess generation available from existing hydroelectric facilities (See Energy Resource Report [Tetra Tech 2016] for additional discussion).

Municipal governments, Alaska Native organizations, corporations, and regional planning and development groups are all involved in energy planning in Southeast Alaska. The City of Wrangell is a strong advocate for the proposed Alaska-British Columbia Intertie (AK-BC Intertie) that would facilitate the export of surplus power from Southeast Alaska to Canada and the lower 48. Tlingit Haida Central Council, Grand Camp of the Alaska Native Brotherhood, and Sealaska

Corporation have all publicly supported hydroelectric power generation and intertie projects in the region. Southeast Conference has funded several energy development plans and worked closely with AEA to secure funding for specific projects (USDA Forest Service 2010).

According to the Southeast Alaska IRP, the Southeast region is currently at a crossroads regarding the mix of generation, demand-side management/energy efficiency, and transmission resources that it will rely on to meet future electric and heating needs. The Southeast Alaska IRP identified four trends influencing energy demand and development in Southeast Alaska: 1) uneven distribution of relatively low cost hydroelectric generation, 2) volatility in diesel prices (especially the unprecedented increase prior to 2010), 3) current shortage of hydroelectric storage projects, and 4) the continued increase in homes converting from fuel oil to electric space heating in those communities where hydroelectric power is available which has let to unplanned growth in electric loads. Additional detail can be found in the Energy Resource Report (Tetra Tech 2016).

Social and Economic Context

Today, the power requirements of the region's larger communities, including Juneau, Ketchikan, Sitka, Petersburg, Wrangell, Skagway, and Haines, as well as some smaller communities, are met by relatively low cost hydroelectric generation, with diesel generation used only as a back-up. Other communities do not have this benefit and are instead entirely dependent on diesel generation. While considerable hydroelectric power is available in some locations, the lack of power transmission facilities prevents its distribution to the region as a whole (Black & Veatch 2012).

Fourteen of the 32 communities within or adjacent to the Tongass National Forest are either completely dependent upon diesel-generated electricity or are partially served by small hydroelectric projects (e.g., Gartina Falls [455 kilowatts]). Nine of these communities (Angoon, Coffman Cove, Elfin Cove, Hoonah, Kake, Naukati Bay, Tenakee Springs, Whale Pass, and Yakutat), ranging in population in 2014 from 16 to 787, have central electric utility systems that rely on diesel generation for all or the majority of their electricity needs. The other five communities that are dependent on diesel generation (Edna Bay, Meyers Chuck, Point Baker, Port Alexander, and Port Protection) with 2014 populations ranging from 13 to 56 have no central utility system and residents rely upon individual generators (USDA Forest Service 2010; Alaska DOL 2015a).

Although relatively easy and inexpensive to install, high fuel costs and the operations and maintenance expenses associated with diesel generators make them expensive to operate. As a result, in communities where hydroelectric power is not available, the reliance upon diesel generation has contributed to very high electric rates. According to the 2012 Southeast Alaska IRP, this has "created a gap or chasm between communities, where stable and "well-to-do" communities exist near struggling communities and a notable absence of private sector economic activity are the norm" (Black & Veatch 2012, p. 1-4). Alexander et al. (2010, p. 8) found that "the high cost of energy in the communities that rely on diesel generation impedes economic development, as decisions to locate new commercial and industrial developments are influenced by the availability of reliable low-cost power. Residents in communities in Southeast Alaska that rely primarily on hydroelectric power to generate electricity have the lowest residential rates in the State, with rates as low as 10 cents/kilowatt hour (kWh) in 2011. Residents of Anchorage and other places in Southcentral Alaska that rely mostly on natural gas for generation also have low rates, paying around 13 cents/kWh in 2011. Rates are much higher in smaller, more remote communities that rely on diesel, with rates ranging from about 50 cents to more than $1.50/kWh. The State helps to lower the price of electricity for residential customers and community facilities in most of these communities through the Power Cost Equalization (PCE) program. However, residents in these communities still pay higher rates even after the receipt of PCE payments (Fay et al. 2013).

The average residential rate in the U.S. was about 12 cents/kWh in 2011. In Southeast Alaska in 2011, electric rates for residential customers ranged from 9 cents to 73 cents/kWh. The lowest rates were in Metlakatla and Sitka (9 cents/kWh), Petersburg and Ketchikan (10 cents/kWh), Wrangell (11 cents/kWh), and Juneau (12 cents/kWh). The highest rates were in Pelican (69 cents/kWh), Tenakee Springs (69 cents/kWh), and Elfin Cove (73 cents/kWh). Rates for commercial and other users in each community are generally the same or very similar to residential rates (See Table 3 in the Energy Resource Report [Tetra Tech 2016]).

As noted above, the effective rate to residential customers in qualifying communities is lowered by the State of Alaska's PCE program. In Southeast Alaska, PCE reimbursement rates in 2011 ranged from 7 cents/kWh in Haines and Skagway to 40 cents/kWh in the communities served by the IPEC (Chilkat Valley, Kake, Hoonah, Klukwan, and Angoon). Commercial and other customers (community and governmental facilities and industrial customers) are not eligible to participate in the PCE program and there is no comparable program for these customers. See the Energy Resource Report for additional detail (Tetra Tech 2016).

Renewable Energy Resources

Hydropower is the main source of power generation in Southeast Alaska, accounting for 96 percent of net generation in 2011 (Fay et al. 2013). Other renewable resources exist and are being explored in the region. The following section provides a brief overview of hydropower and other renewable energy resources in Southeast Alaska.

Hydropower: As part of the Southeast Alaska IRP, AEA contractors developed a comprehensive list of potential hydroelectric projects in the region, with projects identified from numerous sources. One of the main sources was a 1947 report prepared by the Federal Power Commission that identified 200 projects. In total, the Southeast Alaska IRP identified almost 300 projects, but cautioned there is likely some duplication as some project names changed over time making it difficult to track individual projects. These projects are listed in Appendix C to the IRP (Black & Veatch 2012).

The Southeast Alaska IRP subsequently identifies five proposed hydroelectric facilities as "committed resources" (projects assumed to exist for the purposes of their analysis): Blue Lake Expansion, Gartina Falls, Reynolds Creek, Thayer Creek, and Whitman Lake, and uses a refined screening analysis to identify a total of 24 other potential hydroelectric projects that have the potential to be suitable to serve Southeast Alaska utility systems and communities. These projects are identified in Table 10-4 in the IRP (Black & Veatch 2012).

Wind: According to the Southeast Alaska IRP, there are small areas distributed throughout the region that may possess wind resources, but most utility-scale resources are in areas that are inaccessible due to terrain, are located in Inventoried Roadless Areas, or are too far from population centers (Black & Veatch 2012).

Geothermal: According to the Renewable Energy Atlas of Alaska, most of Southeast Alaska has low to moderate temperature geothermal systems with surface expressions as hot springs. Use of geothermal resources can involve direct use, such as district heating, greenhouses, and swimming pool heating, or electricity production (AEA and REAP 2013). Three applications for geothermal projects on the Tongass have been submitted to the Forest Service: Bell Island Geothermal, Neka Geothermal, and Tenakee Geothermal. Bell Island is the only remaining active application on file and carried forward in Table 3.12b-3. The issuance of the 2012 Supplemental Final EIS and Record of Decision (USDA Forest Service 2012c) allows geothermal exploration activities across three leases through 2017.

Biomass: Alaska's primary biomass fuels are wood, sawmill waste, fish byproducts, and municipal waste (AEA and REAP 2013; Lowell et al. 2015). Current biomass projects are mainly geared toward heating facilities (Black & Veatch 2012) and several dozen projects have been funded in some part by the Alaska Energy Authority (AEA) Renewable Energy Fund and USDA Forest Service grants over the past several years. Examples include the Sealaska Corporation which installed the state's first large-scale pellet boiler at its headquarters in Juneau in 2010, followed by the Ketchikan Federal Building in 2012 and the Tlingit-Haida Regional Housing Authority maintenance headquarters located in Juneau in 2013. Wood-fired boilers have been installed in some communities in Southeast Alaska, including Sitka, Craig, Thorne Bay, and Coffman Cove (AEA and REAP 2013; Lowell et al. 2015). According to the Renewable Energy Atlas of Alaska, interest in manufacturing wood pellets continues to increase (AEA and REAP 2013; Lowell et al. 2015). Overall, successfully launched projects provide useful learning opportunities as case studies, but future projects will need to continue analyze overall cost savings based on choosing the right technology for the local biomass fuel supply (USDA Forest Service 2015k).

Tidal: Tidal and river in-stream energy generation involves the use of hydrokinetic devices placed directly into a river or tidal current to capture the kinetic energy of moving water. AEA has granted partial funding for two tidal power reconnaissance and feasibility studies in Southeast Alaska. The Port Frederick Project and Kootznahoo Tidal Energy Project (Kootznahoo Project, formerly known as the Angoon Tidal Power Project) have been surrendered and dismissed by FERC, respectively. A third project—the Gastineau Channel Tidal—identified in the Southeast Alaska IRP (Black & Veatch 2012) was granted a preliminary permit by the FERC in 2010; this permit expired in 2013.

Wave: Alaska has one of the strongest wave resources in the world, but much of this energy is dissipated on remote, undeveloped shorelines. The Renewable Energy Atlas of Alaska identified the Yakutat Wave project as perhaps the best prospect for wave energy development in Alaska (AEA and REAP 2013).

Proposed Renewable Energy Projects

Proposed projects include hydropower, geothermal, and tidal energy. In June 2015, the Forest Service reviewed the list of projects from 2014 (USDA Forest Service 2014c) and identified 11 currently active proposed renewable energy projects in Southeast Alaska. All of these projects are either on or considered likely to affect NFS lands (Table 3.12b-3). Additional summary information is provided for these projects in Appendix A of the Energy Resource Report (Tetra Tech 2016).

Table 3.12b-3
Active Proposed and Unconstructed Renewable Energy Projects on or likely to affect National Forest System Lands

No.	Name	Ranger District	On or Likely to Affect NFS Lands	Applicant	Power Destination	LUD(s)	TUS Identifi-cation	Roadless Area
1	Yakutat Wave	Yakutat	Yes	Resolute Marine Energy	Yakutat	Scenic Viewshed	Window	na
2	Annex Creek	Juneau	Yes	AEL&P	Juneau	Semi-Remote Recreation	Window	302
3	Sweetheart Lake	Juneau	Yes	Juneau Hydropower, Inc.	Juneau	Semi-Remote Recreation	Window	302
4	Angoon Hydroelectric[1]	Admiralty	Yes	Kootznoowoo, Inc.	Angoon	Wilderness	Legislated	na
5	Crooked Creek/Jim's Lake	Hoonah	Yes	Community of Elfin Cove	Elfin Cove	Semi-Remote Recreation	Window	311
6	Tenakee Springs/Indian River[1]	Sitka	Yes	City of Tenakee Springs	Tenakee Springs	na		na
7	Little Port Walter[1]	Sitka	Yes	NOAA/NMFS	Little Port Walter Marine Station	Remote Recreation	Avoidance	334
8	Swan Lake Expansion	KMF	Yes	SEAPA	Ketchikan, Swan-Tyee Intertie	Semi-Remote Recreation	Window	526
9	Bell Island Geothermal[1]	KMF	Yes	B. Wilson	Swan-Tyee Intertie	Semi-Remote Recreation	Window	529
10	Mahoney Lake[2]	KMF	Yes	City of Saxman, AP&T et al.	Swan-Tyee Intertie	Semi-Remote Recreation	Window	524
11	Soule River	KMF	Yes	AP&T	BC and Lower 48	Remote Recreation	Avoidance	530

Notes:
Summary: 11 total: 7 window --- 2 avoidance – 1 legislated – 1 on non-NFS lands.
11 total: 8 in IRA -- 1 in Wilderness
na – not applicable
KMF – Ketchikan-Misty Fiords
[1] Non-Federal Energy Regulatory Commission
[2] FERC licensed in 1998, unconstructed
Source: USDA Forest Service 2014a, 2014b

Six of the 11 of the projects identified in Table 3.12b-3 are FERC hydroelectric projects. The remaining five projects consist of three non-FERC projects (Angoon Hydroelectric, Tenakee Springs/Indian River, and Little Port Walter), one wave project (Yakutat Wave), and one geothermal project (Bell Island Geothermal).

Based on the existing LUDs, 2 of the 11 projects on or likely to affect NFS lands are located in TUS "avoidance areas." Eight of the 11 proposed projects are located in IRAs, with one located in Wilderness (Table 3.12b-3).

Kootznoowoo, Inc., the village corporation of Angoon, is proposing to develop a run-of-river hydroelectric facility and associated features (including a transmission line, access road, and auxiliary buildings) within the Kootznoowoo Wilderness. ANILCA section 506(a)(3)(B) granted Kootznoowoo, Inc., ''the right to develop hydroelectric resources on Admiralty Island within Township 49 South, Range 67 East, and Township 50 South, Range 67 East, Cooper 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.'' ANILCA also recognized the economic and cultural needs and expectations associated with Kootznoowoo, Inc. (ANILCA Sec. 506(a)(3)(B)). FERC determined that it does not have jurisdiction over the project because Admiralty Island is a Congressionally designated National Monument on NFS lands. As directed by ANILCA, the Forest Service will issue special use authorizations, with specified conditions and in accordance with other federal and state permits and/or permissions, to allow construction and operation of the project under the terms of the May 2009 project Record of Decision.

Renewable Energy

The Forest Plan amendment would address renewable energy through the addition of Renewable Energy plan components, e.g., desired condition, objectives, standards and guidelines, to the Forest Plan. The Renewable Energy plan components would address each energy project including all related facilities, access roads, utility lines for the transmission and distribution of electric energy, ancillary equipment sites and areas required for construction and long-term maintenance of the project. As proposed, should there be a conflict in direction, the proposed plan components in Chapter 5 would take priority over forest-wide and LUD-specific standards and guidelines (subject to applicable laws).

Environmental Consequences

Direct and Indirect Effects

The NFS land base is the same for all action alternatives, approximately 16.7 million acres, and no changes are proposed to the 17 existing non-overlay LUD allocations (see Table 3.12b-2) or the Minerals LUD (which is an overlay LUD). The primary difference between the No Action and the Action Alternatives is that the amendment would remove the windows/avoidance language under the TUS LUD .

Under Alternative 1, renewable energy projects would continue to be managed in accordance with the 2008 Forest Plan. Current direction consists of the Transportation and Utility System LUD and the Forest-wide Standards and Guidelines for Lands that address special use administration for right-of-way grants, including those related to transportation and utility systems. There are three TUS areas on the Tongass based on the LUD's emphasis: TUS "windows," TUS "avoidance areas," and TUS "exclusion areas."

Thirteen of the 17 non-overlay LUDs are identified as TUS avoidance areas in the 2008 Forest Plan. Together, lands allocated to these LUDs comprise approximately 10,413,279 acres or 62 percent of the Forest (Table 3.12b-2). These areas are described in the Forest Plan as areas where the "establishment and use of transportation or utility corridors and sites is not desirable given the LUD emphasis"

(USDA Forest Service 2008a, p. 4-32). The Forest Plan directs that: a "search for "windows" should be exhausted before TUS facilities are considered in avoidance areas" and, when feasible, avoidance areas, as their name suggests, should "be avoided through site-specific analysis during project-level planning."

Based on the existing LUDs, 2 of the 12 proposed renewable energy projects on or likely to affect NFS lands are entirely or partially located in TUS "avoidance areas" (Soule River and Little Port Walter). Including the above projects, 8 of the 12 proposed projects are located in IRAs, with one (Angoon Hydroelectric) located in Wilderness (Table 3.12b-3).

Consistent with the 2008 Forest Plan, renewable energy projects need to be consistent with the standards and guidelines for the respective LUDs affected by energy development. All potential impacts to IRAs would be addressed during the permitting and licensing of these projects, with most requiring NEPA analysis. Potential impacts would be mitigated, but some impacts, like the presence of a road in a roadless area, may be unavoidable.

Under the Action Alternatives 2, 3, 4, and 5, the TUS LUD would be removed and replaced with Forest-wide plan components for Renewable Energy. No significant environmental consequences within the Lands category are anticipated for any of the action alternatives. The proposed plan content for Renewable Energy would provide greater flexibility, in meeting project planning, goals, and objectives (subject to applicable laws) across the Forest (see Chapter 5). Implementation of the Renewable Energy Plan Components under Alternatives 2 through 5 would simplify the process for projects, but would not necessarily result in an increase in the number of projects developed. The greatest effect may be in making the permitting process for developers less burdensome, resulting in more rapid development of sites rather than a substantial increase in the number of sites developed.

The Forest Service would continue land administration activities under the respective Forest-wide standards and guidelines presented in Chapter 4 of the 2008 Forest Plan. Proposed plan components developed under the 2012 Planning Rule are reflected in Chapter 5. The primary change is the removal of the Transportation and Utility System LUD (e.g., TUS "windows" and TUS "avoidance areas" approach) described in Chapter 4 (USDA Forest Service 2008a, pp 32-33). Although the 2008 Forest Plan does allow renewable energy projects to be proposed in any LUD, the process to allow such activities was limited, particularly LUDs identified as "avoidance areas".

The proposed Renewable Energy plan components (desired conditions, objectives, standards and guideline, etc.) would allow renewable energy sites to be proposed regardless of LUD type or emphasis. In other respects, administration of special use authorizations would continue under all alternatives. Proposed renewable energy projects (Table 3.12b-3) would be managed under the Renewable Energy Plan Components in Chapter 5 of the Forest Plan.

These Plan Components could affect other resources and are discussed in each respective resource. The proposed amendment would address each renewable energy site including all related facilities, access roads, utility lines for the transmission and distribution of electric energy, ancillary equipment sites and areas required for construction and long-term maintenance of the project. Site-specific locations and mitigation measures for proposed/unconstructed projects would still be determined by project-level planning and environmental analysis at the time a specific project is proposed.

As noted above, 8 of the 11 proposed projects listed in Table 3.12b-3 are located in IRAs. Two of these eight projects are located in "avoidance areas" with the remaining six in areas identified as "windows" and therefore, overall effects are consistent with current direction. Effects on IRA characteristics under all Action

Alternatives would need to be consistent with the new plan components for Renewable Energy (Forest Plan Chapter 5). Current existing and proposed renewable energy projects are widely distributed across the Forest, with 11 identified proposed renewable energy projects across six ranger districts. This would reduce the cumulative effects of these activities on any specific IRA. Overall, Alternatives 2 through 5 would likely have little additional adverse effects to IRAs relative to current conditions (Alternative 1).

Management and administration would remain the same regardless of the action alternative. For projects located on NFS lands, Section 4(e) of the FPA requires FERC to determine whether the project is consistent with National Forest purposes and the land management plan. The Forest Service will continue to use Section 4(e) to impose mandatory conditions in the FERC license to ensure the adequate protection and use of NFS land and resources. Non-FERC projects would continue to be administered through issuance of a special use authorization, with specified conditions and in accordance with other federal and state permits and/or permissions, to allow construction and operation of projects.

Cumulative Effects

Forest Service land use activities under the proposed amendment to the Forest Plan are not considered to have the potential to create or contribute to significant cumulative effects. Incremental effects to the Scenic Integrity Objectives could occur for energy-related projects that may be sited within beach and estuary fringe areas. The addition of the Renewable Energy plan components do not change the need to ensure that resource protection measures are incorporated throughout project-level planning, construction, and operation of renewable energy sites including those projects located in IRAs. The effects of past and present actions on roadless areas are discussed in more detail in the *Inventoried Roadless Areas* section. All proposed projects would continue to be subject to the Forest Plan and the NEPA, as well as FERC regulations in some cases. The energy projects listed in Table 3.12b-3 are considered reasonably foreseeable, including those located in IRAs, and are expected to have low potential for cumulative effects given that over 90 percent of the Tongass is currently roadless or wilderness. Regardless of the alternative chosen, approximately 97 percent of all existing IRAs would remain roadless after 100+ years (See the *Inventoried Roadless Areas* section for additional detail).

Appendix C in this EIS describes of all the past, present, and reasonably foreseeable future actions considered in the cumulative effects analysis.

Timber

Affected Environment

Introduction

The forests of Southeast Alaska are primarily the western hemlock-Sitka spruce forest type. This forest type is part of the temperate rain forest that occupies a coastal strip 2,000 miles long from northern California to Southcentral Alaska. The most extensive occurrence of the western hemlock-Sitka spruce type is in Southeast Alaska. Within the Tongass, western hemlock-Sitka spruce stands cover 98 percent of the forest lands. Western hemlock and Sitka spruce comprise the majority of the stocking in this forest type, associated species include, depending on location, yellow-cedar, western redcedar, mountain hemlock, and silver fir (Harris and Johnson 1983). The remaining 2 percent of forest lands support relatively small stands dominated by yellow-cedar, lodgepole pine (shore pine), red alder, or black cottonwood. Western hemlock is used for pilings, poles, railway ties, windowsills, doors, and construction lumber, and has been an important fiber source for pulp. Sitka spruce is used for lumber and commodity products, as well as specialty products, such as piano sounding boards, guitar faces, oars, planking, masts, and spars for custom-made or traditional boats, and ladders. For centuries Alaska Natives have used cedar species for canoes and paddles, housing (along with Sitka spruce), and totem poles. Today, redcedar is primarily used as a roofing material and yellow-cedar has many uses, including boats, utility poles, heavy flooring, framing, and marine decking and piling.

The forests of Southeast Alaska are the main source of raw materials for the region's wood products industry. From 1980 through 2005, the Tongass National Forest accounted for between 18 and 49 percent of the total annual Southeast Alaska timber harvest, averaging approximately 42 percent. During this period, timber harvest on all ownerships in Southeast Alaska ranged from peak levels of just under 1,000 million board feet (MMBF) in 1989 and 1990 to a low of 169 MMBF in 2004. Timber harvested on National Forest System (NFS) lands is available for processing by the local wood products industry but most timber harvested on non-NFS lands is exported. The wood products industry and associated regional employment is discussed in more detail in the *Economic and Social Environment* section of this document.

Current Condition of the Forest Land Base

The timber inventory on the Tongass, including the forest type composition, age class distribution, and volume classes, is described in Chapter 3 of the 1997 Tongass Land and Resource Management Plan (Forest Plan) Revision Final Environmental Impact Statement (FEIS) (USDA Forest Service 1997a). This information was updated with inventory data published in 2001 (van Hees 2001). Since 2008, extensive updating and inventorying of young growth stands has been conducted and incorporated into this analysis (S. Spores, Tongass Forest Silviculturist, personal communication, September 2015).

Approximately 55 percent of the forest land on the Tongass National Forest (approximately 5.5 million acres) is classified as productive forest land; these lands are considered biologically capable of producing industrial wood products. Approximately 0.5 million acres of the productive forest lands on the Tongass have been converted to young-growth forest due to harvest or other disturbances such as fire or wind. This is approximately 3 percent of the total Tongass land base and 9 percent of the productive forest lands and represents approximately 15 billion board feet of harvested timber.

In addition to productive forest lands, the Tongass includes approximately 4.6 million acres of unproductive forest. These are lands that are not capable of producing industrial forest products, but are important for watershed protection, wildlife habitat, recreation, and other uses. Unproductive forest is land incapable of yielding crops of industrial wood, usually because of adverse site conditions. These conditions may include sterile or poorly drained soil, subalpine conditions, and steep rocky areas where landslides or avalanches curtail timber development.

An analysis of timber resource land suitability on the Tongass in accordance to the 1982 planning rule was completed by the Forest Service for the 1997 Forest Plan Revision FEIS and updated for the 2008 Forest Plan, Appendix A. This was updated to comply with the 2012 planning rule for Alternative 5, the preferred alternative, and is included in the Forest Plan, Appendix A. Modifications to this appendix would be needed for Alternatives 2,3, and 4

Currently, the suitable forest land covers approximately 0.6 million mapped acres. Following field verification, the suitable acreage is expected to amount to approximately 0.5 million acres. A general summary of the derivation of suitable lands is presented in Table 3.13-1 for the 2008 Forest Plan.

Table 3.13-1
Land Classification of Suitable Lands

Classification	Acres[1]
Total National Forest System lands within the plan area	16,755,685
Lands not suited for timber production due to legal or technical reasons	15,794,004
Lands that may be suited for timber production	961,681
Lands not suited for timber production because timber production is not compatible with the desired conditions and objectives established by the plan	369,161
Total lands not suited for timber production	16,163,165
Total lands suited for timber production (mapped suitable) because timber production is compatible with the desired conditions and objectives established by the plan	592,520

[1] Sums and differences may not appear exact due to rounding. Differences between these numbers and those in the 2008 Forest Plan FEIS are due to changes in shoreline mapping, land adjustments (especially the Sealaska adjustment), and updates to the vegetation and other GIS layers.
Source: Forest Service GIS database.

Current Condition of the Timber Resource

Age Class Distribution. The Tongass is a mix of old-growth stands and naturally regenerated young-growth forest, which consists of both wind-created and harvest-created young growth. Harvest-created young growth amounts approximately 5 percent of the total forest land area. Suitable forest lands are classified into five stand conditions: 1) old-growth sawtimber, 2) young-growth sawtimber, 3) pole timber, 4) seedling and sapling, and 5) non-stocked. For timber inventory purposes, stands of trees 150 years old or older are designated as old growth. More than 85 percent of forest lands meet the criteria for old-growth sawtimber (Table 3.13-2).

To help define tree ages on the Tongass, Farr and McClellan (unpublished manuscript) measured and analyzed age data from 67 plots located throughout the Tongass (excluding the Yakutat Area). They found that 90 percent of all overstory trees were more than 180 years old; 84 percent were more than 200 years; 47 percent were more than 300 years; 15 percent were more than 400 years; and 5 percent were more than 500 years old.

Forests less than 150 years cover approximately 0.5 million acres; forests that are 150 years of age or greater cover over 5 million acres. Table 3.13-2 lists the total acres of productive forest land and the acres that are suitable for timber production within two broad age classes.

Table 3.13-2
Estimated Age Class Distribution of All Productive Forest Land and Suitable Productive Forest Land (acres)

Age (Years)	All Productive Forest Lands[1]	Suitable Forest Lands[1,2]
0 to 149	544,000[3,4]	264,000[3]
150+	5,002,000[4]	329,000
Total	**5,546,000**	**593,000**

[1] Numbers may not appear to add correctly due to rounding.
[2] Mapped suitable acres not adjusted (reduced) for falldown (MIRF).
[3] Includes 83,000 acres of natural young growth and 461,000 acres of harvested stands including about 40,000 acres of partial harvested stands.
[4] Differences between these numbers and those in the 2008 Forest Plan FEIS are due to changes in shoreline mapping, land adjustments (especially the Sealaska adjustment), and updates to the vegetation and other GIS layers.
Source: Tongass National Forest GIS database

Table 3.13-3 displays the acres of harvested even-aged young-growth forest by age class. Approximately 46 percent of the area harvested over the past century is no longer suitable, due to Congressional designations such as Wilderness, State and Native land selections, or Forest Plan LUD allocations. For example, areas designated as Wilderness or LUD II by Congress are no longer suitable.

Table 3.13-3
Estimated Age Class Distribution of Even-aged Young-Growth Stands (acres)[1,2]

Age Class (Years)	Development LUDs	Wilderness, National Monument, LUD IIs[3]	Other Non-Development LUDs
0 to 55	326,768	8,484	49,532
56 to 65	16,289	2,420	8,795
66 to 75	2,400	641	534
76 to 85	987	176	307
>85-149	1,160	760	2,363
Total	**347,605**	**12,482**	**61,529**

1 Numbers may not appear to add correctly due to rounding.
2 Acres differ from Table 3.13-2 that includes natural young-growth and uneven-aged stands.
3 Withdrawn Non-Development LUDs include Wilderness, LUD II, and other withdrawn acres.
Source: Tongass National Forest GIS database

Species Mix and Log Types

Timber harvest on the Tongass generally results in a mix of species and log types. The majority of the logs cut in most sales are western hemlock; Sitka spruce is the second most common species. Yellow-cedar and western redcedar account for most of the remaining volume. Cedar, especially yellow-cedar, often commands high prices on the export market and is generally exported (refer to the *Economic and Social Environment* section for discussion of utilization).

Trees harvested from old-growth stands on the Tongass often contain three types of logs: sawlogs, utility logs, and cull logs. Sawlogs are logs that come from that portion of the tree that is of suitable size and quality to be cut into dimension lumber. Sawlogs usually come from the lower portion of the tree, the part of the tree with larger diameter logs. Higher quality sawlogs come from that portion of the tree with fewer branches, which can result in lumber with fewer knots, while lower quality sawlogs often come from that portion of the tree that still retains a live crown. Utility logs are logs that cannot be used to produce lumber but are suitable for chips. They contain at least 50 percent sound wood. Utility wood is also produced from portions of sawlogs that cannot be cut into lumber (refer to Figure 3.13-2). The third type of logs, referred to as cull logs, are logs that do not have enough sound wood to be merchantable, even for chips. These logs are usually left in the woods and contribute to large woody debris (LWD) component and structure left on the forest floor.

Trees harvested from young-growth stands have much lower rates of insects, disease and defect than in the old-growth stands. While productive young-growth stands can carry much higher volumes per acre, it is recognized that the wood quality is lower than from the larger, slower growing old-growth trees. For example, the smaller, younger trees will have more knots and wider-spaced growth rings; in one study, Christensen et al. (2002) showed that recovery of high-grade material (clear and select structural grades) from 90-year old young-growth trees from Prince of Wales Island was considerably lower than the typical old-growth yields of higher grade products.

Timber Inventory

The Timber section in the 2008 Forest Plan Amendment FEIS (USDA Forest Service 2008b) includes a discussion on the history of the timber inventory methodology on the forest through about 2005. Since that time, extensive work has been conducted relative to the inventory of young-growth. A summary of this work is provided below:

- In 2005, approximately 25,000 acres of young-growth stands were inventoried using Common Stand Exam protocols. Approximately 22,000 acres were inventoried on Prince of Wales Island with the remaining acres inventoried on Ketchikan-Misty Fiords Ranger District.
- In 2011, another effort was initiated that inventoried an additional 33,000 acres of young growth.
- In 2009, the Forest contracted with the Forest Biometrics Research Institute to develop a version of the Forest Planning and Projection System (FPS) growth and yield model for both young growth and old growth forests. This model is spatially explicit and has been used to expand existing data into currently uninventoried stands.
- In July 2015, the Forest Service and State of Alaska entered into a cost share agreement to collect an additional $2.5 million dollars of inventory across young-growth stands to help determine feasibility of future harvest treatments and to develop a projected harvest schedule.

Volume Classes and Strata

The Forest established volume classes of commercial timber in the 1979 Forest Plan (amended 1985), also known as TimTyp or TIM86. Using net inventory volumes per acre, these classes are:

Young Growth

Class 3: 0 to 8,000 board feet

Old Growth and Young Growth

Class 4: 8,000 to 20,000 board feet

Class 5: 20,001 to 30,000 board feet

Class 6: 30,001 to 50,000 board feet

Class 7: 50,001 board feet or greater

There were a number of concerns from within and outside the agency regarding the reliability of this information (usually referred to as the volume class map). Therefore, a study addressing concerns about the volume class map reliability was commissioned in 1989. It concluded that there was no statistical difference among volume classes 5, 6, and 7 with respect to mean board feet per acre and that the existing volume class map should not be used to determine volume per acre (Brickell 1989).

The volume class map had been used by the Alaska Region to calculate long-term timber sale contract timber volume proportionality, as required by Section 301 of the Tongass Timber Reform Act (TTRA). However, this procedure was successfully challenged in court by The Wildlife Society, Alaska Chapter. The court disputes over the TTRA Section 301 proportional harvest methodology were settled, with issuance of an updated Forest Service Handbook Supplement (Region 10, FSH 2409.18 Supplement No. 2409.18-96-1), and alternative methods of assigning timber volume (or the capability to produce different timber volumes) to lands currently supporting old-growth forests were considered for the 1997 Forest Plan Revision. Five different options were studied and evaluated (Julin and Caouette 1997). Statistical analysis indicated that three volume strata can be distinguished for the available timberlands (lands not legislatively or administratively withdrawn) using the existing inventory and additional information on soils and slope. The polygon characteristics of the three-strata approach are displayed in Table 3.13-4. In the development of the size-density model (SDM) (see *Biodiversity* section), these strata were redefined from the 1997 volume strata criteria of hydric soils and slope percent by using information on hydric soils and aspect, See Figure 3.9-2. Table 3.13-4 is based on these redefined strata. These volume strata were used to model timber outputs for this analysis (refer to Appendix B for a discussion of the Woodstock model).

Table 3.13-4
Tongass National Forest Strata Characteristics–Productive Old-Growth Forest

Geographic Area	Trees/ Acre	Gross Volume (MBF/ Acre)	Net Sawlog Volume (MBF/Acre)	Net Utility Volume (MBF/Acre)	Total Net Sawlog and Utility Volume (MBF/Acre)
North Islands[1]					
Low	102	17.8	11.1	1.8	12.9
Medium	89	27.8	17.7	3.0	20.7
High	89	39.8	25.6	4.8	30.4
North Mainland[1]					
Low	137	12.3	7.6	0.9	8.5
Medium	148	35.0	19.6	4.5	24.1
High	89	39.8	24.6	4.7	29.3
South Islands[1]					
Low	151	20.9	13.7	2.0	15.7
Medium	100	30.3	20.7	2.9	23.6
High	97	41.7	29.3	5.1	34.4
South Mainland[1]					
Low	97	22.9	15.1	2.0	17.1
Medium	100	30.3	21.0	3.0	24.0
High	111	41.3	30.2	5.4	35.6
Yakutat					
Low	21	6.5	4.7	0.5	5.2
Medium	187	40.4	27.7	5.0	32.7
High	196	45.2	32.7	4.1	36.8

[1] North Islands: Chichagof, Baranoff, Admiralty, and associated islands; North Mainland: mainland north of the Sti River; South Islands: Kupreanof, Mitkof, Kuiu, Prince of Wales, Wrangell, Zarembo, Etolin and Revillagigedo and associated islands; South Mainland: mainland south of the Stikine River.
Source: Refer to USDA Forest Service 2006, SDM Data for documentation on why forests were grouped in these geographic areas. Numbers not exact due to rounding.

While the three-strata approach is useful for estimating timber volume for forest planning purposes, it is not a good tool for identifying other important forest elements, including forest structure, ecosystem diversity, and wildlife habitat. For example, two stands may have the same volume, but one may be a dense stand of medium-sized trees with a single canopy layer, while the other stand may be a combination of widely- spaced large overstory trees and two or three lower canopy layers containing small- and medium-sized trees. To help account for these differences, the Size Density Model (SDM), which is based on a combination of tree sizes and tree densities (Caouette et al. 2001), has proven to be a better tool for representing these other forest elements. Using tree sizes and densities provides a more comprehensive forest measuring system for describing habitat than timber volume (Spies and Franklin 1991). The SDM (Caouette and DeGayner 2005) is described and used in the *Biodiversity* and other sections.

Non-National Forest System Lands

The State of Alaska, Native village corporations, Sealaska (the Native regional corporation) and individuals own over 1,186,000 acres of land in Southeast Alaska, inside the Forest boundary. Approximately 364,000 acres of this land currently consists of productive old-growth forest and 422,000 acres consists of young growth. This means that approximately 54 percent of the original productive old growth on non-NFS lands has been harvested (based on GIS analysis and information provided by the landowners). Most timber harvested from Department of Natural Resources state lands in recent years has been processed locally, while timber harvested from University Trust and Mental Health Trust lands has been exported.

Current Practices

Young-Growth Management

The Secretary of Agriculture issued Memorandum 1044-009, Addressing Sustainable Forestry in Southeast Alaska, dated July 2, 2013. The memorandum guides management of the Tongass National Forest to:

> “Speed the transition away from old-growth timber harvesting and towards a forest industry that utilizes second growth – or young growth – forests. Moreover, we must do this in a way that preserves a viable timber industry that provides jobs and opportunities for residents of Southeast Alaska” (USDA 2013, p. 1).

The objective of this Secretarial Memorandum is to ensure that the USDA, the Chief of the Forest Service, the Alaska Region of the Forest Service, and the Tongass National Forest work together to catalyze a transition from a timber sale program based on old growth to one based on young growth. Pursuant to this Memorandum, the Secretary asks the Forest Service to:

a) Seek opportunities to supply sufficient old-growth “bridge timber” while the industry re-tools for processing young growth. The first step is the Big Thorne timber sale. This project along with other planned timber sales would supply timber to existing mills for several years and allow the Forest Service to reallocate staff to young-growth projects.

b) As soon as possible, allocate staff and financial resources to planning young growth projects, ramping down old-growth sales and increasing investments in young growth.

c) Continue to work with Congress to exempt a limited amount of young growth on the Tongass from current requirements that generally restrict harvesting young growth timber until it has reached maximum growth rates, or Culmination of Mean Annual Increment (CMAI). Providing flexibility with regard to CMAI is essential to permit the development of economically viable young growth projects within the timeframe set as a goal for the transition.

Public Law 113-291 provided the Tongass flexibility to harvest young growth without meeting CMAI requirements in addition to exceptions allowed under the National Forest Management Act.

Managing young-growth forests in Southeast Alaska will become an increasingly important component of forest management on the Tongass in the next decade. Young-growth stands can be treated through thinning and other intermediate treatments to concentrate growth in fewer, larger trees, improve lumber quality, and/or to enhance habitat conditions for wildlife. Zaborske et al. (2000) concluded that the types of treatments applied to young stands will have a profound effect on the types of materials available in the future, including log diameter, knot size, and wood strength.

Over 200,000 acres have been precommercially thinned on the Tongass since 1979. In recent years, precommercial thinning has averaged approximately 5,600 acres per year. The Forest has less experience with other young-growth management techniques, such as pruning and commercial thinning.

Barbour et al: (2005) estimated that precommercial thinning at age 20 with a spacing of 12 by 12 feet would produce more merchantable wood volume at age 70 than wider spaced thinnings. However, there is a trend toward wider tree spacing in precommercial thinning prescriptions to maintain or enhance understory plant cover. These treatments could increase taper, knot size and stimulate the production of epicormic branches in spruce. These changes could adversely affect wood strength and stiffness (McClellan 2005). There is also a concern that wider spacing may increase the occurrence of fluting on sites where this is a problem (Julin et al. 1993; Holsten et al. 2001).

Pruning removes lower branches and can increase future lumber quality. However, care must be taken not to remove too much of the live crown, which can affect tree growth.

There has been increased interest in commercial thinning in recent years, not only to improve timber values, but as a tool to improve wildlife habitat. Studies in other forest types in the Pacific Northwest indicate that stand structures that are similar to old-growth forest conditions can be developed through thinning (Thysell and Carey 2000). However, there are many unanswered questions as to how to implement thinning treatments that provide a sustainable source of high-value wood products while maintaining biological diversity (Zaborske et al. 2000). In a study comparing the lumber harvested from thinned and unthinned, 90-year-old stands on the Tongass National Forest, Christensen et al. (2002) found that there was no difference in volume recovery or lumber grade in thinned and unthinned Sitka spruce. For western hemlock, the unthinned stands produced more wood volume, but the thinned stands produced more high-grade lumber. The Prince of Wales Commercial Thinning Study was awarded as an Integrated Resource Service Contract at the end of FY2008. This study looks at five different commercial thinning prescriptions that offer a range of potential treatments that could be used on the Tongass. The five different prescriptions were implemented at three replicates: near Harris River, in the Maybeso Experimental Forest, and near Naukati. The objectives of the study are to assess how mechanized equipment operates, how the different prescriptions hold up to Southeast Alaska's weather, and what the understory response is after treatment. A 5-year re-measurement of the sites was completed in 2014.

There is also increased interest in managing young-growth stands to increase and maintain understory vegetation, especially as forage for deer and other wildlife. Hanley et al. (2005) noted that much research is needed on new approaches involving thinning of older stands, including red alder in the secondary successional sequence. Zaborske et al. (2002) found that thinning greatly increased forage production, though the amount of useful forage produced varied by the type of thinning implemented. Refer to the *Wildlife* section for a discussion of thinning and wildlife habitat.

In additional to their continuing research on managing young forests, scientists at the Pacific Northwest Research Station joined with the Tongass National Forest in 2001 to establish an operational-scale adaptive management study of young-growth management options. This program, called the Tongass-wide Young-Growth Studies (TWYGS), is designed to evaluate the potential benefits of treating young-growth stands to increase wildlife habitat and wood production. Currently, TWYGS includes experiments that test the effectiveness of alder interplanting, precommercial thinning, slash treatments, girdling and pruning.

Regeneration Methods

Regeneration methods are the harvest methods used to create a new age class within a stand. The methods used on the Forest are not expected to be differ when applied to old-growth or young-growth stands. A description of the primary methods is provided below.

Even-aged Systems. This system includes clearcuts, seed tree, and shelterwood harvest methods. These methods are described in detail in Appendix G of the 1997 Tongass Land Management Plan FEIS. Under an even-aged system, the intention is to replace the entire (or nearly the entire) stand with a new crop of trees that are all of the same age. Under the National Forest Management Act (NFMA), clearcutting can only be used when it is the optimum system. This is determined through a site-specific prescription approved by a certified silviculturist. Also under NFMA, a stand must have reached at least 95 percent of CMAI. This is the point at which the stand reaches its highest average growth. The exact age that this occurs varies by site and stand treatment. A stand on a high site will generally reach CMAI sooner than one on a lower site. However, stand treatments, such as precommercial thinning and commercial thinning, will generally extend the period of fast growth, causing the stand to take longer to reach CMAI. There are, however, exceptions to this NFMA requirement that the Tongass would likely qualify for under the current situation.

Public Law 113-291 specifies that the Tongass may harvest trees prior to 95 percent of CMAI to facilitate the transition away from commercial timber harvest of old-growth stands. However, the sale of young-growth trees harvested under this exception shall not: (i) exceed 15,000 acres during the 10-year period beginning on the date of enactment of the Act (December 19, 2014), with an annual maximum of 3,000 acres sold; (ii) exceed a total of 50,000 acres, with an annual maximum of 5,000 acres sold after the first 10-year period; and (iii) be advertised if the indicated rate is deficit (defined as the value of the timber is not sufficient to cover all logging and stumpage costs and provide a normal profit and risk allowance under the appraisal process of the Forest Service) when appraised using a residual value appraisal. The NFMA also provides exceptions to the CMAI requirement.

Clearcutting, with reliance on natural seeding, has been the most commonly used silvicultural system in the Sitka spruce-western hemlock forest type of Southeast Alaska (Ruth and Harris 1979; Deal et al. 2002). Clearcutting is used where timber production is the primary use and where it is the optimal method. The clearcutting method is favored for several reasons. Clearcutting increases exposure to the sun, which raises soil temperature, speeds up organic decomposition, and thus improves soil productivity. Sitka spruce is less tolerant of shade than western hemlock (USDA Forest Service 1990); therefore, in the mixed spruce-hemlock forests of Southeast Alaska, the open conditions created by clearcutting favor the regeneration of Sitka spruce (Ruth and Harris 1979). Shade intolerance also favors cedar species regeneration in clearcuts relative to western hemlock (S. Spores, Tongass Forest Silviculturist, personal communication, September 2015). Clearcutting in stands infected by dwarf mistletoe substantially reduces infection in the regenerated stand (Shaw and Hennon 1991). Logging costs are lower than with other systems, and the clearcut method has proven very successful in the regeneration (regrowth) of healthy forested stands (refer to Appendix G in the 1997 FEIS for additional discussion).

A variant of this system, referred to as clearcutting with reserves, involves retaining approximately 10 percent of the stand, either in single trees or in small groups. This method is generally used to meet scenery or wildlife needs in areas where timber production is the primary goal.

In 1992, the Chief of the Forest Service directed that the even-aged system (clearcutting) be limited to areas where it is essential to meet Forest Plan objectives. Clearcutting has traditionally been used in the hemlock-spruce forests of Southeast Alaska to reduce mistletoe infection by eliminating infected trees from the overstory, reduce heartrot and stem diseases that may result from logging damage to leave trees, and to eliminate the risk of blowdown of residual trees. As the Forest begins to rotate younger stands, clearcutting may also be used to promote regeneration of desirable species. In addition, it requires fewer miles of road for a given volume (Ruth and Harris 1979; USDA Forest Service 1983). Because more volume is harvested from each acre than would be the case under uneven-aged management, many fewer acres are impacted for the same harvest volume.

Two-aged Systems. In this system, for example, up to 30 percent of a stand is left as residual (or reserve) trees, either as single trees or in patches, and the rest of the stand is harvested. The reserve trees remain unharvested and provide structural diversity and an older aggregation of trees within the otherwise young-growth stand. This system has been used on the Tongass to meet scenery objectives. Logging costs can be higher because of the need to protect the reserve trees.

Experience in other regions indicated that retaining overstory trees led to regeneration of more shade-tolerant species (which would favor hemlock over Sitka spruce in Southeast Alaska), reduced growth, increased dwarf mistletoe infection in understory trees, and resulted in windthrow of overstory trees (Harris and Farr 1974). However, a retrospective study of 18 partial cut stands in Southeast Alaska found that partial cutting had little effect on tree species composition, diameter growth, or dwarf mistletoe levels (Deal and Tappeiner 2002; Deal et al. 2002). Mortality of residual trees was only marginally higher in partial cut stands than in uncut stands; although the location of these stands may have contributed to the relatively low level of wind damage. The stands sampled in this study were all below 100 feet in elevation and within 1.25 miles of the shoreline. Stands on exposed south-facing ridges and on slopes are likely to have a greater risk of windthrow (Nowacki and Kramer 1998). Windthrow may be of particular concern because one of the predicted outcomes of climate change in Southeast Alaska is an increase in the frequency of severe wind storms. Juday et al. (1998) considered it highly likely that there would be increased blowdown across Southeast Alaska in the future.

Uneven-aged Systems. This system typically involves harvesting of single trees or of small groups of trees (usually less than 2 acres) from within a stand. This method maintains a multi-aged, multi-layered stand structure by removing some trees in all age groups. It has been used on the Forest to meet scenery and wildlife habitat needs. Uneven-aged management often involves higher costs due to the generally needing to use a helicopter or a lateral yarder for harvest. Larger harvest areas than would be needed for the same harvest volume under an even-aged or two-aged system (Ruth and Harris 1979). Also, the frequent entries in the stand to remove individual or small groups of trees increases logging costs and the risk of damaging the remaining trees (USDA Forest Service 1983).

Deal (2001) concluded that it may closely mimic the natural disturbance regime of Southeast Alaska based on a retrospective study of 18 partial cut stands. Stand structures were similar to uncut old-growth stands, and cutting had no significant effect on species composition (Deal and Tappeiner 2002). Uneven-aged systems have potential benefits, including protection of wildlife habitat, scenery, and slope stability as well as the maintenance of biological diversity (McClellan et al. 2000).

Growth rates. Estimation of future yields from young-growth stands created by timber harvest is critical for developing project timber sale quantities (PTSQs) for the Forest Plan. Growth and yield tables have been developed for even-aged stands in Southeast Alaska (Taylor 1934; Farr 1984). Although published growth and yield tables have not been developed for stands regenerated under two-aged or uneven-aged methods, unpublished yield tables for these harvest types were developed by the Forest Service for use in estimating sustained yield limit (SYL) and PTSQ. These are part of the planning record.

Given that over 30 percent of the volume in old-growth stands is defective (Farr and Harris 1971), it is unlikely that these trees would respond to the additional growing space made available through partial harvest. While young western hemlock stands respond well to thinning, trees older than 100 years respond poorly to release (USDA Forest Service 1990). Western hemlock is shade tolerant and may grow well under partial shade. Sitka spruce is less shade tolerant than hemlock and it is reasonable to expect some growth loss when Sitka spruce is grown under residual overstory trees. However, Deal and Tappeiner (2002) reported that, in most cases, concerns about greatly reduced stand growth and vigor were unsubstantiated, based on a retrospective study of 18 stands in Southeast Alaska that had been partially cut 12 to 90 years earlier. Analysis of these stands did not detect significant changes in tree species composition, stand growth, hemlock dwarf mistletoe infection, or mortality rates (Deal et al. 2002).

Species Composition

Of the four major commercial tree species on the Tongass, western hemlock is the most shade tolerant, followed by western redcedar, yellow-cedar, and Sitka spruce, in that order (USDA Forest Service 1990). Western hemlock is by far the most prevalent species, making up 83 percent of the old-growth forests (Farr and McClellan 1994). Dwarf mistletoe commonly infects western hemlock. Sitka spruce and yellow-cedar are rarely infected by dwarf mistletoe and western redcedar is not infected (USDA Forest Service 2001b). Western hemlock also appears to have more insect enemies than Sitka spruce (USDA Forest Service 1974). In addition, western hemlock has the lowest economic value of these four species. Having a diverse species mix contributes to wildlife habitat quality, economic value, and minimizes losses due to insect and diseases that are species specific.

Five years following even-aged harvest, Harris (USDA Forest Service 1967) reported that 53 percent of the regenerated stand was western hemlock, 41 percent Sitka spruce, and 6 percent cedar. As even-aged stands age, the density of Sitka spruce decreases and relatively few Sitka spruce exist in old-growth stands, especially in the smaller diameter classes (USDA Forest Service 2000b).

Regeneration harvest methods that create open conditions and expose bare mineral soil, such as clearcutting, would encourage germination and growth of Sitka spruce and the cedars. Group selection with openings of at least 2 acres could also encourage germination and growth of Sitka spruce and the cedars, but to a lesser degree than clearcutting due to side shading. The amount of sun reaching the surface would vary depending on the size, shape, and aspect of the opening. Regeneration methods that create less ground disturbance and smaller openings in the canopy such as single tree selection, smaller sized groups in group selection, overstory removals, and treatments with many reserve trees would encourage growth of western hemlock at the expense of the other species. However, limited retrospective studies indicate that Sitka spruce can be maintained in mixed hemlock-Sitka spruce stands over a wide range of cutting intensities if enough Sitka spruce trees are present in the stand after harvest (McClellan 2005). Two-aged harvest would be similar to even-aged harvest if leave trees are concentrated near the unit boundaries but may be more favorable for western hemlock regeneration if reserve trees are scattered through the unit, due to shading from the residual overstory.

Reforestation

The NFMA requires assurance that all areas receiving final removal harvest can be adequately restocked with trees within 5 years of that harvest. On the Tongass, natural restocking is usually adequate to meet this objective because both western hemlock and Sitka spruce are prolific seed producers (USDA Forest Service 1983). The new stand originates from advance regeneration and from seeds that come from residual trees or from trees adjacent to the harvest unit. Since 1988, natural regeneration has accounted for 94 percent of the reforestation program. The remaining 6 percent has been artificial regeneration (planting). The future need for planting would be determined on a site-specific basis to achieve management objectives such as increasing the abundance of Sitka spruce where western hemlock or brush may have a competitive edge or increasing the abundance of yellow-cedar or western redcedar, where natural regeneration of these species is anticipated to be inadequate. The desired species composition, required number of seedlings, and method of regeneration should be displayed in the silvicultural prescription.

Intermediate Treatment Methods

Intermediate treatments are any manipulation in a stand that occurs between two regeneration periods (Daniel et al. 1979). The regeneration period establishes the new stand, either through natural regeneration or through planting. Intermediate treatments are done to ensure that the new stand has the desired species composition, tree health, growth, and spacing, as well as to recover product value. They can also be used to create or improve habitat for wildlife. Intermediate treatments may be used if approved as part of a site-specific silvicultural prescription. Currently, the only intermediate treatment commonly used on the Tongass is pre-commercial thinning.

Precommercial thinning is applied in young stands that have not reached merchantable size. It is the most commonly applied intermediate treatment in Southeast Alaska. It is used to:

- Favor preferred tree species.
- Concentrate tree growth on fewer individuals to produce larger trees in a shorter period of time.

- Increase the amount of light reaching the forest floor, thereby retaining understory vegetation that is valuable wildlife forage (DellaSalla et al. 1994).

There are concerns over the effects of precommercial thinning on future wood quality, especially wider spacing of residual trees (McClellan 2005). Thinning can increase epicormic sprouting on the Sitka spruce trees (Deal et al. 2003). Lower density thinnings could increase taper and increase the size and longevity of lower branches, thus reducing future wood quality (McClellan 2005). Larger lower branches increase fluting in western hemlock, which reduces wood quality (Julin et al. 1993) (refer to the *Forest Health* section for a discussion of fluting).

Pruning removes the lower branches of a tree at an early age in order to produce knot-free wood. It is the only way to produce clear lumber in rotations less than 100 years (Daniel et al. 1979). However, pruning Sitka spruce trees can encourage epicormic sprouting in Sitka spruce and can limit diameter growth for all species. Deal et al. (2003) found that the total number of sprouts was similar among different levels of pruning but significantly more large sprouts were produced when more of the crown was removed.

Commercial thinning is applied to young stands that have reached merchantable size. The primary difference between commercial and precommercial thinning is that the trees cut in a commercial thinning operation are removed and sold. Commercial thinning can be used to:

- Meet market demand for wood products, either from suitable or unsuitable lands (harvest would only be used on unsuitable lands to meet resource objectives, such as improving wildlife habitat, and where no irreversible damage would occur).
- Maintain or increase the growth rate of dominant and co-dominant trees by removing trees in the lower crown classes, increasing merchantable yields over the rotation.
- Stimulate development of more complex canopy structures or enhance forage in the understory in order to meet wildlife habitat needs.
- Maintain or improve scenic quality.

By maintaining or increasing growth rates, commercial thinning lengthens the time needed for a stand to reach CMAI, extending the rotation length (Daniel et al. 1979).

Precommercial thinning would be implemented under all alternatives based on funding. Pruning is likely to play a minor role in the foreseeable future under all alternatives. Commercial thinning is expected to play a larger role in meeting future demand under all alternatives over the next few decades, as areas harvested in earlier decades reach commercial size. Over the long term, previously harvested stands would regenerate and could be commercially thinned again.

Yarding Methods

On the Tongass, most logs have been yarded downhill using cable logging systems such as highlead and skyline. Access has usually been from valley bottoms, because road building on steep slopes is difficult and costly. Most logging occurs inland, with logs transported via road systems to marine access points, also referred to as log transfer facilities, at tidewater (see the *Transportation* section). Harvest by tractor (shovel yarding) has proven effective on flat to moderate slopes; it is not practical on steep slopes. Harvest by helicopter is typically the costliest method, but also has fewer adverse effects on other resources.

Yarding methods can be divided into three "operability" classes, which relate to the methods necessary to harvest and transport trees under various conditions (see Table 3.13-2). Normal operability includes the standard ground-based and cable logging systems used in areas where access is relatively easy and helicopter logging with distances of up to 0.75 mile. These areas have the lowest logging costs. Difficult operability includes long-span cable systems and helicopter logging with distances between 0.75 and 2.0 miles, occurring where ground access is challenging or not possible. Difficult operability involves higher costs. The third class, isolated operability, consists of isolated stands 2.0 miles or more from a helicopter landing site. These tend to be uneconomical under even high timber markets.

The 2007 LSTA indicates that approximately 89 percent of the suitable timber land would be accessible using normal harvest methods, 10 percent would be difficult, and 1 percent would be isolated. When economic and environmental risk factors are considered, additional areas are likely to be identified as difficult or isolated during project planning (see Table 3.13-2). Risk factors assigned by the LSTA team and district personnel, indicate that about 85 percent of the suitable acres with old-growth forest would be in the normal category.

In the past, stands adjacent to the shoreline were sometimes harvested from the water using A-frame logging, where a floating yarder was used to move logs to the marine waters. As a result, isolated young-growth stands exist within the beach and estuary fringe that are not connected to existing road systems. This yarding system has not been used on the Tongass in decades and it is unlikely any operators currently have the equipment, though it could be built. While currently uncommon, current beach yarding options include shovel access from roads if present, shovel access from the beach (working with barges), helicopter yarding, or some combination of these. Other methods could be employed as long as they meet management objectives.

Tongass Timber Sale Program

The primary sources of timber within Southeast Alaska are the Tongass National Forest, private corporations (principally Alaska Native Corporations formed through the Alaska native Claims Settlement Act (ANSCA), and the State of Alaska (Table 3.13-5). Between 1980 and 1990, harvest from the Tongass contributed about 50 percent of the timber supply in Southeast Alaska. From 2002 to 2014, Alaska Native Corporations harvested an average of 69 MMBF and the State harvested an average of 26 MMBF. This information is presented in greater detail in the *Economic and Social Environment* section of this EIS (see Table 3.22-5). Timber under contract and demand for timber products from the Tongass National Forest are discussed in detail in the *Economic and Social Environment* section.

One objective of the Alaska National Interest Lands Conservation Act (ANILCA) was the maintenance of timber supply for the Southeast Alaska timber industry because of its contribution to the local and regional economies of Southeast Alaska. For similar reasons, TTRA (Section 101) directs the Forest Service to seek to provide a supply of timber from the Tongass that meets annual market demand and the market demand for each planning cycle to the extent consistent with providing for the multiple-use and sustained-yield of all renewable resources. The planning cycle is assumed to be the 10- to 15-year period between Forest Plan revisions.

The current Tongass timber program is composed of a large sale program, a small sale program, and a firewood and personal use program. Annual harvest volumes averaged 36 MMBF between 2002 and 2014 (USDA Forest Service 2015a), notably lower than the Allowable Sale Quantity (ASQ) of 267 MMBF per year approved in the 2008 Record of Decision.

The timber sale program has been in transition since the end of the long-term contracts. Many operators are in the process of developing direct markets for value-added products, such as molding, tongue-in-groove, paneling, and furniture. A census of timber processors in Alaska in 2011 identified 27 sawmills in Southeast Alaska, with almost half this total (12 facilities) located on Prince of Wales Island (Berg et al. 2014). Berg classified essentially all of these mills except one (Viking Mill in Klawock) as small operators if they produce less than 2 MMBF per year

The Forest has created a microsale program to make wood available to small operators. This program allows operators to identify sales of dead and down wood of up to 50,000 board feet or with a value of up to $10,000. These sales are then approved by the Ranger and made available to local purchasers by competitive means.

The Forest Service and the University of Alaska have created the Ketchikan Wood Technology Center to focus on ways to help the local timber industry. Among other things, the center has developed log grades for Alaskan wood products.

Table 3.13-5
Timber Harvest and Imports for Southeast Alaska, 1997-2011 (MMBF)[1]

		1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tongass NF	Sawlogs	94.4	107.6	132.8	133.7	39.8	30	44.1	40.9	43.3	39.4	14.8	24	25.3	30.3	30.2
	Utility Logs[2]	12.2	12.2	12.9	13	7.9	3.8	6.7	5.4	6.2	3.7	3.9	4	3.1	5.1	2.4
State of Alaska[3]	Sawlogs	5.2	5.6	7.3	47.8	48	48	32.7	21.9	40.7	43.6	38.8	10.3	11.8	9	15.5
	Utility Logs	0.3	1.9	0.1	12.1	5.2	9.3	2.1	2.3	2.2	1	5.8	1.6	1.7	1.5	0.8
Bureau of Indian Affairs	Sawlogs and Utility[2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alaska Native Corps.[4]	Sawlogs	335.9	157.6	193.6	114.6	106.5	93.6	98.1	92	99.3	67.1	46.9	45.5	46.9	62.5	58.2
	Utility Logs[2]	47.6	59	45.4	46	13.3	8.1	7.6	6.9	4.6	4.1	3.1	6.8	4.9	3.9	4.9
Southeast Alaska Total	Sawlogs	435.5	270.8	333.7	296.2	194.3	171.6	174.9	154.8	183.3	150.1	100.5	79.8	84	101.8	103.9
	Utility Logs[2]	60.1	73.1	58.4	71.1	26.3	21.2	15.4	14.6	13.2	8.8	12.8	12.4	9.7	10.5	8.1
	Total	495.6	343.9	392.1	367.2	220.6	192.8	190.3	169.4	196.5	158.9	113.3	92.2	93.7	112.3	112
Alaskan Imports[5]	Sawlogs	0	0	0	0.1	3.2	1.7	0.1	2.6	1.7	7.7	7.8	1.1	0	0	0.1
	Utility Logs[2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Chips	0	0	0	0	0	0	0	0	0	0	0.1	0.3	0.2	0.2	0.1

1 National Forest and Bureau of Indian Affairs (BIA) harvests reported for fiscal years. All other ownerships reported in calendar years.
2 Utility volume includes logs with less than one-third net sawlog but at least one-half firm usable pulp chips.
3 Harvests from Alaska Mental Health Trust and University of Alaska lands omitted prior to 2000.
4 Source: USDA Forest Service 2012d.

Environmental Consequences

The analysis of the potential effects of the alternatives addresses the following questions:

- How much land would be allocated to timber production?
- What silvicultural systems and vegetative practices would be utilized?
- What would the PTSQ be under each alternative?
- What projected log grade or quality would be provided?

- What would the product mix be, in terms of sawlogs and utility logs?
- What would the SYL be under each alternative?
- What are the factors that affect the attainment of the PTSQ?
- What would be the future condition of the Forest in 100 years?

The analysis of timber supply and demand for timber products, as well as how existing sales under contract and timber volume in preparation may be affected by the alternatives, is discussed in the *Economic and Social Environment* section.

The effects on the timber industry infrastructure and employment levels are also discussed in that section.

Suitable Timber Lands

There are approximately 5.5 million acres of productive forest land on the Tongass. Approximately 1 million acres of this is mapped as suitable under the 2008 Forest Plan (which includes roadless areas). However, as described below, only an estimated 773,000 acres are actually suitable for harvest. This includes old-growth and young-growth forest. Appendix A of the Forest Plan contains a discussion of the determination of suitable lands. In this FEIS, the amount of suitable land would vary by alternative both for young growth and old growth.

During a plan amendment or revision, the Responsible Official is to identify the amount of timber that can be removed annually in perpetuity on a sustained-yield basis from the applicable national forest. This amount of timber is the forest's SYL. The sustained yield limit is the amount of timber that could be produced on all lands that may be suitable for timber production, assuming all of these lands were managed to produce timber without considering other multiple uses or fiscal or organizational capability. The projected wood sale quantity (PWSQ) is an estimate of the volume of all timber and other wood products that is expected to be sold during the plan period from expected harvests for any purpose (except salvage harvest or sanitation harvest) on all lands in the plan area. The PWSQ includes all woody material likely to be sold from these harvests whether or not the woody material meets the utilization standards. The projected timber sale quantity (PTSQ) is a subset of the PWSQ and is an estimate of the quantity of timber expected to be sold during the plan period. The volume in the PTSQ is the volume that meets utilization standards. The estimation of both the PWSQ and the PTSQ must take into account the fiscal capability of the planning unit and be consistent with all plan components. Both the PWSQ and the PTSQ vary for each alternative (see Table 3.13-8). Table 3.13-6 displays the distribution of forest lands, suitable acres, projected harvest acres, and the PTSQ for old growth and young growth by alternative.

The amount of suitable land would vary from 9 percent to 15 percent of the productive forest land. However, no alternative would have projected old-growth harvest of more than 1.3 percent of the productive old growth (POG). The annual PTSQ would be 46 MMBF for all alternatives during the first decade. Alternative 2 would contribute the highest proportion of young growth and Alternative 1 would contribute the lowest. In the second decade, the PTSQ would range from 46 to 86 MMBF per year following the same pattern for young-growth contribution.

Table 3.13-6
Land Classification, Suitable Lands, Projected Harvest, and PTSQ for Old-Growth and Young-Growth Harvest under Each Alternative[1]

Classification	Alternative				
	1	2	3	4	5
Total National Forest land (thousands of acres)	16,756	16,756	16,756	16,756	16,756
Non-Forest land (includes water)	6,649	6,649	6,649	6,649	6,649
Forest land	10,107	10,107	10,107	10,107	10,107
Productive Forest Land (thousands of acres)	**5,547**	**5,547**	**5,547**	**5,547**	**5,547**
Productive Old Growth (POG)	5,002	5,002	5,002	5,002	5,002
Productive Young Growth (includes natural young growth)	544	544	544	544	544
Mapped Suitable forest lands (thousands of acres)	**592**	**724**	**866**	**533**	**568**
Suitable Old Growth	329	349	517	269	229
Suitable Young Growth	264	375	350	264	339
Projected Harvest Acreage after 25 years (thousands of acres)	**48**	**79**	**70**	**64**	**67**
Old Growth Harvest after 25 years	39	15	17	23	24
Young Growth Harvest after 25 years	10	64	54	41	43
Projected Harvest Acreage after 100 years (thousands of acres)	**272**	**368**	**349**	**277**	**327**
Old Growth Harvest after 100 years	63	33	36	43	42
Young Growth Harvest after 100 years	210	335	313	235	284
Projected Timber Sale Quantity (PTSQ)– annual (MMBF)					
1st Decade Total	**46**	**46**	**46**	**46**	**46**
Old Growth	38	24	26	35	34
Young Growth	8	22	20	11	12
Projected Timber Sale Quantity (PTSQ) – annual (MMBF)					
2nd Decade Total	**46**	**96**	**88**	**69**	**72**
Old Growth	31	5	5	12	12
Young Growth	15	91	83	56	60

[1] Sums and differences may not appear exact due to rounding.
Source: Forest Service GIS database and Woodstock modeling.

Silvicultural Systems and Practices

This section describes vegetation management practices prescribed in the Forest Plan, including regeneration methods, reforestation, and intermediate treatments. Definitions for each of these practices, how they will be applied, and expected effects on the timber resource are provided.

Harvest Methods

For planning purposes, the 2008 Forest Plan considered the three regeneration methods for old growth, discussed under Regeneration Systems: even-aged system, two-aged system, and uneven-aged system (group selection). These same methods were also considered in this Plan Amendment. This does not mean that these are the only regeneration methods that will be used on the Tongass. Other even-aged methods such as shelterwood may be utilized to meet specific objectives and would be similar to clearcut with reserves in regard to appearance and effects (or to clearcuts if the shelterwood is later cut). For modeling purposes, only even-aged and uneven-aged systems were used and displayed. The affected environment section and Appendix G of the 1997 Tongass Land Management Plan Revision FEIS contain detailed descriptions of the various silvicultural systems and their advantages and disadvantages. In addition, other regeneration methods may be applied on a limited scale to test their utility in achieving other forest management objectives.

Implementation of any Forest Plan alternative would include a full array of silvicultural prescriptions, including modification of these methods, depending on the site-specific conditions. The choice of the regeneration method and rotation length would be based upon site-specific analysis done at the project level, would consider multiple resource needs and objectives, and would include the rationale for using the selected regeneration method. This would be documented in the silvicultural prescription, which must be approved by a Region 10 certified silviculturist.

Transitioning to young growth as fast as possible means it is important to harvest stands at the youngest age possible. Based on collective experience of timber managers on the Tongass and discussions with industry representatives, it was decided that in order for a young timber stand to have a chance of being economic, the majority of trees harvested need to produce two logs. Production of one log per tree not only increases logging costs relative to revenues substantially, but also creates a large amount of slash left behind, which can have negative effects on wildlife, scenery, economics and recreation. Based on analysis of yield tables it was decided that to produce two logs per tree for the majority of trees in a stand, a minimum age of 65 years would be used for modeling of high site stands and a minimum age of 75 years would be used for lower site stands.

Harvesting trees at 65 to 75 years of age is prior to their CMAI age, which is likely to be in the 90 to 110 year range. Although this would likely shorten the transition time, in the long term it should be recognized that it would result in lower growth rates and lower overall volumes produced.

Table 3.13-7 displays the annual number of acres estimated for each of the main regeneration methods by alternative for the first and second decades of the Plan based on the Woodstock model outputs. The acreages displayed are for modeling purposes only in order to estimate Forest Plan outputs and do not limit the use of any harvest method to best meet project goals and objectives.

For young growth, harvest methods used for modeling included even-aged systems (primarily clearcutting), patch cuts, and commercial thinning. Patch cuts include harvesting up to 35 percent of the stand in patches or groups with a maximum opening size of 10 acres. Patch cuts are modeled only in Alternative 5 for beach and estuary fringe, riparian management areas, and the Old-Growth Habitat LUD. Commercial thinning in the model includes removal of up to 33 percent of the stand volume. Commercial thinning is used in all of the action alternatives for beach and estuary fringe, riparian management areas, and non-development LUDs, where applicable.

In the first two decades, even-aged management would prevail. However, commercial thinning of young growth would become more significant in the second decade, particularly in Alternatives 2 and 4. Alternative 5 is the only alternative where patch cutting becomes important.

Alternative 1 would result in the most old-growth harvest overall, and the most even-aged harvest, followed by Alternatives 5, 4, 3, and 2 in that order. Alternatives 1 and 5 would have the greatest amount of old-growth uneven-aged management, although the relative amount would be small.

Table 3.13-7
Timber Management Practices as Modeled

Average Annual Harvest Acres of Suitable Lands Modeled in First Decade					
	Alternative				
	1	2	3	4	5
Harvest[1,2]					
OG Even-aged	1,776	1,134	1,236	1,611	1,626
OG Uneven-aged	32	0	0	0	0
YG Even-aged	246	682	619	285	285
YG Patch Cut	0	0	0	0	2
YG Commercial Thinning	0	93	82	243	247
Total Old Growth	**1,808**	**1,134**	**1,236**	**1,611**	**1,626**
Total Young Growth	**246**	**775**	**701**	**528**	**534**
Average Annual Harvest Acres of Suitable Lands Modeled in Second Decade					
	Alternative				
	1	2	3	4	5
Harvest[1,2]					
OG Even-aged	1,365	247	286	592	543
OG Uneven-aged	9	0	0	0	57
YG Even-aged	551	2,675	2,615	1,667	1,747
YG Patch Cut	0	0	0	0	274
YG Commercial Thinning	0	854	247	452	232
Total Old Growth	**1,374**	**247**	**286**	**592**	**600**
Total Young Growth	**551**	**3,529**	**2,862**	**2,119**	**2,253**

[1] Even-aged acres modeled as full timber yield by Woodstock.
[2] Uneven-aged acres modeled as reduced timber yield by Woodstock
OG = old growth; YG = young growth
Source: Woodstock Modeling results

Projected Timber Sale Quantity

Projected Timber Sale Quantity

The PTSQ of each of the alternatives is an indicator of possible future timber supply level that each alternative would produce. PTSQ is the estimated quantity of timber meeting applicable utilization standards that is expected to be sold during the plan period. As a subset of the PWSQ, the PTSQ includes volume from timber harvest for any purpose from all lands in the plan area based on expected harvests that would be consistent with the plan components. The PTSQ is also based on the planning unit's fiscal capability and organizational capacity.

Table 3.13-8 displays the projected timber output for the first through fourth decades that could result from implementing each of the five alternatives. Each alternative is judged by its ability to transition to predominantly young-growth harvest. This condition is judged to be fully achieved when 46 MMBF can be harvested per year with only 5 MMBF coming from old growth. The period required to reach this point is estimated to be approximately 12 years for Alternative 2, 13 years for Alternative 3, 16 years for Alternatives 4 and 5, and 32 years for Alternative 1. All of the action alternatives would produce a majority of the 46 MMBF per year for young growth in less than 15 years. Alternative 1 would require about 25 to 30 years. See Figures 2-1, 2-3, 2-5, 2-7, and 2-9 in Chapter 2 for graphical representations of PTSQ showing old-growth and young growth volume contributions over 100 years.

Table 3.13-8
Projected Timber Sale Quantity (Decades 1 – 4, Annual)

Alt	1st Decade Old Growth (MMBF)[1]	1st Decade Young Growth (MMBF)[1]	2nd Decade Old Growth (MMBF)[1]	2nd Decade Young Growth (MMBF)[1]
1	38.4	7.6	30.8	15.2
2	23.8	22.2	5.0	90.6
3	25.8	20.2	5.0	82.9
4	35.2	10.8	12.3	56.5
5	34.5	11.5	11.6	60.2
Alt	**3rd Decade Old Growth (MMBF)[1]**	**3rd Decade Young Growth (MMBF)[1]**	**4th Decade Old Growth (MMBF)[1]**	**4th Decade Young Growth (MMBF)[1]**
1	28.5	17.5	5.0	103.6
2	5.0	119.8	5.0	119.8
3	5.0	115.8	5.0	115.8
4	5.0	86.6	5.0	86.6
5	5.0	92.6	5.0	92.6

[1] MMBF = million board feet, long log bureau scale
[2] Source: Woodstock model outputs.

Factors Affecting the Projected Timber Sale Quantity

Within LUDs where timber harvest is compatible with the resource objectives of the area, there may be “intrusions,” “physical factors,” and “unmapped” standards and guidelines that limit timber management opportunities. These factors (discussed below), often termed “falldown,” have been recognized at the forest level, and the anticipated timber output adjusted appropriately. These limitations may include lands that are not capable of supporting a sustained timber management program. In other cases, where there are physical limitations, a less intensive or perhaps unregulated output may be scheduled for this period. Other factors also contribute to differences between PTSQs and timber sales, such as budgets and legal challenges.

The Forest-wide estimates used to develop the PTSQ considered many of the factors contributing to differences between PTSQs and the actual volumes produced in timber sales. These include factors affecting the suitability determination of forest lands that are usually encountered in on-the-ground examinations (e.g., sale reconnaissance, stand exams, layout, and sale preparation). For each alternative, areas were set aside (not scheduled for harvest) to allow for those factors most often encountered. Data from previous case studies, monitoring, site visits, inventory data, the GIS database, and an updated vegetation map were used to develop the acreage estimates (see Appendix B for more information).

Economics is an important consideration in determining whether lands should be harvested; however, experience has proven that it is not feasible to effectively factor in economics as part of the suitability determination. Economic conditions fluctuate greatly during the course of a plan period. One year a certain area of land or species may be uneconomic to harvest, and in another year, market conditions may have changed to where the same area or species would be in demand. This makes it difficult to meaningfully assess the economics of harvesting a particular site over a 10-year period. Also, the value of the timber sale program must be considered as a whole rather than by only evaluating individual timber sales or harvest units, because some sales or units of low value are offset by other higher-value sales or units. The economics of harvesting any particular site can be considered as part of the project decision to approve harvest of the area.

Other Factors that Affect the Timber Sale Program

Other factors that may affect the amount of timber actually sold include the cost of preparing a timber sale due to budget constraints, administrative appeals and lawsuits (which may delay or forestall sales), transportation and fluctuating fuel costs (which affect the cost of harvesting a sale, especially a helicopter sale), and market conditions that may discourage purchasers from bidding on sales. Additional harvest may occur on lands that are not suitable for timber management, for example, to stimulate development of more complex canopy structures or to enhance forage in the understory in order to meet wildlife habitat needs or to salvage timber to improve wildlife habitat. Another example would be incidental harvest on steep slopes if they were found to be stable after a site-specific analysis.

Sustained Yield Limit and Projected Timber Sale Quantity

SYL is the amount of timber, meeting applicable utilization standards, “which can be removed from [a] forest annually in perpetuity on a sustained-yield basis” (NFMA at section 11, 16 U.S. Code 1611; 36 Code of Federal Regulations 219.11(d)(6)). It is the volume that could be produced in perpetuity on lands that *may be suitable* for timber production. Calculation of the limit includes volume from lands that may be deemed not suitable for timber production after further analysis during the planning process. The calculation of the SYL is not limited by land management plan desired condition, other plan components, or the planning unit's fiscal capability and organizational capacity. The SYL is not a target but is a limitation on harvest, except when the plan allows for a departure.

The projected yield over the next 10 decades that could contribute to the PTSQ is expected to increase over time as young-growth forests mature and become available for harvest. The average volume per acre of suitable old-growth forest is approximately 29 thousand board feet (MBF) per acre. The expected volume of 100-year-old stands of young growth in the central portion of the Tongass is approximately 56 to 60 MBF per acre (based on the Forest’s managed yield tables for this area), depending on stand management (see below). As more 100-year-old stands become available for harvest, the PTSQ could increase, or the land base needed to produce a given PTSQ could decrease.

The PTSQ does not exceed the SYL during the 100-year-plus planning horizon. The potential PTSQ is expected to be between 37 and 56 percent of the SYL for the rotation under all alternatives based on the SYL calculations (with roadless areas excluded). Table 3.13-9 displays the PTSQ and SYL by alternative. For all alternatives, the PTSQ never exceeds the SYL during the planning horizon.

Table 3.13-9
Projected Timber Sale Quantity and Sustained Yield Limit (MMBF[1])

Alt.	Decade 1 to 2: Annual Volume	Decades 3 to 5: Annual Volume	Decades 6 to 10: Annual Volume	SYL: Annual Volume[2]	Maximum PTSQ as % of SYL
1	46	46-138	138	248	56%
2	46-125	125	125	248	50%
3	46-121	121	121	248	49%
4	46-92	92	92	248	37%
5	46-98	98	98	248	40%

[1] MMBF: million board feet
[2] SYL in table is based on a land base that excludes roadless areas. If roadless areas are included in the land base, then the SYL would increase to approximately 412 MMBF per year.
SOURCE: Woodstock modeling results

Future Conditions

Approximately 90 percent of the existing timber stands on the Tongass are beyond CMAI. Timber stands that exceed CMAI are either in decline or are not growing at optimal rates for their site's potential productivity. The western hemlock-Sitka spruce forest type is one of the world's most productive forest types (USDA Forest Service 1983). The forest yield tables for the Tongass estimate that a normally stocked stand 40 years old would contain 7 MBF of merchantable wood per acre. By age 70, volume should increase to 29 MBF of wood per acre, assuming no precommercial thinning occurred. The age of CMAI would be around 100 years with a merchantable volume of 56 MBF per acre, assuming no precommercial or commercial thinning. If the same stand is thinned, volume at CMAI is estimated to be 60 MBF, in addition to an estimated 8 MBF of commercial thinning volume. Yields from uneven-aged silvicultural systems would be considerably less, approximately 28 MBF at age 200, based on the updated forest yield tables.

As a greater proportion of the Forest is converted from slower growing, highly-defective old-growth stands to stands well-stocked with vigorously growing conifers, total forest growth would increase. Because of higher volumes and lower defect, managed young-growth would be able to provide higher harvests on the same land base or support the same harvest on a smaller land base. However, as noted previously, harvesting trees at 65 to 75 years of age, well prior to CMAI, would shorten the transition time, but in the long term it would result in smaller piece sizes, resulting in fewer options for wood products and lower overall volumes produced.

Only a portion of the Forest would emphasize timber management; most of the existing mature and old-growth stands on the Forest would be maintained. Under all alternatives, more than 100 years from now, the predominant age class on the Tongass would still be greater than 150 years as old-growth forest. The percent of total productive forest land that would be managed stands of less than 150 years of age is expected to be a relatively small component of the forest landscape on a Forest-wide basis for all alternatives. Old growth would still be the predominant vegetative structure on the Tongass (Table 3.13-10).

Conifer growth in young stands can be accelerated through silvicultural treatments to control conifer stocking. Benefits from such treatments may include larger piece size and consequently lower logging costs, increased stand variability, higher quality wood, and employment opportunities. In addition, treatments may shorten the time period spent in the stem exclusion phase of stand development and offer other resource benefits.

Table 3.13-10
Forest-wide Stand Structures Existing and after 100 Years (thousands of acres)

	Alternative					
Stand Structure	**Existing**	**1**	**2**	**3**	**4**	**5**
0 to 149 years, including natural young growth	544	540	542	535	529	538
Productive Old-growth (150+ years)	5,002	5,010	5,008	5,014	5,020	5,012

Note that the alternative totals take into account the harvest over 100 years, as well as the acres of existing young growth that will be over 150 years (POG) after 100 years from now.
Source: Woodstock modeling and GIS analysis results. Numbers may not add correctly due to rounding.

Managing stands to enhance wildlife and fish habitat carrying capacity is one of the objectives of the Tongass National Forest. To help meet this objective, the Forest Service has implemented studies on stand management, including the Tongass wide Young-Growth Study, the Prince of Wales Commercial Thinning Study, the Alternatives to Clearcutting study, and other Pacific Northwest research, some of which has been discussed in this section.

Cumulative Effects

Cumulative effects to timber include past and present and proposed harvest discussed above. Table 3.13-9 presents a comparison of harvest and SYL by alternative, an important measure of the cumulative effect on the growing stock on NFS land. Maximum harvest levels on NFS lands proposed under all alternatives are well within the SYL. Table 3.13-10 displays Forest-wide stand structure on NFS lands under existing conditions and after 100 years. Cumulative effects on timber resources across Southeast Alaska are presented below.

In 1954, there were approximately 6.3 million acres of productive forest land on all ownerships inside the Tongass Forest boundary (including Annette Island). The amount of forest land in Southeast Alaska that is available for timber management has declined over the past century, largely due to Wilderness and LUD II designation by Congress, land selections by the State and ANSCA, and to land allocated to non-development LUDs in the current Forest Plan. This, along with mill closures and changes in timber markets, has contributed to a decline in timber harvest. Harvest on all lands in Southeast Alaska peaked from the late 1960s through the early 1990s and has been in decline since then. Total harvest on federal, state, and private lands declined from just under 1,000 MMBF in 1989 to less than 200 MMBF in 2005. Approximately 722,000 acres of productive forest land have been harvested since 1954 in this portion of Southeast Alaska, approximately 64 percent of this is NFS land and 36 percent is on Native corporation, state, and other lands.

Currently, there are between 0.51 and 0.83 million acres of NFS lands considered suitable for timber management on the Tongass, depending on the alternative. In addition, nearly 0.52 million acres of state, Native corporation, and other private lands are available for harvest. The allowable sale quantity from the Tongass National Forest is an average of 267 MMBF per year under the 2008 Forest Plan, although actual harvests have averaged 30 to 40 MMBF per year for the last few decades. Potential annual harvest on state and private land is estimated to be approximately 90 MMBF (Daniels et al. 2015). Based on past experience, most of the harvest on private land would be exported and would not contribute to meeting local demand. Using this estimate, cumulative harvest in

Southeast Alaska would be about 136 MMBF for the next decade, increasing slowly in succeeding decades, and would be the same for all alternatives. Table 3.13-11 displays the cumulative harvest under the alternatives.

Table 3.13-11
Maximum Estimated Annual Timber Harvest in Southeast Alaska during the First Decade (MMBF)

Alternative	National Forest[1]	State and Private[2]	Total
1	46	90	136
2	46	90	136
3	46	90	136
4	46	90	136
5	46	90	136

[1] Woodstock model estimates, 2015
[2] 70 MMBF/year from Native corporation lands and 20 MMBF/year from state land (Daniels 2015). Most harvest on private land is exported.
MMBF = million board feet.

See Appendix C for a complete list of actions considered in this analysis.

Minerals

Affected Environment

Mineral deposit types and mineral resource occurrences were described thoroughly in the 2008 Land and Resource Management Plan (Forest Plan) Amendment Environmental Impact Statement (EIS) and the 1997 Forest Plan EIS. This section will briefly summarize the affected environment for minerals and provided updated information where conditions have changed.

Mineral resources occurring within the boundaries of the Tongass National Forest include gold, silver, molybdenum, and uranium, and nationally designated “strategic” and “critical” minerals such as lead, zinc, copper, tungsten, and platinum group metals. The Forest Service recognizes that minerals are fundamental to the Nation’s well-being and, as policy, encourages the exploration and development of the mineral resources it manages. The Secretary of Agriculture has provided regulations (36 Code of Federal Regulations [CFR] 228) to ensure surface resource protection, while encouraging the orderly development of mineral resources on National Forest System (NFS) lands.

With respect to National Forest management, mineral resources are legally divided into three groups: locatable minerals, leasable minerals, and salable minerals. The authority of the Forest Service to influence and regulate the exploration, development, and production phases of mining operations varies with each group. As a result, the Forest Service manages mineral resource programs that are specific to each group of minerals.

Locatable Minerals

A locatable mineral is any mineral that is “valuable” in the usual economic sense, or has a property that gives it distinct and special value. These are typically what are known as “hardrock” minerals. Locatable minerals may be recovered from lode deposits (solid rock) or placer (surficial) deposits. Examples of some locatable minerals on the Tongass National Forest are gold, silver, copper, molybdenum, iron, nickel, lead, and zinc. The General Mining Law of 1872, as amended, grants every United States citizen the right to prospect and explore public domain lands open to mineral entry. The right of access is guaranteed and is not at the discretion of the Forest Service.

The Forest Service works with mining claimants to provide reasonable access to their claims, minimize adverse environmental impacts on surface resources, and ensure reasonable reclamation of disturbed lands affected by mining operations. Protection of surface resources is accomplished by reviewing the mining plan of operations submitted by the claimant, disclosing impacts of the proposed mining operations in a site-specific environmental document, approving only those activities that are reasonably incident to the proposed operation, monitoring operations to ensure environmental standards are met, and ensuring prompt and reasonable reclamation of disturbed areas.

By law, designated Wilderness, National Monuments, Research Natural Areas, Enacted Municipal Watersheds, and Wild Rivers (when designated by Congress) are withdrawn from mining claim location. These withdrawn areas are, however, subject to mining claims with valid existing rights established before the date the areas were withdrawn from mineral entry. As a consequence, some mining claims located within existing or proposed withdrawn areas could be developed in the future.

On the Tongass, Modified Landscape, Scenic Viewshed, Recreational Rivers, Timber Production, and Minerals Land Use Designations (LUDs) are open to mineral entry. The Primitive Recreation, Semi-Remote Recreation, Old-Growth Habitat, Experimental Forest, Special Interest Areas, Scenic Rivers, and LUD II LUDs remain open to mining activities; however, special stipulations and more stringent mitigation measures may be required for mining activities in these LUDs.

Leasable Minerals

Certain types of minerals, primarily energy resources (e.g. oil, gas, coal and geothermal resources), are not subject to mining claim location, but are available for exploration and development under provisions of the Mineral Leasing Act of 1920. Access to these types of minerals is provided through leases, permits, or licenses that include fee and/or royalty payment conditions. Federally owned leasable minerals include oil, gas, coal, geothermal resources, potassium, sodium, phosphates, and sulfur. The authority to manage these minerals is presently administered by the U.S. Department of Interior, Bureau of Land Management (BLM) in cooperation with the Forest Service.

No leasable minerals are presently being produced on the Tongass National Forest, and the anticipated demand is expected to remain low. The BLM conducted an assessment of mineral resource potential in support of a resource management plan for the Ring of Fire planning area (BLM 2006), which includes Southeast Alaska. The assessment indicated the potential for oil and gas occurrence in the Yakutat region was considered to be high, based on geologic factors (URS Corporation 2006). While there has been exploration activity in the Yakutat area in the relatively recent past, the resource development potential is considered low; therefore, the BLM expects no exploration or development activity within the next 10 to 15 years. Outside of the Yakutat area, oil and gas occurrence potential elsewhere in the Tongass is considered low to none.

Occurrences of coal found at several locations in Southeast Alaska; however, the BLM considers development of these resources to be uneconomic in the near future, other than possibly for local use, and does not foresee associated exploration or development activity.

Geothermal resources occur in 19 known locations in Southeast Alaska. Thermal springs in several locations have been developed for small-scale commercial uses such as tourism, aquaculture, community bathhouses, and district heating of buildings (URS Corporation 2006). There has been some recent interest in geothermal resources in the Bell Island area.

In 2008, in response to the Energy Policy Act (EPAct) of 2005, the BLM and the Forest Service, in cooperation with the Department of Energy, jointly prepared a Final Programmatic EIS (PEIS) for Geothermal Leasing in the Western United States (BLM and USDA Forest Service 2008). The PEIS provides a framework to facilitate the BLM and Forest Service efforts regarding geothermal lease applications that were pending as of the EPAct of 2005, as well as future determinations for projects on BLM and NFS lands. The PEIS considered pending leases, including the three Bell Island leases that encompass much of Bell Island and a portion of the Cleveland Peninsula on the adjacent mainland. The PEIS analyzed whether or not the lands should be made available for the BLM to lease to a private geothermal developer. In December 2013, the Tongass National Forest completed an additional environmental analysis for the Bell Island Geothermal Leases with the publishing of a Supplemental EIS (USDA Forest Service 2012c). Of note, the SEIS considered effects to inventoried roadless areas and changed social and economic conditions. A Record of Decision (ROD) was published, documenting the Forest Service's decision to provide a consent determination to the BLM for the issuance of the three pending lease applications on Bell Island and the adjacent mainland.

While the occurrence potential for geothermal resources is considered high in several locations and some exploration could occur, geothermal development activity is not anticipated in the near future.

Salable Minerals

Salable, or "common variety," minerals on NFS lands are sold rather than located or leased. These minerals include petrified wood and common varieties of sand, rock, building stone, gravel, pumice, clay, and other similar materials. These minerals are most commonly used as building materials and are also used for agriculture, cleaners and abrasives, and as inputs to manufacturing processes.

The predominant salable commodity extracted on the Tongass National Forest is crushed rock used to construct roads. The supply of quality rock sources is largely dependent upon the locations of active logging operations. Presently, there is an adequate supply of rock sources with suitable quality (hardness and durability) in the southern third of the Tongass. However, rock quality is poor in the northern two-thirds of the Forest, and good material sources are difficult to locate in current timber production areas. Sand and gravel sources are scarce throughout the Forest, except within the Yakutat Ranger District.

Limestone and marble are abundant in Southeast Alaska, and both have historically been produced from quarries in the region for use as building stone (BLM 2006). Identified marble resources in the region are estimated at over 800 million tons. Large quantities of limestone have been quarried from Prince of Wales and Dall Islands. Continued exploitation of these building material resources could be expected in the future. While several areas in Southeast Alaska also have geologic formations that are favorable for the occurrence of pumice deposits, market and location conditions indicate there will be little or no foreseeable development potential for pumice (URS Corporation 2006).

Mineral Resource Inventory and Development Potential

The 2008 Forest Plan Amendment provides a summary of Mineral Resource Inventory and Development potential on the Tongass including identified mineral resources and undiscovered resources. There has been no update to mineral inventories since that time.

Mineral Resource Demand

The extent to which identified and undiscovered mineral resources on the Tongass will be exploited in the future will depend largely upon the level of demand for those resources. Demand for mineral resources can be inferred based on the amount of money spent by the mining industry to prospect and explore for mineral resources in Southeast Alaska. Between 1982 and 1987, the mineral industry spent an average of $2.92 million per year on mineral exploration in Southeast Alaska, with a high of $5.85 million in 1987 (USDA Forest Service 1997a). Exploration expenditures increased drastically for the 1988 to 1991 period, when the industry spent more than $20 million each year. Expenditures generally declined for the next 10 years, reaching $1.6 million in 2001, before increasing again to a level of $9.9 million in 2006 (Alaska Department of Natural Resources [ADNR], Alaska's Mineral Industry annual reports and summaries for 1997 to 2005). Annual exploration expenditures remained high between 2007 and 2013, averaging $20 million with a high of $34.3 million in 2011.

Mineral Production

Mineral production in Southeast Alaska in recent years has been dominated by the Greens Creek Mine at the north end of Admiralty Island and Kensington Gold Mine located on the mainland north of Berners Bay. Greens Creek is an underground mining operation that opened in 1989 and produces silver, zinc, lead, and gold. In 2013, the mine milled about 805,000 tons of ore worth about $397 million and reported 306 total employees (Athey et al. 2014). Another operating mine on the Tongass is the Kensington Gold Mine, located about 45 air miles north of Juneau, which began production in 2010. The Kensington Mine milled about 554,000 tons of gold bearing ore in 2013 and reported 300 total employees (Athey et al. 2014).

Tongass Land Management for Minerals

As described previously, the Forest Service administers mineral exploration, development, and production activities through the legal/regulatory systems for locatable, leasable, and salable minerals. The Forest Service also accounts for mineral resources in the land management planning process. One way of recognizing the importance and potential of mineral resources is through the designation of Minerals LUDs in the Forest-wide land allocation. The intent of the Minerals LUD designation is to encourage exploration and development of locatable minerals in areas of high mineral potential, while taking other resource values into account. The Tongass Forest Plan includes management prescriptions for those areas, and standards and guidelines specific to minerals and geology.

The current Tongass Forest Plan, as amended, allocates several areas of the Forest to the Minerals LUD. The 2008 ROD expanded the Minerals LUD to about 249,570 acres, an increase of about 80,000 acres. These areas are widely distributed across most portions of the Tongass, excluding Wilderness and LUD II lands. Several Minerals LUDs are clustered around Juneau (near Lynn Canal, Berners Bay, Stephens Passage, Gastineau Channel, and Taku Inlet); on the north end of Admiralty Island; on Yakobi Island and on the mainland east of Wrangell; a cluster near Clarence Strait and the southern part of Prince of Wales Island; and an area near Hyder.

Unlike other LUDs, the Minerals LUD is an "overlay" designation that applies management prescriptions for minerals to the affected area in addition to the prescriptions of the underlying LUD, with the Minerals LUD having priority.

Environmental Consequences

None of the alternatives propose any changes to the current Minerals LUD. Expenditures for mineral prospecting and exploration, the demand for access to National Forest lands for the purpose of mineral exploration, and development is expected to remain high in the near future. Mineral entrants will continue to submit plans of operation to the Forest Service for approval, and regulations under which those operating plans are processed will not change by alternative. Identified and undiscovered mineral resource tracts, characteristics and location of mineral deposits, and Southeast Alaska geology will not vary as a result of implementing any of the alternatives.

Direct and Indirect Effects

Locatable Minerals

The effects of the Forest Plan alternatives on locatable minerals are not discussed in detail, as there are no aspects of the Forest Plan that would have a specific direct or indirect effect on activity related to locatable minerals. Under any alternative, future exploration and development (except for valid, currently existing rights) would be precluded in areas withdrawn from mineral entry, such as Wilderness. None of the alternatives would modify the boundaries of existing LUDs in a manner that would economically constrain existing or future mineral activities.

Leasable Minerals

Alternative 1

Similarly, the effects of the Forest Plan alternatives on leasable minerals are not discussed in detail because there are no aspects of the Forest Plan that would have a specific direct or indirect effect on activity related to leasable minerals. The Tongass has no current leasable mineral activity, and the anticipated demand for leasable minerals is expected to remain low. The Forest Service is aware of some level of interest in oil and gas, coal, and geothermal resources in specific areas of the Tongass. Consistent with the current Forest Plan, any mineral leasing activity would need to be consistent with the standards and guidelines for the respective LUDs affected by leasing. The effects of any mineral leasing activity will be analyzed at the appropriate future time if the Forest Service receives specific requests for access to leasable minerals.

Alternatives 2, 3, 4, and 5

Each of the action alternatives includes new plan components governing the development of renewable energy projects, including geothermal resources. Any geothermal project would need to be consistent with the new plan components for Renewable Energy (Forest Plan Chapter 5). The effects of any geothermal energy project will be analyzed at the appropriate future time if the Forest Service receives specific requests for such projects. For all other mineral leasing activity, the effects would be the same those of Alternative 1.

Salable Minerals

Salable or common variety minerals, primarily crushed rock, are utilized in each of the alternatives. Their predominant use is to construct roads in support of the Tongass National Forest transportation system, and thus the amounts used will correspond closely to the miles of new road construction by alternative. These are shown in Chapter 2 as well as the *Transportation* section of this chapter.

Effects on Other Resources

The development of mineral resources in the Forest generally requires construction of an underground or surface mine complex, a millsite, road and pipeline systems, tailings and waste rock disposal areas, a marine transfer/docking facility, and lodging accommodations if the mine location is not close to an existing community. Total surface-disturbing acreage can vary markedly with specific project characteristics; the operating Greens Creek mine involves about 350 acres for facility development. The Kensington mine project occupies about 280 acres. The effects of any such development are analyzed at the time a specific project is proposed.

Cumulative Effects

There are no aspects of any of the alternatives that would have a specific direct or indirect effect on activity related to locatable, leasable (excluding geothermal) or saleable minerals. Thus, there are no cumulative effects to these resources from any of the alternatives. Under all alternatives, the right to prospect and explore public domain lands open to mineral entry are preserved. Existing mineral projects are expected to continue and new projects are expected to be explored and developed. The effects of any mineral activity operating under the standards and guidelines of the Forest Plan would be evaluated at the time appropriate future time if the Forest Service receives specific requests for such projects. Appendix C of this EIS provides a full list of all the projects considered in the cumulative effects analysis.

See the *Renewable Energy* section for a discussion of renewable energy direct, indirect, and cumulative effects.

Recreation and Tourism

Affected Environment

The affected environment portion of the recreation and tourism analysis is divided into two broad sections, the first addressing the supply of recreation opportunities, and the second addressing existing use levels and trends. The supply section discusses the existing supply of recreation opportunities in terms of the Forest Service's Recreation Opportunity Spectrum (ROS) classes and inventoried recreation places on the Tongass. The existing use and trends section discusses overall forest use, resident recreation, tourism, and commercial outfitter/guide use.

The remainder of this introductory section provides a general overview of recreation in Southeast Alaska and the Tongass National Forest, which comprises approximately 80 percent of the region. Southeast Alaska possesses a remarkable and unique combination of features including inland waterways with over 11,000 miles of shoreline, mountains, fiords, glaciers, and large or unusual fish and wildlife populations that provide opportunities for a wide range of outdoor recreation experiences. Southeast Alaska imparts a sense of vastness, wildness, and solitude. These sentiments are enhanced by a small resident population and a relative absence of development compared to most other National Forests.

Recreation and tourism on National Forests encompasses more than the provision of facilities or recreation sites. This is especially true on the Tongass National Forest where most recreation and tourism attractions occur in remote undeveloped areas. Many Alaska residents purposefully live in proximity to such settings as a part of their lifestyle. Most visitors who travel long distances to see Alaska expect to find it in a wild and "unspoiled" state, but also expect comfort and convenience, reliable transportation, and other features requiring some level of infrastructure and development. The challenge to managers is to identify and understand the relationship between the settings and the variety of client groups. Commercial providers of recreation activities base much of their marketing strategy on particular environmental settings and identified recreation places within those settings.

The Tongass National Forest includes approximately 17 million acres of land available for recreation. This land contributes greatly to the feeling of vastness and solitude that dominates the region; however, much of the land is not suitable for outdoor recreation. Difficult and steep terrain, wetlands, icefields, glaciers, and heavy vegetation confine most recreation activities to accessible shorelines, river and stream bottoms, and around the many lakes within the Forest. Extensive use is made of some of the icefields and alpine areas (above tree line), but access to these areas is usually by aircraft. Both residents and visitors use the developed campground and picnic areas, beaches, trails, cabins, shelters, and visitor centers that are located near communities. An inventory of developed recreation sites on the Tongass is presented in Table 3.15-1.

Table 3.15-1
Tongass Recreation Facilities, 2015

Type of Facility	Number
Anchor Buoys	42
Boating Sites	7
Campgrounds	15
- Number of Sites	220
Camping Areas	7
Day Use Areas	10
Picnic Sites	33
Group Picnic Sites	2
Hotel, Lodge, Resort	2
Interpretive Site	3
Interpretive Visitor Centers	3
Lookout/Cabin	147
Shelters	39
Observation Site	2
Recreation Residence	3
Swimming Site	2
Trailheads	120
Trails (number of miles):	
– Nonwilderness	900
– Wilderness	93
Total Trail Miles	993
Wildlife Viewing Sites	10

The National Park Service manages 3.3 million acres in three park units in Southeast Alaska: Glacier Bay National Park and Preserve, Sitka National Historic Park, and Klondike Goldrush National Historic Park. The majority of this land is located within the Glacier Bay National Park and Preserve.

The State of Alaska also administers land for recreation. Many of the state land selections were made with recreation opportunities for the residents of local communities in mind. Most of these opportunities are still undeveloped. State selections were also made for future development of a system of marine parks. Currently, Alaska State Parks manages about 80,000 acres and 34 park units, including 16 marine parks, in Southeast Alaska. In addition, the Alaska Department of Fish and Game (ADF&G) manages two state wildlife refuges, two critical habitat areas, and one wildlife sanctuary, and the Alaska Division of Forestry manages the 247,000-acre Haines State Forest (Alaska State Parks 2009).

Community road systems are limited and heavily used for access to recreation sites and attractions near local communities. Existing road systems are primarily located near the larger communities of Juneau, Sitka, Ketchikan, Petersburg, and Wrangell. There is an extensive road system connecting the small communities on Prince of Wales Island, as well as road systems near the communities of Hoonah and Kake. There is no interconnecting highway system between islands or between communities on the mainland.

Haines, Skagway, and Hyder all have highway connections to Canada and the Alaska Interior, as well as the lower 48 states, and serve as gateways for tourists heading north. Haines and Skagway are also visited by cruise ships and served by the Alaska Marine Highway System (AMHS).

Roads exist in other locations where timber harvest has taken place. Independent visitors from outside the state and residents from other parts of Southeast Alaska use road systems that are accessible from the AMHS ferries or from local communities for recreational purposes. Roads in locations where there are no communities or interconnecting access to the AMHS receive relatively low levels of recreation use. However, recreation-related vehicle use has been growing on some remote islands, including Kruzof, Zarembo, and Etolin Islands, and isolated systems on Kuiu and Kupreanof Islands. While the total amount of recreation use on these islands is low, it can be heavy at times, such as during hunting season.

Supply of Recreation Opportunities

The supply of recreation opportunities is described in this analysis using two concepts: ROS and recreation places. These concepts describe the quantity of recreation opportunities. Quality is addressed using the “Home Range” concept and by assigning a value to the recreation places. These concepts are discussed in the following sections.

The Tongass National Forest has the potential to provide a wide variety of recreation settings. The ROS has been developed to help identify, quantify, and describe these settings. The ROS system portrays the combination of activities, settings, and experience expectations along a continuum that ranges from highly modified to primitive environments. Seven classifications are identified along this continuum: Urban (U), Rural (R), Roaded Modified (RM), Roaded Natural (RN), Semi-Primitive Motorized (SPM), Semi-Primitive Non-Motorized (SPNM), and Primitive (P). The ROS inventory may be used to assess the potential effects of the alternatives on recreation settings.

The seven ROS classes are summarized in Table 3.15-2, based on seven elements that are considered in the allocation and management of recreation settings. Forest-wide ROS acres are presented in Table 3.15-3.

Table 3.15-2
Comparison of ROS Classes

	Urban (U)	Rural (R)	Roaded Modified (RM)	Roaded Natural (RN)
Scenic Quality	Alterations to landform and vegetation dominate landscape; nonrecreational activities not to exceed Low SIO - FG; Very Low SIO - MG.	Alterations to landform and vegetation dominate landscape; nonrecreational activities not to exceed Low SIO - FG; Very Low SIO - MG.	Alterations dominate the landscape; nonrecreational activities/structures evident, but do not exceed Very Low SIO.	Alterations to landscape subordinate; nonrecreational activities not to exceed Low SIO though typically Moderate SIO.
Access[1]	Access and travel facilities are highly intense, motorized, and often with mass transit supplements.	All methods of access and travel may occur, but subject to formal regulation.	All methods of access and travel when needed and compatible with intended activities.	All methods of access and travel may occur when compatible with intended activities; zones of non-motorized use.
Remoteness	Remoteness from sites and sounds of human activity not available or important.	Remoteness from sites and sounds of human activity not available or important.	Remoteness from continuous sounds of human activity is of moderate importance.	Remoteness from continuous sounds of human activity is expected.
Visitor Management	Intensive on-site controls are numerous and obvious.	On-site regimentation and control is obvious.	On-site regimentation and control is obvious.	On-site regimentation and controls are few.

Table 3.15-2 (continued)
Comparison of ROS Classes

	Urban (U)	Rural (R)	Roaded Modified (RM)	Roaded Natural (RN)
On-site Recreation Development	Recreation structures and facilities readily evident, but appropriate for setting; designed for high use levels. Information and interpretive facilities may be large and complex.	Recreation structures and facilities readily evident, but appropriate for setting, designed for high use levels. Information and interpretive facilities may be large and complex.	Recreation structures and facilities provided for site protection and user convenience. Facilities are contemporary but of rustic design and harmonize with natural setting.	Recreation structures and facilities may be present, but are provided primarily for protection of the resource rather than user convenience. Facilities are rustic and harmonize with a backcountry setting.
Social Encounters	High concentrations of people at one time.	Moderate to high concentrations of people at one time.	Interactions with others may be moderate to high. Moderate concentrations of people, especially on trails and in dispersed areas.	Moderate concentration of users on roads and little evidence of others or interactions at campsites.
Visitor Impacts	Very noticeable, but managed to prevent physical resource degradation.	Very noticeable, but managed to prevent physical resource degradation.	Human use noticeable, but not degrading to resources. Site hardening dominates campsites, parking areas.	Visitor use noticeable, but not degrading to resources; established SIOs.

	Semi-Primitive Motorized (SPM)	Semi-Primitive Non-Motorized (SPNM)	Primitive (P)
Scenic Quality	Alterations few and subordinate to landscape; designed and located to not exceed Moderate SIO.	Alterations few and subordinate to landscape; nonrecreational activities and structures designed not to exceed High SIO.	Alterations to landscape not evident; structures do not exceed High SIO.
Access[1]	Travel on trails designed for/open to motor vehicles; roads maintained for high clearance vehicles; motorboats operating on waterways; may establish zones of non-motor use for facility/resource protection.	Trails closed to motorized use; nonmotorized boats used on freshwater lakes and streams.	Trails closed to motorized use; non-motorized boats used on freshwater lakes and streams.
Remoteness	Nearby sights and sounds of human activity are rare; distant sounds may occur.	Nearby sounds of human activity are rare; distant sounds may occur.	Sounds of human activity are very infrequent to nonexistent.
Visitor Management	On-site regimentation and controls are few.	On-site regimentation and controls are rare.	On-site regimentation and controls are very rare.
On-site Recreation Development	Recreation structures and facilities may be present, provided primarily for protection of site rather than user convenience. Facilities, when present, are rustic and harmonize with natural setting.	Recreation structures and facilities may be present but provided primarily for protection of site. Facilities, when present, are rustic and harmonize with natural setting.	Recreation structures are rarely present, provided primarily for the protection of the site. Facilities, when present, are rustic and harmonize with natural setting.
Social Encounters	Low interaction between users. Campsites seldom within sight or sound of another group except during peak periods.	Low interaction between users. Campsites seldom within sight or sound of another group except during peak periods.	Very low interaction between users and no other groups in sight or sound of overnight camps.
Visitor Impacts	Human use noticeable, but not degrading to resource or backcountry setting.	Human use noticeable, but not degrading to resource elements.	Human use essentially unnoticeable. Site hardening—boardwalks, boat moorings, food caches.

[1] Subject to ANILCA provisions.
Note: SIO = Scenic Integrity Objective, FG = Foreground, MG = Middleground
Source: USDA Forest Service 1997a (Table 3-30).

Viewed in terms of acres, the Primitive ROS setting is the largest on the Tongass, with approximately 10.4 million acres allocated to this setting (Table 3.15-3). The Wilderness and Natural Setting Land Use Designation (LUD) groups currently account for 47 and 46 percent of this total, respectively (Table 3.15-4). Approximately 33 percent of the areas presently inventoried as SPNM (3 million acres) are located in the moderate development (11 percent) or intensive development (22 percent) LUD groups[1], with 19 percent located in existing Wilderness. Areas inventoried as SPM account for approximately 1.5 million acres Forest-wide and are mostly located in the Wilderness (31 percent) and Natural Setting (48 percent) LUD groups. Approximately 72 percent of areas allocated to the RN, RM, Rural, and Urban settings are located in the moderate development (22 percent) or intensive development (50 percent) LUD groups (Table 3.15-4).

Existing Wilderness on the Tongass is mostly associated with the Primitive ROS setting (82 percent), with the remaining 18 percent comprised of SPNM (10 percent) and SPM (8 percent). Much of the area inventoried as SPM on the Tongass is accessed via motorized watercraft. The Primitive ROS setting also comprises a large share of the Natural Setting LUD group (64 percent), with SPNM accounting for a further 20 percent (Table 3.15-4).

Table 3.15-3
Forest-wide Recreation Opportunity Spectrum Acres, 2015

ROS Class	Acres	Percent of ROS Total
Primitive (P)	10,357,832	62
Semi-Primitive Non-Motorized (SPNM)	3,052,410	18
Semi-Primitive Motorized (SPM)	1,458,528	9
Roaded Natural (RN)	157,386	1
Roaded Modified (RM)	1,662,825	10
Rural and Urban (R and U)	5,618	<0

Note:
The total acres by ROS class shown in this table is slightly lower than the Forest-wide total because the ROS inventory does not include the entire Forest.

[1] The Recreation and Tourism analysis divides the Tongass LUDs into four groups:
- Wilderness: Wilderness, Wilderness National Monument, and Non-Wilderness National Monument.
- Natural Setting: LUD II, Research Natural Area, Old Growth Habitat, Special Interest Area, Municipal Watershed, Wild River, Scenic River, Recreational River, Remote Recreation, and Semi-Remote Recreation.
- Moderate development: Modified Landscape, Scenic Viewshed, and Experimental Forest.
- Intensive development: Timber Production.

Table 3.15-4
Forest-wide Recreation Opportunity Spectrum Acres by LUD Group, 2015

LUD Group	P	SPNM	SPM	RN	RM	R+U
Acres by LUD Group and ROS						
Wilderness	4,841,150	575,099	450,580	19,669	18,862	468
Natural Setting	4,789,784	1,474,340	701,878	87,088	369,164	4,043
Moderate Development	159,971	327,470	170,247	39,256	370,468	399
Intensive Development	566,863	675,473	135,749	11,347	904,262	684
Percent of ROS Setting						
Wilderness	47	19	31	12	1	8
Natural Setting	46	48	48	55	22	72
Moderate Development	2	11	12	25	22	7
Intensive Development	5	22	9	7	54	12
Percent of LUD Group						
Wilderness	82	10	8	0	0	0
Natural Setting	64	20	9	1	5	0
Moderate Development	15	31	16	4	35	0
Intensive Development	25	29	6	0	39	0

Notes:
[1] P=Primitive, SPNM=Semi-Primitive Non-Motorized, SPM=Semi-Primitive Motorized, RN=Roaded Natural, RM=Roaded Modified, R+U=Rural and Urban
[2] The total acres by ROS class shown in this table is slightly lower than the Forest-wide total because the ROS inventory does not include the entire Forest.
[3] The Recreation and Tourism analysis divides the Tongass LUDs into four groups:

- Wilderness: Wilderness, Wilderness National Monument, and Non-Wilderness National Monument.
- Natural Setting: LUD II, Research Natural Area, Old Growth Habitat, Special Interest Area, Municipal Watershed, Wild River, Scenic River, Recreational River, Remote Recreation, and Semi-Remote Recreation.
- Moderate development: Modified Landscape, Scenic Viewshed, and Experimental Forest.
- Intensive development: Timber Production.

Recreation Places

The Tongass offers a unique recreation setting because it provides an island and marine environment in close proximity to major mountain ranges and icefields. Forested mountains rising from the saltwater provide unique and remote coastal recreation opportunities not found in other areas of the United States. Recreation enthusiasts are able to view a variety of natural landforms and wildlife, such as glaciers, old-growth forests, humpback whales, spawning salmon, brown bears, and bald eagles. The immense amount of land on the Tongass National Forest provides a great diversity of recreation attractions and opportunities. Most recreation activities take place in, and are dependent on, settings that are primarily undeveloped and widely dispersed. The surrounding saltwater, which is not managed by the Forest Service, allows for motorized boat and floatplane access throughout Southeast Alaska.

The pattern of use associated with known protected boat anchorages, boat landings, aircraft landing sites, and the limited road systems makes it possible to identify specific "recreation places." Recreation places are those areas that are used for recreation activities and are easy to access. Approximately 1,436 recreation places, totaling about 3.6 million acres (22 percent of the total Tongass National Forest), have been identified. Approximately 22 percent, or 311 of these places, are located in existing designated wildernesses. Although these areas comprise only 22 percent of the Forest-wide number of recreation places, they account for 36 percent of total recreation place acres.

The setting of a recreation place plays a key role in its attractiveness and use. Many recreation opportunities, such as viewing scenery or pursuing solitude, are dependent on this relationship and require a natural type of setting, whereas others, such as hunting or fishing, are less dependent on the type of setting. Table 3.15-5 identifies the distribution of recreation place acres by ROS class. Recreation places can be categorized into three general groupings based on their principle uses and attractions. These three general groupings, marine, freshwater, and land-based, are discussed in the *Recreation and Tourism* section of the 1997 Forest Plan Revision Final Environmental Impact Statement (FEIS) (USDA Forest Service 1997a, pp. 3-107, 3-108). The distribution of recreation places among these general groupings is presented in Table 3.15-6.

For the purposes of this analysis, recreation places are classified in two basic ways. First, recognizing that access plays a key role in recreation in Southeast Alaska, "home ranges" were defined for each community. Inventoried recreation places were classified into two categories: those located within a radius of approximately 20 miles from communities ("home range") and those outside ("rest of forest"). Almost half (48 percent) of the recreation place acres are within a community home range. Second, recreation places are identified as either important or ordinary/ common based on five categories: facilities, marine, hunting, fishing, and tourism. The Forest Service developed this rating system in response to public comments received on the 1990 Draft Environmental Impact Statement (DEIS). Recreation places may be important for one, several, or none of the identified categories. Important recreation places by category are summarized in Table 3.15-7 and discussed further in the *Recreation and Tourism* section of the 1997 Forest Plan Revision FEIS (USDA Forest Service 1997a, pp. 3-109, 3-111).

Table 3.15-5
Distribution of Recreation Place Acres by Recreation Opportunity Spectrum Class

ROS Class	Acres (1,000s)
Primitive	1,306
Semi-Primitive Non-Motorized	916
Semi-Primitive Motorized	870
Roaded Natural	103
Roaded Modified	432
Rural and Urban	3

Note: These totals include all identified recreation places within the Tongass National Forest boundary, including those on state and private lands.

Table 3.15-6
Distribution of Recreation Places by General Use

	Number of Places	Percent of Total	Acres (1,000s)[1]	Percent of Total
Marine	617	43	1,234	34
Freshwater	302	21	908	25
Land-based	531	37	1,488	41
Total	**1,436**	**100**	**3,630**	**100**

[1] Updated acreages were calculated using the ratios from USDA Forest Service 1997a (pp. 3-107, 3-108) and the total acres identified in Table 3.15-5. Totals may not sum exactly due to rounding.

Table 3.15-7
Important Recreation Places by Category[1]

	Number of Places	Percent of Total[2]	Acres (1,000s)	Percent of Total[2]
Facilities[3]	402	28	1,053	29
Marine[4]	617	43	1,089	30
Hunting[5]	373	26	1,452	40
Fishing[6]	187	13	472	13
Tourism	876	61	1,924	53
Total Acres/Places	**1,436**	**NA**	**3,630**	**NA**

[1] Recreation places are rated as either important or common/ordinary.
[2] Percent columns sum to more than 100 because a recreation place can be rated important in more than one category.
[3] All recreation places with facilities were rated as being important. In addition, other recreation places with some type of facility, such as a viewing platform, and facilities authorized by a special use permit for recreation purposes, were identified as important.
[4] The marine category identified here is different to the marine type identified in Table 3.15-6. The marine category in this table only includes those recreation places that are truly unique or typify the Southeast Alaska marine experience.
[5] Important hunting areas were distinguished from ordinary hunting areas based on a number of factors, including heavy recurring use, hunter success, ease of access, opportunities for several species, and prized species, such as mountain goats and moose.
[6] Important fishing recreation places were identified using ADF&G ratings for recreational fishing.
Note: This estimate of total recreation place acres is slightly higher than the estimate used in the current Forest Plan Revision FEIS (USDA Forest Service 1997a). The database used to develop these estimates has been updated and these estimates were developed using a more precise methodology than the grid-sampling approach that was employed in the 1997 Forest Plan Revision FEIS analysis.
Source: USDA Forest Service 1997a (pp. 3-109, 3-111).

Existing Use Levels and Trends

The following section is divided into four parts that discuss forest use in general, resident recreation, tourism, and commercial outfitter/guide use on the Tongass National Forest.

Forest Use

Although there are some locations on the Tongass where fees are collected and locations where people can be easily counted, much of the information regarding general public use has been historically based on long-term observations, anecdotal information, and professional estimates, adjusted by quantitative indicators where available. In general, many residents and nonresidents seek the same type of recreation experiences and many engage in similar activities. Alaska has a reputation for vastness, rugged beauty, and solitude, and both residents and nonresidents usually expect to find these qualities in recreation settings. Expectations often vary by group and individual, however, with some people having higher expectations of wilderness and solitude than others.

The Alaska Region of the Forest Service (Region 10) has been participating in the Forest Service's National Visitor Use Monitoring (NVUM) program since 2000. Based on the results of the NVUM program and supplemental survey results for 2008 and 2009, White and Stynes (2010) calculated a revised visitation estimate of 1,885,513 annual visits to the Tongass National Forest. The revised estimate took into account previously undocumented travel to the forest via boat and plane (the visitation estimate based on the national survey was 1,628,000). Half of Alaska residents surveyed who live in Southeast Alaska reported using a boat or plane to access the national forest. This is different to the ways national forests are accessed in other states and reflects the undeveloped and remote nature of Southeast Alaska, and is one reason recreation sampling in Alaska is very challenging (USDA Forest Service 2013f). Based on more recent NVUM surveys conducted as part of the NVUM Round 3 (2010 to 2014), the current estimate for the Tongass National Forest is approximately 1,836,000 annual visits (USDA Forest Service 2015f).

Resident Recreation

Many residents of Southeast Alaska place a high value on the quality and availability of outdoor recreation opportunities in the region, with the proportion of Alaskan residents who participate in outdoor activities generally much higher than elsewhere in the United States (Bowker 2001). Many local residents engage in dispersed recreation activities on National Forest System (NFS) land and adjacent saltwater. Accurate data on this type of use are difficult to obtain and estimates tend to either underestimate the nature and extent of much of this use or overcompensate in inconsistent ways (USDA Forest Service 1997a, p. 3-120). The net result is that while there is a general consensus that outdoor recreation opportunities and activities provided by the Tongass are highly important to residents, there is limited data that accurately quantifies resident recreation use.

Resident recreation demand is influenced by a number of factors, including regional population levels, per capita participation rates, and recreation travel behavior. Over time, the supply of certain recreation opportunities in Southeast Alaska has increased. Road systems have expanded into previously inaccessible areas and visitor services and tourism marketing have also increased. In some cases, supply-induced increases in participation have occurred. On Prince of Wales, Wrangell, and Mitkof Islands, for example, road systems developed for timber harvesting created an opportunity for road-related access to previously inaccessible recreation settings and an opportunity for recreation activities involving wheeled vehicles.

Supply-induced participation changes have also been accompanied by additional demand for specific recreation places or facilities for a related activity. Increased opportunities for roaded access and activities are typically accompanied by a need for parking, dispersed campsites, picnic sites, trails to scenic attractions, and additional short access routes to cabin sites and previously inaccessible beaches. Increased tourism has resulted in increased demand for interpretive services as well as walking and hiking opportunities near the major communities.

The use of off-highway vehicles (OHVs) and over-snow vehicles is another growing activity on the Tongass. Use is limited by topography, dense vegetation, and wet soils. These types of vehicles are most frequently used on road systems connected to communities, with riders seeking out primitive roads or spurs. Limited accessibility often results in OHV use on muskegs, beaches, tidal areas, and river channels during low flows.

NFS routes (roads and trails) and areas designated as open to motorized use are identified on the Motor Vehicle Use Map (MVUM) for the Tongass. The MVUM also displays allowed uses by vehicle class (such as highway-legal vehicles, vehicles less than 50 inches wide and motorcycles), seasonal allowances, and distance allowances, and provides information on other travel rules and regulations. Routes not shown on the MVUM are not open to public motor vehicle travel. The MVUM is updated annually in January with separate maps available for each ranger district. In the next few years, the Tongass will address the management of over-snow vehicles in a similar manner with the issuance of maps identifying areas where their use is permitted after holding public meetings and subsistence hearings.

Tourism

Nonresident pleasure visitors or tourists can be generally divided into package and independent visitors. Package visitors are typically the cruise ship clients, though some arrive by ferry and airplane. The vast majority of visitors to Southeast Alaska are cruise ship passengers. The Summer 2011 statewide Alaska Visitor Statistics Program (AVSP)[2] found that cruise ship passengers accounted for 85 percent of visitors to Southeast Alaska compared to 57 percent of visitors statewide (McDowell Group 2012). Cruise ship passengers as a share of total visitors in Southeast Alaska varied by community, ranging from 12 percent of summer visitors to Prince of Wales Island to 98 percent of visitors to Hoonah. Cruise ship passengers also accounted for more than 90 percent of summer visitors to Juneau, Ketchikan, and Skagway (McDowell Group 2012).

The Tongass is home to a vibrant and growing tourism industry. Tourism from large and small cruise ships and independent tour operators plays an important role in the economies of communities throughout Southeast Alaska. Cruise ship and other package visitors are a very large group that uses the Tongass National Forest primarily as a scenic resource. These visitors spend less time in the area and generally follow preplanned and regimented itineraries. Shore excursions have, however, become an important part of the cruise ship experience, with much of this activity centered around communities. Half-day and day excursions into the Forest have also increased in popularity.

Independent visitors, who constitute a much smaller group, tend to arrive by air, ferry, and highway and engage in a variety of activities. Independent visitors spend more time in the communities and on the Forest, and may secure the services of outfitters and guides, restaurants, motels, and transportation services such as floatplanes, boats, and gas stations. Independent travelers tend to plan their own itineraries, but often secure the services of mini-packages, such as day excursions or fishing charters. These types of visitors compete more directly with residents for recreation opportunities on the Forest. Lodges have grown in popularity in recent years, with fishing lodges in particular playing an important role in the tourism industry in some local areas. This is, for example, the case with Elfin Cove, a small town located west of Hoonah, where nine recreational fishing lodges are located in the vicinity of the town (Dugan et al. 2006). Fishing lodges accounted for 65 percent of the non-cruise, multi-day packages identified in Summer 2011, with remote-lodges accounting for a further 15 percent of the total. Adventure tours (8 percent), rail packages (4 percent), motor coach tours (4 percent), rental car/RV package (4 percent) and “other” (1 percent) accounted for the remaining share of multi-day packages (McDowell Group 2012).

The marketing of recreation opportunities by commercial suppliers has important similarities to resident recreation concerns. For example, many businesses that provide boat or aircraft access for wildlife viewing and other activities have a low tolerance for the presence of other groups in the same area. The presence of more than two or three other parties in a bay or area may cause such operators to seek substitute locations. The ability to market Alaska tourism is dependent on meeting customer expectations of seeing and experiencing vast, untamed land and its wildlife. Resident recreationists who traditionally use an area may, however, be discouraged by commercial businesses operating in the same area.

[2] The AVSP is a significant visitor industry research project conducted periodically by the State of Alaska. The most recent study was conducted in 2011 (McDowell Group 2012).

Visitors to Southeast Alaska

The 2011 Summer AVSP found that city/sightseeing tours, cultural activities, and wildlife viewing were the most popular activities among visitors to Southeast Alaska based on estimated participation rates, with 46 percent, 46 percent, and 42 percent of visitors engaging in these activities, respectively (Table 3.15-8). Other popular activities included hiking/nature walk (28 percent), day cruises (26 percent), flightseeing (15 percent), tramway/gondola (14 percent), and fishing (11 percent) were other popular activities among visitors to Southeast Alaska based on participation rates (Table 3.15-8).

Table 3.15-8
Activities Participated in by Visitors to Southeast Alaska, Summer 2011

Activities	Percent of Visitors
City/Sightseeing Tours	46
Cultural Activities	46
Wildlife Viewing	42
Hiking/Nature Walk	28
Day Cruises	26
Flightseeing	15
Tramway/Gondola	14
Fishing	11

Note:
[1] The McDowell Group (2012) identified 12 other activities with participation rates ranging from less than 1 percent to 10 percent.
Source: McDowell Group 2012

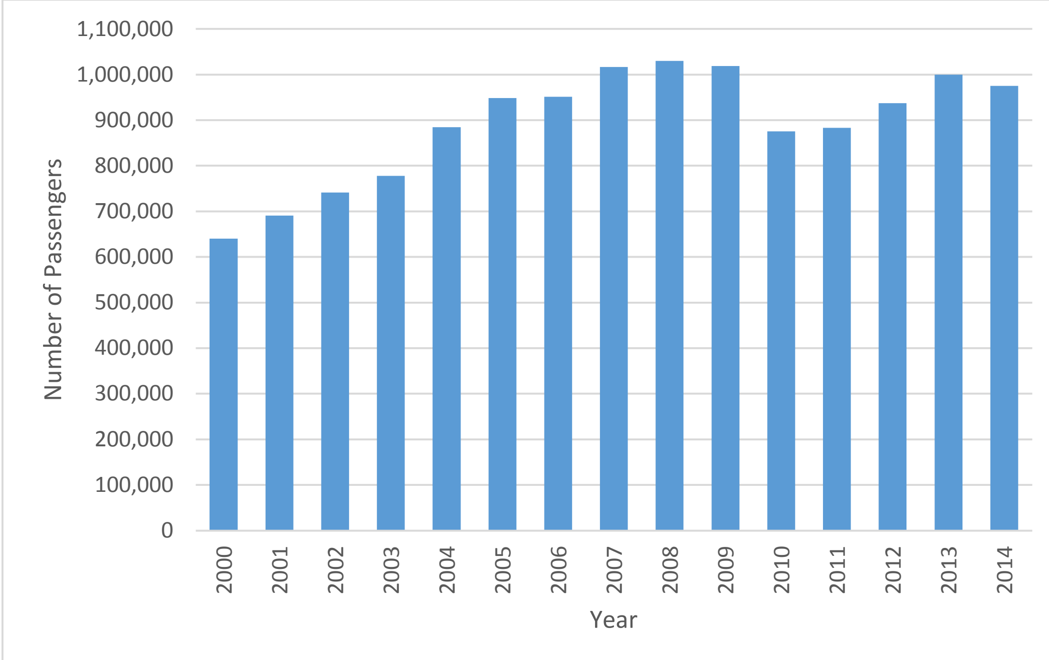
Southeast communities accounted for four of the six most frequently visited communities and places in the state in 2011: Juneau ranked first, Ketchikan second, Skagway fourth, and Glacier Bay sixth (McDowell Group 2012).

Trends in Visitation

The number of summer visitors to Alaska increased dramatically in the 1990s and the first part of the 2000s, increasing from 861,100 in 1993 to 1,631,500 in 2006, which equates to an average annual growth rate of 5 percent and a total net increase of 89 percent. Statewide, visitation peaked in 2007 and 2008 with approximately 1.71 million visitors. The total number of visitors dropped in 2009 and 2010 due to the nationwide economic recession (McDowell Group 2012). The State as a whole received an estimated 1,659,600 summer visitors in 2014. Cruise ship visitors accounted for 58 percent of the 2014 total, with 38 percent arriving via air, and 4 percent by highway or ferry (McDowell Group 2012).

Average annual visitation grew at an even faster rate in Southeast Alaska in the 1990s and early 2000s, increasing by 131 percent from 502,800 in 1993 to 1,160,000 in 2006 (McDowell Group et al. 2007). An estimated 1,037,000 people visited Southeast Alaska in 2011, approximately 67 percent of total statewide visitation during the summer of that year. Cruise ship passengers make up a much larger share of visitors to Southeast Alaska than they do statewide, accounting for 85 percent of all visitors in 2011 compared to 57 percent statewide (McDowell Group 2012 – Summer 2011 AVSP). The annual number of cruise passengers visiting Southeast Alaska is shown for 2000 through 2014 in Figure 3.15-1. An estimated total of 975,000 cruise passengers visited Southeast Alaska in 2014 (Southeast Conference 2014).

Figure 3.15-1
Southeast Alaska Cruise Passengers, 2000-2014



Notes:
1/ Data for 2014 are a preliminary estimate.
Source: Southeast Conference (2014)

The sheer magnitude of the cruise ship industry has important implications for recreation planning on the Tongass. Shore excursions have become an integral part of the cruise ship experience, providing increased revenues for ship operators and opportunities for local entrepreneurs. Much of this activity has been concentrated at ports of call that accommodate large or mid-sized cruise ships. Survey data from 2005, for example, indicate that approximately 83 percent of cruise visitors to Juneau participated in at least one tour while they were in Juneau. Glacier tours were the most popular type of tour in 2005, with 42 percent of cruise visitors taking this type of tour. Wildlife/marine life viewing, the Mt. Roberts Tramway, and flightseeing via helicopter were also popular (McDowell Group 2005).

Alongside the international cruise lines, several small and mid-size cruise operators are active in the region, often taking their customers to smaller places such as Metlakatla and Petersburg in addition to the larger communities. The Alaska Department of Economic Development (ADED) (2013) found that small cruise ships – generally those with capacities of less than 100 passengers – accounted for about 1 percent of Alaska's cruise passengers in 2011. Although accounting for a small share of the overall market, this segment of the cruise market is important for smaller communities that do not have the infrastructure to accommodate larger vessels. Twelve of the 18 communities visited by small ship operators in 2011 had very limited economic activity (ADED 2013).

Table 3.15-9 and Figure 3.15-2 provide information on non-cruise visitation to the region. The number of Southeast Alaska State ferry passengers has generally declined since 2000 with a pre-recession peak of 268,335 visitors in 2008. The number of Juneau airline departures also dropped sharply between 2008 and

2009, but has since increased to close to pre-recession levels. The number of arrivals by land at Haines and Skagway have generally declined since 2000, with fewer arrivals in 2013 than in 2000 in both cases (Table 3.15-9; Figure 3.15-2).

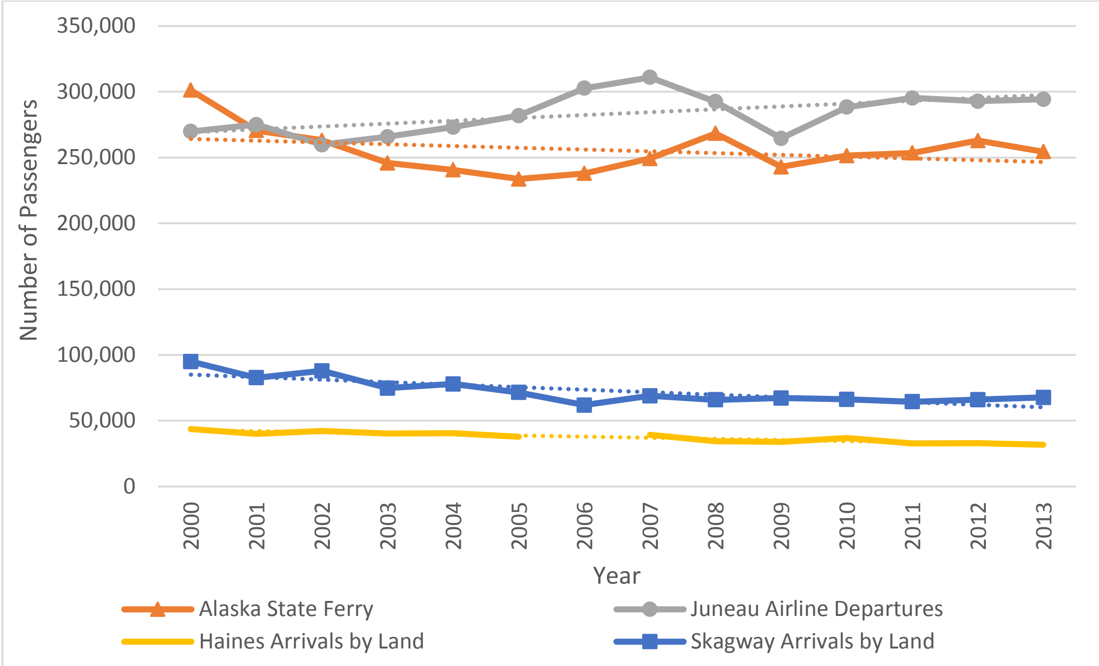
Table 3.15-9
Southeast Alaska Visitation, 1990 to 2013

Year[1]	Southeast Alaska State Ferry Passengers[2]	Juneau Airline Departures	Haines Arrivals by Land[3]	Skagway Arrivals by Land
2000[4]	301,244	269,880	43,621	94,925
2001	270,507	275,074	39,865	82,629
2002	263,105	259,759	42,290	87,851
2003	245,818	265,815	40,238	74,750
2004	240,666	273,152	40,438	77,837
2005	233,667	281,870	37,756	71,387
2006	237,965	302,710	na	61,870
2007	249,310	310,938	39,338	68,855
2008	268,335	292,474	34,434	65,826
2009	242,940	264,646	33,931	67,232
2010	251,503	288,300	36,806	66,238
2011	253,554	295,277	32,603	64,368
2012	262,931	292,789	33,040	66,016
2013	254,437	294,347	31,631	67,610

na – not available
[1] In addition to visiting tourists, visitation estimates in this table include Alaska residents and nonresidents visiting for reasons other than recreation and tourism.
[2] These totals do not include Inter-Island Ferry Authority passengers.
[3] Arrivals by land are per passenger.
[4] The ferry Columbia was out of service for most of the summer season, which reduced total ferry passengers.
Sources: Alaska Marine Highway System (2014), Alaska DOT (2006), Alaska Travel Industry (2006), Haines Convention and Visitors Bureau (2014), Juneau Economic Development Council (2014a, 2014b), Skagway Convention and Visitors Bureau (2014), and USDA Forest Service (2008a) (Table 3.13-15).

Essentially, all cruise ship use is by nonresident tourists. Ferry and airline passenger volumes and arrivals by land, on the other hand, also include Alaska residents and nonresidents visiting for reasons other than recreation and tourism, such as business or visiting relatives or friends. Larger communities; like Juneau, Ketchikan, and Sitka, also provide medical and other services that are not available in smaller communities.

Figure 3.15-2
Southeast Alaska Visitation, 2000 to 2014



Notes:
1/ This figure shows visitation by means other than cruise ship.
2/ State ferry data do not include Inter-Island Ferry Authority passengers.
3/ Data on Haines arrivals by land are not available for 2006 (Haines Convention and Visitors Bureau 2015).
Source: See Table 3.15-9.

Data on the division between visitor and resident arrivals are not available for Southeast Alaska, but are available for the state as a whole. In summer 2011, non-residents accounted for an estimated 77 percent of total arrivals (Table 3.15-10). The percent of total arrivals accounted for by non-residents varied by type of transport, ranging from 32 percent of arrivals by highway to 100 percent of arrivals by cruise ship. Non-residents accounted for 68 percent and 81 percent of domestic air and international air arrivals, respectively, and 64 percent of arrivals by ferry (Table 3.15-10). These data are for the state as a whole, but are likely broadly representative of Southeast Alaska and illustrate the importance of the state ferry and domestic airlines to local residents.

Table 3.15-10
Alaska Arrivals by Transport Type and Visitor/Resident, Summer 2011

	Percent Visitor	Percent Resident
Domestic Air	68	32
International Air	81	19
Highway	32	68
Ferry	64	36
Cruise Ship	100	0
Total	**77**	**23**

Source: McDowell Group (2012)

The ferry data provided in Tables 3.15-9 and 3.15-10 and Figure 3.15-2 are for the AMHS only. These data do not include passengers transported by the Inter-Island Ferry Authority (IFA), which is a public corporation providing transportation to island communities in southern Southeast Alaska. Roundtrip service is currently (as of winter 2014) provided between Hollis and Ketchikan (IFA 2014). This service has been operating since 2002 and connects with AMHS vessels at Ketchikan. Annual ridership on this route from 2002 to 2013 averaged 52,000 (Sheinberg Associates 2014). An estimated 11 percent of this total (5,740 rides) are made by summer tourists and fall hunters visiting Prince of Wales Island (Sheinberg Associates 2014). Roundtrip service operated between Coffman Cove and Wrangell and Petersburg during the summers of 2006, 2007, and 2008, but has since been on hold. The availability of inter-island ferry services could affect resident recreation patterns in the future, as well as the recreation patterns of independent visitors to the region.

Visitation trends for two popular excursions, Juneau Icefield and Mendenhall Glacier, are presented in Table 3.15-11. The number of visitors to these areas has increased considerably since 1990. The number of Juneau Icefield helicopter landing tour passengers peaked in 2004 with almost 95,000 passengers reported. Nearly 66,600 Juneau Icefield helicopter landing tour passengers were reported in 2014. A total of approximately 449,200 people visited the Mendenhall Glacier in 2014, up from about 440,400 in 2013 (Table 3.15-11).

Table 3.15-11
Juneau Icefield and Mendenhall Glacier Visitation, 2000 to 2014

Year	Juneau Icefield Tour Passengers	Mendenhall Glacier Visitors[1]
2000	85,531	NA
2001	89,961	236,340
2002	85,680	250,363
2003	85,407	284,867
2004	94,928	319,630
2005	93,902	367,333
2006	81,047	372,464
2007	89,250	414,138
2008	81,592	424,359
2009	69,889	434,391
2010	60,292	386,751
2011	66,864	385,245
2012	64,966	407,264
2013	69,502	440,405
2014	66,579	449,168

[1] These data are for visitors to the Mendenhall Glacier Recreation Area entering via the Visitors Center Unit on the east side of the Mendenhall Glacier Recreation Area. Use also occurs on the west side of the Recreation Area, though to a lesser degree.

Sources: 2001 to 2005: USDA Forest Service (2006c; 2006d); 2006 to 2014: USDA Forest Service (2015g, 2015h)

Commercial Outfitter/Guide Use

The Forest Service authorizes outfitter and guiding services to provide for public health and safety and foster successful small businesses consistent with the Forest Plan. Outfitter and guiding services facilitate greater participation in programs by organizations and businesses that work with youth and educational groups. Also, outfitters and guides are normally skilled and experienced individuals who conduct activities in a manner that protects environmental resources and ensures that national forest visitors receive high-quality services. Due to its remote and rugged nature, recreation use on much of the Tongass National Forest requires good outdoor skills and/or specialized equipment. Commercial outfitters and guides provide access and equipment to assist people who might not otherwise be able to pursue certain recreation activities on the

Forest. Outfitter/guides on the Tongass range from small family-run operations to larger corporations and non-profit organizations.

Commercial recreation activities in Southeast Alaska and on the Tongass National Forest cover a broad spectrum of uses, ranging from fishing and hunting to helicopter flights and photography. Both residents and nonresidents use the services of outfitter/guides, but nonresidents tend to use outfitter/guides more often because they do not have the local knowledge or necessary equipment. Local residents tend to use their own boats and equipment to reach the Forest. Outfitter/guides are authorized use through special use permits to operate on the Tongass and are required to report annual use as part of their permit.

Most outfitter/guides using the Forest shorelines access them via boat from saltwater. Some clients access NFS lands from beaches, while others are also guided on land. The majority of charter boats in Southeast Alaska operate exclusively on saltwater for fishing or sightseeing without ever using the Forest (USDA Forest Service 2004g).

While people often participate in several different activities in one or more settings on any given trip, different activities result in different numbers of people in a group and different amounts of time spent on the Forest. At one end of the spectrum, guided bear hunting consists of many small groups of one or two people. (State regulations require non-resident hunters to use guides for hunting brown bear and mountain goats which are present in southeast Alaska). Hunters are dispersed across a large area and are on the Forest for long periods of time, typically 5 to 10 days, during spring and fall. At the other end of the use spectrum are mid-sized nature-viewing tour boats with relatively large group sizes (from 12 to 70 people). These groups are typically concentrated in a few areas of the Forest. Their use is short-term and concentrated in the summer season.

The Shoreline Outfitter/Guide FEIS, prepared for four northern Ranger Districts on the Tongass (USDA Forest Service 2004c), found that recreation group size is highly variable along shorelines in that study's project area. Groups generally consisted of less than 12 people, although larger groups, often associated with commercially guided groups from tour boats, may also be present. The largest shoreline group identified as part of that EIS was a tour boat with 70 people.

This type of use accounts for a large number of visitors, but tends to be concentrated in relatively few areas of the Forest. Businesses providing services to these types of larger groups are heavily influenced by physical conditions that allow for large boat access and their schedules.

Helicopter landing tours are another popular form of outfitter/guide use (Table 3.15-12). An estimated 67,000 cruise ship passengers visiting Juneau in 2014 (about 7 percent of all cruise passengers visiting that year) participated in helicopter landing tours on the Juneau Icefield (Table 3.15-11). These tours to the Juneau Icefield involve high volumes of people concentrated at specific locations for short periods of time, typically 2 to 4 hours. Helicopter traffic, in groups of one to three helicopters, is almost continuous to and from icefield locations during the summer. Clients are typically outfitted and guided to walk, photograph, hike, or trek on, and explore the glacial environment.

Table 3.15-12
Helicopter Tour Locations by Client and Group, 2014

Area	Number of Groups[1]	Number of Clients
Juneau Icefield 1 – Gilkey Backcountry	175	832
Juneau Icefield 3 – Herbert	2,086	10,726
Juneau Icefield 4 – Mendenhall	8,577	42,919
Juneau Icefield 5 – Lemon	1	3
Juneau Icefield 7 – Norris	2,005	8,984
Juneau Icefield 8 – Taku	1,192	6,266
P24 Baird Patterson Glaciers	2	8
Skagway Icefield – Denver	1,921	10,109
Skagway Icefield – Meade	2,827	14,352
Skagway Icefield – Shubee	34	173

[1] These numbers are an estimate of the total number of helicopter landings, including gratuity, training, and tour landings.
Source: USDA Forest Service (2015i)

Helicopter landing tours also occur in a number of locations elsewhere on the Forest, including the Skagway Icefield and Baird Patterson Glaciers (Table 3.15-12). Visitors to the Juneau Icefield accounted for about three-quarters of the total number of groups (75 percent) and clients (74 percent) in 2014, with most of the remainder visiting the Skagway Icefield.

The number of reported outfitter/guide clients and groups in 2013 are presented by Ranger District in Table 3.15-13. A total of 607,000 clients and 25,000 groups were reported in 2013. The Juneau Ranger District accounted for 92 percent of the total clients in 2013, with 72 percent of these clients (403,657) visiting the Mendenhall Glacier Visitor's Center.

Table 3.15-13
Outfitter/Guide Use by Ranger District, 2013

Ranger District	Clients	Groups
Admiralty National Monument	2,446	611
Craig	2,326	350
Hoonah	3,224	313
Juneau	557,980	17,008
Ketchikan - Misty	12,096	2,009
Petersburg	8,036	1,264
Sitka	11,248	1,797
Thorne Bay	904	126
Wrangell	8,472	1,259
Yakutat	56	7
Total	**606,788**	**24,744**

Note:
Data are likely underreported for the Yakutat Ranger District.
Source: USDA Forest Service 2015j

This diversity in the range of activities, the season of use, and types of recreation experience offered by outfitter/guide businesses can lead to conflicts between businesses when incompatible activities occur in close proximity. Comments received during the Shoreline Outfitter/Guide EIS process highlighted conflicts between helicopter and wheeled airplane access on one hand and some boat or foot travel access on the other. Several comments noted that the activities of smaller operations tend to be similar and compatible resulting in minimal conflicts, while larger operations often tend to detract from the setting and expectations of smaller groups. Some smaller operators believe that they are being displaced from their traditional use areas by larger commercial operations (such as mid-sized cruise ships). On the other hand, some tour boat operators providing services to large groups felt they have been progressively excluded from areas on the Tongass National Forest over the past two decades (USDA Forest Service 2004g).

Environmental Consequences

Direct and Indirect Effects

This section describes the potential direct, indirect, and cumulative effects of the proposed alternatives on recreation and tourism. The following subsections review the potential effects of the alternatives on the existing supply of recreation opportunities in terms of the Forest Service's ROS settings and inventoried recreation places on the Tongass. Potential effects to developed recreation facilities, resident recreational use, and tourism are also discussed.

Timber Harvest

Recreation Opportunity Spectrum

As discussed in the preceding affected environment section, the ROS system is designed to help identify and quantify different types of recreation setting on the Tongass National Forest and portrays the appropriate combination of activities, settings, and experience expectations along a continuum that ranges from highly modified to primitive environments (Table 3.15-2). Estimated maximum acres likely to be harvested after 100 years by ROS setting and alternative are presented in Table 3.15-14.

Table 3.15-14
Estimated Maximum Acres Likely to be Harvested after 100 Years by ROS Setting

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
ROS Setting	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth
P	119	2,169	1,277	1,068	1,187	1,325	117	63	346	22
SPNM	577	5,121	2,549	2,909	2,897	9,272	716	2,686	822	2,347
SPM	1,805	2,940	12,263	1,687	12,086	3,001	4,103	1,602	6,430	1,655
RN	982	2,034	2,005	1,002	2,211	312	527	643	1,283	678
RM	206,286	50,538	316,831	25,919	294,430	21,647	229,238	37,587	275,131	37,759
R and U	87	25	285	12	283	11	107	15	94	17
Unmapped	27	24	135	12	121	0	76	0	39	0
TOTAL	**209,882**	**62,851**	**335,344**	**32,609**	**313,216**	**35,568**	**234,885**	**42,597**	**284,144**	**42,479**

Notes:
P = Primitive, SPNM=Semi-Primitive Non-Motorized, SPM=Semi-Primitive Motorized, RN=Roaded Natural, RM=Roaded Modified, R and U=Rural and Urban
[1] The total acres shown in this table are slightly lower than the Forest-wide total because the ROS inventory does not include the entire Forest.

Recreational visitors with an expectation of a remote experience would be most affected by timber production in Primitive, SPNM, and SPM settings. In terms of maximum acres likely to be harvested after 100 years, Alternatives 2 and 3 would involve the largest amount of young-growth harvest in these three ROS settings (Table 3.15-14). Alternatives 5, 4, and 1 would all involve less young-growth harvest in these ROS settings, with the amount decreasing in that order. Alternatives 3 and 1 would include the largest amount of old-growth harvest in the P, SPNM, and SPM ROS settings, followed by Alternatives 2, 4, and 5 in that order (Table 3.15-14). As a percentage of total ROS acres, however, less than one percent of total Primitive, SPNM, and SPM setting acres would likely be harvested (young-growth or old-growth) under any of the alternatives. Similarly, less than 1.5 percent of total RN acres would be harvested (young-growth or old-growth) under any of the alternatives.

Most harvest would occur in ROS settings where some modification of the natural environment is expected. Alternatives 2 and 3 have the greatest amount of likely young-growth harvest in the Rural and Urban setting, at 285 and 283 acres, respectively, compared to 107 acres for Alternative 4 and less than 100 acres for Alternatives 1 and 5 (Table 3.15-14). Young-growth harvest would be most heavily concentrated in the RM setting, with all alternatives allowing harvest of more than ten percent of existing RM acres. Alternatives 2 and 3 would allow the largest area of young-growth harvest in RM, at 316,831 acres (19 percent of total RM acres) and 294,430 acres (18 percent), respectively (Table 3.15-14). While less extensive, representing 3 percent or less of RM acres, old-growth harvest is also most concentrated in the RM setting, ranging from 21,647 acres under Alternative 3 to 50,538 acres under Alternative 1 (Table 3.15-14).

Land Use Designation

The Forest Plan LUDs govern allowable uses and desired conditions on the Tongass, including specific designations for recreation. Table 3.15-15 presents the estimated maximum acres likely to be harvested after 100 years by LUD group, LUD, and alternative. All LUDs where harvest could take place allow recreation access, with varying degrees of focus on the recreational experience. Viewed by LUD, young-growth and old-growth harvest could occur in nine LUDs depending on the selected alternative.

The maximum acres likely to be harvested after 100 years are mostly or entirely located in the Intensive Development (Timber Production) and Moderate Development (Modified Landscape and Scenic Viewshed) LUD groups under all five alternatives, with the majority in Timber Production and Modified Landscape LUDs. Alternatives 2, 3, and 5 also include acres in the Natural Setting LUD group, with 12 percent, 11 percent, and 1 percent of total harvest acres in the Natural Setting LUD group, respectively. The majority (Alternatives 2 and 3) or all (Alternative 5) of these Natural Setting LUD group acres (9 percent, 8 percent, and 1 percent of the total, respectively) are located in the Old-Growth Habitat LUD. Other Natural Setting LUDs affected under Alternatives 2 and 3 include Semi-remote Recreation and Special Interest Area (Table 3.15-15). Total acres likely to be harvested in these LUDs represent a very small share of total acres and were harvest to occur in these areas it would have very limited impact on the supply of recreational experiences allowed in these LUDs.

Recreation Places

This analysis assesses the potential effects of the proposed alternatives on recreation places based on the estimated maximum acres of young-growth and old-growth likely to be harvested after 100 years. In general, timber harvest can have adverse impacts on recreation places while also increasing access to some recreation opportunities via new road construction. Adverse impacts would be most pronounced in recreation places within natural setting LUDs, where recreationists are seeking a remote experience in a near pristine environment. No old-growth acres harvest is proposed within the natural setting LUD Group in recreation places under any alternative; however, young-growth harvest is proposed in natural setting LUDs under Alternatives 2, 3, and 5, varying between alternatives and by recreation place category. For all alternatives and recreation places, proposed harvest is concentrated within the moderate development and intensive development LUD groups. Recreation places within the home range of communities, and those important for developed facilities, marine recreation, hunting, fishing, and tourism are discussed below.

Table 3.15-15
Approximate Maximum Acres Potentially Harvested after 100 Years by LUD Group and LUD

	Estimated Maximum Harvest (Acres)					Estimated Maximum Harvest (Percent of Total)				
	Alternative					Alternative				
LUD Group/LUD	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Intensive Development										
Timber Production	189,103	219,432	210,236	189,221	220,797	69	60	60	68	68
Subtotal	***189,103***	***219,432***	***210,236***	***189,221***	***220,797***	***69***	***60***	***60***	***68***	***68***
Moderate Development										
Modified Landscape	68,153	84,197	80,536	74,207	84,897	25	23	23	27	26
Scenic Viewshed	15,477	19,731	18,785	14,054	19,118	6	5	5	5	6
Subtotal	***83,631***	***103,928***	***99,321***	***88,261***	***104,015***	***31***	***28***	***28***	***32***	***32***
Natural Setting										
Old-Growth Habitat	0	31,640	26,186	0	1,811	0	9	8	0	1
Semi-remote Recreation	0	6,625	7,224	0	0	0	2	2	0	0
Remote Recreation	0	360	391	0	0	0	0	0	0	0
Special Interest Area	0	5,966	5,425	0	0	0	2	2	0	0
Recreation River	0	0	0	0	0	0	0	0	0	0
Scenic River	0	0	0	0	0	0	0	0	0	0
Subtotal	***0***	***44,592***	***39,226***	***0***	***1,811***	***0***	***12***	***11***	***0***	***1***
TOTAL	**272,733**	**367,952**	**348,783**	**277,481**	**326,623**	**100**	**100**	**100**	**100**	**100**

Home Range Recreation Places

Home range recreation places are those inventoried recreation places within an approximate 20-mile radius from one or more communities. Estimated maximum acres of young-growth and old-growth harvest in home range recreation places are summarized for each alternative in Table 3.15-16. Alternatives 2, 3, and 5 include young-growth acres in natural setting LUDs within home range, ranging from 8,693 acres for Alternative 5 to 13,195 acres for Alternative 2. Overall, the total percent of home range recreation place harvest acres ranges from 3.4 percent under Alternative 4 to 4.9 percent under Alternative 2 (Table 3.15-16).

Table 3.15-16
Estimated Maximum Acres of Harvest in Home Range Recreation Places, by LUD Group

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
LUD Group	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth
Natural Setting	0	0	13,195	0	12,183	0	0	0	8,639	0
Moderate Development	21,291	6,208	31,642	3,089	28,856	2,872	24,515	3,860	27,814	4,034
Intensive Development	24,935	7,571	34,167	3,879	30,368	3,490	26,246	5,235	30,602	5,263
TOTAL	**46,226**	**13,779**	**79,004**	**6,968**	**71,408**	**6,362**	**50,761**	**9,095**	**67,056**	**9,297**
% of Total	**2.7%**	**0.8%**	**4.5**	**0.4**	**4.1**	**0.4**	**2.9**	**0.5**	**3.8**	**0.5**
Home Range Acres	**3.5**		**4.9**		**4.5**		**3.4**		**4.7**	

Important Recreation Places

Recreation places are identified as either important or ordinary/common based on five categories: facilities, marine, hunting, fishing, and tourism. Individual recreation places may be important for one, several, or none of these categories. The following sections discuss the long-term effects of the proposed alternatives on important recreation places by category.

Facilities. Estimated maximum acres of harvest in recreation places important for facilities are summarized in Table 3.15-17. The potential effects of timber harvest would likely vary by the type of facility. The importance of a remote public recreation cabin may, for example, be greatly enhanced by the solitude and natural scenery the area provides. This type of setting may be of only secondary importance for a similar cabin where the attraction might be the outstanding steelhead fishing in the spring or fall. Alternatives 2, 3, and 5 include young-growth harvest acres in natural setting LUDs within recreation places important for facilities. Overall, a relatively small portion of recreation places important for facilities include estimated maximum young-growth and old-growth harvest acres, ranging from 1.4 percent under Alternative 1 to 2.3 percent under Alternative 2 (Table 3.15-17).

Table 3.15-17
Estimated Maximum Acres of Harvest in Recreation Places Important for Facilities, by LUD Group

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
LUD Group	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**
Natural Setting	0	0	3,609	0	3,485	0	0	0	1,555	0
Moderate Development	5,370	2,023	8,664	1,017	7,951	964	7,551	1,301	7,566	1,437
Intensive Development	6,177	1,541	9,529	796	8,737	688	8,145	1,252	8,340	1,010
TOTAL	**11,548**	**3,564**	**21,801**	**1,813**	**20,173**	**1,651**	**15,696**	**2,552**	**17,462**	**2,447**
% of Total	**1.1**	**0.3**	**2.1**	**0.2**	**1.9**	**0.2**	**1.5**	**0.2**	**1.7**	**0.2**
Acres Important for Facilities	**1.4**		**2.3**		**2.1**		**1.7**		**1.9**	

Marine. Estimated maximum acres of harvest in recreation places that are important for marine recreation are summarized in Table 3.15-18. The perception of naturalness and scenery are very important values among Forest visitors engaged in the unique marine recreation opportunities offered by the Tongass. Approximately 30 percent of inventoried recreation place acres are currently important for marine recreation activities (Table 3.15-7). Many of these recreation places are within the beach fringe and are allocated to the SPM ROS. Alternatives 2, 3, and 5 include young-growth harvest acres in natural setting LUDs within recreation places important for marine recreation. Overall, the portion of recreation place acres important for marine recreation with potential young-growth and old-growth harvest ranges from 2.0 percent under Alternative 1 to 3.2 percent under Alternative 2 (Table 3.15-18).

Table 3.15-18
Estimated Maximum Acres of Harvest in Recreation Places Important for Marine Recreation, by LUD Group

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
LUD Group	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**
Natural Setting	0	0	4,881	0	5,091	0	0	0	2,066	0
Moderate Development	8,533	2,491	15,564	1,229	14,309	1,099	12,669	1,707	13,300	1,882
Intensive Development	7,736	2,457	12,727	1,188	11,843	1,423	10,950	1,616	11,097	1,470
TOTAL	**16,269**	**4,948**	**33,172**	**2,418**	**31,242**	**2,522**	**23,619**	**3,323**	**26,463**	**3,351**
% of Total	**1.5**	**0.5**	**3.0**	**0.2**	**2.9**	**0.2**	**2.2**	**0.3**	**2.4**	**0.3**
Acres Important for Marine Rec	**2.0**		**3.2**		**3.1**		**2.5**		**2.7**	

Hunting. Estimated maximum acres of harvest in recreation places that are important for hunting are summarized in Table 3.15-19. Hunters who favor hunting in an undisturbed, natural setting would likely prefer those alternatives that have the least acres of harvest in these recreation places. Hunters who prefer using roads and road access would generally benefit from those alternatives with more potential acres of harvest. Approximately 40 percent of inventoried recreation place acres are currently important for hunting (Table 3.15-7). Alternatives 2, 3, and 5 include young-growth harvest acres in natural setting LUDs within recreation places important for hunting. Overall, the portion of recreation place acres important for hunting with potential young-growth and old-growth harvest ranges from 2.4 percent under Alternative 4 to 3.9 percent under Alternative 2 (Table 3.15-19).

Table 3.15-19
Estimated Maximum Acres of Harvest in Recreation Places Important for Hunting, by LUD Group

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
LUD Group	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**
Natural Setting	0	0	9,059	0	8,211	0	0	0	5,746	0
Moderate Development	11,865	3,084	16,933	1,506	14,888	854	11,799	1,553	15,465	1,614
Intensive Development	17,895	5,596	25,854	2,770	22,269	2,238	18,801	3,261	23,403	3,336
TOTAL	**29,761**	**8,680**	**51,846**	**4,276**	**45,369**	**3,092**	**30,599**	**4,814**	**44,614**	**4,949**
% of Total	**2.0**	**0.6**	**3.6**	**0.3**	**3.1**	**0.2**	**2.1**	**0.3**	**3.1**	**0.3**
Acres Important for Hunting	**2.6**		**3.9**		**3.3**		**2.4**		**3.4**	

Fishing. Estimated maximum acres of harvest in recreation places that are important for fishing are summarized in Table 3.15-20. Approximately 13 percent of inventoried recreation places acres are currently important for fishing (Table 3.15-7). Access to streams and areas immediately adjacent to streams may be subject to modifications, with the settings adjacent to the stream side corridors appearing more modified over time. Access may affect the quality of the fishing experience regardless of the degree of setting changes leading up to the stream. Alternatives 2, 3, and 5 include young-growth harvest acres in natural setting LUDs within recreation places important for fishing. Overall, the portion of recreation place acres important for fishing with potential young-growth and old-growth harvest ranges from 2.2 percent under Alternative 4 to 4.2 percent under Alternative 2 (Table 3.15-20).

Table 3.15-20
Estimated Maximum Acres of Harvest in Recreation Places Important for Fishing, by LUD Group

	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
LUD Group	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**	**Young Growth**	**Old Growth**
Natural Setting	0	0	3,380	0	3,144	0	0	0	2,009	0
Moderate Development	5,974	913	9,558	446	8,025	284	5,944	457	8,217	502
Intensive Development	3,503	1,897	5,679	950	4,629	1,124	3,166	1,073	5,084	940
TOTAL	**9,476**	**2,810**	**18,616**	**1,396**	**15,798**	**1,408**	**9,110**	**1,531**	**15,310**	**1,442**
% of Total	**2.0**	**0.6**	**3.9**	**0.3**	**3.3**	**0.3**	**1.9**	**0.3**	**3.2**	**0.3**
Acres Important for Fishing	**2.6**		**4.2**		**3.6**		**2.2**		**3.5**	

Tourism. Estimated maximum acres of harvest in recreation places that are important for tourism are summarized in Table 3.15-21. Approximately 53 percent of inventoried recreation place acres are currently considered important for tourism (Table 3.15-7). Based on surveys and marketing campaigns for visitors, it is widely accepted that natural beauty and scenery are some of the principal factors attracting visitors to the region. Alternatives 2, 3, and 5 include young-growth harvest acres in natural setting LUDs within recreation places important for tourism. Overall, the portion of recreation place acres important for tourism with potential young-growth and old-growth harvest is relatively low under all alternatives, ranging from 1.2 percent under Alternative 4 to 1.9 percent under Alternative 2 (Table 3.15-21).

Table 3.15-21
Estimated Maximum Acres of Harvest in Recreation Places Important for Tourism, by LUD Group

LUD Group	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth
Natural Setting	0	0	6,380	0	5,910	0	0	0	3,467	0
Moderate Development	9,841	3,210	15,260	1,592	13,323	1,025	10,934	1,544	13,234	1,670
Intensive Development	7,140	3,531	11,720	1,761	10,098	1,632	7,804	2,024	10,286	1,368
TOTAL	**16,980**	**6,740**	**33,360**	**3,353**	**29,330**	**2,657**	**18,738**	**3,569**	**26,987**	**3,039**
% of Acres	**0.9**	**0.4**	**1.7**	**0.2**	**1.5**	**0.1**	**1.0**	**0.2**	**1.4**	**0.2**
Important for Tourism	**1.3**		**1.9**		**1.6**		**1.2**		**1.6**	

Developed Recreation Facilities

The number of developed recreation facilities that are located within 0.5-mile of suitable harvest areas is shown in Table 3.15-22, broken out by LUD group (no harvest acres are proposed in the Wilderness LUD group). The potential effects of timber harvest would likely vary by the type of facility. In addition, expectations for the type of recreation experience would vary by LUD group. Visible timber harvest in natural setting LUDs may be perceived as a more severe adverse impact, than similar harvest located in intensive development LUDs.

The total number of developed facilities within 0.5 mile of suitable old-growth and young-growth stands ranges from 180 facilities under Alternative 5 to 235 facilities under Alternative 2 (Table 3.15-22). Alternative 2 has the most facilities within 0.5-mile of both suitable old-growth (124 total) and young-growth (111 total) (Table 3.15-22). Across all alternatives, larger numbers of recreation facilities are within 0.5 mile of suitable acres in moderate development LUDs than natural setting or intensive development LUDs. Recreation facilities within 0.5 mile of young-growth or old-growth suitable acres in natural setting LUDs range from 38 facilities under Alternative 4 to 63 facilities under Alternative 2.

Table 3.15-22
Number of Developed Recreation Facilities within 0.5-mile of Suitable Old-Growth and Young-Growth Stands, by LUD Group

LUD Group	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth	Young Growth	Old Growth
Natural Setting	20	27	36	27	35	22	20	18	28	12
Moderate Development	36	57	43	59	43	44	37	40	39	39
Intensive Development	29	37	32	38	32	36	26	34	29	33
Totals	**85**	**121**	**111**	**124**	**110**	**102**	**83**	**92**	**96**	**84**
	206		**235**		**212**		**175**		**180**	

Resident Recreational Use

As noted in the Affected Environment part of this section, resident recreation demand, like other forms of recreation demand, is influenced by a number of factors, including regional population levels, per capita participation rates, and recreation travel behavior. The alternatives evaluated here are unlikely to affect broader trends in recreation behavior, but it is possible that they could result in different supply-induced changes in participation. These potential changes, along with the potential effects of the alternatives on recreation places, would likely affect resident recreationists.

In the past, supply-induced changes in participation on the Tongass have been mainly related to changes in road systems and road access. This type of change in participation appears to have occurred on Prince of Wales, Wrangell, and Mitkof Islands, for example. In these locations, road systems developed for timber harvesting created an opportunity for road-related access to previously inaccessible recreation settings and, therefore, an opportunity for recreation activities involving wheeled vehicles. In addition, new roads that provide easier access to a wider area may create new semi-primitive opportunities that increases the capacity of a recreation place or creates a new recreation place. Over time, continuation of such new opportunities would be dependent on the availability of funds for road maintenance and other system management needs.

Under all alternatives, while there would be some new road access in the long run, nearly all new roads constructed under the alternatives would be closed following harvest. These roads would, therefore, not be available for use by highway vehicles or high-clearance vehicles. They would, however, be available for access by other methods and would, as a result, have the potential to affect existing recreation patterns. Any potential increase in recreational access may be limited by the extent to which road closures include restoring the road bed to a more natural condition, possibly blocking or discouraging non-vehicle access as well. In general, new roads would be required to harvest old growth while reconstruction of existing closed or decommissioned roads would be required to harvest young growth.

Viewed at a programmatic level, changes in participation related to road systems and access are more likely to occur under alternatives that involve higher levels of projected road construction and reconstruction. Based on the miles of new road construction projected under each alternative and viewed at a programmatic level, Alternative 1 would involve the construction of most new roads over 25 years: 281 miles of new roads versus the next highest maximum of 267 miles under Alternative 5. However, Alternative 1 would require much less road construction on decommissioned roadbeds and road reconstruction over this period than the other alternatives, with a maximum combined total length of 224 miles versus 306 miles (Alternative 4) to 381 miles (Alternative 2) under the other alternatives.

Viewed over 100 years, new road construction would range from 871 miles (Alternative 4) to 1,056 miles (Alternative 2), with road construction on decommissioned roadbeds and road reconstruction miles ranging from 1,315 miles (Alternative 1) to 1,791 miles (Alternative 2). Harvest would be limited to areas outside Inventoried Roadless Areas (IRAs) under Alternatives 1, 4, and 5 and would, therefore, tend to increase road density in already roaded areas rather than provide new access to presently undeveloped areas.

As the preceding discussion suggests, the trend across all alternatives is toward an increase in general recreation access and a corresponding decrease in primitive recreation opportunities. Viewed at this level, Alternative 1 would have the lowest impact on primitive areas and associated opportunities because no potential timber harvest is proposed within the existing Inventoried Roadless Areas (IRAs) on the Tongass and it would involve the least road construction.

Alternatives 4 and 5 would have the next lowest potential impacts in that order, as they also do not include potential harvest acres within IRAs and would involve fewer new road miles than Alternatives 2 and 3. Alternatives 2 and 3 would both include young-growth and old-growth harvest within IRAs that could impact primitive recreation opportunities, and have the greatest potential road construction. While Alternative 3 would involve less road construction than Alternative 2, it would involve more timber harvest in IRAs and therefore the greatest potential impacts to primitive recreation opportunities. In both cases, the areas in IRAs expected to be harvested represent a small percentage of total IRA acres (0.1 to 0.3 percent) (see the *Inventoried Roadless Areas* section). As discussed in the *Inventoried Roadless Areas* section, timber harvest and road construction in IRAs is not consistent with the 2001 Roadless Rule. Harvest and road constructions in IRAs would be deferred until there was a change in the Rule or the Tongass Roadless Rule exemption were reinstated.

Given the programmatic nature of this planning document, it is not possible to predict site-specific changes that would occur under any of the alternatives. Potential impacts to recreation places and recreation activities in other areas would be evaluated on a project-by-project basis and in accordance with the applicable Forest Plan standards and guidelines under all alternatives.

The Forest will change over time under all of the alternatives, and recreation demand and use patterns are also likely to change. Recreationists may respond to changes to specific areas and locations in three general ways. Some may adapt to new situations, and changes in settings will have little or no impact to these current Forest users. For others, change may not be acceptable, and these users will be displaced to other areas where the setting and use patterns are more in line with their expectations and needs. A third group of current recreationists may find that they cannot adapt to the new situation nor find suitable substitute areas, and as a result, substitute other leisure activities in place of recreating on the Forest.

Tourism

The vast majority of visitors to Southeast Alaska are cruise ship passengers, accounting for 85 percent of visitors to Southeast Alaska in 2011 (McDowell Group 2012). Future development of the tourism industry in Southeast Alaska and elsewhere in the United States is dependent on a wide range of factors, including the value of the dollar in foreign countries, the price of oil, world events and international unrest, and political and social change. In addition, regions like Southeast Alaska directly compete with other locations and activities for tourist dollars. As a result, changes in other tourist markets, both positive and negative, have the potential to affect the tourism industry in Southeast Alaska. These factors are, for the most part, unrelated to management of the Tongass National Forest.

While it is reasonable to assume that the vast majority of tourism activity in the region is related to the natural environment, many visitors experience the Tongass passively—from the deck of a cruise ship, for example—without directly using the Forest for recreation purposes. Effects to this type of visitor would depend on the level of visibility of proposed timber production along cruise ship and other marine corridors. According to the analysis in the *Scenery* section, harvest areas under Alternatives 1 and 4 would be the least visible to viewers from waterways, while harvest under Alternative 2 would be the most visible. See the *Scenery* section for detailed impact discussions by viewshed and alternative.

Cruise ships have heavily marketed Forest-related activities in recent years, and many passengers take at least one trip to the Forest during their visit. As discussed in the affected environment portion of this section, the tourism industry and outfitter/guides in Southeast Alaska offer a wide spectrum of recreation activities, ranging from guided bear hunting through helicopter tours and guided wildlife-viewing boat tours. Viewed in terms of Forest management, the requirements of these activities are often at odds with one another. Some activities require developed facilities, utilities, and easy access, while others require vast and remote areas in a natural setting, with outfitter/guides providing only the basic essentials for their clients.

There are indications that demand exceeds supply in some recreation places, especially those used more extensively by tourist operators and outfitter/guides. Activities that are presently near or at capacity include bear-viewing areas and helicopter use in the immediate vicinity of urban areas. Other areas may be able to accommodate current levels of tourism and potential increases in the future without negatively affecting the tourist experience or causing detrimental environmental effects. The number of visitors cruising the Inside Passage or viewing Mendenhall Glacier may, for example, be sustainable at current and future levels of use (Schroeder et al. 2005).

Management practices for specific areas, such as limiting the number of visitors by permit, would continue to be evaluated on a project-by-project basis and in accordance with the applicable Forest Plan standards and guidelines under all alternatives.

Assuming that the volume of tourists remains at its current level or more substantially recovers from the recession-induced dip during the late 2000s, the overall recreation trend would likely be toward more group experiences on the Tongass and fewer opportunities for solitude and isolation in natural areas close to cruise ship stops.

Renewable Energy Development

All renewable energy development projects built and operated in Southeast Alaska have to meet detailed local, state and, in most cases, federal laws, regulations, and requirements. Projects are also subject to Tongass National Forest Plan standards and guidelines. The Forest Plan identifies three types of area related to energy development on the Tongass based on the existing LUDs: windows, which represent areas potentially available for energy development; avoidance areas; and exclusion areas. Avoidance areas are those LUDs where development of energy projects are inconsistent with land use management objectives and desired future conditions. Alternative locations in other LUDs must be exhausted before facilities are considered in avoidance areas. LUDs classified as windows and avoidance areas make up 38 percent and 62 percent of the Forest, respectively. There are no exclusion areas on the Tongass due to special authorities provided in the Alaska National Interest Lands Conservation Act, Title XI. These classifications and the standards and guidelines in the current Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, renewable energy sites would be managed under the new Renewable Energy Plan Components identified in Chapter 5 of the Forest Plan amendment. This is discussed in more detail in the *Renewable Energy* section of this EIS.

The Forest Service has identified 11 proposed renewable energy projects in Southeast Alaska that are currently active (Table 3.12b-3). Five of these proposed projects would be located in important recreation places. All five projects are located within recreation places important for tourism, four are within home range recreation places or places important for facilities, and one is within a place important for marine and hunting recreation.

In addition, two developed recreation sites are within 0.5 mile of a proposed renewable energy project: the Swan Lake boat dock and the marine access point at Indian River. The proposed renewable energy projects are further discussed in in the *Renewable Energy* section of this EIS.

Effects from the proposed projects on recreation would depend on site-specific plans. In general, project activities that would impact recreation could include new access road construction, forest clearing, ground disturbance, temporary construction noise, temporary (construction) or long-term (operations) access restrictions, and visual impacts depending on the location and design features. Any associated transmission lines could also impact recreation areas and activities through forest clearing and potential additional road construction. All potential impacts to specific recreation resources would be addressed during the permitting and licensing of the projects, including National Environmental Policy Act (NEPA) assessment.

Cumulative Effects

This section considers the incremental effects of the alternatives when added to other past, present, and reasonably foreseeable actions. The effects of past and present actions on recreation are included in the Affected Environment portion of this section, which discusses current recreation facilities and activities on the Tongass. Past actions include past timber harvest and road building that has facilitated roaded recreation and changed ROS settings, as well as the development of recreation facilities, such as cabins, campgrounds, interpretive sites, and visitor centers. Present actions include the impacts of current management policies on existing recreation patterns, particularly those that are authorized by special use permits.

Despite the recent recession-related drop, the number of cruise ship passengers visiting the region remains a significant source of current and future recreation demand on the Tongass. Current recreation patterns on the Tongass also reflect past timber harvest and road building activities on adjacent private and Native corporation lands, as well as wildland recreation opportunities on federal- and state-managed lands elsewhere in the region.

Reasonably foreseeable actions on NFS lands include the projected levels of future timber harvest and renewable energy development that are used in the preceding analysis to assess the potential impacts of the alternatives on the supply of recreation opportunities and recreation use and demand.

Other reasonably foreseeable actions include regional transportation development as defined by the State Transportation Plan and the Forest Service Alaska Region Long Range Transportation Plan, as well as road paving on Prince of Wales Island, the closing of roads, and construction of the Angoon Airport. In addition, the expansion of cities like Juneau and Ketchikan, recreational cabin development, and land auctions by the State could include additional road construction. Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

It is not possible at this time to predict exactly which roads would be developed or their likely impact on future recreation patterns. None of the alternatives is expected to affect this type of future road development, which would be expected to go or not go forward regardless of the selected alternative. The overall cumulative effect of new regional road corridors viewed in conjunction with the

Forest Plan alternatives would be a trend toward the roaded end of the ROS spectrum that would be highest under Alternative 2 and lowest under Alternative 1.

Other reasonably foreseeable future actions include an expected growth in recreation and tourism businesses based on recovery in the cruise ship industry, as well as the development of additional fishing and other lodges. This type of development would facilitate additional recreation and tourism in the region and on the Forest. Human settlement expansion is expected to occur around the region's larger cities, such as Juneau and Sitka, with residential expansion also expected as a result of state land auctions. These developments would likely result in increased demand for a range of recreation activities, with some developments favoring developed recreation opportunities, and others more dependent on undeveloped lands.

Mining activities are expected to expand at existing sites, including Greens Creek on Admiralty Island and Kensington Gold Mine north of Juneau, as well as possible future sites, including the Bokan Mountain and Niblack sites on the southern end of Prince of Wales Island. Mining projects are for the most part expected to have a negative effect on recreation activities, because most recreational activities are incompatible with these types of land use.

Risk and Uncertainty

As stated in a number of locations in this section, recreation and tourism in Southeast Alaska and on the Tongass is influenced by a number of factors that are largely independent of forest management decisions. Future recreation and tourism demand is difficult to predict with any precision and no attempt is made to quantify future demand in this section. The number of cruise ship visitors to the region is generally expected to remain at current levels or continue to increase, but there is uncertainty that this will be the case for the foreseeable future.

Likely impacts to the supply of recreation opportunities on the Forest are easier to project, as they are directly affected by management decisions, at least to the extent that proposed harvest levels and renewable energy projects affect different types of recreation. Much of the analysis in this section is based on this relationship, which allows a comparison between alternatives over time.

Changes in Southeast Alaska's climate (discussed in the *Climate and Air* section) could affect recreation and tourism in the region in the future. Many tourists visiting the region travel long distances from across the United States, as well as from other countries. Many tourists arriving by cruise ships travel a considerable distance by air before even boarding the cruise ship in Seattle, Vancouver, or elsewhere. Others travel directly to Southeast Alaska via air. Future regulatory or market-based pressures to reduce transportation-related greenhouse gases could affect the level of visitation to the region.

Recreation activities could also be directly affected by global warming, with, for example, fewer winter recreation opportunities available and for shorter periods of time. Climate change could also affect recreational fishing through changes in biodiversity and water levels, as well as changes in the length of season and user experience (Kelly et al. 2007).

This page is intentionally left blank.

Scenery

Affected Environment

The Tongass National Forest offers a variety of scenery to its visitors, from spectacular mountain ranges and the glaciers of the mainland to low-lying marine landscapes composed of intricate waterways, bays, and island groups. The Forest is viewed from a variety of vantage points, including the communities of Southeast Alaska, the Alaska Marine Highway ferry route, cruise ship routes, existing road systems, popular small boat routes and anchorages, developed recreation sites and facilities, and hiking trails. Tourist-related flight seeing via small aircraft is increasing in popularity and provides aerial views of the forest landscape.

The Forest Service developed a Visual Management System (VMS) in 1974 to integrate aesthetic considerations into large-scale resource management decisions. Due to advances in technology, as well as the increased demand for high-quality scenery, the Scenery Management System (SMS) was released in 1996. The SMS integrates the increased understanding of ecosystem processes and cultural landscapes in identifying the effects of various management practices on scenic resources. The SMS was used in this analysis to inventory existing scenic resources, provide measurable scenic quality management objectives for each portion of the landscape, and estimate the landscape's sensitivity based on the visibility from priority travelways and use areas.

In order to apply SMS to the Forest, a viewshed analysis of the entire Tongass National Forest was completed using the Tongass Geographic Information System (GIS) for the 2008 Land and Resource Management Plan (Forest Plan) Amendment. The analysis was completed separately for each Ranger District. Step one involved identifying the Visual Priority Routes (VPRs) and use areas (listed in Appendix F of the 2008 Forest Plan). These are the major points from which people view the forest. They include the Alaska Marine Highway; cruise ship and small boat routes; major roads, trails, and anchorages; and important recreation areas on the land. The viewshed analysis identified points at regular intervals along the VPRs and use areas. Each viewpoint along a route was assigned a viewing height from which a person would observe the forest. For example, the average height of a person was selected for the viewing height along a hiking trail, and the height of the cruise ship's deck was used for the cruise ship route. Each cell in the digital elevation model was evaluated for visibility from each of the points along each VPR and use area. Visibility was assessed separately for each marine viewpoint and land viewpoint.

The second phase of the analysis identified distance zones, breaking the visible areas into foreground, middleground, and background from each viewpoint, based on distance. Foreground is the visible area within 0.5 mile of a VPR; background is the visible area greater than 5 miles and less than 15 miles from a

VPR; and middleground is the visible area between foreground and background of a VPR. Areas more than 15 miles from any viewpoint and those not seen from any of the VPRs or Use Areas were considered seldom seen. Distance zones were also assessed separately for land and water viewpoints. The final layers for each Ranger District were generated by combining the results from the marine analysis and the land analysis. Any point that was visible from either a land or marine viewpoint was considered visible in the final layer. Any area that was foreground from either a land or marine viewpoint was considered foreground, and any land that was only background from either a land or marine viewpoint became background. All other visible land became middleground. Any areas not seen from any viewpoints are referred to as unseen or seldom seen. The distance zones were subsequently overlaid with the land use designations (LUDs) to generate the Scenic Integrity Objectives (SIOs) (refer to the Forest-wide standards and guidelines in the Tongass Land and Resource Management Plan for details on how SIOs were determined for each LUD).

Existing Scenic Integrity

The existing scenic resources of the Tongass encompass everything from vast tracts unmodified by human activity to extensive areas of heavily modified landscapes. Existing Scenic Integrity (ESI) ratings are used by the Forest Service to analyze the degree of intactness of the landscape character. These ratings are used to categorize the degree of alteration visible in the landscape on a continuum from a natural setting to a heavily altered landscape. The ratings apply to the broad landscape affected, not just the acres altered. As described below, ESI ratings range over six levels of integrity, from Very High to Unacceptably Low.

- **Very High**—Landscapes where the valued landscape character is intact with only minute deviations, if any. The existing landscape character and sense of place is expressed at the highest possible level.
- **High**—Landscapes where the valued landscape character appears intact. Deviations may be present, but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.
- **Moderate**—Landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.
- **Low**—Landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed, but compatible or complimentary to the character within.
- **Very Low**—Landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed.
- **Unacceptably Low**—Landscapes where the valued landscape character being viewed appears extremely altered. Deviations are extremely dominant and borrow little if any form, line, color, texture, pattern or scale from the landscape character.

Table 3.16-1 displays the percent of acres of each ESI for the Tongass. In this and succeeding tables, a breakdown between "seen" and "seldom seen" areas is presented. Seen areas are those areas that can be viewed in the foreground, middleground, or background from inventoried VPR and Use Areas with a concern level of 1 or 2, the travelways and use areas with the highest number of users. Seldom seen areas are all the rest of the Forest. The ESI for wilderness is also included in this table. Approximately 88 percent of the Tongass is rated as a Very High ESI, which is a visually unaltered condition. About 10 percent of the land is rated as Low, Very Low, or Unacceptably Low, which indicates noticeable development activity. The remainder of the Forest is rated as High or Moderate. Some of the wilderness acres have a High or lower rating. This is mostly due to the landscape effect of developments adjacent to wilderness and past development activities within wildernesses.

Table 3.16-1
The Existing Scenic Integrity of the Tongass National Forest (percent)

ESI Rating	Very High/High	Moderate	Low	Very Low	Unaccept-ably Low
Seen	26.5	1.0	2.5	4.2	0.1
Seldom seen	27.1	0.2	0.9	1.9	0.1
Wilderness	34.1	0.1	0.0	0.0	0.0
Subtotals	**87.7**	**1.3**	**3.6**	**6.1**	**0.2**

Note: Numbers are GIS estimates and are not exact. Columns and rows may not sum exactly due to rounding. Less than 1 percent of the Forest is unclassified.

Under the 1997 Forest Plan, all land has a designated LUD, which guides the types and intensity of development actions. The LUDs designate the SIOs for each area, which define the degree to which the natural landscape can be altered, and provide guidelines for timber harvest, road building, and other activities to ensure they are conducted in a way that allows the scenic objectives to be achieved. A LUD may have different SIOs depending on the distance zone (foreground, middleground, background) in which the development activity is to take place. SIOs are classified using the same terms outlined above for ESI: Very High, High, Moderate, Low, and Very Low. The Unacceptably Low rating is only used to inventory existing conditions and cannot be used as a management objective.

- The current adopted SIOs for all land within the Tongass are displayed in Table 3.16-2. This table separates the percent of acres of each SIO into five categories: foreground, middleground, background, seldom seen, and other (municipal watersheds and non-wilderness national monuments where the SIO is determined on a project-by-project basis). The Very High SIO is typically assigned to wilderness; however, it is not used for Tongass wilderness because of the potential alterations allowed under the Alaska National Interest Lands Conservation Act (ANILCA). In reality, the vast majority of wilderness acreage will be managed through the specific wilderness plans with a Very High SIO. Thus, over 60 percent of the Tongass is to be managed at the High or Very High Scenic Integrity level.

- Demand for scenic quality can best be represented by the increase in tourist-related travel to the Tongass, as well as a heightened awareness and sensitivity of Alaskan residents to scenic resource values. These facts result in a strong indirect connection between scenic resource values and the economy of Southeast Alaska. For example, Southeast Alaska's Inside Passage is advertised and promoted by the Division of Tourism, cruise ship operators, and the Southeast Alaska Tourism Council. Their marketing strategy focuses on the scenery of the Tongass National Forest as a major attraction. The visitors to Southeast Alaska would, therefore, arrive with expectations and an image of the environment and scenery awaiting them. If current trends continue, demand for viewing scenic landscapes will increase. A report published by the Alaska Department of Community and Economic Development show that the largest number of visitors (1.96 million) for 2013-2014 was 5,000 more than the last record set in 2007-2008. This increase also represents a 6 percent increase over 2012-2013.

Table 3.16-2
Adopted Scenic Integrity Objectives for the Tongass (percent)

	Scenic Integrity Objective				
	High	Moderate	Low	Very Low	Other[1]
Foreground	7.7	3.6	1.4	0.1	0.1
Middleground	18.3	7.2	2.3	6.0	0.1
Background	0.8	0.4	0.0	0.2	0.0
Seldom seen	33.9	8.8	0.5	6.9	0.1
Unmapped	0.0	0.0	0.0	0.0	0.3
Total	**60.7**	**20.0**	**4.2**	**13.1**	**0.6**

[1] Includes land in the Municipal Watershed and Non-wilderness National Monument LUDs. SIOs in these LUDs are to be determined on a project-by-project basis. Generally, the High SIO will be met.
Source: USDA Forest Service, GIS. Numbers are not exact and may not sum correctly due to rounding.

Lands adjacent to the Alaska Marine Highway, cruise ship routes, flight-seeing routes, high-use recreation areas, and other marine and land-based travel routes will be seen by more people, more frequently, and for greater duration.

Environmental Consequences

The Tongass has adopted specific management objectives for scenic resources (i.e., SIOs) for each LUD in the Forest. The adopted SIOs indicate the desired or acceptable level of human-induced alteration to the valued landscape character. Harvest of old growth would follow the SIOs of the 2008 Forest Plan for all alternatives. However, Alternatives 2, 3, and 5, have relaxed these SIOs for young-growth harvest in order to increase the availability of young growth, especially in the first few decades. In other words, these alternatives have reduced SIOs in viewsheds where young growth is to be harvested. As a result, the current SIO designated for the LUD in which young-growth harvest takes place, is not likely to be met in many cases. Each alternative described in this Environmental Impact Statement (EIS) would, if implemented, maintain or alter the visual character of the landscape to varying degrees. By varying the degree of change in SIOs for the harvest of young-growth, the alternatives would result in different amounts of land managed under each SIO. The adopted SIOs for young growth are, therefore, the units used to measure potential change in visual resources for each alternative.

Adopted SIOs can be thought of as an indicator of long-term cumulative effects. SIOs are adopted to provide a threshold for the amount of modification to the landscape during land altering activities; therefore, land may have an adopted SIO of Low, but currently meet the High SIO.

The potential effects to the scenic resource are primarily described in the following three ways:

1. A display of acres of each SIO adopted for suitable young growth, along with LUD and distance zone, for each alternative.

2. A display of the number of acres of SIO Changes for suitable young growth and the degree of change (e.g., from Moderate to Low) for each alternative.
3. A display of the effects of each alternative on a selected group of key viewsheds throughout the Tongass.

Effects associated with renewable energy development are also addressed.

Direct, Indirect, and Cumulative Forest-wide Effects

Table 3.16-3 displays the acres of suitable young growth in each SIO that would result from the five alternatives. Table 3.16-3 also shows the acres under each alternative and SIO that would be located within different LUDs and distance zones. Distance zones stratify the landscape into seen areas and unseen areas, relative to inventoried travelways and use areas. The seen areas are stratified further into foreground, middleground, and background zones. The acres displayed for Alternative 1 (No Action) and Alternative 4 are based on the current mix of adopted SIOs because these alternatives include no SIO changes. Alternative 2 relaxes the SIO for young-growth harvest to Very Low, no matter what the SIO is currently. Alternative 3 would relax the SIO for young-growth harvest by one level in all LUDs, except in Timber Production. The Timber Production LUD SIOs would not change (i.e., Low in the Foreground and Very Low in the Middleground and Background). This is because the currently prescribed SIO of Low in the foreground is already very permissive (up to 60-acre clearcut) and probably in concert with anticipated unit sizes. Alternative 5 would relax the SIOs for young-growth harvest to Very Low, no matter what the SIO is currently, in all development LUDs. However, Alternative 5 also includes harvest in the Old Growth Habitat LUD and there would be no change in the SIO for this LUD (it would remain High).

Alternatives 2 and 3 include no acres designated as High SIO for young growth. Alternative 5 would include acreage designated as High SIO because it does not change SIOs in the Old Growth Habitat LUD. Alternative 2 would include no acreage designated as Moderate or Low SIO either; all acres would be designated Very Low. Alternative 3 on the other hand, would include almost 40 percent in Moderate and Low (Table 3.16-3).

A more direct way to assess the relative effects of the alternatives on scenic integrity is to compare the area under each alternative where the SIO would change and the degree of this change. This analysis is presented in Table 3.16-4.

Table 3.16-4 demonstrates again that Alternatives 1 and 4 would result in no changes to SIOs. The alternative with the most significant changes is Alternative 2, which would result in about 102,000 acres changing from High or Moderate to Very Low. The next most significant change would be with Alternative 5, which would result in about 46,000 acres changing from High or Moderate to Very Low. Alternative 3 would not result in any acres dropping more than one level.

Table 3.16-3
Scenery Integrity Objectives for Suitable Young Growth by LUD, Distance Zone, and Alternative (percent)

	Scenery Integrity Objectives					
	High	Moderate	Low	Very Low	Other[1]	Total
Alternative 1						
Timber Production						
Foreground			15%			**15%**
Middleground				34%		**34%**
Background				+		**+**
Seldom Seen Areas				20%		**20%**
Unmapped Areas					+	**+**
Subtotal	**0%**	**0%**	**15%**	**55%**	**+**	**70%**
Modified Landscape						
Foreground		9%				**9%**
Middleground			13%			**13%**
Background			+			**+**
Seldom Seen Areas				4%		**4%**
Unmapped Areas					+	**+**
Subtotal	**0%**	**9%**	**13%**	**4%**	**+**	**26%**
Scenic Viewshed						
Foreground	2%					**2%**
Middleground		2%				**2%**
Background		+				**+**
Seldom Seen Areas						
Unmapped Areas					+	**+**
Subtotal	**2%**	**2%**	**0%**	**0%**	**+**	**5%**
Total	**2%**	**11%**	**28%**	**59%**	**+**	**100%**
Suitable Acres	**5,721**	**29,773**	**73,382**	**154,970**	**30**	**263,905**
Alternative 2						
Timber Production						
Foreground				13%		13%
Middleground				27%		27%
Background				+		**+**
Seldom Seen Areas				18%		18%
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**0%**	**58%**	**0%**	**58%**
Modified Landscape						
Foreground				9%		9%
Middleground				11%		11%
Background				+		**+**
Seldom Seen Areas				3%		3%
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**0%**	**23%**	**0%**	**23%**
Scenic Viewshed						
Foreground				3%		3%
Middleground				2%		2%
Background				+		**+**
Seldom Seen Areas				+		**+**
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**0%**	**5%**	**0%**	**5%**
Non-Development LUDs						
Foreground				6%		6%
Middleground				5%		5%
Background				+		**+**
Seldom Seen Areas				3%		3%
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**0%**	**14%**	**0%**	**14%**
Total	**0%**	**0%**	**0%**	**100%**	**0%**	**100%**
Suitable Acres	**0**	**0**	**0**	**374,712**	**0**	**374,712**

Table 3.16-3 (continued)
Scenery Integrity Objectives for Suitable Young Growth by LUD, Distance Zone, and Alternative (percent)

	Scenery Integrity Objectives					
	High	Moderate	Low	Very Low	Other[1]	Total
Alternative 3						
Timber Production						
Foreground			13%			13%
Middleground				28%		28%
Background						
Seldom Seen Areas				17%		16%
Unmapped Areas					+	**+**
Subtotal	**0%**	**0%**	**13%**	**45%**	**+**	**58%**
Modified Landscape						
Foreground			9%			9%
Middleground				11%		11%
Background				+		**+**
Seldom Seen Areas				3%		3%
Unmapped Areas					+	**+**
Subtotal	**0%**	**0%**	**9%**	**14%**	**+**	**23%**
Scenic Viewshed						
Foreground		2%				**2%**
Middleground			2%			**2%**
Background			+			**+**
Seldom Seen Areas				+		**+**
Unmapped Areas					+	**+**
Subtotal	**0%**	**3%**	**2%**	**+**	**+**	**5%**
Non-Development LUDs						
Foreground		4%	1%			**6%**
Middleground		5%				**5%**
Background		+	+			**+**
Seldom Seen Areas		3%	+			**3%**
Unmapped Areas		+	+			**+**
Subtotal	**0%**	**11%**	**1%**	**0%**	**0%**	**14%**
Total	**0%**	**13%**	**26%**	**59%**	**0%**	**100%**
Suitable Acres	**0**	**48,355**	**93,866**	**207,574**	**75**	**349,870**
Alternative 4						
Timber Production						
Foreground			16%			16%
Middleground				33%		33%
Background				+		**+**
Seldom Seen Areas				19%		19%
Unmapped Areas					+	**+**
Subtotal	**0%**	**0%**	**16%**	**52%**	**+**	**68%**
Modified Landscape						
Foreground		11%				11%
Middleground			12%			12%
Background			+			**+**
Seldom Seen Areas				3%		3%
Unmapped Areas					+	**+**
Subtotal	**0%**	**11%**	**12%**	**3%**	**+**	**27%**
Scenic Viewshed						
Foreground	2%					2%
Middleground		2%				2%
Background		+				**+**
Seldom Seen Areas						0%
Unmapped Areas					+	**+**
Subtotal	**2%**	**2%**	**0%**	**0%**	**+**	**5%**
Total	**2%**	**13%**	**29%**	**56%**	**0%**	**100%**
Suitable Acres	**6,315**	**35,015**	**75,540**	**146,763**	**75**	**263,708**

Table 3.16-3 (continued)
Scenery Integrity Objectives for Suitable Young Growth by LUD, Distance Zone, and Alternative (percent)

	Scenery Integrity Objectives					
	High	Moderate	Low	Very Low	Other[1]	Total
Alternative 5						
Timber Production						
Foreground				14%		**14%**
Middleground				28%		**28%**
Background				+		**+**
Seldom Seen Areas				18%		**18%**
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**0%**	**61%**	**0%**	**61%**
Modified Landscape						
Foreground				9%		**9%**
Middleground				11%		**11%**
Background				+		**+**
Seldom Seen Areas				3%		**3%**
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**9%**	**24%**	**0%**	**24%**
Scenic Viewshed						
Foreground				3%		**3%**
Middleground				2%		**2%**
Background				+		**+**
Seldom Seen Areas						**0%**
Unmapped Areas				+		**+**
Subtotal	**0%**	**0%**	**0%**	**5%**	**0%**	**5%**
Non-Development LUDs (OG Habitat)						
Foreground	4%					**4%**
Middleground	4%					**4%**
Background	+					**+**
Seldom Seen Areas	2%					**2%**
Unmapped Areas	+					**+**
Subtotal	**10%**	**0%**	**0%**	**0%**	**0%**	**10%**
Total	**10%**	**0%**	**0%**	**90%**	**0%**	**100%**
Suitable Acres	**35,537**	**0**	**0**	**303,436**	**0**	**338,974**

[1] Consists of unmapped areas.
Note: Numbers are based on GIS estimates and are not exact due to rounding.

Table 3.16-4
SIO Changes in Estimated Suitable Young Growth Forest Land for Each Alternative

	Alternatives				
SIO	**1**	**2**	**3**	**4**	**5**
No Changes					
High	5,751			6,315	35,537
Moderate	29,773			35,015	
Low	73,382			75,540	
Very Low	154,970	234,285	168,043	146,763	170,995
Unmapped	30		75	75	38
Subtotal	**263,905**	**234,285**	**168,118**	**263,708**	**206,570**
Changes					
High to Moderate			50,313		
High to Very Low		9,611			8,781
Moderate to Low			47,398		
Moderate to Very Low		41,670			38,255
Low to Very Low		89,146	84,041		85,369
Subtotal	**0**	**140,427**	**181,752**	**0**	**132,405**
Total Suitable	**263,905**	**374,712**	**349,870**	**263,708**	**338,974**

Note: Numbers are based on GIS estimates and are not exact. Columns do not sum correctly due to rounding.

Alternative 1. Alternative 1 would result in the largest acreage of old-growth harvest. An estimated 38,527 acres would be harvested in the first 25 years and 62,851 acres would be harvested in 100 years. The 25-year harvest level is 62 percent more than the next highest old-growth harvest among the alternatives. Harvest of old growth would follow the SIOs under the 2008 Forest Plan so the SIOs would be met.

Young-growth harvest levels are estimated to be 9,669 acres in the first 25 years and 209,882 acres after 100 years. Both of these harvest levels are the lowest among the alternatives. Furthermore, young-growth harvest would follow the SIOs under the 2008 Forest Plan with this alternative. This alternative is ranked comparable to Alternative 4 and these two alternatives are expected to have the lowest visual impacts among the alternatives.

Alternative 2. Under Alternative 2, old-growth harvest levels would be lowest among the alternatives. An estimated 15,027 acres would be harvested in the first 25 years and 32,609 acres would be harvested in 100 years. This amounts to 39 and 52 percent of the Alternative 1 old-growth harvest, respectively. In addition, as in Alternative 1, harvest of old growth would follow the SIOs under the 2008 Forest Plan so the SIOs would be met after harvest.

In contrast, young-growth harvest levels are estimated to be 63,787 acres in the first 25 years and 335,344 acres after 100 years. Both of these harvest levels are the highest among the alternatives. In addition, young-growth harvest would be subject to the lowest SIOs among the alternatives – all SIOs would be Very Low. About 37 percent of the current SIO acreage covering these harvests would need to be reduced to achieve the Very Low SIO. Also, this alternative permits young-growth harvest in most non-development LUDs. Therefore, even though this alternative would result in the lowest old-growth harvest acreage, its visual impacts are likely to be the highest among the alternatives. It is likely that many areas across the Forest will not comply with the SIOs associated with their underlying LUDs, because of young-growth harvest under this alternative.

Alternative 3. Under Alternative 3, old-growth harvest levels would be almost as low as Alternative 2. An estimated 16,599 acres would be harvested in the first 25 years and 35,568 acres would be harvested in 100 years. This amounts to 43 and 57 percent of the Alternative 1 old-growth harvest, respectively. In addition, as in Alternative 1, harvest of old growth would follow the SIOs under the 2008 Forest Plan so the current SIOs would be met after harvest.

As in Alternative 2, young-growth harvest levels would be relatively high, estimated to be 53,734 acres in the first 25 years and 313,216 acres after 100 years. Both of these harvest levels are the second highest among the alternatives. Young-growth harvest would be subject to reductions in SIOs – all SIOs would be reduced one level except in the Timber Production LUD, which includes about 58 percent of the projected harvest. Therefore, the SIOs for about 52 percent of the projected harvest would be reduced by one level. This alternative would be similar to Alternative 5 in terms of overall visual impacts.

Alternative 4. Alternative 4 would have old-growth harvest levels lower than Alternatives 1, higher than Alternatives 2 and 3, and comparable to Alternative 5. An estimated 23,255 acres would be harvested in the first 25 years and 42,597 acres would be harvested in 100 years. This amounts to 60 and 68 percent of the Alternative 1 old-growth harvest, respectively. In addition, as in Alternative 1, harvest of old growth would follow the SIOs under the 2008 Forest Plan so the SIOs would be met after harvest.

Young-growth harvest levels would be second lowest among the alternatives; estimated to be 40,760 acres in the first 25 years and 234,885 acres after 100 years. Young-growth harvest would be subject to the SIOs of the 2008 Forest Plan, so the current SIOs would be met after harvest. As a result, this alternative, along with Alternative 1 would be likely to have the lowest visual impacts among the alternatives.

Alternative 5. Alternative 5 would have very similar old-growth harvest levels as Alternative 4. An estimated 23,813 acres would be harvested in the first 25 years and 42,479 acres would be harvested in 100 years. This amounts to 62 and 68 percent of the Alternative 1 old-growth harvest, respectively. As in Alternative 1, harvest of old growth would follow the SIOs under the 2008 Forest Plan so the SIOs would be met after harvest.

Young-growth harvest levels would also be very similar to Alternative 4; estimated to be 43,316 acres in the first 25 years and 284,144 acres after 100 years. Young-growth harvest would be subject to the SIOs of the current Forest Plan in the Old Growth Habitat LUD, but would be reduced to Very Low in the development LUDs. As a result, the SIOs on about 39 percent of the projected young-growth harvest would be reduced to the Very Low SIO level. This alternative would be similar to Alternative 3 in terms of overall visual impacts

Effects on Selected Viewsheds

To help focus the visual effects on more familiar areas, the alternatives were also analyzed by selected large viewsheds in the Tongass. These 23 viewsheds were selected for their popularity and intensity of public use and travel and are the same as those analyzed in the EIS associated with the 1997 Forest Plan Revision (USDA Forest Service 1997a) and in the EIS associated with the 2008 Forest Plan Amendment (USDA Forest Service 2008b). They technically represent a series of viewsheds along a travelway and take in entire Value Comparison Units (VCUs). Table 3.16-5 compares the percentage of land in each SIO on suitable young-growth acres under the five alternatives for each of the viewsheds. The table also includes the total suitable young-growth acres, the suitable acres potentially old enough to be harvested in the first decade, and the acreage of the viewshed. Acres that are seldom seen or unseen from any viewpoint along the travelway are excluded from each of these categories.

For two reasons, only the SIOs of young-growth acres are compared in this table in order to emphasize the differences among the alternatives. First, the SIOs for suitable young growth change in some alternatives while the SIOs for suitable old growth do not change. Secondly, the acres of young growth to be harvested over time are much higher than the acres of old growth and old-growth harvest over the next 100 years represents a small percentage (9 to 20 percent) of the suitable old growth.

While the previous section of this effects analysis summarized overall effects by alternative, this section is intended to be a viewshed-specific assessment of effects. As such, it takes into account past harvest and represents a cumulative assessment of scenery effects Listed below are some summary points that can be observed from the viewshed-specific assessment:

- Five of the 23 viewsheds (Hyder/Salmon River Highway, Icy Strait, Lynn Canal, Mendenhall Glacier, and Salmon Bay Lake) do not include any suitable young growth of harvestable age during the first decade, in any alternatives.

- Two of the 23 viewsheds (Hyder/Salmon River Highway and Mendenhall Glacier) do not include any suitable young growth in any alternatives.
- In most viewsheds, the highest effects on scenery would be associated with Alternative 2, followed by Alternative 5, followed by Alternative 3, followed by Alternative 1 or 4. This is based on the percentage of the viewshed that consists of suitable young growth and the changes in SIOs.
- Viewsheds with the highest potential for effects during the first decade include Behm Canal (West), Carroll Inlet, Clarence Strait, and Sumner Strait, based on the percentage of the viewshed consisting of suitable young growth that is harvestable in the first decade, the total amount of suitable young growth, and the extent of past harvest.

Behm Canal (West)

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Behm Canal, because it would have the highest acreage with SIO changes (84 percent), the highest acreage in which the SIO would drop by two levels, and the highest level of young-growth harvest. Alternative 5 would have the second highest effects with 75 percent of the suitable acres with SIO changes and 15 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

In some areas, particularly on the Revilla Island side of the west Canal, existing harvest is likely near the level allowed by the adopted SIOs. Additional harvest may need to be deferred in some areas in the coming decade depending on the SIO prescribed by the alternative; however, the number of young-growth acres of harvestable age within the next decade is limited, ranging from 866 to 2,485 acres (Table 3.16-5). A high portion of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning is allowed in Alternatives 3 and 4. Thinning is expected to have little impact because it creates a fine patchwork of openings (less than 2 acres); this fine pattern would not be very noticeable and would become less noticeable after a short period. Clearcutting and patch cutting, with up to 10-acre openings, are allowed in Alternatives 2 and 5, respectively. A 200-foot shoreline buffer would be maintained in Alternative 5, which would help conceal the opening created by clearcuts. Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized high effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Carroll Inlet

As with Behm Canal, Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, it represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Carrol Inlet, because it would have the highest percentage of suitable young growth with SIO changes (73 percent), the highest percentage in which the SIO would drop by two levels (29 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 71 percent of the suitable acres having SIO changes and 25 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Carroll Inlet has experienced relatively heavy past harvest and existing harvest is likely near the level allowed by the adopted SIOs in some areas. Additional harvest may need to be deferred in localized areas in the coming decade depending on the SIO prescribed by the alternative; however, the number of young-growth acres of harvestable age within the next decade is limited, ranging from 109 to 592 acres (Table 3.16-5). A high portion of these acres are scattered along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (low scenery impacts) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would be maintained in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized moderate effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5

Chatham Strait (West side)

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Chatham Strait, because it would have the highest percentage of suitable young growth with SIO changes (59 percent), the highest percentage in which the SIO would drop by two levels (34 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 29 percent of the suitable acres having SIO changes and 2 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Chatham Strait has experienced relatively high past harvest but much of it is in seldom seen areas. Further, the number of young-growth acres of harvestable age within the next decade is very limited, ranging from 0 to 34 acres (Table 3.16-5). Therefore, all of the alternatives are expected to have low effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth permitted to be harvested under Alternatives 2 through 5.

Table 3.16-5
SIO Changes and Suitable Young Growth Acres in Selected Viewsheds [1,2,3]

	Alternative				
Scenic Integrity Objective	**1**	**2**	**3**	**4**	**5**
Behm Canal (West)					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	16%	45%	100%	25%
High to Moderate			11%		2%
High to Very Low		10%			
Moderate to Low			15%		
Moderate to Very Low		15%			13%
Low to Very Low		59%	29%		60%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**866**	**2,485**	**2,281**	**2,200**	**2,060**
Suitable YG Acres in Viewshed	**7,070**	**10,339**	**9,768**	**8,951**	**9,825**
Total Acres in Viewshed (2% of Total Acres are Non-NFS)	**49,276**	**49,276**	**49,276**	**49,276**	**49,276**
Carroll Inlet					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	27%	57%	100%	29%
High to Moderate			3%		
High to Very Low		2%			
Moderate to Low			27%		
Moderate to Very Low		27%			25%
Low to Very Low		44%	14%		46%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**109**	**571**	**592**	**497**	**411**
Suitable YG Acres in Viewshed	**6,016**	**7,913**	**7,782**	**7,194**	**7,253**
Total Acres in Viewshed (6% of Total Acres are Non-NFS)	**52,281**	**52,281**	**52,281**	**52,281**	**52,281**
Chatham Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	41%	64%	100%	71%
High to Moderate			32%		
High to Very Low		31%			
Moderate to Low			2%		
Moderate to Very Low		3%			2%
Low to Very Low		26%	2%		26%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**34**	**33**	**0**	**14**
Suitable YG Acres in Viewshed	**4,456**	**7,466**	**6,887**	**4,686**	**7,198**
Total Acres in Viewshed (4% of Total Acres are Non-NFS)	**107,799**	**107,799**	**107,799**	**107,799**	**107,799**
Cholmondeley Sound					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	56%	83%	100%	77%
High to Moderate			12%		
High to Very Low		13%			
Moderate to Low			3%		
Moderate to Very Low		3%			
Low to Very Low		28%	2%		23%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**112**	**97**	**0**	**75**
Suitable YG Acres in Viewshed	**574**	**944**	**895**	**744**	**789**
Total Acres in Viewshed (21% of Total Acres are Non-NFS)	**36,164**	**36,164**	**36,164**	**36,164**	**36,164**

Table 3.16-5 (continued)
SIO Changes and Suitable Young Growth Acres in Selected Viewsheds [1,2,3]

Scenic Integrity Objective	Alternative 1	2	3	4	5
Clarence Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	27%	43%	100%	34%
High to Moderate			8%		
High to Very Low		7%			
Moderate to Low			31%		
Moderate to Very Low		32%			32%
Low to Very Low		33%	18%		34%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**1,193**	**1,985**	**2,000**	**1,393**	**1,688**
Suitable YG Acres in Viewshed	**16,253**	**20,987**	**20,147**	**17,641**	**19,516**
Total Acres in Viewshed (11% of Total Acres are Non-NFS)	**201,376**	**201,376**	**201,376**	**201,376**	**201,376**
Duncan Canal					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	46%	46%	100%	49%
High to Moderate			13%		
High to Very Low		12%			
Moderate to Low			5%		
Moderate to Very Low		5%			3%
Low to Very Low		36%	36%		48%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**253**	**251**	**0**	**130**
Suitable YG Acres in Viewshed	**2,025**	**3,105**	**3,074**	**1,904**	**2,354**
Total Acres in Viewshed (0% of Total Acres are Non-NFS)	**69,810**	**69,810**	**69,810**	**69,810**	**69,810**
Eastern Passage					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	22%	63%	100%	36%
High to Moderate			15%		
High to Very Low		14%			1%
Moderate to Low			21%		
Moderate to Very Low		23%			19%
Low to Very Low		41%	2%		44%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**1**	**163**	**103**	**0**	**67**
Suitable YG Acres in Viewshed	**2,436**	**3,107**	**2,967**	**2,463**	**2,924**
Total Acres in Viewshed (9% of Total Acres are Non-NFS)	**135,765**	**135,765**	**135,765**	**135,765**	**135,765**
Ernest Sound					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	1%	4%	100%	4%
High to Moderate			18%		
High to Very Low		17%			6%
Moderate to Low			46%		
Moderate to Very Low		46%			40%
Low to Very Low		36%	32%		50%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**15**	**431**	**433**	**0**	**193**
Suitable YG Acres in Viewshed	**147**	**789**	**784**	**351**	**521**
Total Acres in Viewshed (7% of Total Acres are Non-NFS)	**36,387**	**36,387**	**36,387**	**36,387**	**36,387**

Table 3.16-5 (continued)
SIO Changes and Suitable Young Growth Acres in Selected Viewsheds [1,2,3]

Scenic Integrity Objective	Alternative 1	2	3	4	5
Frederick Sound					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	36%	47%	100%	38%
High to Moderate			23%		
High to Very Low		25%			20%
Moderate to Low			19%		
Moderate to Very Low		20%			21%
Low to Very Low		20%	12%		21%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**389**	**1,015**	**895**	**615**	**787**
Suitable YG Acres in Viewshed	**6,065**	**9,049**	**8,234**	**6,491**	**7,797**
Total Acres in Viewshed (2% of Total Acres are Non-NFS)	**163,049**	**163,049**	**163,049**	**163,049**	**163,049**
Hyder/Salmon River Hiqhway					
Percent of Suitable YG Acres with SIO Changes					
No Change					
High to Moderate					
High to Very Low					
Moderate to Low					
Moderate to Very Low					
Low to Very Low					
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**0**	**0**	**0**	**0**
Suitable YG Acres in Viewshed	**0**	**0**	**0**	**0**	**0**
Total Acres in Viewshed (2% of Total Acres are Non-NFS)	**22,603**	**22,603**	**22,603**	**22,603**	**22,603**
Icy Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	46%	91%	100%	47%
High to Moderate			4%		
High to Very Low		4%			3%
Moderate to Low			4%		
Moderate to Very Low		4%			4%
Low to Very Low		46%			46%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**0**	**0**	**0**	**0**
Suitable YG Acres in Viewshed	**2,223**	**2,519**	**2,273**	**2,241**	**2,519**
Total Acres in Viewshed (5% of Total Acres are Non-NFS)	**71,270**	**71,270**	**71,270**	**71,270**	**71,270**
Lynn Canal					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%			100%	
High to Moderate					
High to Very					
Moderate to Low					
Moderate to Very Low		54%	95%		6%
Low to Very Low		46%	5%		94%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**0**	**0**	**0**	**0**
Suitable YG Acres in Viewshed	**31**	**70**	**591**	**18**	**34**
Total Acres in Viewshed (15% of Total Acres are Non-NFS)	**233,520**	**233,520**	**233,520**	**233,520**	**233,520**

Table 3.16-5 (continued)
SIO Changes and Suitable Young Growth Acres in Selected Viewsheds [1]

Scenic Integrity Objective	Alternative 1	2	3	4	5
Mendenhall Glacier					
Percent of Suitable YG Acres with SIO Changes					
No Change					
High to Moderate					
High to Very Low					
Moderate to Low					
Moderate to Very Low					
Low to Very Low					
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**0**	**0**	**0**	**0**
Suitable YG Acres in Viewshed	**0**	**0**	**0**	**0**	**0**
Total Acres in Viewshed (3% of Total Acres are Non-NFS)	**55,266**	**55,266**	**55,266**	**55,266**	**55,266**
Peril Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	29%	51%	100%	55%
High to Moderate			19%		
High to Very Low		24%			7%
Moderate to Low			29%		
Moderate to Very Low		28%			19%
Low to Very Low		19%	1%		19%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**439**	**1,749**	**1,192**	**572**	**1,165**
Suitable YG Acres in Viewshed	**4,473**	**9,642**	**8,436**	**6,236**	**7,988**
Total Acres in Viewshed (7% of Total Acres are Non-NFS)	**190,244**	**190,244**	**190,244**	**190,244**	**190,244**
Salmon Bay Lake					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%		5%	100%	19%
High to Moderate			29%		
High to Very Low		29%			11%
Moderate to Low			45%		
Moderate to Very Low		45%			45%
Low to Very Low		26%	20%		26%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**0**	**0**	**0**	**0**
Suitable YG Acres in Viewshed	**1,083**	**1,371**	**1,349**	**0**	**1,352**
Total Acres in Viewshed (8% of Total Acres are Non-NFS)	**8,422**	**8,422**	**8,422**	**8,422**	**8,422**
Stephens Pass					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%				
High to Moderate					
High to Very					
Moderate to Low			100%		
Moderate to Very Low		100%			100%
Low to Very Low					
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**15**	**113**	**427**	**0**	**67**
Suitable YG Acres in Viewshed	**15**	**113**	**427**	**0**	**67**
Total Acres in Viewshed (25% of Total Acres are Non-NFS)	**259,490**	**259,490**	**259,490**	**259,490**	**259,490**

Table 3.16-5 (continued)
SIO Changes and Suitable Young Growth Acres in Selected Viewsheds [1,2,3]

Scenic Integrity Objective	Alternative 1	2	3	4	5
Stikine Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	7%	8%	100%	15%
High to Moderate			35%		
High to Very Low		35%			25%
Moderate to Low			25%		
Moderate to Very Low		25%			26%
Low to Very Low		33%	33%		35%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**63**	**62**	**0**	**47**
Suitable YG Acres in Viewshed	**2,359**	**4,201**	**4,164**	**2,215**	**3,435**
Total Acres in Viewshed (0% of Total Acres are Non-NFS)	**60,823**	**60,823**	**60,823**	**60,823**	**60,823**
Sumner Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	27%	37%	100%	35%
High to Moderate			13%		
High to Very Low		13%			7%
Moderate to Low			20%		
Moderate to Very Low		20%			14%
Low to Very Low		40%	30%		44%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**1,588**	**2,878**	**2,837**	**2,436**	**2,482**
Suitable YG Acres in Viewshed	**16,333**	**23,605**	**23,041**	**19,300**	**20,246**
Total Acres in Viewshed (5% of Total Acres are Non-NFS)	**151,992**	**151,992**	**151,992**	**151,992**	**151,992**
Sweetwater Lake/Honker Divide					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	7%	11%	100%	35%
High to Moderate			29%		
High to Very Low		29%			1%
Moderate to Low			22%		
Moderate to Very Low		22%			22%
Low to Very Low		41%	38%		41%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**16**	**29**	**26**	**16**	**18**
Suitable YG Acres in Viewshed	**6,681**	**9,734**	**9,370**	**4,630**	**9,636**
Total Acres in Viewshed (9% of Total Acres are Non-NFS)	**107,457**	**107,457**	**107,457**	**107,457**	**107,457**
Tennakee Inlet to Tenakee Springs					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	45%	53%	100%	77%
High to Moderate			30%		
High to Very		29%			1%
Moderate to Low			10%		
Moderate to Very Low		10%			9%
Low to Very Low		16%	8%		14%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**64**	**490**	**334**	**71**	**150**
Suitable YG Acres in Viewshed	**2,104**	**4,035**	**3,476**	**2,233**	**3,638**
Total Acres in Viewshed (1% of Total Acres are Non-NFS)	**152,342**	**152,342**	**152,342**	**152,342**	**152,342**

Table 3.16-5 (continued)
SIO Changes and Suitable Young Growth Acres in Selected Viewsheds [1,2,3]

Scenic Integrity Objective	Alternative 1	2	3	4	5
West Coast Waterway -POW					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	47%	72%	100%	65%
High to Moderate			17%		
High to Very Low		17%			
Moderate to Low			6%		
Moderate to Very Low		7%			7%
Low to Very Low		29%	5%		29%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**404**	**888**	**840**	**725**	**746**
Suitable YG Acres in Viewshed	**9,921**	**14,431**	**13,878**	**10,789**	**12,737**
Total Acres in Viewshed (1% of Total Acres are Non-NFS)	**140,773**	**140,773**	**140,773**	**140,773**	**140,773**
Wrangell Narrows					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	0%	0%	100%	19%
High to Moderate			29%		
High to Very Low		29%			8%
Moderate to Low			48%		
Moderate to Very Low		47%			48%
Low to Very Low		24%	23%		24%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**0**	**49**	**50**	**0**	**43**
Suitable YG Acres in Viewshed	**2,495**	**3,489**	**3,369**	**2,507**	**3,260**
Total Acres in Viewshed (26% of Total Acres are Non-NFS)	**87,498**	**87,498**	**87,498**	**87,498**	**87,498**
Zimovia Strait					
Percent of Suitable YG Acres with SIO Changes					
No Change	100%	17%	35%	100%	37%
High to Moderate			18%		
High to Very Low		19%			1%
Moderate to Low			35%		
Moderate to Very Low		35%			36%
Low to Very Low		29%	11%		26%
Suitable YG Acres of Harvestable Age in 1st Decade in Viewshed	**71**	**233**	**225**	**74**	**193**
Suitable YG Acres in Viewshed	**2,725**	**3,934**	**3,997**	**2,835**	**3,637**
Total Acres in Viewshed (12% of Total Acres are Non-NFS)	**82,826**	**82,826**	**82,826**	**82,826**	**82,826**

Cholmondeley Sound

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Cholmondeley Sound, because it would have the highest percentage of suitable young growth with SIO changes (44 percent), the highest percentage in which the SIO would drop by two levels

(16 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 23 percent of the suitable acres having SIO changes and 0 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Cholmondeley Sound has experienced limited past harvest on National Forest System (NFS) lands, but relatively high past harvest on non-NFS lands. About 21 percent of the Viewshed consists of non-NFS lands. Further, the number of young-growth acres of harvestable age within the next decade is very limited, ranging from 0 to 112 acres (Table 3.16-5). Therefore, all of the alternatives are expected to have low effects during the first few decades; however, additional harvest may need to be deferred in localized areas near non-NFS land, especially where harvest includes openings in the beach fringe, as in Alternatives 2 and 5. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Clarence Strait

Clarence Strait is a large viewshed (over 200,000 acres), extending along both sides of the strait from its northern end south to Gravina Island. The viewshed includes portions of the South Etolin Wilderness Area, which would have an SIO of High under all alternatives; however, a Very High SIO would likely be achieved.

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed and neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Clarence Strait, because it would have the highest percentage of suitable young growth with SIO changes (73 percent), the highest percentage in which the SIO would drop by two levels (39 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 66 percent of the suitable acres having SIO changes and 32 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Clarence Strait has experienced considerable past harvest, but much of it is not readily visible from the Strait, so much of the viewshed appears relatively pristine. However, the number of young-growth acres of harvestable age within the next decade ranges from 1,393 to 2,000 acres (Table 3.16-5). A number of these acres are scattered along the beach fringe, especially along the Prince of Wales and adjacent islands in the northern portion of the Strait in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively. A 200-foot shoreline buffer would be maintained in Alternative 5, which would mitigate the visibility of openings. Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized moderate effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Duncan Canal

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternatives 2 and 3 would have the greatest effects on scenery in Duncan Canal, because they would have the highest percentage of suitable young growth with SIO changes (54 percent), the highest percentage in which the SIO would drop by two levels (17-18 percent), and the highest young-growth harvest. Alternative 5 would have the third highest effects with 51 percent of the suitable acres having SIO changes and 3 percent dropping two levels.

Duncan Canal has experienced considerable past harvest on the east side of the Canal, but much of it is not readily visible from the Strait. However, the number of young-growth acres of harvestable age within the next decade ranges from 0 to 253 acres (Table 3.16-5). A number of these acres are scattered along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200- foot shoreline buffer would mitigate the visibility of openings in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have local effects along the travelway during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Eastern Passage

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Eastern Passage, because it would have the highest percentage of suitable young growth with SIO changes (78 percent), the highest percentage in which the SIO would drop by two levels (36 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 64 percent of the suitable acres having SIO changes and 20 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Eastern Passage has experienced considerable past harvest on the Wrangell Island side, but much of it is not readily visible from the Passage. The number of young-growth acres of harvestable age within the next decade ranges from 1 to 163 acres (Table 3.16-5). A few of these acres are scattered along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate the visibility of openings in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have small local effects along the travelway during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Ernest Sound

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Ernest Sound, because it would have the highest percentage with SIO changes (99 percent), the highest percentage in which the SIO would drop by two levels (63 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 96 percent of the suitable acres having SIO changes and 46 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Ernest Sound has experienced considerable past harvest on Deer Island and along the beach to the north. The number of young-growth acres of harvestable age within the next decade ranges from 15 to 433 acres (Table 3.16-5). Most of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Frederick Sound

Frederick Sound is a large viewshed (163,000 acres) along Kupreanof Island and the mainland. Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Frederick Sound, because it would have the highest percentage of suitable young growth with SIO changes (64 percent), the highest percentage in which the SIO would drop by two levels (45 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 62 percent of the suitable acres having SIO changes and 41 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

Frederick Sound has experienced considerable past harvest in local areas on Kupreanof Island and along the mainland. The number of young-growth acres of harvestable age within the next decade ranges from 389 to 1,015 acres (Table 3.16-5). Some of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized moderate effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Hyder/Salmon River

No suitable young growth acres occur in this viewshed under any of the alternatives. Therefore, no impacts related to young-growth harvest would occur. Limited harvest of old growth could occur, but this would be well within 2008 Forest Plan SIOs.

Icy Strait

Icy Strait would experience limited effects due partly to the Wilderness LUDs on Pleasant and Lemesurier Islands and the LUD II at Point Adolphus. Wilderness areas would have an SIO of High under all alternatives, but would likely achieve an SIO of Very High.

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Icy Strait, because it would have the highest percentage of suitable young growth with SIO changes (54 percent), the highest percentage in which the SIO would drop by two levels (8 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 53 percent of the suitable acres having SIO changes and 7 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

No young-growth acres of harvestable age within the next decade occur in the viewshed (Table 3.16-5). Therefore, little to no effects are expected to occur under any alternatives during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Lynn Canal

Scenic effects within the Lynn Canal Viewshed would be limited and would be very similar under all of the alternatives except Alternative 3 (Table 3.16-5). None of the alternatives would include only suitable young growth within the viewshed that would be of harvestable age within the next decade. Alternative 3 would have 591 acres of suitable young growth of all ages, but none of the other alternatives would have more than 70 acres. None of these latter acres and few of the younger acres occur in the beach fringe. Therefore, effects of Alternative 3 are expected to be higher than under the existing Forest Plan, but relatively minor as well.

Mendenhall Glacier

No effects would occur on the Mendenhall Glacier Viewshed under any of the alternatives. No suitable young growth or old growth occurs within the viewshed.

Peril Strait/Neva-Olga Strait/Sitka

This viewshed is a large one (190,000 acres) that begins near Sitka and wraps around the northern end of Chichagof Island and the southern end of Baranof Island. Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in the Peril Strait complex, because it would have the highest percentage of suitable young growth with SIO changes (71 percent), the highest percentage in which the SIO would drop by two levels (52 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 45 percent of the suitable acres having SIO changes and 26 percent dropping two levels. In this viewshed, Alternative 3 would likely be comparable to Alternative 5 in terms of scenery effects overall, with 49 percent of the suitable acres having SIO changes but none dropping two levels.

The Peril Strait complex has experienced considerable past harvest in local areas, mostly on Chichagof, Kruzof, and adjacent small islands. The number of young-growth acres of harvestable age within the next decade ranges from 439 to 1,749 acres (Table 3.16-5). Many of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have local moderate effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Salmon Bay Lake

In the Salmon Bay Lake Viewshed, Alternative 4 would have very minor to no effects on scenery because it has no suitable young-growth acres. The other four alternatives would have comparable suitable young-growth acres, ranging from 1,083 to 1,371 acres. However, none of the alternatives have any young-growth acres that would be of harvestable age within the next decade. Therefore, none of the alternatives are expected to have more than minor effects in the next few decades. In the long-term, Alternatives 2, 3, and 5 could have higher effects; they all have SIOs changing on the majority of their suitable acres and Alternatives 2 and 5 would have 56 to 74 percent of their suitable acres with SIOs dropping by two levels. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Stephens Passage

Stephens Passage is a large viewshed (259,000 acres) running between Admiralty Island and the mainland. It excludes the majority of the wilderness portion of the Admiralty National Monument.

Alternatives 1 and 4 would have only 15 and 0 acres of suitable young growth in the viewshed (Table 3.16-5), respectively, so the effects resulting from young-growth harvest under these alternatives would be negligible to none. Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

All SIOs would change for suitable young growth in Alternatives 2, 3, and 5 and 100 percent of the SIOs in Alternatives 2 and 5 would drop by two levels. However, these alternatives would include only 113 and 67 acres of suitable young growth, which represents less than 0.1 percent of the large viewshed. Although the majority of these acres are older stands in the beach fringe, they are scattered throughout the viewshed. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternative 3, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, effects would likely occur in the first few decades, but they would be minor and localized, especially under Alternative 5 with the smaller openings and 200-foot buffer and under Alternative 3 with the commercial thinning. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Stikine Strait

This viewshed covers the corridors between Etolin, Zarembo, and Woronkofski Islands. Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Stikine Strait, because it would have the highest percentage of suitable young growth with SIO changes (93 percent), the highest percentage in which the SIO would drop by two levels (60 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 85 percent of the suitable acres having SIO changes and 51 percent dropping two levels. In this viewshed, Alternative 3 would likely be almost comparable with Alternatives 2 and 5 in terms of scenery effects overall, with 92 percent of the suitable acres having SIO changes but none dropping two levels.

The Stikine Strait Viewshed has experienced considerable past harvest in most areas within the viewshed. The number of young-growth acres of harvestable age within the next decade ranges from 47 to 63 acres for Alternatives 2, 3, and 5 (Table 3.16-5). Many of these acres are along the beach fringe. No acres of suitable young growth would be of harvestable age in Alternatives 1 and 4 within the next decade. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternative 3, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Sumner Strait

The Sumner Strait Viewshed is a large viewshed (152,000 acres) along northern Prince of Wales, Kosciusko, Kuiu, Kupreanof, Zarembo, and other islands. It includes portions of the Kuiu Wilderness and the Mt. Calder/Mt. Holbrook and Salmon Bay LUD II areas. These areas would have an SIO of High but would likely achieve an SIO of Very High.

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in Sumner Strait, because it would have the highest percentage of suitable young growth with SIO changes (73 percent), the highest percentage in which the SIO would drop by two levels (33 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 65 percent of the suitable acres having SIO changes and 21 percent dropping two levels. In this viewshed, Alternative 3 would likely be almost comparable with Alternative 5 in terms of scenery effects overall, with 63 percent of the suitable acres having SIO changes but none dropping two levels.

The Sumner Strait Viewshed has experienced extensive past harvest in many areas within the viewshed. The number of young-growth acres of harvestable age within the next decade ranges from 1,588 to 2,878 acres for Alternatives 2, 3, and 5 (Table 3.16-5). Many of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have relatively high effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Sweetwater Lake/Honker Divide

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable young-growth and old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, it represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in the viewshed, because it would have the highest percentage of suitable young growth with SIO changes (93 percent), the highest percentage in which the SIO would drop by two levels (51 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 65 percent of the suitable acres having SIO changes and 23 percent dropping two levels. Alternative 3 would likely be in the middle in terms of scenery effects overall.

The Sweetwater Lake/Honker Divide Viewshed has experienced relatively heavy past harvest in some portions. Additional harvest may need to be deferred in localized areas in the coming decade depending on the SIO prescribed by the alternative; however, the number of young-growth acres of harvestable age within the next decade is very small, ranging from 16 to 29 acres (Table 3.16-5). Therefore, the alternatives would have only minor local effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Tenakee Inlet to Tenakee Springs

This is a large viewshed (152,000 acres), which contains the Trap Bay and Kadashan LUD II areas, which have an SIO of High under all alternatives (Table 3.16-5). The viewshed also contains land designated as Research Natural Area and Wild River LUDs, which also have a High SIO under all alternatives.

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in the viewshed, because it would have the highest percentage of suitable young growth with SIO changes (55 percent), the highest percentage in which the SIO would drop by two levels (39 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 23 percent of the suitable acres having SIO changes and 10 percent dropping two levels. In this viewshed, Alternative 3 would likely be almost comparable with Alternative 5 in terms of scenery effects overall, with 47 percent of the suitable acres having SIO changes but none dropping two levels.

The Tenakee Inlet to Tenakee Springs Viewshed has experienced considerable past harvest in many areas within the viewshed. The number of young-growth acres of harvestable age within the next decade ranges from 64 to 490 acres (Table 3.16-5). Many of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have relatively high localized effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

West Coast Waterway/Prince of Wales

This large viewshed (141,000 acres) contains the Mt. Calder/Mt. Holbrook LUD II area, which would have an SIO of High under all alternatives. Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in the viewshed, because it would have the highest percentage of suitable young growth with SIO changes (53 percent), the highest percentage in which the SIO would drop by two levels (24 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 35 percent of the suitable acres having SIO changes and 7 percent dropping two levels. In this viewshed. Alternative 3 would likely be in the middle in terms of scenery effects overall.

The West Coast Waterway/Prince of Wales Viewshed has experienced relatively heavy past harvest in many areas within the viewshed. The number of young-growth acres of harvestable age within the next decade ranges from 404 to 888 acres (Table 3.16-5). Many of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have relatively high localized effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Wrangell Narrows

Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in the viewshed, because it would have the highest percentage of suitable young growth with SIO changes (100 percent), the highest percentage in which the SIO would drop by two levels (76 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 81 percent of the suitable acres having SIO changes and 56 percent dropping two levels. In this viewshed, Alternative 3 would likely be almost comparable with Alternative 5 in terms of scenery effects overall, with 100 percent of the suitable acres having SIO changes but none dropping two levels.

The Wrangell Narrows Viewshed has experienced relatively high past harvest in many areas within the Viewshed and includes 26 percent non-NFS lands. However, the number of young-growth acres of harvestable age within the next decade ranges from 0 to 50 acres (Table 3.16-5). Most of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting

, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 16 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Zimovia Strait

The Zimovia Strait Viewshed runs between Etolin and Wrangell Islands. Alternatives 1 and 4 would have the fewest acres of suitable young growth in the viewshed. In addition, neither of these two alternatives would change SIOs relative to the 2008 Forest Plan (Table 3.16-5). Alternative 4 would have fewer suitable old-growth acres compared with Alternative 1, so it would likely have the lowest visual impact among all alternatives. Even though Alternative 1 would permit the highest level of old-growth harvest, this harvest level represents only 20 percent of the level allowed by the 2008 Forest Plan.

SIOs would change for young growth in Alternatives 2, 3, and 5. Alternative 2 would have the greatest effects on scenery in the viewshed, because it would have the highest percentage of suitable young growth with SIO changes (83 percent), the highest percentage in which the SIO would drop by two levels (54 percent), and the highest young-growth harvest. Alternative 5 would have the second highest effects with 63 percent of the suitable acres having SIO changes and 37 percent dropping two levels. In this viewshed, Alternative 3 would likely be almost comparable with Alternative 5 in terms of scenery effects overall, with 65 percent of the suitable acres having SIO changes but none dropping two levels.

The Zimovia Strait Viewshed has experienced relatively high past harvest in some areas within the viewshed. The number of young-growth acres of harvestable age within the next decade ranges from 71 to 233 acres (Table 3.16-5). Most of these acres are along the beach fringe in all alternatives except Alternative 1. Only commercial thinning (generally low impact to scenery) is allowed in the beach fringe in Alternatives 3 and 4, but clearcutting and patch cutting, with up to 10 acre openings, are allowed in Alternatives 2 and 5, respectively (in addition, a 200-foot shoreline buffer would mitigate opening size in Alternative 5). Therefore, Alternative 2 in particular, and Alternative 5 to a lesser degree, could have localized effects during the first few decades. Overall harvest of old growth is expected to be much lower than under the existing Forest Plan with only 7 to 19 percent of the suitable old growth to be harvested under Alternatives 2 through 5.

Renewable Energy Development

The Forest Plan identifies three types of area related to energy development on the Tongass based on the existing LUDs: windows, which represent areas potentially available for energy development; avoidance areas; and exclusion areas. Avoidance areas are those LUDs where development of energy projects are inconsistent with land use management objectives and desired future conditions. Alternative locations in other LUDs must be exhausted before facilities are considered in avoidance areas. LUDs classified as windows and avoidance areas make up 38 percent and 62 percent of the Forest, respectively. There are no exclusion areas on the Tongass due to special authorities provided in the Alaska National Interest Lands Conservation Act, Title XI. These classifications and the standards and guidelines in the 2008 Forest Plan would continue to apply under Alternative 1, which permits energy developments to "dominate the seen area" but meet a Low SIO. Under Alternatives 2 through 5, renewable energy sites would be managed under the new Renewable Energy Plan Components identified in Chapter 5 of the Forest Plan amendment. Although the new components are likely to result in more energy project development over the long term, the scenery requirements for Alternatives 3 through 5 are similar to those in the existing Forest Plan. Under Alternative 2, scenery standards would be relaxed to Very Low for renewable energy development so effects on scenery would likely be greater. The new components are discussed in more detail in the *Renewable Energy* section of this EIS.

The Forest Service has identified 11 proposed renewable energy projects in Southeast Alaska that are currently active (Table 3.12b-3). Nine of the projects are hydroelectric projects, one is a wave project, and one is a geothermal project. Five of these proposed projects would be located in important recreation places. The proposed renewable energy projects are further discussed in in the *Renewable Energy* section of this EIS.

Effects from the proposed projects on scenery would heavily depend on site-specific plans. In general, project activities that would impact scenery could include new access road construction; forest clearing and ground disturbance; dam, powerhouse, and penstock construction; and transmission line construction. There is a wide range of types and sizes for these disturbances and facilities and the eventual impacts to scenery will depend on the location and design features. All potential impacts to scenery resources would be addressed during the permitting and licensing of the projects, and would include National Environmental Policy Act assessment.

The impacts to scenery associated with Alternatives 2 through 5 are expected to be similar, as these alternatives would follow the same renewable energy-related plan components except that Alternative 2 would reduce the SIO to Very Low, whereas Alternatives 3, 4, and 5 would have an SIO of Low. Impacts associated with Alternative 1 are expected to be slightly lower because of the development of fewer projects over the long term; however, the Alternative 1 standards and guidelines for scenery related to renewable energy projects are similar to the plan components of Alternatives 2 through 5. Although on a site-specific basis differences would occur, on a Forest-wide basis the scenery effects associated with all of the alternatives would show little differences because of the small number of projects likely to be developed.

Cumulative Effects

This section considers the incremental effects of the alternatives when added to other past, present, and reasonably foreseeable actions. The effects of past and present actions on scenery are included in the Affected Environment portion of this section, which discusses the level of scenic quality on the Tongass. Past actions include past timber harvest and road building, as well as the development of facilities and mines, which have resulted in reduced ESIs in many areas. Present actions include the impacts of current management policies on scenery; these have resulted in modifications to SIOs.

Reasonably foreseeable actions on NFS lands include the projected levels of future timber harvest and renewable energy development that are used in the preceding analysis to assess the potential impacts of the alternatives on the scenic quality. Other reasonably foreseeable actions include regional transportation development as defined by the State Transportation Plan and the Forest Service Alaska Region Long Range Transportation Plan, as well as road paving on Prince of Wales Island, the closing of roads, and construction of the Angoon Airport. In addition, the expansion of cities like Juneau and Ketchikan, recreational cabin development, land auctions by the State, and land exchanges could include additional road construction, timber harvest, and facility construction.

It is not possible at this time to predict exactly which roads, energy projects, or other projects would be developed or their likely impact on future scenic integrity. Human settlement expansion is expected to occur around the region’s larger cities, such as Juneau and Sitka, with residential expansion also expected as a result of state land auctions. These developments would likely result in increased impacts on scenery. Mining activities are expected to expand at existing sites, including Greens Creek on Admiralty Island and Kensington Gold Mine north of Juneau, as well as possible future sites, including the Bokan Mountain and Niblack sites on the southern end of Prince of Wales Island. Mining projects are for the most part expected to have a negative local effect on scenery. Overall, the cumulative effects of past, present, and future actions on scenery are expected to be negative, but are not expected to be substantially different than the effects associated with the actions addressed under direct and indirect effects.

Subsistence

Affected Environment

Subsistence hunting, fishing, trapping, and gathering activities are a major part of life for many Southeast Alaska residents. Some individuals participate in subsistence activities to supplement personal income and provide needed food. Nearly all rural Alaska communities depend on subsistence resources to meet some portion of their nutritional needs (Fall 2014). Others pursue subsistence activities to perpetuate cultural customs and traditions. Still others participate in subsistence activities for reasons unconnected with income or tradition. For all these individuals, subsistence is a lifestyle reflecting deeply held attitudes, values, and beliefs.

Within the context of Southeast Alaska's seasonal and cyclical resource-based employment, subsistence harvest of fish and wildlife resources takes on special importance. The use of these resources may play a major role in supplementing cash incomes during periods when the opportunity to participate in the wage economy is either marginal or nonexistent. Because of high prices of commercial products provided through the retail sector of the cash economy, especially in remote communities, the economic role of locally available fish and game takes on added importance.

Native and non-Native communities both have high subsistence participation rates and rely heavily on wild foods, with approximately 86 percent of rural Alaska households using wild game and 95 percent using fish (Fall 2014). The opportunity to participate in subsistence activities reinforces a variety of cultural and related values in both Native and non-Native communities. For example, the distribution of harvested fish and wildlife contributes to the cohesion of kinship groups and community stability through the sharing of resources. Subsistence resources provide the foundation for Native culture, forming the basis for different clans and potlatch ceremonies, as well as reinforcing basic values of respect for the earth and its resources. Participating in subsistence activities contributes to the self-reliance, independence, and ability to provide for oneself; values that social surveys indicate are important reasons why many non-Native people move to or remain in Southeast Alaska (USDA Forest Service 1997a).

The Legal Context for Subsistence Use

While there are a variety of cultural, popular, and sociological definitions and interpretations of subsistence, Congress addressed this subject in Title VIII of the 1980 Alaska National Interest Lands Conservation Act (ANILCA). Section 803 of ANILCA defines subsistence use as:

> "the customary and traditional uses by rural Alaska residents of wild renewable resources for direct, personal, or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

ANILCA provides for "the continuation of the opportunity for subsistence uses by rural residents of Alaska, including both Natives and non-Natives, on the public lands." It also states, in part, that "subsistence uses of fish and wildlife and other renewable resources shall be the priority consumptive uses of all such resources on the public lands of Alaska when it is necessary to restrict taking."

The provisions in ANILCA established a harvest priority for rural residents in an attempt to protect subsistence resource harvest. Under ANILCA, in times of resource scarcity or when demand exceeds biologically sound harvest levels, subsistence harvests have priority over other consumptive use of resources. In practice, this meant that commercial, sport, or other harvests were to be curtailed by state or federal fish and wildlife management authorities before subsistence harvests were limited. The Alaska legislature subsequently passed a regulation to comply with ANILCA, but in 1989, the Alaska Supreme Court ruled in McDowell v. State of Alaska that a harvest priority for rural residents conflicted with the state constitution, which guarantees all Alaskans equal access to the state's natural resources. This ruling took the state out of compliance with ANILCA and the federal government has managed subsistence resources on federal lands in Alaska since 1990. As a result, federal subsistence harvests of fish and wildlife on the Tongass National Forest are presently managed by the Forest Service (Schroeder and Mazza 2005).

ANILCA requires the analysis of the potential effects on subsistence uses of all actions on federal lands in Alaska. This analysis typically focuses on those food-related resources most likely to be affected by habitat degradation associated with land management activities. Three factors related to subsistence uses are specifically identified by ANILCA: 1) resource distribution and abundance, 2) access to resources, and 3) competition for the use of resources. These factors are discussed in general terms in the following paragraphs.

Abundance and Distribution

Southeast Alaska subsistence resources include terrestrial wildlife (including deer, moose, mountain goat, black and brown bear, furbearers, and small game), waterfowl (including ducks, geese, and seabirds), marine mammals (harbor seal), salmon, other finfish, marine invertebrates, plants, and firewood. The abundance and distribution of these resources on the Tongass is described in the 1997 Land Management Plan Revision Final Environmental Impact Statement (FEIS), as well as in other sections of this EIS.

Access

Road building, a byproduct of timber harvesting and, to a much lesser extent, mining, is an important agent of change in Southeast Alaska. New road networks often provide greater access to previously unconnected areas and can affect subsistence both positively and negatively by providing access, dispersing hunting and fishing pressure, and creating the potential for increased competition. On Prince of Wales Island, for example, areas that have become connected by road are now more easily reached by local residents and other nearby communities. Road systems tend to bring more people into an area and also give subsistence hunters access to previously remote regions and provide a greater opportunity for subsistence harvest.

Southeast Alaska is comprised of isolated islands unconnected by road systems; however, with the transportation means available (floatplanes, ferry systems, automobiles, and boats), Southeast Alaska residents are very mobile in their subsistence resource use activities. Wrangell, the fifth largest community in Southeast Alaska, for example, has documented their subsistence gathering from the southern tip of Prince of Wales Island to Yakutat, covering most of the islands in between (Kruse and Muth 1990).

Competition

The Tongass National Forest, with nearly 17 million acres of largely undeveloped land, includes extensive subsistence resources. These resources are not, however, distributed or used evenly across the Forest. Where the resources are confined to island groups or river systems and access is costly or nonexistent, use of the resources is low. Where the resource is abundant, and a community is present but access by other communities is costly, the resource tends to be used primarily by the community that resides in the area. Where resources are abundant and access is readily available to local and other communities of Southeast Alaska, competition for resources may exist.

Increased competition may result when less expensive access to the area or within the area is provided. Such is the case when road systems are established to local communities. When areas historically not used for subsistence purposes are made available because of easier, more cost-effective access, the new area then tends to be used. When communities with road access to abundant resources are connected to a ferry system or to commercial air services, competition for the resources may be generated from outside communities with lower abundance of the same resource.

Examples of the effect of ease of access are readily available in Southeast Alaska. Chichagof Island, Prince of Wales Island, and the Yakutat Forelands at one time were isolated portions of the Tongass with limited use from communities in the vicinity. Today, road construction, primarily a result of timber harvest activities, has created relatively large areas that are easily accessed from local communities. Access provided by ferry systems and small commuter planes to Chichagof and Prince of Wales Islands allows relatively easy access from off-island communities. Access to the Yakutat Forelands has been made easier because of commercial jet service and ferry service to the community of Yakutat.

Subsistence Users

Under ANILCA, only rural Alaska residents qualify for subsistence hunting and fishing on federal lands. Alaska residents living in urban areas can harvest under sport, personal use, or commercial regulations, but not under subsistence regulations. Following the Alaska Supreme Court's 1989 ruling in *McDowell v. State of Alaska*, all Alaska residents qualify as subsistence users on state lands with federal lands continuing to be managed under ANILCA.

In 2013, Southeast Alaska had an estimated population of 74,382, with the majority (about 92 percent) living in established communities (either incorporated cities or Census Designated Places [CDP]) (Alaska Department of Labor [DOL] 2014a). Almost two-thirds (63 percent) of the area's population lived in the city and borough of Juneau (44 percent) or Ketchikan Gateway Borough (19 percent), the only two communities considered as urban areas for subsistence purposes. An additional 23 percent of the area's population resided in the communities of Sitka, Petersburg, Wrangell, Haines, and Craig. The remaining 13 percent of the population lived in communities ranging in size from Excursion Inlet with 8 people to Metlakatla with 1,471 people (Alaska DOL 2014a).

In addition to permanent communities, there are a small number of logging camps across the Tongass National Forest that, in the past, were large enough and existed long enough to have had an effect on local uses of fish and wildlife. Currently, the remaining camps have few residents and do not have much effect on competition for resources.

A relatively small number of Southeast Alaska residents live at remote isolated locations. These include people living at home sites throughout Southeast Alaska, at summer fishing sites along the outer coast, tree thinners camped near areas where they have Forest Service contracts, trappers, and people living on floathouses and fishing boats. This diverse group is typically transient, generally has very low cash income, and is closely tied to non-commercial harvest of fish, game, and other renewable natural resources.

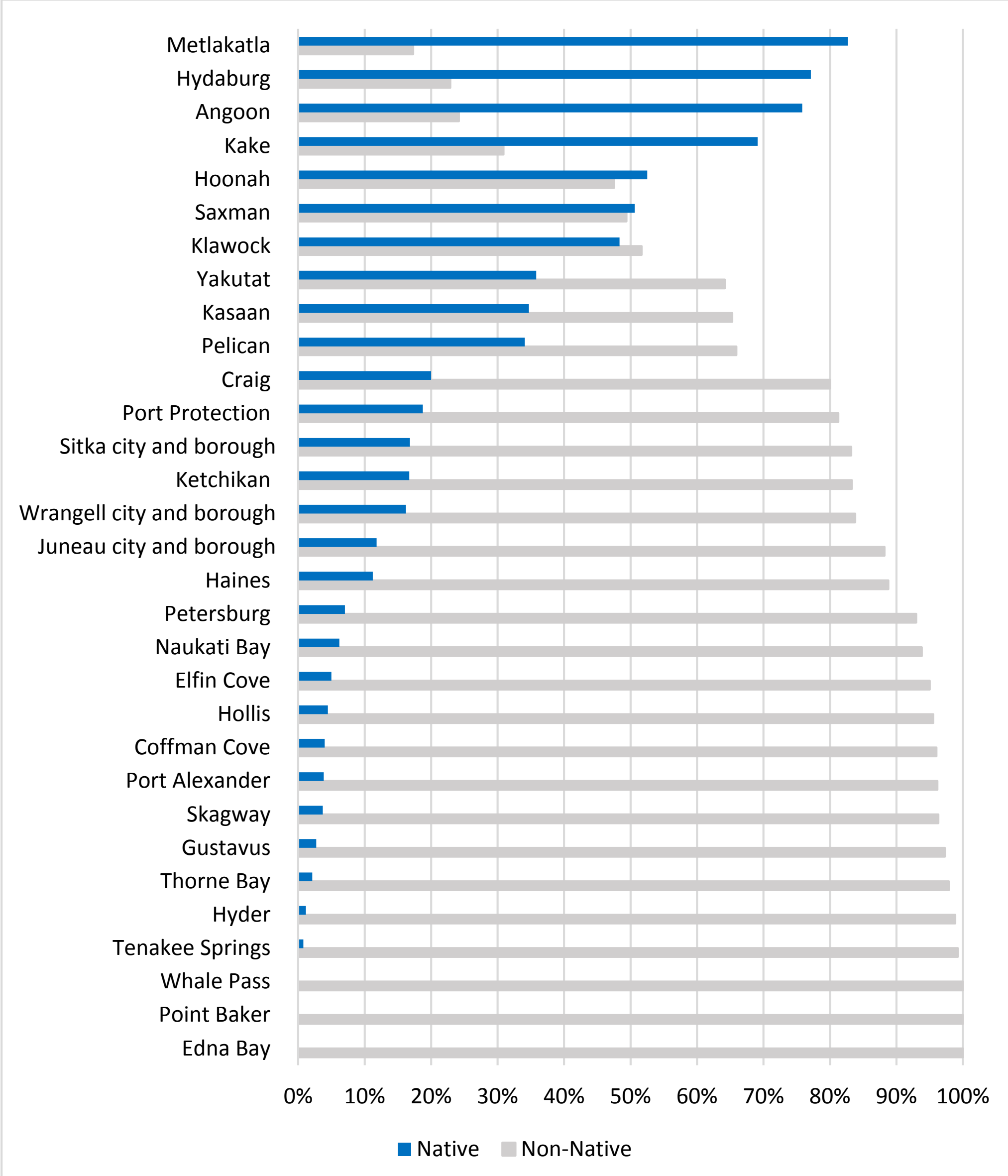
Alaska Natives made up about 12 percent of the region's population in 2010 and comprised about 24 percent of the total population of Southeast Alaska's 30 rural communities in 2010 (Alaska DOL 2014b, 2014c) (Figure 3.17-1). These rural communities include: places that are predominately Native, such as Metlakatla, Hydaburg, and Angoon, where Alaska Natives made up 83 percent, 77 percent, and 76 percent of the population, respectively; other communities that are predominately non-Native, like Edna Bay, Point Baker, and Whale Pass; and places with more mixed ethnicity where Alaska Natives range from about one-third to two-thirds of the population (Figure 3.17-1).

The Bureau of Indian Affairs identifies 17 localized Indian tribes in the region, including the Metlakatla of the Annette Island Reserve. At the time of contact, tribes occupied seasonal camps and temporary villages throughout traditional territories. In the late 1800s, the individual tribes of the region coalesced at what had been their winter villages. The area's extant tribes live within their earlier territories and use a similar set of subsistence resources and in this way maintain long standing ties to place. For Native people, this tie to place and the harvest and use of traditional foods are key elements in fostering Native cultural identity (Alaska Native Heritage Center 2014).

Economy

Subsistence use of fish and wildlife has been and continues to be an important component of the economies of Southeast Alaska communities. In Native communities, harvest and use of wild resources supported the subsistence-based economy that predated the introduction of cash income. In the modern era, beginning in the late-1700s, the economies of Native communities have undergone a progressive transformation, incorporating cash income into the subsistence-based system. Southeast Alaska communities that were settled primarily by non-Native immigrants have also depended on a mix of subsistence use of wild resources and cash income.

Figure 3.17-1
Native/Non-Native Components of Southeast Communities, 2010



Source: Alaska DOL (2014c).

Cash income in most Southeast Alaska rural communities is limited and intermittent, and frequently supports the purchase of fuel and equipment that are part of subsistence harvest technology. Subsistence harvests have been found to fill essential food needs in most rural communities in the region. These harvests are also customarily shared among community residents and between members of different communities. Some subsistence products are traded and bartered within the region. Subsistence harvests are not geared toward market sale or commercial profit. A mixed subsistence-market economy in which subsistence harvests and cash income are complementary characterizes the economies of most of the region's rural communities (Wolfe 2004).

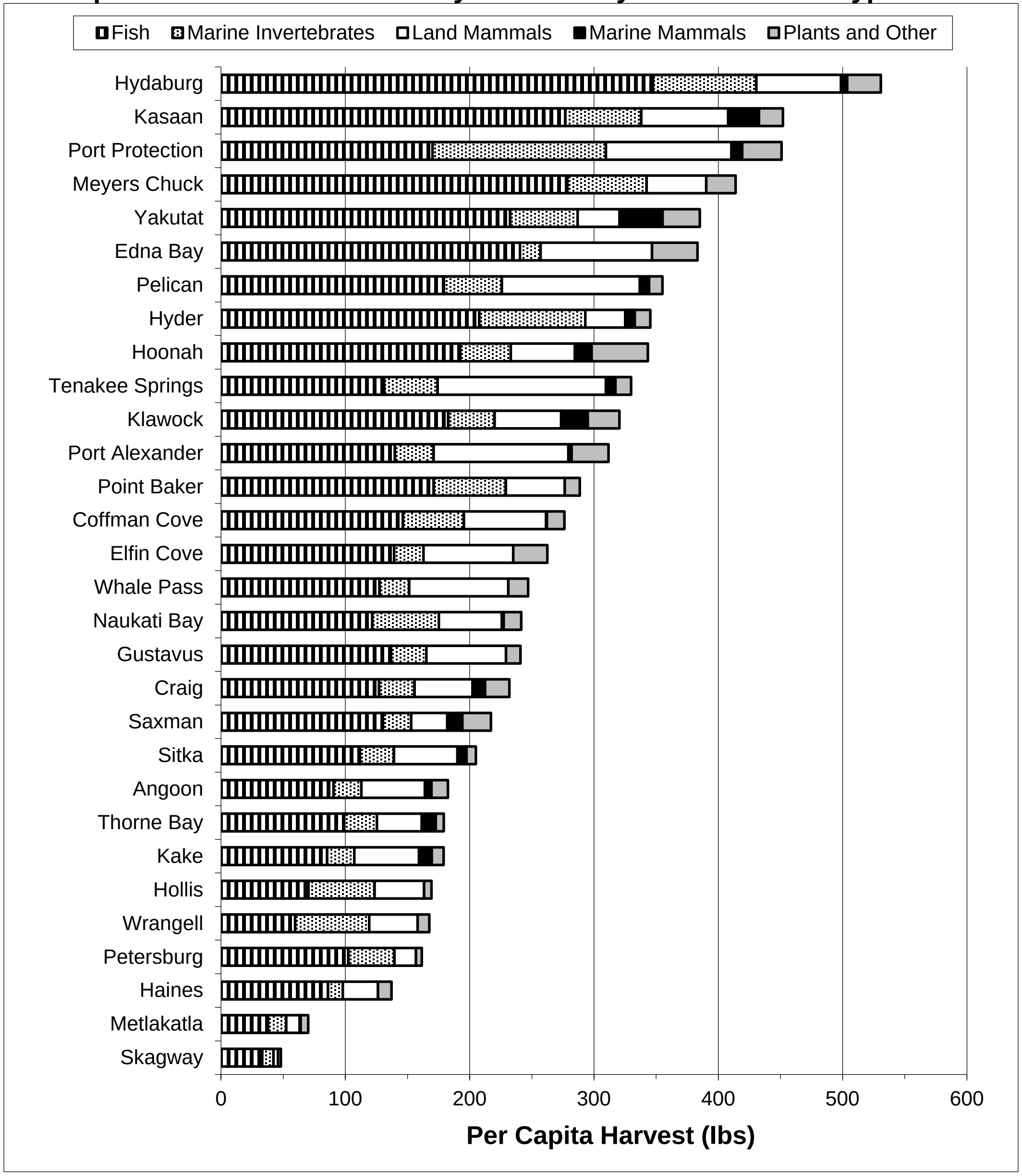
Subsistence research conducted in Southeast Alaska over the past two decades has included detailed community studies, use area mapping, household surveys, and studies of specific subsistence harvests. During the 1980s, the Forest Service supported research that examined the impacts of timber harvests in the Tongass National Forest on subsistence resources in the area. The Tongass Resource Use Cooperative Survey (TRUCS) was completed in 1988. Data from TRUCS are summarized in the 1997 Tongass Land Management Plan Revision FEIS.

From 1987 to 2001, interviews were conducted with 1,064 households in 24 Southeast Alaska communities as part of the Tongass Land and Resource Management Plan (Forest Plan) subsistence administrative studies. This fieldwork was conducted cooperatively with the Forest Service, Alaska Department of Fish and Game (ADF&G), and the area's tribes and communities all participating. Summary data from this and past community harvest assessments were compiled from the ADF&G Subsistence Community Profile Database (www.state.ak.us) and harvest levels are presented by community and species in Figure 3.17-2. The data presented in Figure 3.17-2 are the most recent available in the ADF&G database. The year these data were collected does, however, vary by community and the data summarized in Figure 3.17-2 should be considered a general overview of harvest patterns rather than an exact representation of current harvest activities.

The findings of this research are summarized in an unpublished paper by Schroeder and Mazza (2005) who identify a number of key subsistence characteristics that are evident in these data and generally consistent with the following past findings:

- Wild foods account for a large share of the diet for residents of the studied communities, ranging from 48 pounds per capita for Skagway in 1987 to over 500 pounds per capita for Hydaburg in 2012 (see Figure 3.17-2). The average American diet includes about 225 pounds of meat, fish, and poultry on a per capita basis. In more than half of the identified communities, wild foods came close to, or exceeded, this national average (Figure 3.17-2). Although residents of subsistence communities purchase food, most could meet their entire protein need from wild sources.
- Marine resources, including fish, mammals, and plants, comprise the majority of subsistence harvests in all communities when measured by food weight. Marine resources account for more than half of total per capita harvest in all Southeast Alaska communities, ranging from 55 percent in Tenakee Springs to 88 percent in Skagway (Figure 3.17-2). As a result, management activities that restrict access for subsistence harvest of land mammals have had a relatively small effect on overall subsistence harvest by weight.
- More recent subsistence harvest levels in the main Native communities and the larger non-Native communities appear very similar to harvest levels estimated in the late 1980s or before. Harvest levels identified in the recent assessments conducted in Angoon, Hoonah, Hydaburg, Kake, Petersburg, Wrangell, and Yakutat, for example, are very similar to those identified in earlier studies. In a few communities, such as Coffman Cove, Kasaan, Klawock, and Port Protection, there are larger differences in harvest levels over time. However, these differences seem to be more influenced by special events or small community sizes than by patterned changes in subsistence harvests.

Figure 3.17-2
Per Capita Subsistence Harvest by Community and Resource Type



Note:
The year these data were collected varies by community, as follows:
1987: Elfin Cove, Gustavus, Hyder, Metlakatla, Meyers Chuck, Pelican, Port Alexander, Skagway, and Tenakee Springs
1996: Kake, Point Baker, Port Protection, and Sitka
1997: Craig, Hydaburg, and Klawock
1998: Coffman Cove, Edna Bay, Hollis, Kasaan, Naukati Bay, and Thorne Bay
1999: Saxman
2000: Petersburg, Wrangell, and Yakutat
2012: Angoon, Haines, Hoonah, Hydaburg, and Whale Pass
Source: ADF&G (2006, 2014)

- Subsistence harvest levels vary considerably from community to community. Recent research and other data suggest that intercommunity variability may not be fully explained by ethnicity, income, community size, or access to resources. Other factors, such as community demographic composition, cultural traditions and orientations, and community history, may have a larger influence on harvest levels than more easily analyzed standard socioeconomic variables.
- Subsistence harvesters use a wide variety of species, but use tends to be concentrated on a relatively small number of species. In Yakutat, for example, individual subsistence harvesters use as many as 65 of the 150 different species that are harvested in the community, but 84 percent of overall community harvest (in food weight) involves just 10 species. That said, the contribution of a particular species to the total subsistence harvest generally appears to vary from year to year, although the overall total harvest in food weight may remain nearly constant.
- A small number of high harvesting households account for a disproportionate share of the total community harvest and tend to harvest more fish and wildlife than their family members can consume. The surplus is distributed to other subsistence users through a kinship network and through barter and trade. These networks are also used to distribute specialty subsistence products such as herring roe and hooligan oil, which are produced in large quantities in only a few communities. In Yakutat, for example, just 25 percent of subsistence households account for about 75 percent of total community subsistence harvest (in terms of food weight), with the lowest harvesting 50 percent of households taking just 8 percent of the total community harvest.

Subsistence Use Areas

Historically, subsistence use occurred where access to the resources cost less in energy than the resources gathered. Many of the gathering activities occurred in easily accessible areas. These activities occurred close to settlements where they could be accessed by foot or boat. Over time, as new technology developed, ease of access meant a movement outward into new resource use areas. The advent of motorized boats and the development of road systems associated with timber harvest activities have had a substantial influence on subsistence gathering activity in Southeast Alaska. Today, all communities use motorized boats and many are tied to nearby lands by road systems.

The distribution of subsistence harvest activity is described in further detail in the 1997 Tongass Land Management Plan Revision FEIS, with traditional household deer hunting areas mapped in Appendix H. These areas were identified based on the 1987 TRUCS (Kruse and Muth 1990). The traditional household deer hunting areas mapped in Appendix H show that the road systems are extensively used. This is particularly true on Prince of Wales Island. These maps also show that subsistence use tends to be concentrated in close proximity to individual communities and along beaches.

Each of the communities in Southeast Alaska has a distinct home range where concentrated use occurs, with a wide range of use typically occurring on a less concentrated scale outside the normal home range. More than half (54 percent) of all households surveyed in rural Southeast Alaska in 1987 traveled a minimum of 11 miles by boat to reach the one reliable deer hunting area that they chose to describe in TRUCS (Kruse and Muth 1990). An additional 18 percent of all households also used boats to reach their reliable deer hunting area, but traveled shorter distances (10 miles or less). Only 15 percent of all households used cars or trucks to travel to their most reliable areas. Thirteen percent used some other form of transportation, such as airplanes, walking, all-terrain vehicles, and the Alaska Marine Highway System (Kruse and Muth 1990).

While the majority of use occurs within about a 15-mile radius of rural communities, nearly all of the forested lands of the Tongass are used to some degree for subsistence deer hunting (USDA Forest Service 1997a). Appendix H in the 1997 Tongass Land Management Plan Revision FEIS also displays, by community, the individual Wildlife Analysis Areas (WAAs) where approximately 75 percent of the average annual deer harvest occurred.

Kruse and Muth (1990) found that nearly one-half of the households harvesting deer mentioned the existence of clearcuts of various ages occurring in presently reliable areas (44 percent), most-often-used areas (48 percent), and areas no longer used (55 percent). They also reported that old-growth forests were mentioned as most reliable by 90 percent of households harvesting deer, were most-often-used areas by 91 percent of households, and were areas no longer used by 90 percent of those households harvesting deer.

Many of the fish and wildlife resource values of Southeast Alaska watersheds, based on the Value Comparison Unit (VCU) classification of the Tongass, are summarized in the 1998 Tongass Fish and Wildlife Resource Assessment (ADF&G 1998). This report shows the relative value of areas for black bear, brown bear, deer, sport fishing, salmon production, and subsistence use. This resource assessment also included a ranking of the VCUs that have the highest community use values.

Environmental Consequences

The analysis of the likely effects of the EIS alternatives on subsistence resources and uses is presented in two parts. Effects on subsistence resources and uses important to each rural community are discussed individually by community in the *Subregional Overview and Communities* section. This section provides a Forest-wide evaluation that assesses the three factors related to subsistence uses identified by ANILCA: abundance and distribution, access, and competition. This general analysis relies on the community discussions and also on the Forest-wide effects analyses from the related resource sections (primarily *Fish* and *Wildlife*) where abundance and distribution are of concern.

Section 810 of ANILCA requires the Forest Service, in determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of NFS lands in Alaska, to evaluate the potential effects on subsistence uses and needs, followed by specific notice and determination procedures should there be a significant possibility of a significant restriction of subsistence uses. The Alaska Land Use Council's definition of "significantly restrict subsistence use" is one guideline used in the evaluation:

> "A proposed action shall be considered to significantly restrict subsistence uses, if after any modification warranted by consideration of alternatives, conditions, or stipulations, it can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources."

Considerations of abundance and distribution, access, and competition (by non-rural residents) are mentioned.

It should be noted that the term "significant" as used in this context does not have the same definition as used in the implementing regulations for the National

Environmental Policy Act (NEPA). See 40 Code of Federal Regulations (CFR) Section 1508.27 for definitions of "significant" in a NEPA context.

The U.S. District Court Decision of Record in *Kunaknana v. Watt* provided additional clarification. In part it states:

> "restrictions for subsistence uses would be significant if there were large reductions in abundance or major redistribution of these resources, substantial interference with harvestable access to active subsistence-use sites, or major increases in non-rural resident hunting."

Direct and Indirect Effects

Abundance and Distribution

Based on the 1987 survey information compiled as part of TRUCS, 61 percent of subsistence resources (by weight) are fish or marine invertebrates, 21 percent are deer, 4 percent are other land mammals, and another 3 percent are marine mammals. More recent community data compiled by ADF&G (2014) indicate that fish and marine invertebrates still comprise the majority of subsistence harvest per capita (in pounds). As shown in Figure 3.17-2, the share of total subsistence harvest that consists of fish and marine invertebrates ranges from 55 percent in Tenakee Springs to 88 percent in Skagway.

The subsistence analysis conducted for the 1997 Forest Plan Revision FEIS found that the primary subsistence resource likely to be significantly affected by the alternatives was Sitka black-tailed deer. Some effects to fish habitat may also result from land management activities, but the magnitude of the effects could not be calculated. Alternatives with more roads and timber production within riparian management areas and/or beach and estuary fringe would generally have the highest potential for adverse effects to fish and wildlife resources in the Tongass.

As a result of their association with old-growth forest habitat, which is the main terrestrial habitat type affected by the alternatives, deer are considered the "indicator" for potential subsistence resource consequences concerning the abundance and distribution of the resources. The community-based subsistence analysis (see the *Subregional Overview and Communities* section) focuses largely on deer, which is, in most cases, by far the largest terrestrial component of subsistence food resources.

Both the 1997 Forest Plan Revision FEIS and 2008 Forest Plan Amendment FEIS concluded that deer habitat capabilities in several portions of the Tongass may not be adequate to sustain the current levels of deer harvests, and that implementation of any of the 1997 and 2008 alternatives could, therefore, be accompanied by a significant possibility of a significant restriction on the abundance and/or distribution of subsistence uses of deer. This possibility was largely due to the continuation of reduced habitat capabilities resulting from past habitat alterations, which is why it applied to all alternatives.

The possibility of a significant restriction, resulting from a change in abundance or distribution, would be less than the possibility under the 1997 Forest Plan or 2008 Forest Plan for all of the alternatives considered in this EIS because of the lower anticipated rates of timber harvest. Further, although the harvest of old growth is likely to have negative effects on deer habitat, the vast majority of the harvest proposed under the alternatives in this EIS represents the harvest of young-growth stands that are currently in the stem exclusion stage of plant succession. Harvesting these stands would convert them to the stand initiation stage or open them up to provide more light to forage, which is generally of much higher value to deer. As a result, the harvest under the alternatives in this EIS would have both adverse and beneficial effects on deer habitat, depending on the stand (see *Wildlife* section).

Management of energy projects under the new Renewable Energy Plan Components identified in Chapter 5 of the amended Forest Plan under Alternatives 2 through 5 would not affect this conclusion. This would also be the case under Alternative 1 where the current Transportation and Utility System classifications and the standards and guidelines in the current Forest Plan would continue to apply to energy projects.

In the short term, the risk of a significant restriction would be about the same under any of the alternatives because the effects of past harvest would override the effects of new harvest during the next 10 years. In the long term, those alternatives that limit the areas available for future harvesting of old growth the most would result in the largest reduction in risk. Total maximum harvest over 100 years would range from about 273,000 acres under Alternative 1 to about 368,000 acres under Alternative 2 (Table 3.4-3).

Access

Subsistence users typically hunt and fish in traditional areas surrounding their communities. Many of the communities in Southeast Alaska are compact, centralized places surrounded by undeveloped land with limited infrastructure. Most subsistence food production is supported by a central or core use area surrounding a community. Traditional household deer hunting areas are identified for 32 communities in Southeast Alaska in Appendix H to the 1997 Forest Plan EIS. Access to and use of surrounding areas for subsistence activities may be guided by local customary rules, as well as federal and state regulation and economic considerations, with traditional use areas for different communities often overlapping at their margins. Customary rules guiding subsistence harvest may be related to local histories and social customs of clans and communities (Wolfe 2004).

Forest plans are programmatic, meaning that they establish direction and allowable activities for broad land areas, rather than schedule specific activities in specific locations. This makes it difficult to evaluate the effects of the alternatives on particular groups of subsistence users or resources. The following discussion addresses potential impacts at the programmatic or forest scale and assesses relative potential impacts in terms of overall proposed road construction and timber management activities.

Viewed at this scale, none of the alternatives would directly limit the use of public lands for the purposes of subsistence gathering activities. Traditional access methods would remain available under all the alternatives for present and foreseeable future activities. Access methods differ by Game Management Unit (GMU). Those subsistence users who use a boat as their primary method of access may have temporary and localized disruptions under the alternatives that propose the most young-growth harvest in the beach fringe.

Data on documented deer harvest by transportation type are available at the GMU level. Data from the 2013 Deer Management Report are presented by transportation type and GMU in Table 3.17-1. GMU 4, the ABC Islands (Admiralty, Baranof, and Chicagof Islands), accounted for two-thirds (66 percent) of deer harvested in Southeast Alaska in 2011 (8,665 deer), with GMU 2, Prince of Wales Island, accounted for one-quarter (25 percent) (3,251 deer). Hunters accessing hunting areas by boat accounted for 63 percent of total deer harvest in 2011. Hunters accessing the area by highway vehicle accounted for 23 percent of total deer harvest. The relative share of harvest by transportation type varies by GMU, with boat access, for example, accounting for 84 percent of harvest in GMU 4, but just 23 percent in GMU 2. Highway vehicle was the most frequently used method of access in GMU 2, Prince of Wales Island, accounting for 58 percent of deer harvest in 2011 (Table 3.17-1). This relatively high share reflects the more densely roaded nature of Prince of Wales Island and may be considered generally indicative of the effects of timber harvest and associated road building in areas connected to communities and the marine highway system. Most of the lands suitable for young-growth harvest in the beach fringe are within GMUs 1A, 2, and 3.

Table 3.17-1
Deer Harvest by Game Management Unit and Transportation Type, 2011

			Percent of Deer Harvested by Transportation Type[2]					
GMU Number[1]	**Area**	**Deer Harvested**	**Airplane**	**Boat**	**3- or 4-Wheeler**	**Highway Vehicle**	**Foot**	**Un-known**
1A	Ketchikan[3]	176	NA	NA	NA	NA	NA	NA
1B	Petersburg[4]	83	1	84	3	4	7	2
1C	Juneau	388	0	30	0	45	20	2
2[5]	Prince of Wales Island	3,251	3	23	NA	58	8	8
3	Central Islands	514	1	45	12	26	5	11
4	ABC Islands[5]	8,665	6	84	2	3	3	3
	Total	**13,077**	**883**	**6,938**	**329**	**2,529**	**240**	**139**
	Percent of Total	100	8	63	3	23	2	1

Notes:
ABC Islands = Admiralty, Baranof, and Chichagof Islands
[1] Game Management Units (GMUs) are a geographic unit of measurement established and used by ADF&G.
[2] These data were compiled as part of ADF&G's mandatory hunt report cards issued in conjunction with deer harvest tickets. Hunters report transportation method for traveling to their hunting areas. Numbers may not sum to 100 percent due to rounding.
[3] Airplane data are not available for this GMU.
[4] The foot category for this GMU includes 1 percent of hunters that used a horse/dog team to access their hunting area.
[5] In GMU 2, 3- or 4- Wheelers were accounted for in the Highway Vehicle category.
Source: ADF&G (2013).

New road construction is likely to result in the development of new use patterns around some communities, but these changes are not likely to lead to a significant possibility of a significant restriction of subsistence access to the resources. New use patterns may, however, favor some subsistence groups and disadvantage others. Subsistence access may be via a number of different transportation types and often involves more than one form of transportation. Subsistence users may, for example, access an area via boat followed by road (and on-foot) or via boat and on-foot, with types of access varying by location and user. Some hunters may access specific areas using more than one form of transportation, but others may favor one form of transportation over another, say highway vehicle over foot.

While there would be some new road access under all alternatives in the long run, nearly all new roads constructed under the alternatives would be closed following harvest. These roads would, therefore, not be available for use by highway vehicles or high-clearance vehicles. They may, however, be available for access by other methods and would, as a result, have the potential to affect existing subsistence patterns.

Based on the miles of new road construction projected under each alternative and viewed at a programmatic level, Alternative 1 would involve the construction of most new roads over 25 years: 281 miles of new roads versus the next highest maximum of 267 miles under Alternative 5. However, Alternative 1 would require much less road construction on decommissioned roadbeds and road reconstruction over this period than the other alternatives, with a maximum combined total length of 224 miles versus 306 miles (Alternative 4) to 381 miles (Alternative 2) under the other alternatives. Viewed over 100 years, new road construction would range from 871 miles (Alternative 4) to 1,056 miles (Alternative 2), with road construction on decommissioned roadbeds and road reconstruction miles ranging from 1,315 miles (Alternative 1) to 1,791 miles (Alternative 2). Harvest would be limited to areas outside Inventoried Roadless Areas (IRAs) under Alternatives 1, 4, and 5 and would, therefore, tend to increase road density in already roaded areas rather than provide new access to presently undeveloped areas.

Renewable energy development is not expected to substantially increase road density on the Forest under any of the alternatives.

Some subsistence users have a preference for unroaded areas. Viewed at a programmatic level, Alternatives 1, 4, and 5 would likely have the lowest impact on subsistence users who prefer unroaded areas because timber management would be primarily limited to areas outside the existing IRAs on the Tongass.

Another potential access impact relates to the effects of clearcut harvesting on the landscape. Subsistence hunters have varying opinions on the effects of clearcut harvest on hunting success. Some hunters say that timber harvest clearcuts are productive for some years after harvest, while others prefer not to use clearcuts. Hunters interviewed on Prince of Wales Island, for example, reported that the best hunting in clearcut areas begins approximately 2 years after an area is logged, with hunt quality typically starting to decline 9 years after the area was cut (Brinkman 2006). Concern has been expressed by hunters that clearcuts in the process of regrowth become impassable to hunters after a period of time (Galginaitis 2004). Young-growth harvest would likely improve hunting in many previously harvested areas.

In addition to long-term access effects, timber management activities may also have short-term, temporary displacement effects for subsistence users because it is standard practice to close logging roads to outside traffic when logging is taking place. Subsistence users who use existing roads for access would be preempted from using those roads for the duration of logging activity in the affected area. These types of effects would, however, be short term and temporary, and would not be likely to lead to a significant possibility of a significant restriction of subsistence access to the resources. In addition, as previously noted, most or all new roads would be closed following harvest.

Competition

Almost two-thirds (63 percent) of the population in Southeast Alaska in 2014 resided in Juneau (44 percent) or Ketchikan (19 percent) and is, therefore, considered non-rural from a subsistence perspective (Alaska DOL 2014a). Residents in the remaining communities are considered rural. Competition for the more abundant wildlife and fisheries resources near rural communities is affected by a number of factors, including fish and game regulations, the mobility of community residents, the Forest-wide distribution of game species, decreases in resource populations as a result of habitat reductions and/or over-harvest, and types of community access, such as roads, ferries, and commercial air services.

The following assumptions were made for the purposes of evaluating potential impacts to competition:

- New road construction adjacent to communities with ferry access will result in increased competition from outside communities.

- New road construction adjacent to existing road systems where interties between communities exist will result in increased competition from surrounding communities associated with the interconnected roads.
- Habitat reductions will result in increased competition if regulations allow sport use to remain constant, with the same number of users seeking fewer huntable resources.
- The demand for resources will remain constant or increase slightly as the habitat capability remains the same or declines over time.

Given these assumptions, the 1997 Forest Plan Revision FEIS concluded that implementation of Alternative 11 (the Selected Alternative) would result in a significant possibility of a significant restriction of subsistence use of deer by increasing competition for some subsistence resources by non-rural, as well as rural residents. This was judged most likely to occur on Chichagof, Baranof, and/or Prince of Wales Islands, where competition for deer and some other land mammals was identified as heavy, and habitat capability had already been reduced as a result of timber harvest.

Cumulative Effects

The significant possibility of a significant restriction, resulting from a change in competition, would still exist but be less than the possibility under Alternative 11 (the Selected Alternative) of the 1997 Forest Plan Revision FEIS for all of the alternatives considered in this EIS because of the much lower anticipated rates of timber harvest and road construction.

Cumulative effects are discussed in four categories.

1. **Effects Resulting from Timber Harvesting of Private Lands**. Native corporation lands adjacent to the Tongass National Forest support extensive timber harvest operations and old-growth forest wildlife habitat capability on Native corporation lands (especially that for deer) has declined. This decline has occurred primarily on North Chichagof, Kupreanof, Admiralty (localized), and Prince of Wales Islands, as well as in some mainland areas. The resulting lower habitat capabilities on these private lands are likely to increase hunting demands in adjacent National Forest areas, increasing competition and potentially leading to reduced hunter success, reduced or eliminated sport seasons, and in some places reduced or eliminated subsistence seasons.
2. **Effects from Past Activities**. Timber harvest has been more influential in changing the landscape than any other use of the resources of the Tongass National Forest. Timber harvest has historically been accompanied by road building, log transfer facility development, and reductions in old-growth forest habitat.
3. **Effects of Present Activities**. Implementation of the current Forest Plan allowed an annual maximum timber harvest of approximately 267 million board feet (MMBF) (based on the Allowable Sale Quantity [ASQ]), with an annual conversion of up to 8,900 acres of old-growth habitat to young growth (although a much lower volume and acreage of old growth has been harvested in recent years). This timber harvest involved the projected construction of up to 106 miles of system roads each year. In reality, less than 25 miles of new system roads has been built each year since the plan was implemented. Two mining operations, the Greens Creek Mine on Admiralty Island and Kensington Mine north of Juneau, are currently operating.
4. **Effects of Reasonably Foreseeable Future Activities**. Timber harvest activities have typically been accompanied by new access and often

increased use of subsistence resources by rural and non-rural residents. The effects of timber harvest on deer habitat capability would be reduced over time as harvest areas transition from old-growth to young-growth under all alternatives.

Counting all lands in Southeast Alaska, an estimated 86 percent of the original old growth remains today. After 100 years of implementing any of the alternatives, it is estimated that the percentage of the original old growth remaining would be 82 percent, due to combined harvest on NFS and non-NFS lands, assuming maximum rates of harvest. Although the percentage reduction would not be high overall, areas of concentrated harvest could have higher effects on subsistence. Areas of concentrated harvest are described in the *Biodiversity* section, which quantifies the estimated effects of cumulative future harvest on the amount of old growth by biogeographic province for all of Southeast Alaska (see Tables 3.9-16, 3.9-17, and 3.9-18).

Timber harvest of Native corporation lands is anticipated to continue at a relatively low but constant level over the next decade. New land conveyances under Public Law 113-291 could result in some previously unharvested areas being logged. Actual mineral development is difficult to predict, but effects to subsistence resources would be highly localized where it does occur. Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

ANILCA Determination

An ANILCA Section 810 evaluation and determination is not required for approval of a Forest Plan amendment, which is a programmatic level decision and not a determination whether to “withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition” of National Forest land. This EIS is part of the Forest Plan Amendment process and, therefore, does not require an ANILCA Section 810 evaluation and determination. However, public hearings on subsistence issues for the proposed Forest Plan Amendment were held in several communities between the Draft and Final versions of this EIS.

Subsistence testimony during these hearings did not provide specific examples of how the proposed action would affect the commenter’s subsistence use in terms of access or increasing competition. Some commenters were concerned in general that the proposed Forest Plan could impact subsistence and cultural heritage resources in RMAs, particularly in the beach and estuary fringe, or that by not improving forest and water ecosystems there could be a reduction in abundance and distribution of subsistence resources. The alternatives consider various levels of young-growth treatment in the RMAs and beach fringe. Alternatives 3 and 4 propose commercial thinning only in beach fringe and do not allow harvest in RMAs. Alternative 2 allows for even-aged management within the beach fringe for 15 years followed by commercial thinning for the life of the Forest Plan and allows commercial thinning up to 33 percent in the RMAs. Alternative 5 allows for up to 10-acre openings and/or up to 35 percent of the acres to be removed in the first 15 years in both RMAs and the beach fringe.

This page is intentionally left blank.

Heritage Resources and Sacred Sites

Affected Environment

Heritage Resources

The Tongass National Forest has a rich and varied history. Its early history is represented by the Tsimshian and Haida in southern Southeast Alaska, and the Tlingit who occupy areas from southern Southeast Alaska all the way to Yakutat and the Copper River area. Tribal groups—or Kwáan within the Tlingit—have associated tribal boundaries; for example, the Stikine Tlingit (Stax'heen Kwáan), the Sitka Tlingit (Sheet'ka Kwáan), and the Hoonah Tlingit (Xuna Káawu) all claim traditional use areas.

Important historic properties and other cultural resources located throughout the Forest that represent Alaska Native migration into the area thousands of years ago and continued occupation of the area are exemplified by the well documented and publicized Ground Hog Bay, Hidden Falls, and On Your Knees Cave sites. In addition, there are pictograph and petroglyph sites, forts, and seasonal hunting and fishing sites. Oral histories and ethnographies provide evidence for sacred lands, battle sites, transportation and trade corridors, and traditional subsistence use areas.

Early contact with Europeans, and the subsequent exploitation and colonization of Southeast Alaska, resulted in historic properties representing early Russian occupation, fur farming, gold mining, large-scale fishing and canning operations, and the timber industry. Historic properties and other cultural resources representing these different uses and periods in history are present within the Forest and are managed as part of the Heritage Program. Cultural resources are broadly defined in the National Environmental Policy Act (NEPA) and can include prehistoric and historic sites, cultural landscapes, artifacts, and sacred sites that may or may not be eligible for the National Register of Historic Places (NRHP). Historic properties, on the other hand, are defined in the National Historic Preservation Act (NHPA) and specifically refer to sites that either have the potential to be eligible or are eligible to be listed on the National Register. Historic properties that are identified, but have not yet had a "determination of eligibility" are treated as "eligible" properties for the purposes of Section 106 of the NHPA. Properties identified as not eligible are managed in accordance with Forest Service policy, but still are analyzed as a cultural resource for NEPA purposes.

National Register–eligible historic properties within the Tongass National Forest have met one or more of the four primary criteria to deem them significant enough for national recognition: they have been associated with events that made a significant contribution to the broad patterns of our history; were associated with the lives of significant persons in our past; embodied a distinctive characteristics of a type, period, or method of construction; or have yielded or may be likely to yield, information important in history or prehistory. It is within this context that historic properties are discussed and the potential adverse effects are analyzed.

The terms "cultural resources" and "historic properties" are generally used interchangeably even though they have different meanings within NEPA and NHPA. They may also be lumped under the broader category of "heritage resources."

As of the end of June 2015, approximately 145,330 acres of Tongass National Forest lands have been inventoried for heritage resources. A total of 3,399 heritage resource sites have been identified, 46 of which have been listed on the NRHP, while 666 have been determined eligible for listing either through concurrence with the Alaska State Historic Preservation Office (SHPO) or by a decision of the Keeper of the National Register. Of the remaining known sites, 2,354 are currently unevaluated for National Register eligibility.

Of the known sites, 1,436 represent the historic period beginning with the early contact period and include World War II sites, Civilian Conservation Corps–era shelters, historic canneries, trappers' cabins, fox farms, shipwrecks, military installations, and early logging and recreational sites. Prehistoric sites total 1,699 and are represented by pictographs, petroglyphs, Native villages, fish traps and weirs, lithic scatters, fortifications, burials sites, and rockshelters. The remaining known sites have not yet been classified as to associated time period. These known sites are distributed throughout the Forest and, with their associated features that enable their eligibility to the NRHP (such as integrity of location and sense of place), make up the "affected environment" for cultural resources. They are located throughout the Forest, in all ecosystems, from shoreline to alpine, along streams and rivers, in caves and in the open.

The majority of the known sites occur in close proximity to food and fresh water sources, normally below 100 feet in elevation and near the shoreline. These areas are described as "high sensitivity areas" in the current predictive model for locating sites. Other types of heritage resources such as mineral resource areas, or rock cairns of unknown use, may occur in higher elevations, but in general they are less abundant and more sparsely dispersed, and are considered to be in "low sensitivity" areas.

Because a small percentage of the total acreage of the Forest has been surveyed for cultural resources, the heritage staff rely on a predictive model to understand and evaluate potential impacts in areas that have not benefitted from a current field survey. The current model predicts that most sites will be below 100 feet in elevation and/or in areas of animal, plant, or mineral resource abundance was based on the assumption that the shorelines were static and had not changed through time. These are considered "high sensitivity areas." Because of a new understanding of elevation and sea level changes, both raising and lowering, after deglaciation, this model is no longer appropriate for some portions of the Forest and in particular for locating prehistoric sites. The model is still useful in predicting the locations of more recent human occupation, however.

A new model for locating historic properties looks at the changing landscapes of both emergent and submerging shorelines, and predicts sites both at higher elevations and lower elevations. The changing landscape situation is complex, and is not uniform across Southeast Alaska. It is difficult to predict where cultural resources, in particular archaeological resources, are located without having a good understanding of geomorphology, and in particular glacial geomorphology. It also should be noted that this model is for archaeological sites, only one type of historic property or cultural resource found throughout the Forest.

Recent research has demonstrated the validity of a model that predicts the oldest, and potentially most important, sites for understanding the early prehistory of the Tongass may expect to be found between modern day sea level and higher elevation relict beaches that are 60 or more feet above present-day sea level, depending on the geomorphology.

Identification and evaluation of heritage resources is an ongoing process. Historic research, literature reviews, oral interviews, and field surveys all provide information about the location or potential location of resources and insight into resource distribution and the sensitivity of sites to damage. Further scientific study will increase knowledge about early human migration, later exploration and development of the region, and human behavior in response to social and environmental change. Overall only a small portion of the Tongass National Forest has been surveyed; therefore, additional heritage sites are expected to be located within the Forest in the future. As heritage resources are located the Forest has the responsibility to evaluate the recovered data and to make determinations regarding eligibility to the NRHP. In addition, the Forest has the responsibility to curate collected artifacts and conserve records, photographs, and other data specific to heritage resource projects and sites within an appropriate environment under 36 Code of Federal Regulations (CFR) 79 and in accordance with federal Records Management requirements.

Sacred Sites

Numerous sacred sites have been identified throughout the Tongass National Forest. Sacred sites are defined by the persons who believe they are sacred. Generally, the authoritative voice is a tribal representative, but Traditional Cultural Practitioners and tribal members may also define what is sacred. Sacred sites and their definition can and do change through time. Sacred sites have both tangible and intangible qualities. They can include old village sites, pictographs, petroglyphs, burials, traditional hunting and gathering areas, traditional areas for collection of minerals or source materials for artifacts, as well as places that are visited for their “spiritual” qualities.

Many sacred sites are also considered cultural resources or historic properties. Those sites are managed as heritage resources subject to Section 106 review should they have the potential to be affected by a federal undertaking.

In December 2014, Congress passed legislation that included the Sealaska Land Entitlement Finalization which conveys the remaining 70,075 acres on the Tongass specified in 1971 under the Alaska Native Claims Settlement Act (ANCSA). The conveyance includes 18 parcels of land totaling 69,585 acres and 490 acres of land containing not more than 76 cemetery and historic sites. The conveyed parcels contain 15 heritage resource sites that will be deducted from the above total once conveyance is complete. All of the cemetery sites being conveyed are considered to be sacred sites. While these properties will be conveyed out of federal ownership, they may still be surrounded by Forest lands and developmental activities and will need to be considered in planning.

Other sacred sites might include places where traditional cultural practices occur such as healing ceremonies, certain subsistence practices, or places of spiritual qualities that cannot be measured or pointed to on a map. In order to protect and preserve Alaska Native religious practices, Executive Order 13007 and other laws and Executive Orders of the U.S. Government require the Forest Service, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions to:

- Accommodate access to, and ceremonial use of, Alaska Native sacred sites by Alaska Native religious practitioners,
- Avoid adversely affecting the physical integrity of sacred sites, and
- Maintain the confidentiality of sacred sites.

Alaska Native groups or an appropriately authoritative representative of an Alaska Native religion shall be responsible for identifying such sites to the Forest Service as the managing agency.

Further, the Culture and Heritage Cooperation Authority (25 United States Code [USC] 32a) provides for reburial of human remains on Forest lands. These sites are treated as sacred sites.

Burial sites are also considered sacred, and are generally discovered during ground-disturbing activities. The Native American Graves Protection and Repatriation Act covers inadvertent discoveries of Alaska Native remains and affords protection to these sites.

Environmental Consequences

Direct and Indirect Effects

Direct effects to heritage sites include damage or destruction caused inadvertently or by intent. Inadvertent damage to archaeological sites can result from access and use around the site that causes soil compaction, or from other ground-disturbing activities. Other historic properties and cultural resources may be inadvertently damaged by careless behavior. Intentional damage includes looting and vandalism, relic collecting, theft, and defacement and is a violation of the Archaeological Resources Protection Act. Damage or destruction of historic properties and cultural resources can result in the loss of information and change the eligibility of the property for National Register purposes and may cause a property to be delisted if the factors that contributed to listing no longer remain.

While multiple-use activities have benefited heritage resources by providing opportunities for inventory, evaluation, and interpretation in remote areas of the Forest, ground-disturbing activities have the most potential to adversely affect these resources and their environmental settings. The amount of impact an activity has is determined largely by the location and nature of the activity, the characteristics of the soils, the degree of use, and the nature of the historic property or cultural resource.

Under all of the alternatives, the preferred management of heritage resource sites eligible for, nominated to, or listed in the National Register is avoidance and protection in accordance with the Forest-wide Standards and Guidelines. If avoidance and protection are not possible, and a determination of “Adverse Effect to Historic Properties” is made, a Memorandum of Agreement (MOA) with the State Historic Preservation Officer is required in order to mitigate the effects. If the historic properties are listed on the National Register of Historic Places, the ACHP must also be invited to consult. Alaska Native tribes and other potential stakeholders also may be invited to be signatories on the MOA depending on the historic property or cultural resource in question. The potential for adverse effects, and therefore the need for mitigation, is diminished when the physical settings around significant heritage resources are allowed to retain their integrity of place (i.e., original location and setting, whether in a natural setting or a cultural landscape).

Direct effects are mostly likely to occur under Land Use Designations allowing timber harvesting, mining, and road construction. Existing standards and guidelines (e.g., those for riparian and beach and estuary buffer zones) result in the protection of many of the Forest’s heritage resources by eliminating or minimizing ground disturbing activities in those locales. However, all action alternatives would allow some harvest in Beach Fringe and Alternatives 2 and 5 would allow harvest in Riparian Management Areas (Alternative 2 more than Alternative 5).

Indirect effects are mostly like to occur as a result of recreation and special uses simply because people want to recreate and use the forest in the same places people have for thousands of years. In many instances, retention of an historic property's original setting, or cultural landscape, is crucial to imparting and protecting the values that qualify a heritage resource for National Register status.

Except for those sacred sites that are also considered archaeological sites or historic properties, the potential effects to sacred sites are difficult to evaluate because the 'sacred' nature of a site is determined by the tribes or their religious practitioners, and may or may not be obvious to a casual observer. Development on or near sacred sites with intangible or "spiritual" qualities may be considered a direct effect if the landscape or the qualities of that site are impaired.

An indirect effect common to all alternatives and prescriptions is that the discovery of new sites can lead to vandalism if locations become known to the public.

In applying the current model that predicts the majority of significant heritage resources located below 100 feet elevation, Alternative 3 has the least impact to old-growth areas below 100 feet (Table 3.18-1). Conversely, Alternative 1 would have the least impact to areas below 100 feet in young growth areas. Presumably, previous harvests have impacted areas now considered young growth; therefore, less harvest of old growth in Alternative 3 would be preferable from the standpoint of potential effects on heritage resources. While this is a presentation of the potential effects to heritage resources using the current quantifiable model, consideration will need to be given to the location of relict beaches and other refinements to the model in relation to future proposed sales.

Table 3.18-1
Approximate Suitable Acres Under 100 Feet Elevation Likely to be Harvested over 25 Years

Alternative	Old-Growth Harvest (Acres)	Young-Growth Harvest (Acres)
1	692	243
2	255	4,797
3	169	3,421
4	338	1,931
5	350	2,387

In addition, Alternative 1 does not include any entry into beach or estuary fringes or riparian buffers. Therefore, heritage resources in those locations should be less subjected to impacts related to logging. Table 3.18-2 identifies the maximum estimated acres of old growth and young growth that can be harvested and miles of road likely to be constructed and reconstructed under each alternative over 25 years, and Table 3.18-3 presents harvest acreages and road miles over 100 years. These acreages and mileages provide relative indicators of potential adverse effects, with the alternatives having the most acreage and mileage likely to produce the highest risk of effects. Under this scenario, Alternatives 2 and 3 have the highest risk of effects because they include more area where development would be permitted. They would be followed by Alternatives 5, 4, and 1, in decreasing order of risk level. However, because project areas are inventoried for ancient and historic heritage resource sites and tribal consultation for sacred sites should occur prior to implementation and avoidance of impacts is the preferred option for resource protection, the levels of risk are considered relatively low for all alternatives. In addition, existing standards and guidelines should result in the protection of most heritage resources and sacred sites in those areas.

While it is true that increased project activity might accelerate the loss of heritage resources, primarily by improving public access and increasing the probability for looting and vandalism of heritage resource sites, there are potential positive effects as well. Over time, decay, neglect, and natural landscape changes threaten the preservation of significant heritage resources. By expanding the Forest's inventory of its heritage resources, development projects result in identification of many sites that might otherwise decay unnoticed. Once sites are known, the Forest has the opportunity to better protect them and encourage collection of information from a greater number of them.

Table 3.18-2
Approximate Maximum Acres Likely to be Harvested and Maximum Road Miles to be Constructed/Reconstructed over 25 Years

Alternative	Old-Growth Harvest (Acres)	Young-Growth Harvest (Acres)	New Road Construction (Miles)	Road Reconstruction & Roads Constructed on Decom. Roadbeds (Miles)
1	38,527	9,669	281	224
2	15,027	63,787	260	381
3	16,599	53,734	245	339
4	23,255	40,760	257	306
5	23,813	43,316	267	321

Table 3.18-3
Approximate Maximum Acres Likely to be Harvested and Maximum Road Miles to be Constructed/Reconstructed over 100 Years

Alternative	Old-Growth Harvest (Acres)	Young-Growth Harvest (Acres)	New Road Construction (Miles)	Road Reconstruction & Roads Constructed on Decom. Roadbeds (Miles)
1	62,851	209,882	944	1,315
2	32,609	335,344	1,056	1,790
3	35,568	313,216	1,020	1,696
4	42,597	234,885	871	1,344
5	42,479	284,144	994	1,585

Cumulative Effects

The vast majority of Southeast Alaska is occupied by the Tongass National Forest (16.7 million acres), so the disturbances described above for the Tongass are the major disturbances affecting heritage resources. However, Glacier Bay and Haines/Skagway National Park areas, Haines State Forest, and other ownerships in the Haines/Skagway area occupy 3.6 million acres, while state, Native corporations, and other ownerships inside the Forest boundary occupy a combined 1.1 million acres. Therefore, activities on these lands contribute to Southeast Alaska cumulative effects. However, extensive timber harvest, road construction, and renewable energy, mining, and infrastructure development for tourism-related activities occur on these ownerships, which have the potential to affect cultural resources.

If Forest Service policy of avoidance and protection is followed, cumulative effects would be minimal with the implementation of this plan. However, if mitigation becomes the primary strategy for responding to potential adverse effects to historic properties, then the cumulative effects could be significant. Mitigation does not nullify cumulative effects. At present, there is no reason to believe that the policy of avoidance and protection will not be followed, and cumulative effects are expected to be minimal.

Extensive landscape changes and ground disturbance have occurred and will continue to occur on many non-federal lands in Southeast Alaska. Projects that are on non-federal lands, and not funded or authorized by the federal government are not subject to the same protections for heritage resources. Heritage resources are nonrenewable, and once disturbed they are permanently damaged or destroyed; their information and values are lost and cannot be recovered. Preservation of these resources and values on federal lands is critical so that future generations can continue to enjoy the heritage and knowledge about our past that we enjoy today.

Appendix C of this Environmental Impact Statement provides a full list of all the projects considered in the cumulative effects analysis.

This page is intentionally left blank.

Inventoried Roadless Areas

This section provides an overview of the existing conditions related to Inventoried Roadless Areas (IRAs) as defined in the Roadless Area Conservation Rule (2001 Roadless Rule; USDA Forest Service 2000) and assesses the potential direct, indirect, and cumulative effects of the alternatives on these areas.

The Ninth Circuit Court of Appeals recently upheld the United States District Court for District of Alaska's 2011 reinstatement of the Roadless Rule on the Tongass National Forest. Consequently, the Roadless Rule remains in effect in Alaska and the Forest Service continues to apply the Rule to the Tongass National Forest. A second case involving the Roadless Rule is currently being adjudicated in the United States District Court for the District of Columbia. The Forest Service will comply with all court orders.

Affected Environment

IRAs in the Alaska Region include 9.2 million acres (57 percent) of the Tongass National Forest. Including Wilderness, Land Use Designation (LUD) II designated areas, and National Monument areas, the Tongass National Forest is currently more than 90 percent undeveloped and unavailable for timber harvest and road building. In some locations short-term "boom and bust" developments including fox farming, salmon canneries, mining, and military activity resulted in the temporary development and occupation of small areas mostly near the shoreline. Many of these areas have since been largely reclaimed by nature. Developed areas cover about 1.3 million acres, or about 8 percent, of the Tongass. Southeast Alaska residents (approximately 74,000) are, for the most part, surrounded by land that has many of the characteristics of wilderness. Routine travel and ordinary outdoor recreation activities typically require a higher degree of skill, risk-taking, and self-reliance than is usually required of adventurous backcountry visitors on other National Forests.

Several characteristics of IRAs on the Tongass are unique relative to other areas in the National Forest System (NFS). The Tongass has very large undeveloped land areas that could potentially be managed as wilderness or in an unroaded condition. Several portions of the Forest constitute contiguous IRAs exceeding 1 million acres, and thus represent large, unfragmented wildlife habitats and exceptional opportunities for solitude.

Many of the Tongass IRAs represent wildlife habitats, ecosystems, and visual character, such as coastal islands facing the open Pacific, extensive beaches on inland saltwater, old-growth temperate rain forests, ice fields, and glaciers that exist nowhere else in the NFS. Many of these areas are remote and difficult to access for primitive recreation and many contain other important resources, such as timber, minerals, and salmon-producing streams.

Current Situation

IRAs are defined as undeveloped areas typically exceeding 5,000 acres that meet the minimum criteria for wilderness consideration under the Wilderness Act and were inventoried during the Forest Service's Roadless Area Review and

Evaluation (RARE) II process and subsequent updates and forest planning analyses. The Tongass is using the IRA boundaries associated with the 2001 Roadless Rule (USDA Forest Service 2000), which are identified in a set of maps, associated with the Forest Service Roadless Area Conservation, Final Environmental Impact Statement (FEIS), Volume 2, dated November 2000. These maps identify 9.2 million acres in IRAs on the Tongass and correspond closely with the 1996 roadless area inventory that was prepared for the 1997 Forest Plan Revision (USDA Forest Service 1997c). The current acreage represents an approximately 292,000-acre reduction compared to the 2008 Forest Plan due to land adjustments, refinements to boundaries, additional road construction, and mapping corrections.

Roadless characteristics (i.e., values or features that make the area meet the minimum criteria for wilderness consideration under the Wilderness Act) are described in the Roadless Area Conservation FEIS (USDA Forest Service 2000, Vol. 1, pp. 3-3 to 3-7).

Detailed descriptions of the IRAs are included in Appendix C to the Tongass Land Management Plan Revision, Final Supplemental EIS (SEIS), Roadless Area Evaluation for Wilderness Recommendations (USDA Forest Service 2003b). These characteristics are also discussed in detail in the individual resource sections in this FEIS.

Table 3.19-1 summarizes the roadless characteristics considered and the section in this chapter where potential effects are discussed.

Table 3.19-1
Roadless Characteristics and Discussion Sections

2001 Roadless Rule Characteristics	Chapter 3 Section
Biological Values	
Diversity of plant and animal communities	Wildlife, Biodiversity, Plants, Fish
Habitat for threatened, endangered, proposed, candidate, and sensitive species, and for those species dependent on large, undisturbed areas of land	Wildlife, Biodiversity, Plants, Fish
Physical Values	
High quality or undisturbed soil, water, and air	Soils, Geology, Karst and Caves, Water, Climate and Air
Sources of public drinking water	Water
Social Values	
Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized classes of dispersed recreation opportunities	Recreation and Tourism
Reference landscapes	Scenery
Natural appearing landscapes with high scenic quality	Scenery
Traditional cultural properties and sacred sites	Heritage Resources and Sacred Sites
Other locally identified unique characteristics	Recreation and Tourism; Heritage Resources and Sacred Sites

Source: USDA Forest Service 2000

The roadless area inventory displays the extent of the roadless resource and provides data for use by managers, legislators, and others to formulate land management proposals. Roadless areas may retain their roadless character by being managed in a way that emphasizes relatively large undeveloped or natural areas, such as areas usually required for old-growth habitat, scenic backdrops, or primitive recreation. Roadless areas identified in the inventory that are outside of the Wilderness LUD may be considered for wilderness recommendation, or managed for a wide range of other resource management activities.

Table 3.19-2 provides an overview of the IRAs identified in the 2001 Roadless Rule. These areas consist of approximately 9.2 million acres spread over 110 separate IRAs ranging in size from just 466 acres (Fake Pass #532) to 1.19 million acres (Juneau-Skagway Icefield #301). All but 5 of the 110 IRAs identified in the 2001 Roadless Rule are larger than 5,000 acres (Table 3.19-2). Table 3.19-2 also includes the amount of each area that is productive old growth (POG). If the additional 5.8 million acres of the Tongass in Wilderness and Wilderness National Monument are combined with the IRA acreage, the resulting total (15.0 million acres) represents about 90 percent of the Tongass.

Table 3.19-2
Tongass National Forest Inventoried Roadless Areas Covered by the 2001 Roadless Area Conservation Rule

Roadless Area Number	Roadless Area Name	Roadless Rule National Forest Acres	Productive Old-Growth Forest (Acres)
201	Fanshaw	48,118	29,247
202	Spires	533,366	65,442
204	Madan	67,878	32,357
205	Aaron	78,598	16,889
206	Cone	127,869	10,706
207	Harding	173,344	54,497
208	Bradfield	197,826	20,018
209	Anan	36,646	15,878
210	Frosty	37,369	17,511
211	North Kupreanof	114,318	25,083
212	Missionary	16,661	8,256
213	Five Mile	18,822	8,114
214	South Kupreanof	216,579	84,620
215	Castle	49,194	19,247
216	Lindenberg	25,797	11,419
217	Green Rocks	10,578	4,589
218	Woewodski	10,052	5,570
220	East Mitkof	7,922	2,973
223	Manzanita	8,385	4,781
224	Crystal	18,324	7,789
225	Kadin	2,023	1,979
227	North Wrangell	7,829	4,375
229	South Wrangell	14,193	6,096
231	Woronkofski	11,098	5,961
232	North Etolin	40,909	19,683
233	Mosman	53,118	24,718
234	South Etolin	26,230	9,740
235	West Zarembo	6,781	3,064
236	East Zarembo	10,845	5,084
237	South Zarembo	36,228	14,618
238	Kashevarof Islands	4,630	3,281
239	Keku	9,019	4,956
240	Security	31,370	20,491
241	North Kuiu	6,352	5,625
242	Camden	36,676	18,068
243	Rocky Pass	77,674	37,946
244	Bay of Pillars	27,083	19,177
245	East Kuiu	27,215	17,009
246	South Kuiu	61,906	36,408

Table 3.19-2 (continued)
Tongass National Forest Inventoried Roadless Areas Covered by the 2001 Roadless Area Conservation Rule

Roadless Area Number	Roadless Area Name	Roadless Rule National Forest Acres	Productive Old-Growth Forest (Acres)
247	East Wrangell	7,269	4,689
288	West Wrangell	8,849	4,042
289	Central Wrangell	13,097	5,899
290	Southeast Wrangell	18,340	7,661
301	Juneau-Skagway Icefield	1,186,714	57,950
302	Taku-Snettisham	661,162	95,065
303	Sullivan	67,114	13,422
304	Chilkat-West Lynn Canal	194,888	45,554
305	Juneau Urban	100,412	39,212
306	Mansfield Peninsula	52,730	27,189
307	Greens Creek	26,965	16,648
308	Windham-Port Houghton	160,445	105,861
310	Douglas Island	24,382	13,234
311	Chichagof	552,423	176,502
312	Trap Bay	13,217	6,664
313	Rhine	22,830	6,779
314	Point Craven	10,726	6,706
317	Point Augusta	15,439	10,240
318	Whitestone	5,616	2,794
319	Pavlof-East Point	4,886	3,935
321	Tenakee Ridge	20,512	5,757
323	Game Creek	49,839	18,053
325	Freshwater Bay	43,132	15,924
326	North Kruzof	32,006	15,339
327	Middle Kruzof	14,698	7,643
328	Hoonah Sound	79,524	24,776
329	South Kruzof	54,639	16,340
330	North Baranof	311,224	75,786
331	Sitka Urban	110,803	12,942
332	Sitka Sound	13,270	5,970
333	Redoubt	67,652	28,392
334	Port Alexander	120,181	31,064
338	Brabazon Addition	498,364	0
339	Yakutat Forelands	320,932	75,272
341	Upper Situk	16,397	10,946
342	Neka Mountain	6,103	1,950
343	Neka Bay	7,056	3,729
501	Dall Island	103,861	61,050
502	Suemez Island	19,862	11,244
503	Outer Islands	98,303	51,366
504	Sukkwan	43,901	16,303
505	Soda Bay	63,371	20,559
507	Eudora	190,697	84,718
508	Christoval	9,079	6,867
509	Kogish	63,608	23,470
510	Karta	51,177	17,781
511	Thorne River	72,971	38,017
512	Ratz	5,322	2,444
514	Sarkar	51,876	25,141
515	Kosciusko	63,655	36,544
516	Calder	8,693	6,517
517	El Capitan	26,081	13,316
518	Salmon Bay	22,628	9,318
519	McKenzie	76,054	26,015

Table 3.19-2 (continued)
Tongass National Forest Inventoried Roadless Areas Covered by the 2001 Roadless Area Conservation Rule

Roadless Area Number	Roadless Area Name	Roadless Rule National Forest Acres	Productive Old-Growth Forest (Acres)
520	Kasaan	7,576	3,060
521	Duke	44,650	6,152
522	Gravina	37,183	18,478
523	South Revilla	51,834	20,862
524	Revilla	29,049	9,962
525	Behm Islands	4,349	2,746
526	North Revilla	212,772	95,720
528	Cleveland	185,741	95,547
529	North Cleveland	105,132	46,154
530	Hyder	121,521	14,180
531	Nutkwa	40,810	21,894
532	Fake Pass	466	396
533	Hydaburg	11,021	6,382
534	Twelvemile	37,914	12,631
535	Carroll	11,268	4,421
536	Kasaan Bay	6,210	1,045
577	Quartz	142,889	46,978
Total Acres		**9,224,182**	**2,560,474**

Within IRAs, there are areas where roads were constructed that were either grandfathered in (i.e., constructed prior to the 2001 Roadless Rule) or constructed during the period following the December 30, 2003, Tongass Exemption (68 Federal Register [FR] 75136). These areas are referred to as “roaded roadless” in this FEIS. In total, 80,251 acres (0.9 percent) of current IRAs are considered roaded roadless.

Environmental Consequences

Direct, Indirect, and Cumulative Effects

There are currently 9,224,182 acres in IRAs on the Tongass (Table 3.19-2). Not all lands that are identified as suitable for timber production would actually be harvested. Some of the road construction associated with timber harvest or renewable energy sites would occur in areas already roaded. Some of the road construction would fragment existing IRAs, either creating new roadless areas (if more than 5,000 acres remains) or simply resulting in small blocks of undeveloped land surrounded by roads and harvest areas. In addition, not all of the effects of the alternatives would occur at once.

For these activities to take place there would need to be a change in the Roadless Rule (rule making). Under current regulations, commercial timber harvest in IRAs is inconsistent with the 2001 Roadless Rule; therefore, harvest activities in IRAs would be postponed until there was a change in the Roadless Rule or the Tongass Roadless Rule Exemption were reinstated.

Effects of Alternatives

Timber Harvest

Estimated acres of old-growth harvest and young-growth harvest after 100 years within current IRAs are presented in Table 3.19-3 by alternative. Only Alternatives 2 and 3 would allow harvest within IRAs, butharvest would be deferred until agency rulemaking modifies 36 CFR 294.13(b)(4) (2001). Under Alternative 2, 100 percent of the proposed old-growth harvest within IRAs is located within roaded roadless areas (areas that were roaded before the 2001

Roadless Rule and during the 2001 Roadless Rule exemption period). This alternative would harvest an estimated 2,171 acres of old-growth forest, and 9,118 acres of young-growth, which is equivalent to 0.02 and 0.1 percent of total IRA acres, respectively (Table 3.19-3). If this alternative were selected, no harvest could occur in IRAs until agency rulemaking modifies 36 CFR 294.13(b)(4) (2001).

Alternative 3 would allow young-growth and old-growth harvest in 2001 Roadless Rule areas and includes almost eight times more old-growth harvest within IRAs than Alternative 2 (Table 3.19-3). An estimated total of 17,037 acres of old-growth would be harvested under Alternative 3 (0.2 percent of total IRA acres), with just 9 percent of this total located in roaded roadless. Alternative 3 includes an estimated 11,810 acres of young-growth harvest (0.1 percent of total IRA acres), about 2,700 acres more than Alternative 2 (Table 3.19-3). Approximately 77 percent of this estimated young-growth harvest would occur in roaded roadless areas (Table 3.19-3). If this alternative were selected, harvest in IRAs would be deferred until agency rulemaking modifies 36 CFR 294.13(b)(4) (2001).

Table 3.19-3
Estimated Old-Growth and Young-Growth Harvest After 100 Years within Current Inventoried Roadless Areas by Alternative

	Estimated Old-Growth Harvest Acres			Estimated Young-Growth Harvest Acres		
Alternative	Acres	Percent of IRA Acres	Percent in "Roaded Roadless"	Acres	Percent of IRA Acres	Percent in "Roaded Roadless"
1	0	0	0	0	0	0
2	2,171	0.02	100	9,118	0.1	100
3	17,037	0.2	9	11,810	0.1	77
4	0	0	0	0	0	0
5	0	0	0	0	0	0

[1] IRAs do not include Wilderness and Wilderness National Monument, even though they are roadless. Commercial timber harvest in IRAs is inconsistent with the 2001 Roadless Rule; harvest activities in IRAs would not be possible unless there was a change in the Roadless Rule or the Tongass Roadless Rule Exemption were reinstated.

Renewable Energy

All renewable energy sites have to meet detailed local, state and, in most cases, federal laws, regulations, and requirements. Projects are also subject to Tongass National Forest Plan standards and guidelines. The 2008 Forest Plan identifies three types of areas related to energy development on the Tongass based on the existing LUDs: windows, which represent areas potentially available for energy development; avoidance areas; and exclusion areas. Avoidance areas are those LUDs where development of energy projects is not allowed unless there is no feasible alternative. Exclusion areas preclude Transportation and Utility Systems. There are no exclusion areas on the Forest due to special authorities provided in the Alaska National Interest Lands Conservation Act, Title XI. These classifications and the standards and guidelines in the 2008 Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, energy projects would be managed under the Renewable Energy Plan Components identified in Chapter 5 of the Forest Plan. This is discussed in more detail in the *Renewable Energy* section of this FEIS.

The Forest Service has identified 11 proposed renewable energy projects that are on or considered likely to affect NFS lands and are currently active (Table 3.12b-3). These projects consist of nine hydroelectric projects, one geothermal project, and one wave project.

Eight of the 11 proposed renewable energy projects on or likely to affect NFS lands are located in IRAs. These projects include seven hydroelectric projects and one geothermal project. Effects from the proposed projects would depend on site-specific plans. In general, project activities that would impact IRAs could include new access road construction (temporary and permanent), forest clearing, ground disturbance, temporary construction noise, and visual impacts depending on the location and design features. Any associated transmission lines would also impact the IRAs crossed through forest clearing and potential additional road construction.

All potential impacts to IRAs would be addressed during the permitting and licensing of these projects, with most requiring project-specific National Environmental Policy Act (NEPA) assessment. Potential impacts would be mitigated, but some impacts, like the presence of a road in an IRA, would be unavoidable. Implementation of the Renewable Energy Plan Components under Alternatives 2 through 5 would simplify the development process for some projects, but would not necessarily result in an increase in the number of projects developed. The greatest effect may be in making the permitting process for developers less burdensome, resulting in more rapid development of sites rather than a substantial increase in the number of sites developed. Current existing and proposed renewable energy projects are widely distributed across the Forest, with 11 identified proposed renewable energy projects spread across six ranger districts. This would reduce the cumulative effects of these activities on any specific IRA. Overall, Alternatives 2 through 5 would likely have little additional adverse effects to IRAs relative to current conditions (Alternative 1).

Cumulative Effects

This section considers the incremental effects of the alternatives when added to other past, present, and reasonably foreseeable actions. The effects of past and present actions on IRAs are included in the affected environment portion of this section, which discusses the existing IRAs on the Tongass. IRAs are identified based on past actions—specifically, timber harvest and road development, with all areas on the Forest within 1,200 feet of an existing road or within 600 feet of an existing harvest unit generally considered developed. Present actions include the impacts of current management policies on IRAs.

Reasonably foreseeable actions on NFS lands include the projected levels of future timber harvest, road construction, and renewable energy project development. The direct and indirect effects of these actions on IRAs are discussed above. The contribution to the timber program for the proposed alternatives would be largest under Alternative 3, followed by Alternative 2, as these alternatives include old-growth and young-growth suitable acres in IRAs. No suitable acres are identified in IRAs under Alternatives 1, 4, and 5. Harvest in IRAs would be deferred under Alternatives 2 and 3 until agency rulemaking modifies 36 CFR 294.13(b)(4) (2001).

Other reasonably foreseeable actions include regional transportation development as defined by the State Transportation Plan and Forest Service Alaska Region Long Range Transportation Plan, as well as road paving on Prince of Wales Island, the closing of roads, and construction of the Angoon Airport. In addition, the expansion of cities like Juneau and Ketchikan, recreational cabin development, and land auctions by the State could include additional road construction.

If one or more of these actions crossed IRAs, the overall effect would be a reduction in the size of existing IRAs. It is not possible at this time to predict exactly which roads would be developed. None of the alternatives are expected to affect this type of future development, which would be expected to go or not go forward regardless of the selected alternative. The overall cumulative effect of these regional activities viewed in conjunction with the Forest Plan alternatives would be a reduction in existing IRAs.

New utility line projects, if they were to go forward, would have similar effects. The 2010 Region 10 Energy Program Overview (USDA Forest Service 2010b) indicated that at least 20 new transmission line corridors being considered for Southeast Alaska would cross NFS lands, noting, however, that many of these are still in the early conceptual planning stage and applications have not been submitted to the Forest Service. Several organizations in Southeast Alaska have planned interconnected transmission lines and or interties that would connect multiple power projects and allow power sales and sharing throughout the region (USDA Forest Service 2010b). These include the Swan Lake-Lake Tyee Intertie Project, completed in 2009, and the Kake to Petersburg Transmission Line Intertie Project, which is currently undergoing NEPA review; the DEIS was released in November 2014 and a FEIS and Draft Record of Decision is anticipated in July 2016. None of the alternatives would affect these developments, which would be expected to go or not go forward regardless of the selected alternative. The overall cumulative effects if one or more of the utility projects that cross IRAs were developed would be a reduction in the size of existing IRAs, which could occur under any of the alternatives. The potential reduction in existing IRA acres would be greatest under Alternatives 3 and 2, as described above.

The Tongass National Forest comprises about 78 percent of the land area of Southeast Alaska. Over 90 percent of the Tongass is currently roadless or wilderness. The other major land ownership in Southeast Alaska is Glacier Bay Park and Preserve (12.5 percent of Southeast Alaska), the vast majority of which is managed as wilderness by the National Park Service. In addition, the State of Alaska and the Bureau of Land Management manage another 6 percent of Southeast Alaska, a large portion of which is roadless. Combining all ownerships, approximately 90 percent of Southeast Alaska is currently roadless. At least 97 percent of all existing IRAs would remain roadless under any of the alternatives. As a result, the vast majority of existing wilderness and IRAs in Southeast Alaska would remain in wilderness or roadless after 100+ years, and the potential for cumulative effects is considered low.

Appendix C in this FEIS lists and describes the past, present, and reasonably foreseeable future actions considered in the cumulative effects analysis.

Wilderness

Affected Environment

Introduction

This section provides a general overview of wilderness, describes existing wilderness in Alaska and on the Tongass National Forest, discusses the relative contribution of Tongass wilderness to the National Wilderness Preservation System, and addresses wilderness management direction in Alaska. The only other National Forest in Alaska, the Chugach National Forest, currently has no designated wilderness, but includes 2 million acres of wilderness study area. None of the alternatives evaluated in this Environmental Impact Statement (EIS) include new Wilderness recommendations.

Wilderness Overview

The Wilderness Act of 1964 defines wilderness "as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." The Act further elaborates on the definition to mean:

> "an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which 1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; 2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; 3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and 4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Wilderness Character

The Wilderness Act does not define wilderness *character*, but according to Landres et al. (2005), wilderness character may be described as the "combination of biophysical, experiential, and symbolic ideals that distinguish wilderness from all other lands." Landres et al. identify four qualities of wilderness that may be used to approximate wilderness character for the purposes of monitoring changes to wilderness character over time. These qualities, which were identified based on the Definition of Wilderness, Section 2(c) from the 1964 Wilderness Act, and are described below, are equally important and reinforce one another. A fifth category, other features of value, has also been identified and is described below.

Untrammeled—The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man" and "generally appears to have been affected primarily by the forces of nature." This quality refers to wilderness being essentially unhindered and free from modern human control or manipulation.

Natural—The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." This quality refers to the intended and unintended effects of modern people on ecological systems inside wilderness since the time of designation.

Undeveloped—The Wilderness Act states that wilderness is "an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation." The undeveloped quality refers to the absence of structures, construction, habitations, and other evidence of modern human presence or occupation, including the development level of trails and campsites.

The undeveloped quality also refers to the absence of mechanical transport and motorized equipment. Wilderness was partly established "in order to assure that…growing mechanization, does not occupy and modify all areas within the United States…" (Wilderness Act, Section 2a).

Outstanding opportunities for solitude or a primitive and unconfined type of recreation—The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality includes the values of inspiration and physical and mental challenge. Primitive recreation in wilderness has largely been interpreted as travel by nonmotorized and nonmechanical means. It also encompasses reliance on personal skills to travel and camp in an area. Unconfined encompasses attributes such as self-discovery, exploration, and freedom from societal and managerial controls.

Other features of value—Wilderness preserves other tangible features that are of scientific, educational, scenic, or historical value. This quality is based on the last clause of section 2(c) of the Wilderness Act which states that a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historic value." This quality captures important elements of the wilderness that may not be covered in the other four qualities, such as cultural or paleontological resources. This quality is preserved or improved when these resources are preserved; the loss of or impacts to such features degrades this quality of wilderness character.

The existing wilderness on the Tongass was established under the 1980 Alaska National Interest Lands Conservation Act (ANILCA) and the 1990 Tongass Timber Reform Act (TTRA), which amended ANILCA. In ANILCA, Congress reaffirmed and expanded upon the purposes of wilderness as stated in the 1964 Wilderness Act, specifically for wilderness established in Alaska. Except as otherwise expressly provided for in ANILCA, wilderness designated by this Act shall be administered in accordance with applicable provisions of the Wilderness Act. In recognition of unique situations and established uses in Alaska, ANILCA provided a number of important specific exceptions to the prohibitions of the Wilderness Act. These included exceptions related to subsistence, access, and public use cabins among others. These exceptions are addressed in detail in the final part of this Affected Environment section.

Wilderness Values

People value wilderness for a variety of reasons, but most reasons involve three central themes: the *experiential* value, the *scientific* and *ecological resource* value, and the *symbolic* and *spiritual* values (slightly modified from Hendee and Dawson 2002). The *experiential* value is the direct value of the wilderness experience. The experience is seen as valuable in its own right because of its primitive recreation, aesthetic, closeness to nature, education, freedom, solitude, simplicity, spiritual, and mystical dimensions. The value of wilderness as a *scientific* and *ecological resource* includes the importance of wilderness to science, including its importance in preservation of fauna and flora, particularly those species requiring large tracts of unmodified habitats. Finally, the *symbolic* and *spiritual* values of wilderness are represented by the high values some people place on the knowledge that wilderness exists, whether they use it or not. In a world characterized by rapid change and complexity, wilderness symbolizes comforting stability and simplicity to many.

Wilderness in Alaska and the Tongass

Congress has the sole authority for designating additions to the National Wilderness Preservation System. Fourteen wildernesses totaling 5.5 million acres were established under ANILCA. Two of these wilderness areas on Admiralty Island and within Misty Fiords are encompassed by designated National Monuments.[1] Prior to ANILCA, there was no designated wilderness on the Tongass. The TTRA amended ANILCA and designated five new wildernesses and one wilderness addition totaling 296,080 acres. As a result of these two pieces of legislation, there are currently 5.8 million acres of wilderness on the Tongass in 19 separate wildernesses (Table 3.20-1).

Table 3.20-1
Existing Wildernesses on the Tongass National Forest

Name	Total Acres	Non-National Forest Acres	National Forest Acres
Wildernesses Established December 2, 1980, by ANILCA			
Kootznoowoo Wilderness (Admiralty Island National Monument)	988,050[1]	32,129	955,858[1]
Coronation Island Wilderness	19,232	0	19,232
Endicott River Wilderness	98,729	0	98,729
Maurelle Islands Wilderness	4,937	0	4,937
Misty Fiords National Monument Wilderness	2,142,907	600	2,142,307
Petersburg Creek-Duncan Salt Chuck Wilderness	46,849	0	46,849
Russell Fiord Wilderness	348,701	0	348,701
South Baranof Wilderness	319,568	0	319,568
South Prince of Wales Wilderness	91,018	50	90,968
Stikine-LeConte Wilderness	449,951	1,025	448,926
Tebenkof Bay Wilderness	66,839	27	66,812
Tracy Arm-Fords Terror Wilderness	653,179	0	653,179
Warren Island Wilderness	11,181	0	11,181
West Chichagof-Yakobi Wilderness	265,529	1,038	264,491
Wildernesses Established November 28, 1990, by the TTRA			
Chuck River Wilderness	74,990	692	74,298
Karta Wilderness	39,894	5	39,889
Kuiu Wilderness	60,581	0	60,581
Pleasant-Lemusurier-Inian Islands Wilderness	23,151	55	23,096
South Etolin Wilderness	83,371	752	82,619
Total Acreage	**5,788,657**	**36,436**	**5,752,221**

[1] Kootznoowoo Wilderness includes 18,486 acres, including 24 acres of Non-National Forest System lands in the Young Lake Addition established by the Tongass Timber Reform Act (TTRA), November 28, 1990.
Source: Total acreages are as reported to Congress with official boundary maps. These wildernesses include only the public lands above mean high tide.

Wilderness recommendations were not considered in the 1997 Land and Resource Management Plan (Forest Plan) Final Environmental Impact Statement

[1] Note that the Admiralty Island National Monument Wilderness was renamed the Kootznoowoo Wilderness by separate legislation in 1990.

(FEIS) and Record of Decision (ROD) because additional wilderness had been created under the TTRA. In March 2001, the U.S. District Court of Alaska ruled in response to a lawsuit filed by the Sierra Club (*Sierra Club v. Lyons*) and other environmental groups that the 1997 FEIS should have considered making additional wilderness recommendations and ordered the Forest Service to prepare a Supplemental EIS (SEIS) to evaluate wilderness recommendations and update the Analysis of the Management Situation (AMS) relative to roadless areas and their relative contribution to the National Wilderness Preservation System. The Forest Service subsequently updated the AMS and determined the eligibility of each of the inventoried roadless areas for wilderness recommendation. Eight alternatives that identified roadless areas within the Tongass for recommendation as potential wilderness were evaluated in a Final SEIS to the 1997 Forest Plan FEIS in 2003 (USDA Forest Service 2003b). The ROD for the Final SEIS concluded that it was not "the appropriate time for significantly changing land use designations on the Tongass National Forest" and did not recommend any additional wilderness on the Tongass at that time (USDA Forest Service 2003b).

Relative Contribution of Tongass Wilderness

Overview

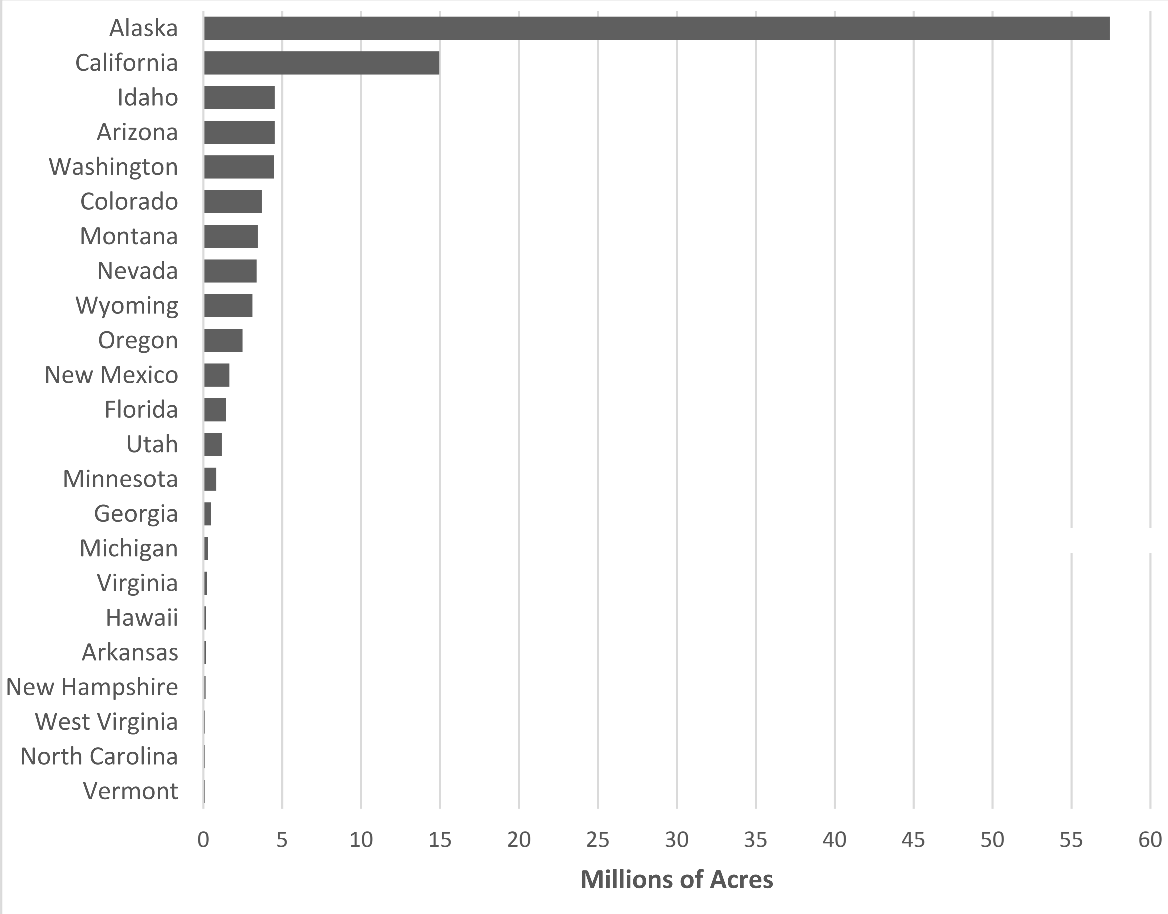
The National Wilderness Preservation System includes almost 110 million acres, with more than half of this total (57 million acres) in Alaska (Figures 3.20-1 and 3.20-2). In addition to having the largest total land area in wilderness, Alaska also has the highest proportion of its land area in wilderness (15.4 percent), followed closely by California (13.8 percent) (Figure 3.20-3). The states with both the greatest land area and highest percent land area in wilderness are Alaska, California, Washington, Idaho, Arizona, and Colorado (Wilderness.net 2014).

Alaska also has the highest number of wilderness acres per resident, with almost 90 acres per resident. This ratio increases to slightly more than 120 acres per resident when only Southeast Alaska is considered. The next closest state is Wyoming with about 6 acres of wilderness per resident.

Existing wilderness on the Tongass, approximately 5.8 million acres, represents about 34 percent of the forest land base and 28 percent of the land in Southeast Alaska. Viewed on a national basis, existing wilderness on the Tongass represents 16 percent of all wilderness on NFS lands and 5.3 percent of all lands in the National Wilderness Preservation System (Wilderness.net 2014).

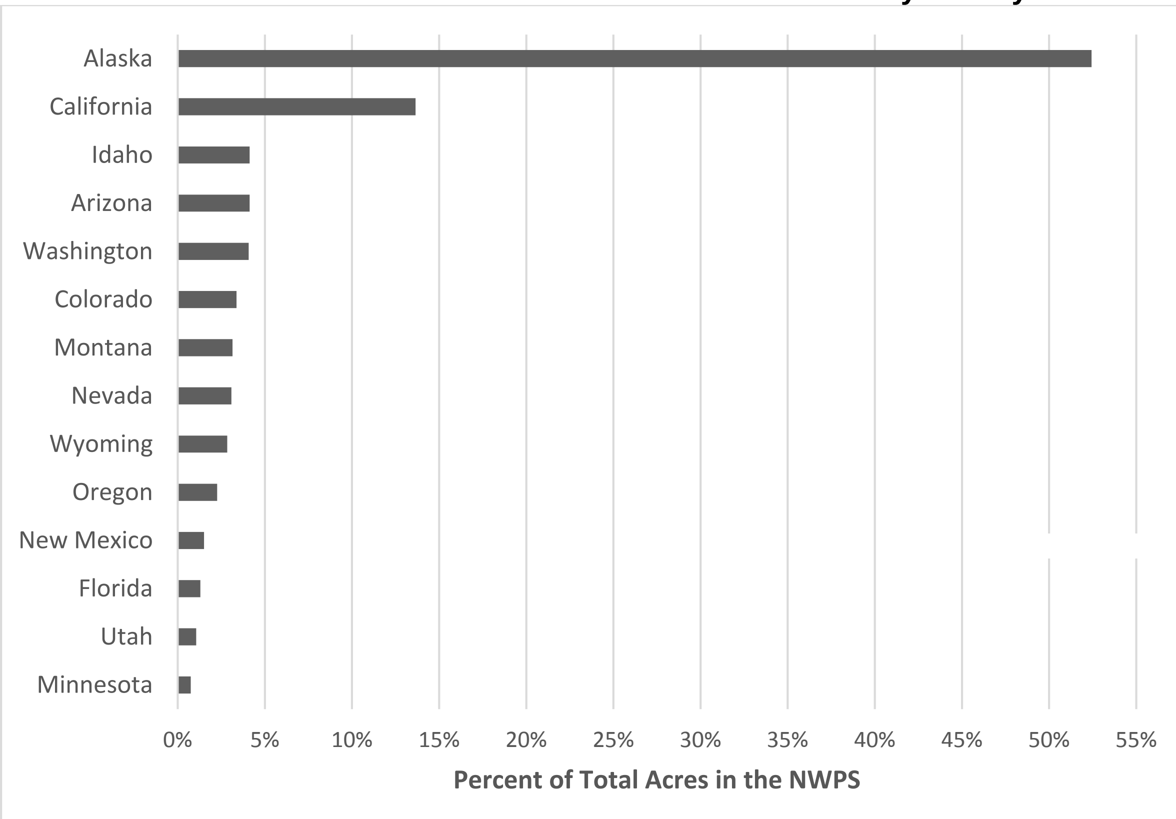
Two of the largest wildernesses on the Tongass, Misty Fiords National Monument Wilderness (2.1 million acres) and Kootznoowoo (Admiralty Island) Wilderness (almost 1 million acres), contain vast, intact ecosystems. Five other wildernesses are each more than 250,000 acres. The wildernesses of the Tongass are mostly in a pristine condition, with the imprint of humans generally not noticeable. They offer outstanding opportunities for solitude and primitive recreation.

Figure 3.20-1
Acres of Wilderness by State



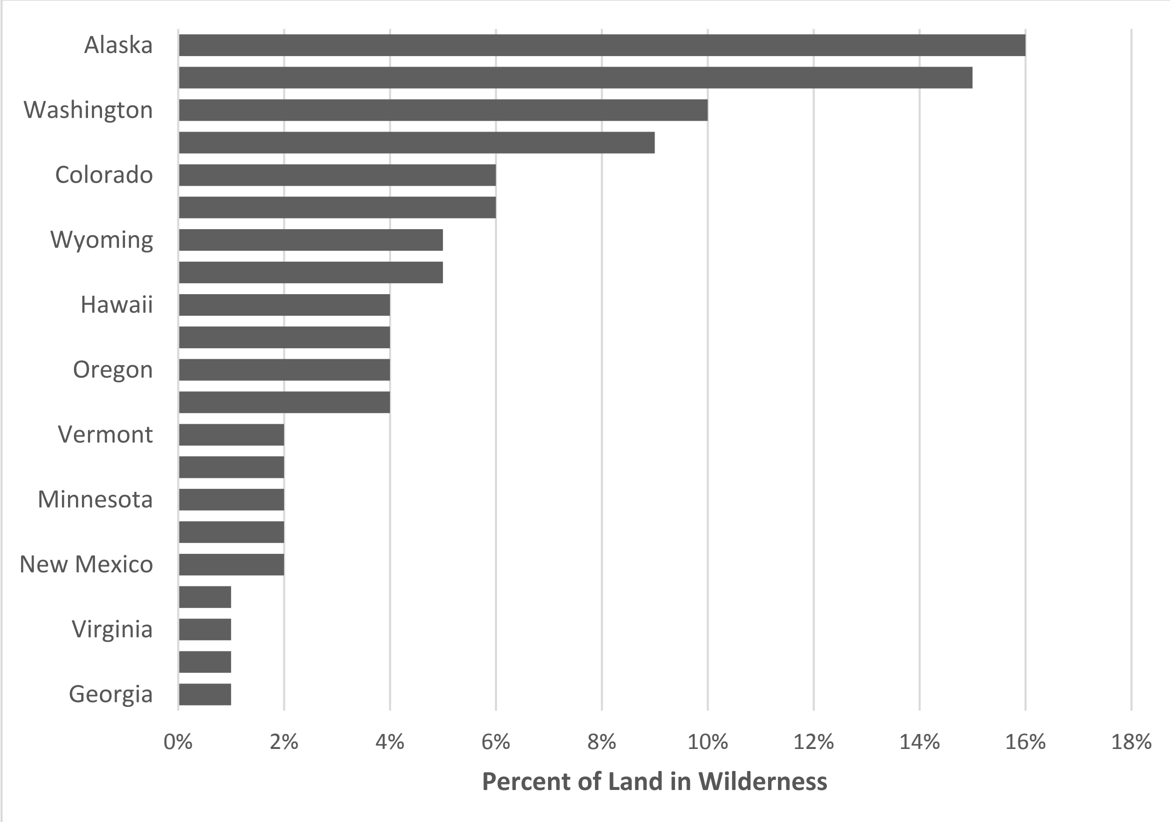
Source: Wilderness.net (2014)

Figure 3.20-2
Percent of Total Acres in the National Wilderness Preservation System by State



Source: Wilderness.net (2014)

Figure 3.20-3
Percentage of Land Area in Wilderness by State



Source: Wilderness.net (2014)

In the remainder of this section, the Tongass National Forest is evaluated in terms of how well its landforms and ecosystems are represented in existing wilderness.

Ecoregions

DeVelice and Martin (2001) provide a national summary of acreage in National Forest roadless areas versus designated wilderness, National Parks, and other areas primarily managed to maintain natural values (i.e., conservation reserves or reserves). In Alaska, all but 1 of 15 ecoregions (as defined by Ricketts et al. 1999) have greater than 12 percent of their area in reserves. No other region in the country surpasses Alaska in ecological representation in reserves.

Two ecoregions cover the Tongass National Forest: the Northern Pacific Coastal Forest and the Pacific Coastal Mountain Tundra and Ice Fields (Ricketts et al. 1999). These two ecoregions extend from eastern Kodiak Island to the southern end of the Alaska panhandle. Approximately 19 percent of the Northern Pacific Coastal Forest and 37 percent of the Pacific Coastal Mountain Tundra and Ice Fields ecoregions are in reserves (DeVelice and Martin 2001). The portions of both of these areas protected in wilderness are above the 12 percent threshold considered by some authorities (e.g., World Commission on Environment and Development 1987) as the minimum area for representation (DeVelice and Martin 2001).

When the acreage of inventoried roadless areas is added to the acreage of conservation reserves in the two ecoregions, the percentage increases to 64 percent for the Northern Pacific Coastal Forest and 66 percent for the Pacific Coastal Mountain Tundra and Ice Fields ecoregions (DeVelice and Martin 2001). These values are in the 25 to 75 percent range that Noss and Cooperrider (1994) argue is required to achieve representation and are higher than the 12 percent threshold.

When one considers only NFS lands, the percentage of NFS lands area in wilderness in these ecoregions is 25 percent for the Northern Pacific Coastal Forest and 21 percent for the Pacific Coastal Mountain Tundra and Ice Fields. If all inventoried roadless areas are counted along with wilderness, the total area of wilderness plus inventoried roadless areas on the Tongass in these ecoregions increases to 69 percent and 79 percent, respectively (DeVelice and Martin 2001).

Land Cover Classes

The various ecosystems of Southeast Alaska are generally represented within the Tongass' wilderness. These areas include glaciers and ice fields, off-shore islands and seacoasts facing both the open Pacific Ocean and inland passages, major river systems, and 1.5 million acres of old-growth temperate rain forests. Viewed in terms of broad National Forest land cover classes, designated Wilderness on the Tongass exceeds 12 percent of the area in five land cover classes that are prevalent in Southeast Alaska. These five classes are: 1) Evergreen Forest (23 percent), 2) Tundra (15 percent), 3) Barren Land (37 percent), 4) Water (23 percent), and 5) Glaciers-Snow (15 percent). Designated Wilderness does not exceed 12 percent of the area for Deciduous Forest (0 percent), Mixed Forest (0 percent), and Shrub-Brush (9 percent) (Martin et al. 2000). However, these latter three land cover types are not prevalent in Southeast Alaska.

Biogeographic Provinces

The extent to which identifiable landform types and ecosystems are represented in the wildernesses (and other natural setting Land Use Designations [LUDs]) of the Tongass National Forest may be evaluated based on the extent to which the biogeographic provinces of Southeast Alaska are represented. The Tongass can be subdivided into 21 biogeographic provinces characterized by similar species composition, similar patterns in distribution for many species, similar geologic barriers and historic events (such as glaciation), and similar climatic conditions. These provinces are discussed in the Biodiversity section of this chapter. Table 3.20-2 identifies the percentage of each biogeographic province that is included in existing wilderness. It also includes the percentage of each biogeographic province in other natural setting LUDs.

Twelve of the 21 biogeographic provinces on the Tongass have 20 percent or more of their lands within the National Forest boundary in Wilderness or National Monument; 16 of the 21 have 15 percent or more. Five provinces (Dall Island and Vicinity, Kupreanof/Mitkof Island, and North Central Prince of Wales) have from 1 to 6 percent in Wilderness or National Monument. However, these areas have from 37 to 80 percent of their land areas within wilderness or natural setting LUDs. Overall, 18 of the 21 provinces have more than 50 percent of their land areas in either wilderness or natural setting LUDs. The remaining three have 37 to 42 percent.

Table 3.20-2
Percentage of Biogeographic Province in Existing Wilderness or Natural Setting LUDs

	Province	Percent in Wilderness or National Monument	Percent in Other Natural Setting LUDs[1]	Total Percent in Wilderness or Natural Setting LUDs[1]
1	Yakutat Forelands	1	78	79
2	Yakutat Uplands	37	63	100
3	East Chichagof Island	6	50	56
4	West Chichagof Island	82	18	100
5	East Baranof Island	24	52	75
6	West Baranof Island	29	57	86
7	Admiralty Island	93	6	99
8	Lynn Canal	17	64	81
9	North Coast Range	23	56	78
10	Kupreanof/Mitkof Island	6	34	40
11	Kuiu Island	26	40	66
12	Central Coast Range	39	38	77
13	Etolin Island	16	26	42
14	North Central Prince of Wales	3	34	37
15	Revilla Island/Cleveland	18	42	60
16	South Outer Islands	16	57	73
17	Dall Island and Vicinity	3	77	80
18	South Prince of Wales	24	41	64
19	North Misty Fiords	82	14	95
20	South Misty Fiords	100	0	100
21	Ice Fields	33	62	95
	Total	**33**	**43**	**76**

Wilderness Management in Alaska

Management under the Wilderness Act

The Wilderness Act of 1964 mandates that designated "wilderness areas … shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness."

Subject to existing private rights, the Act prohibits permanent roads and, except as necessary for realizing the recreation and other wilderness purposes of the area, commercial enterprises. Temporary roads, the use of motor vehicles, motorized equipment, other mechanized equipment, motorboats, the landing of aircraft, and structures and installations are prohibited except as necessary to meet minimum requirements for the administration of the area as wilderness. The Act provides that the use of aircraft or motorboats, where these uses were established prior to designation, may be permitted to continue subject to restrictions by the Secretary of Agriculture. In 1997, the Regional Forester decided to maintain a prohibition on recreational helicopter use within wilderness. Wildernesses were withdrawn from mineral entry as of December 31, 1983, and patenting of valid claims is limited to subsurface mineral rights.

Management under the Alaska National Interest Lands Conservation Act

In ANILCA, Congress reaffirmed and expanded upon the purposes of wilderness as stated in the Wilderness Act of 1964, specifically for wilderness established in Alaska. In recognition of unique situations and established uses in Alaska, ANILCA also provided a number of exceptions to the requirements of the Wilderness Act.

Subsistence Policy (Applies to All Federal Lands)

Section 811 mandates that the Secretary "shall ensure that rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public lands." This section further directs that, other laws (including the Wilderness Act) notwithstanding, the Secretary "shall permit on the public lands appropriate use for subsistence purposes of snowmobiles, motorboats, and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulation."

Transportation and Utility Systems

In Section 1101, Congress finds that:

> "(a) Alaska's transportation and utility network is largely undeveloped and the future needs for transportation and utility systems in Alaska would best be identified and provided for through an orderly, continuous decisionmaking process involving the State and Federal Governments and the public."

Section 1105 provides that in any case in which there is no applicable law with respect to a transportation or utility system, the head of the federal agency concerned shall make recommendations to authorize the system within the Conservation Unit concerned (including Wilderness) if it is determined that the system would be compatible with the purposes for which the unit was established, and there is no economically feasible and prudent alternative route for the system (see Section 1104 regarding National Environmental Policy Act [NEPA] procedural requirements). Section 1106(b) requires that following federal agency review and decision recommendation, the President has the authority to review and either approve or disapprove the application. If the application is approved by the President, Congress must issue a joint resolution approving the application by the transportation or utility system for the project to move forward (Section 1106(c)). ANILCA (Section 506) includes specific exceptions for Admiralty Island National Monument Wilderness regarding the right to develop hydroelectric resources and public access and use.

Special Access

Section 1110(a) requires that the Secretary "shall permit" on Conservation Units, which include Wilderness, "the use of snowmachines (during periods of adequate snow cover or frozen river conditions, in the case of Wild or Scenic rivers), motorboats, airplanes, and nonmotorized surface transportation methods for traditional activities (where such activities are permitted by this Act or other law) and travel to and from villages and homesites." Such use is subject to reasonable regulation, but shall not be prohibited unless after notice and hearing the Secretary finds that such use would be detrimental to the resource values of the area.

Inholding Access

Section 1110(b) assures adequate and feasible access to state and private land and to valid occupancies, including valid mining claims.

Navigation Aids and Facilities

Section 1310(a) provides that reasonable access to, and operation and maintenance of, existing air and water navigation aids, communication sites, facilities for national defense, and related facilities and existing facilities for weather, climate and fisheries research, and monitoring shall be permitted. "Nothing in the Wilderness Act shall be deemed to prohibit such access, operation and maintenance within wilderness areas designated by this Act." Section 1310(b) provides that the establishment, operation, and maintenance of new such facilities shall be permitted within wilderness after consultation with the Secretary and in accordance with mutually agreed upon terms and conditions to minimize the adverse effects within the unit.

Aquaculture

Section 1315(b) provides that the Secretary may permit fishery research, management, enhancement, and rehabilitation activities within National Forest System Wilderness, in a manner that adequately assures protection, preservation, enhancement, and rehabilitation of the wilderness resource. Subject to reasonable regulations, permanent improvements and facilities such as fishways, fish weirs, fish ladders, fish hatcheries, spawning channels, stream clearance, egg planting, and other accepted means of maintaining, enhancing, and rehabilitating fish stocks may be permitted.

Public Use Cabins

Section 1315(c) provides for the continued use, maintenance, and replacement of existing public use cabins within wilderness. Section 1315(d) authorizes the construction and maintenance of a limited number of new public use cabins and shelters, if necessary, for public health and safety, and also requires the Secretary to notify Congress of his intention to remove an existing or construct a new public use cabin or shelter.

Beach Log Salvage

Section 1315(f) allows the Secretary to permit or otherwise regulate the recovery and salvage of logs from the coastlines of National Forest Wilderness and National Monuments. Agency policy further defines the salvage of logs to include only the recovery of logs that were harvested and then lost in transport. Downed trees resulting from natural forces, such as blow down, and stream bank or shore erosion shall not be sold or removed under this authority. Removal where allowed will normally be accomplished by the use of "pull boats" (boats that pull logs off the beach by long cable usually at high tides) without use of other mechanical devices on the beach.

Temporary Hunting and Fishing Facilities

Section 1316(a) provides that the Secretary shall permit, subject to reasonable regulation to ensure compatibility, the continuation of existing uses and future establishment and use of temporary campsites, tent platforms, shelters, and other temporary facilities and equipment directly and necessarily related to the taking of fish and game. Facilities and equipment shall be constructed, used, and maintained in a manner consistent with the protection of the area where they are located. New facilities shall be constructed of materials that blend with and are compatible with the surrounding landscape. Section 1316(b) allows the Secretary to deny new facilities and equipment upon making a determination, after public notice, that the establishment and use of new facilities or equipment would constitute a significant expansion of existing facilities or uses that would be detrimental to the purposes for which the unit was established, including "wilderness character."

Other Forest Plan Restrictions

ANILCA defines “wilderness” as having the same meaning as when it is used in the Wilderness Act (Sec. 102(13)). Section 707 states that, except as expressly provided in ANILCA, wilderness designated by ANILCA “shall be administered in accordance with applicable provisions of the Wilderness Act governing areas designated by that Act as Wilderness.” Some of the restrictions identified for Tongass wilderness by the 2008 Forest Plan include the following:

- New roads, motorized trails, and airstrips are not permitted, except where authorized by ANILCA and to access state and private inholdings and valid mining claims, subject to stipulations for protection of natural and other values of the land.
- The landing of helicopters for access by the general public is prohibited. The administrative use of helicopters may be allowed on a case-by-case basis after evaluation of the need and full consideration of all alternative options for access.
- There is a group size limitation of no more than 12 persons for commercial or general public use, unless otherwise approved by the appropriate line officer.
- No new permanent administrative facilities are allowed, except as consistent with ANILCA.

Environmental Consequences

None of the alternatives include lands suitable for timber production. Therefore, there would be no direct effects to Wilderness from timber harvest. Potential indirect effects from timber harvest and direct and indirect effects from renewable energy development to Wilderness are discussed below.

Direct and Indirect Effects

Existing wilderness on the Tongass, which encompasses approximately 5.7 million acres and represents about 34 percent of the forest land base and 28 percent of the land in Southeast Alaska, would remain unchanged under all of the alternatives. The 19 wildernesses on the Tongass are identified in Table 3.20-1. The acres of each biogeographic province presently in Wilderness areas on the Tongass would also remain unchanged (see Table 3.20-2).

Wilderness areas may be indirectly affected if old-growth or young-growth harvest, including associated road construction, takes place in an adjacent area. Depending on the actual location and extent of harvest, there could be edge-related effects, increasing the potential for impacts to portions of Wilderness boundary areas. Such impacts could include introduced non-native or invasive plant species, vulnerability to windthrow events, noise from harvest activities, reduced scenic quality, and unauthorized recreation access. The effects of individual proposed harvest projects on Wilderness would be analyzed in a site-specific NEPA analysis.

All renewable energy projects built and operated in Southeast Alaska have to meet local, state and, in most cases, federal laws, regulations, and requirements. Projects are also subject to Forest Plan direction (e.g., standards and guidelines). The 2008 Forest Plan identifies three types of areas related to Transportation and Utility Systems, including hydroelectric power projects on the Tongass based on the LUD windows, which represent areas potentially available for transportation and utility development; avoidance areas; and exclusion areas. Avoidance areas are those LUDs where development of energy projects is only allowed if no feasible alternative exists outside of that LUD. Exclusion areas preclude Transportation and Utility Systems. There are no exclusion areas on the Forest due to special authorities provided in ANILCA, Title XI. The Wilderness, Wilderness National Monument, and Non-Wilderness National Monument LUDs are identified as avoidance areas in the 2008 Forest Plan. These classifications and the standards and guidelines in the 2008 Forest Plan would continue to apply under Alternative 1.

Under Alternatives 2 through 5, renewable energy direction in Chapter 5 of the Forest Plan would be applied to the LUDs, similar to how the forest-wide standards and guidelines in Chapter 4 of the Forest Plan are applied to the LUDs. Renewable energy direction in Chapter 5 identifies the following with respect to the suitability of lands: "SUIT-RE-01**:** All NFS lands may be suitable for renewable energy sites on a case-by-case basis in consideration of the LUD, ecological and social values, and benefit to Southeast Alaska communities." This direction also states that "(i)dentifying renewable energy sites as suitable is not a commitment but only an indication that the use might be appropriate."

Implementation of the renewable energy direction under Alternatives 2 through 5 may simplify the administrative process for projects; however, the change would not likely result in an increase in the number of projects developed due to the ANILCA Title XI requirements for Forest Service assessment of alternatives and the requirement for Presidential and Congressional approval. All proposed projects would continue to be evaluated in accordance with applicable local, state, and federal regulations and requirements.

The Forest Service has identified 12 proposed renewable energy projects that are currently active (Table 3.12b-3). One of the identified projects is located in Wilderness. The Angoon Hydroelectric project is exempted from the requirements of the Wilderness Act through ANILCA Section 506 (a)(3)(D).

Cumulative Effects

There would be no direct effects and minimal indirect effects to Wilderness from timber harvest under any of the alternatives. One of the 12 proposed renewable energy projects is located in Wilderness: the Angoon Hydroelectric project. The Angoon Hydroelectric project is exempted from the requirements of the Wilderness Act through ANILCA section 506 (a)(3)(D). Given the current regulatory protections in place for Wilderness, the potential for cumulative effects associated with timber harvest or renewable energy development is low. Appendix C provides a list and description of the past, present, and reasonably foreseeable future projects considered in the cumulative effects analysis.

This page is intentionally left blank.

Other Special Land Use Designations

A number of areas on the Tongass National Forest have been allocated to special Land Use Designations (LUDs) because they possess outstanding resources, research opportunities, or other factors of special interest. These areas include LUD II management areas, Experimental Forests, Research Natural Areas (RNAs), Special Interest Areas, and Wild and Scenic Rivers. Each of these is described in this section, as are the effects of the alternatives on these areas.

Affected Environment

Land Use Designation II Management Areas

The Tongass Timber Reform Act of 1990 (TTRA) amended the Alaska National Interest Lands Conservation Act (ANILCA), and designated 12 areas encompassing 726,862 acres to LUD II management areas (Table 3.21-1). On December 19, 2014, the National Defense Authorization Act for Fiscal Year 2015[1] designated eight LUD II management areas (Table 3.21-1), encompassing 151,832 acres for a combined total of 878,694 acres (Table 3.21-1). The goal for LUD II areas is to manage them in a roadless state to retain their wildland character. Minor developments may be compatible with LUD II objectives depending on the specific proposal. Also, access by boats, aircraft, and snowmachines is permitted so long as such uses do not become excessive.

Table 3.21-1
National Forest System Land and Non-National Forest System Land within LUD II Areas

LUD II Area	Acres
LUD II Areas Established by the Tongass Timber Reform Act	
Yakutat Forelands	137,477
Berners Bay	46,314
Anan Creek	38,326
Kadashan	34,124
Lisianski River/Upper Hoonah Sound	147,114
Mt. Calder/Mt. Holbrook	60,066
Nutkwa	21,445
Outside Islands	75,218
Trap Bay	6,471
Point Adolphus/Mud Bay	117,427
Naha	31,546
Salmon Bay	11,334
Subtotal	***726,862***

[1] Public Law No. 113-291, December 19, 2014, 128 Stat. 3729, section 3720(e)(4).

Table 3.21-1 (continued)
National Forest System Land and Non-National Forest System Land within LUD II Management Areas

LUD II Area	Acres
LUD II Areas Established by Public Law 113-291	
Bay of Pillars	20,836
Kushneahin Creek	33,515
Northern Prince of Wales	8,724
Western Kosciusko	8,023
Eastern Kosciusko	1,657
Sarkar Lakes	24,509
Honker Divide	19,809
Eek Lake and Sukkwan Island	34,759
Subtotal	***151,832***
Grand Total	**878,694**

Experimental Forests

Experimental forests provide areas for conducting forest management-related research. Natural resources in experimental forests are used or altered under controlled scientific studies. The Tongass has two experimental forests, Maybeso and Héen Latinee, with a combined area of about 36,264 acres.

Maybeso

The Maybeso Experimental Forest (10,644 acres) was established in the early 1950s as a part of an intensive research program to document the effects of large-scale harvesting on hydrology, fisheries, and timber productivity. The forest is located in a large steep-sided alluvial valley with a south to southeast-facing aspect near the central-eastern coast of Prince of Wales Island. By the early 1960s, most of the suitable forest land on the experimental area had been harvested. Permanent research plots were established and monitored to study hillslope erosion, movement of large woody debris in and through streams, forest regeneration, and silvicultural responses to precommercial thinning. Most of these plots are still monitored. The upper slopes of the Maybeso watershed are included in the Karta Inventoried Roadless Area (IRA) (IRA # 510).

Because nearly all of the old-growth timber on the Maybeso Experimental Forest has been harvested for research, the timber in the area is now primarily young growth. Consequently, while there are limited opportunities to design new old-growth harvest-related experiments, there exists the potential for experiments concerning young-growth timber which is now up to 45 years in age. Several recent young-growth studies have taken place in this area.

Héen Latinee

Héen Latinee Experimental Forest (25,621 acres) was established on June 25, 2009, as a site for coastal temperate rainforest research (USDA Forest Service 2009c). Located 37 miles north of Juneau, the forest extends from temperate rain forests on the shores of Lynn Canal to alpine tundra bordering the Juneau Icefield. The area represents a nearly undeveloped watershed that is readily accessible and provides opportunities to study ecological systems ranging from glacier to marine environments. The Héen Latinee Experimental Forest was established to provide:

1. Lands for conducting scientific research that serves as a basis for the management of temperate rainforests in the Alaska Region of the Forest Service;

2. Opportunities and facilities for the general public, Forest Service staff, and other cooperating organizations such as universities to pursue scientific inquiry and education; and

3. Monitoring data to inform society about the trajectory and speed of climate change.

This Experimental Forest consists of Cowee and Davies Watersheds and is referred to as the Cowee-Davies Experimental Forest in the 2008 Tongass National Forest Land and Resource Management Plan (Forest Plan), Appendix L (USDA Forest Service 2008a).

Young Bay (de-established)

The Young Bay Experimental Forest (6,660 acres) was de-established in 2009 in the Record of Decision (ROD) that established the Héen Latinee Experimental Forest (USDA Forest Service 2009c). The Young Bay Experimental Forest was located just south of Juneau on northern Admiralty Island. Originally selected for long-term hydrologic and fisheries monitoring with a paired comparison between streams, this site was used extensively for fisheries and hydrology research in the 1960s and 1970s. The area is currently managed as Semi-Remote Recreation LUD.

Research Natural Areas

RNAs are part of a national network of ecological areas designated for research and education and/or to maintain biological diversity of representative ecosystems on NFS lands. RNAs are used for non-manipulative research, observation, and study. These areas also may serve to carry out provisions of special acts, such as the Endangered Species Act and the monitoring provisions of the National Forest Management Act.

Current Situation

Six RNAs were established within the Tongass National Forest prior to 1996. One of the six, Pack Creek, was declassified in the ROD for the 1997 Tongass Forest Plan due to a long history of human presence related to viewing brown bears. At the same time, Pack Creek was re-designated as a zoological area to be managed under the Special Interest Area LUD. Seven additional areas were classified as RNAs by the 1997 ROD. That action resulted in the current total of 12 Tongass RNAs incorporating a total area of 66,998 acres. Brief descriptions of each follow below.

Cape Fanshaw RNA

Established in 1965, this 573-acre RNA is located at the junction of Frederick Sound and the Stephens Passage in Roadless Area 201. This area was established to represent undisturbed old-growth yellow-cedar and western hemlock forests. It represents a good example of cedar decline on the mainland, and has been used for long-term monitoring of changes in species composition and stand dynamics.

Dog Island RNA

Established in 1976, this 705-acre RNA is located on Dog Island in Roadless Area 521. The area represents a small island ecosystem containing the northern limit of Pacific yew (*Taxus brevifolia*), associated scrub timber, and low-volume, mixed-conifer sites of southern Southeast Alaska.

Kadin Island RNA

Established in 1997, this 1,630-acre RNA is located just north of Wrangell in Roadless Area 225. Kadin Island experiences high winds blowing down through the Stikine River corridor. The high winds pick up silt from the unvegetated glacial river floodplain and cause the deposition of loess on the island at the river's mouth. The continuing rain of loess onto the upper soil layers provides a supply of unleached, nutrient-rich soil material to the forests of the island. The loess deposition overcomes the process of acid bog formation (paludification) that overtakes most stable sites of moderate topographic relief on the Tongass National Forest. Few areas in the world have a combination of high rainfall and recent loess deposition, so the properties of the soils here are of special interest. The fringe of the island is subject to tidal influence and changes in water level because of shifts of the river. Wetland marsh communities are included in this area. The bald eagle nest concentration on Kadin Island is second only to parts of Admiralty Island, according to the U.S. Fish and Wildlife Service (USFWS).

Marten River RNA

Established in 1997, this 7,459-acre RNA is located within the Misty Fiords National Monument Wilderness adjacent to the Red River RNA. The Marten River RNA contains riparian spruce stands and has excellent habitat for brown bears along its major mainland streams.

Limestone Inlet RNA

Established in 1951 and expanded in 1971, this 8,964-acre RNA is located in Stephens Passage in Roadless Area 302. The area represents typical vegetation types common to the Juneau mainland, including many avalanche chutes and a mainland stream. In 1951, Limestone Inlet was considered the most pristine drainage in the northern mainland coast, making it an excellent area for documenting baseline conditions on the mainland. The Alaska Department of Fish and Game (ADF&G) has altered the native salmon runs since 1980 by operating a hatchery in nearby Snettisham Lake; however, upland areas remain intact.

Old Tom Creek RNA

Established in 1951, this RNA, 4,544 acres in size prior to Public Law 113-291, has been reduced to 1,335 acres or about 30 percent of its original size. Located on central Prince of Wales Island in Roadless Area 519, this RNA is situated in a low-site, cedar-dominated watershed. Established as an example of cedar-hemlock old-growth forest, the RNA also includes some examples of riparian spruce forest, extensive tidal meadows, and dense bald eagle and black bear populations. The RNA also included a U.S. Geological Survey (USGS) gauging station. Prior to the reduction in size, this RNA was functioning as part of a medium old-growth reserve (OGR). Following the reduction, there is no longer a medium OGR. As a result, this area was one of the areas re-evaluated by an interagency team of biologists (Forest Service, USFWS, and ADF&G). The new location for a medium OGR in this area as proposed by this interagency team is discussed in detail in Appendix E.

Red River RNA

Established in 1980, this 8,004-acre RNA is located in Misty Fiords National Monument Wilderness. This RNA represents the northern range of Pacific silver fir (*Abies amabilis).*

Rio Roberts RNA

Established in 1997, this 1,621-acre RNA is located on central Prince of Wales Island in Roadless Area 511. This area contains riparian flood plain spruce stands, upland old-growth and natural young-growth stands, and upland hemlock on drumlin fields. A high level of recreation use occurs in the area, including hiking, camping, boating, and fishing in the Thorne River near this RNA. As a result of Public Law 113-291, the Rio Roberts RNA is now included within the Honker Divide LUD II area.

Robinson Lake RNA

Established in 1997, this 6,473-acre RNA is located in the Misty Fiords National Monument Wilderness. This RNA focuses on a natural slump lake, forest types typical of the southern portion of mainland Southeast Alaska, and some uncommon plants of restricted distribution in Alaska. Robinson Lake formed when a natural earthslide dammed Robinson Creek. The area extends to the shore of Behm Canal to include habitat diversity associated with the shoreline and proximity to deep water.

Tonalite Creek RNA

Established in 1997, this 10,037-acre RNA is located south of Tenakee Springs across Tenakee Inlet in Roadless Area 311. This RNA includes pristine examples of Sitka spruce, western and mountain hemlock, and yellow cedar forest types. The Tonalite drainage is a narrow glacial valley that supports runs of pink, chum, and coho salmon. The drainage is prime brown bear, Sitka black-tailed deer, and beaver habitat.

Warm Pass Valley RNA

Established in 1997, this 8,401-acre RNA is located along the U.S.-Canada border between the Taku River and Chilkat Pass in Roadless Area 301; the valley includes the northernmost example of subalpine fir in Alaska. The valley is also an important area for interior vegetation species that mix with the coastal forest and tundra. The Warm Pass Valley RNA has a unique climate caused by a pronounced rain shadow effect. The valley supports a moose population that uses both the alpine shrub belt and riparian shrubs at lower elevation.

West Gambier Bay RNA

Established in 1997 to replace the Pack Creek RNA, this 11,976-acre RNA is located at the head of the west arm of Gambier Bay in Admiralty Island National Monument-Kootznoowoo Wilderness. The area includes long, narrow Pybus Lake and several smaller lakes; productive wildlife habitat; an anadromous fish stream; and a variety of geological features, including karst. West Gambier Bay contains forest and nonforest vegetation types typically found on the islands of northern Southeast Alaska.

Special Interest Areas

Special Interest Areas are areas possessing unique or unusual scenic, historic, prehistoric, scientific, natural, or other characteristics. The objective of designating and managing such areas is to protect their unique values and, foster public use and enjoyment of these areas. Special Interest Areas may be designated as scenic, recreation, historic, archaeological, geological, botanical, zoological, or paleontological areas. Special Interest Areas differ from RNAs in that management may promote public use as well as scientific study.

Special Interest Area designations are intended to maintain natural to near-natural conditions in most cases; the Recreation Area designation may include developed facilities within a natural or near-natural setting. The resources contained within these areas are not available for development, except for public facilities designed to allow recreation use while protecting the values of the area, or for interpretation and scientific study. Each area may require unique management direction determined through individualized study and planning. Special Interest Areas may be withdrawn from mineral entry. The LUD for Special Interest Areas applies to all the designated areas.

Current Situation

Thirty-four Special Interest Areas have been designated within the Tongass National Forest. Eight of the 34 areas were designated prior to the 1997 Forest Plan:

- Mendenhall Glacier Recreation Area (5,791 acres)
- Ward Lake Recreation Area (440 acres)
- Walker Cove-Rudyerd Bay Scenic Area (93,540 acres)
- Admiralty Lakes Recreation Area (8,710 acres)
- New Eddystone Rock Geological Area (1 acre)
- Hubbard Glacier Geological Area (46,000 acres)
- Tracy Arm-Fords Terror Scenic Area (283,000 acres)
- Naha Recreation Area (2,363 acres)

A further 16 Special Interest Areas, plus one expansion, were identified and designated with the 1997 Forest Plan as follows:

- Arena Cove/Cape Felix Geological Area (9,465 acres)
- Bailey Bay Hot Springs Recreation Area (3,510 acres)
- Blind Slough Scenic and Zoological Area (8,150 acres)
- Blue River Lava Flow Geological Area (13,520 acres)
- Clear River Zoological Area (11,530 acres)
- Duke Island Zoological Area (44,650 acres)
- Falls Creek Windthrow Botanical Area (820 acres)
- Fish Creek Hot Springs Recreation Area (100 acres)
- Karst Areas Geological Areas (multiple areas totaling 13,635 acres)
- Keku Islets Geological and Scenic Area (2,300 acres)
- Mount Edgecumbe Geological Area (49,050 acres)
- North Hamilton River Redcedar Cultural and Botanical Area (80 acres)
- Pack Creek Zoological Area (5,837 acres)
- Patterson Glacier Geological and Botanical Area (13,900 acres)
- Pike Lakes Recreation Area (2,340 acres)
- Soda Springs Geological Area (3,515 acres)
- Ward Lake Recreation Area Expansion (7,535 acres)

The remaining 10 Special Interest Areas were identified and designated in the 2008 Forest Plan. These areas are all geologic areas and most of them contain unique karst features. The 10 geologic areas are described in Appendix L to the 2008 Forest Plan (USDA Forest Service 2008a).

- Big Creek Geological Area (2,000 acres)
- Blake Channel Geological Area (700 acres)
- Calamity Creek Caves Geological Area (200 acres)
- Dall Island Geological Area (13,600 acres)
- Eastern Chichagof Geological Area (23,900 acres)
- Heceta Geological Area (4,100 acres)
- Kosciusko Geological Area (8,700 acres; reduced by 700 acres by Public Law 113-291)
- Northern Prince of Wales Geological Area (2,400 acres; reduced by 400 acres by Public Law 113-291)
- North-Central Prince of Wales Geological Area (700 acres)
- Suemez Island Volcanics Geological Area (7,100 acres)

Eight of the Special Interest Areas are within Wildernesses, National Monuments, or LUD II areas. These areas are managed in a way that accounts for the Wilderness, National Monument, or LUD II area surrounding them. They include the following:

- Admiralty Lakes Recreation Area (Admiralty Island National Monument and Kootznoowoo Wilderness)
- Blue River Lava Flow Geological Area (Misty Fiords National Monument and Wilderness)
- Hubbard Glacier Geological Area (Russell Fiord Wilderness)
- Naha Recreation Area (Naha LUD II)
- New Eddystone Rock Geological Area (Misty Fiords National Monument and Wilderness)
- Pack Creek Zoological Area (Admiralty Island National Monument and Kootznoowoo Wilderness)
- Tracy Arm-Fords Terror Scenic Area (Tracy Arm-Fords Terror Wilderness)
- Walker Cove-Rudyerd Bay Scenic Area (Misty Fiords National Monument and Wilderness)

The Tongass also contains a portion of the 5-acre Fort Durham National Historic Landmark (most of which is on private land).

Special Interest Areas are not considered suitable for timber production, and roads are allowed only if they are compatible with the interpretive goals of a particular area. Other restrictions may be imposed on a case-by-case basis to protect an area's unique values. These could include closures to off-highway (or off-road) vehicle use, and withdrawals from mineral entry. The Mendenhall Glacier, Ward Lake, and Naha Recreation Areas are withdrawn from mineral entry. The need for restrictions for newly designated or expanded areas may be determined during Forest Plan implementation.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act of 1968, as amended, provides a means for recognizing and protecting the "outstandingly remarkable" scenic, recreation, geologic, fish and wildlife, historic, cultural, ecological, and other values of selected rivers. The intent of including a river in the National Wild and Scenic Rivers System is to preserve the free-flowing condition of the river itself, as well as the characteristics of the river's immediate environment for the enjoyment and benefit of present and future generations. The U.S. Congress is responsible for final designation of rivers to be included in the National Wild and Scenic Rivers System.

Rivers are eligible to be considered for inclusion in the National Wild and Scenic River System if they are essentially free-flowing (without major dams, diversions, or channel modifications), and if they possess at least one "outstandingly remarkable" scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar value. These values should be a unique or exceptional representation for the area studied, and must be related to the river or its immediate environment.

The classification for each eligible stream segment was done according to the criteria in the Wild and Scenic Rivers Act with segments identified as Wild, Scenic, or Recreational Rivers, which are defined as follows:

- Wild River areas are defined as those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive in character and waters unpolluted.
- Scenic River areas are defined as those rivers or sections of rivers that are free of impoundments with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
- Recreational River areas are defined as those rivers or sections of rivers that are readily accessible by road or railroad, that may have undergone some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

Eligible rivers are further evaluated for "suitability." Generally this analysis considers the appropriateness of Congressional designation as a Wild, Scenic, or Recreational River in light of social and economic values, the resource opportunities enhanced, curtailed, or foregone, and the effect on private lands and other uses of the area. Suitable rivers may be recommended to Congress for designation. If designation occurs, a final boundary is established and a management plan developed.

A total of 26 rivers in central and northern Alaska were designated as components of the National Wild and Scenic Rivers System under ANILCA in 1980, with an additional 12 rivers designated as "study rivers." No rivers in Southeast Alaska or the Tongass National Forest were designated. One of the 12 study rivers is located in Southeast Alaska on the Tongass National Forest. This river, the Situk River, is located near the community of Yakutat.

The Situk River, including the West Fork and Old Situk Creek, was studied in 1983 and was found to possess outstandingly remarkable fish, wildlife, and recreational values of national significance, but was not recommended for designation. The community of Yakutat, the local and regional Native corporations, the Citizens Advisory Council of Federal Areas, the Governor of the State of Alaska, and the Regional Forester on behalf of the Forest Service signed an agreement to recognize each other's responsibility in cooperative management of the Situk River corridor in lieu of designation as a Wild and Scenic River. The Alaska Land Use Council supported development of a management plan for the Situk River, rather than designation as a Wild and

Scenic River (USDA Forest Service 1993) and the Secretary of the Interior formally determined to not recommend designation of the Situk River. The Situk River continues to be managed through a cooperative process.

The National Park Service initiated an evaluation to determine the eligibility of the rivers within the National Parks and Preserves in Alaska. The Alsek River near Yakutat is included in that evaluation. The Tongass National Forest includes the surface and west bank of an 18-mile segment that was found to be eligible and meeting a “Scenic” classification.

The planning process for the 1997 Forest Plan evaluated and identified rivers that could be eligible for inclusion in the National Wild and Scenic Rivers System. There are nearly 900 watersheds on the Tongass National Forest containing some 42,500 miles of perennial stream. As part of this process, all of the rivers and streams on the Forest were examined and evaluated for eligibility for the National Wild and Scenic Rivers System. A total of 300 rivers and streams were initially identified for further study, with 112 of these rivers encompassing a total of 1,394 stream miles subsequently determined to be eligible for consideration as components of the National Wild and Scenic Rivers System. More detail about the process that was used and the individual rivers studied is available in the 1997 Tongass Forest Plan Revision Final Environmental Impact Statement (FEIS) (USDA Forest Service 1997a).

Based on a suitability analysis, the Regional Forester recommended 32 of the 112 eligible rivers for inclusion in the National Wild and Scenic Rivers System as either Wild, Scenic, or Recreational. Appendix E of the 1997 Tongass Land Management Plan Revision Final EIS provides descriptions of each river, and the 1997 ROD contains the rationale for the decision made for each river (USDA Forest Service 1997b, 1997c).

Table 3.21-2
Rivers (Segments) Recommended for Inclusion in National Wild and Scenic River Program in miles

				Outstandingly Remarkable Values						
River Name	Wild	Scenic	Rec.	Fish	Wildlife	Recreatio	Scenic	Hist./Cult	Geology	Ecology
Aaron, Oerns, Berg Creeks	-	21	16	X	X	X	X	-	-	-
Anan Creek	17.5	.5	-	X	X	X	-	-	-	-
Blind River	-	-	5	X	X	X	-	-	-	X
Blue River	26	-	-	-	X	-	X	-	X	X
Chickamin River	94	2	-	X	X	X	X	X	X	-
Essowah Lake and Streams	13	-	-	X	X	-	X	-	-	-
Fall Dog Creek (local)	4	-	-	X	X	-	X	X	-	-
Farragut River	29	1	-	X	X	-	X	-	-	-
Gilkey River	9	-	-	-	-	-	X	-	X	-
Glacial River	10	-	-	-	-	-	X	-	X	X
Gokachin-Mirror-Low-Fish Creeks	30	-	-	X	X	X	X	X	-	-
Harding River	-	16	-	X	X	X	-	-	-	-
Hasselborg River and Lakes	24	-	-	X	X	X	-	X	-	-
Kadake Creek	-	-	23	X	X	X	X	X	-	-
Kadashan River	-	8	-	X	X	-	-	-	-	X

Table 3.21-2 (continued)
Rivers (Segments) Recommended for Inclusion in National Wild and Scenic River Program (in miles)

River Name	Wild	Scenic	Rec.	Outstandingly Remarkable Values						
				Fish	Wildlife	Recreatio	Scenic	Hist./Cult	Geology	Ecology
Kah Sheets Creek and Lake	5	4	-	X	X	X	-	X	-	-
Katzehin River	10	-	-	X	-	-	X	-	X	-
Kegan Lake and Streams	9	-	-	X	-	X	X	-	-	-
King Salmon River	8	-	-	X	X	-	-	-	-	-
Kutlaku Creek and Lake	2	-	-	X	-	-	-	-	-	-
LeConte Glacier	6	-	-	-	-	-	X	-	X	-
Lisianski River	5	-	-	-	X	-	-	-	-	X
Naha River	17	2	-	X	X	X	-	X	-	-
Niblack Lakes and Streams[1/]	5	-	-	X	-	-	-	-	-	-
Orchard Creek and Lake	10	-	16	X	X	X	X	-	-	X
Petersburg Creek	7	-	-	X	-	X	X	X	-	-
Salmon Bay Lake and Stream	4	2	-	X	X	-	X	-	-	-
Santa Anna Creek - L. Helen	-	4	-	X	-	X	-	-	-	X
Sarkar Lakes	14	3	2	X	X	-	X	X	-	-
Thorne River-Hatchery Creek	-	24	18	X	X	X	X	-	-	-
Virginia Lake and Creek	-	-	9	X	-	X	-	-	-	-
Wolverine Creek-McDonald Lake	6	-	-	X	X	X	-	-	-	-
Total Miles[2]	**359.5**	**87.5**	**89.0**							

Rec. = Recreational river
[1] In November 1998, a non-significant Forest Plan amendment subsequently rescinded the Wild and Scenic River recommendation and associated LUDs for Niblack Lakes and Streams (USDA Forest Service 1999), leaving 31 potential Wild, Scenic, and/or Recreational Rivers
[2] The total miles of recommended Wild River do not include the 5 miles for Niblack Lakes and Streams, which were, as noted above, removed from the recommended list.

Current Situation

Congress has not yet designated any rivers on the Tongass National Forest to be included in the National Wild and Scenic Rivers System. The goal for management of the rivers that were recommended for Wild and Scenic designations is to maintain their outstandingly remarkable values and their free-flowing conditions. The objective is to manage the 31 rivers (or segments), pending designation by Congress as Wild, Scenic, or Recreational Rivers, to maintain the eligibility of the total miles of river for the Wild, Scenic, or Recreational classification.

The 1997 Forest Plan directs that the rivers be managed, within the existing authorities of the Forest Service, to retain their free-flowing character and outstandingly remarkable values. Three LUDs were created for these rivers, one for each classification: Wild River, Scenic River, and Recreational River. The 1997 Forest Plan includes goals, objectives, desired conditions, and specific management prescriptions for each LUD. These are summarized below and described in more detail in the 1997 Forest Plan (USDA Forest Service 1997a).

Wild River LUD. This is the most restrictive of the three LUDs. Scheduled timber harvest and construction of major recreation facilities, roads, and hydroelectric power projects is not allowed. Mining may be allowed or the area may be withdrawn from mineral entry by Congress at the time of designation as a Wild River. Some fish and wildlife habitat enhancements are permitted. This is a Transportation and Utility Systems "Avoidance Area," but corridors will be allowed in accordance with ANILCA, Title XI. Twenty-three river segments encompassing a total of 359.5 river miles are currently managed under this LUD (Table 3.21-2).

Scenic River LUD. Hydroelectric power projects are not allowed, but timber harvest is allowed if the adjacent LUD allows timber harvest. Major recreational developments may be compatible with this LUD and minor recreational developments are allowed. The construction of NFS roads is allowed and bridges may occasionally span the river. Mining and some fish and wildlife habitat enhancement are permitted. Like the Wild River LUD, this is a Transportation and Utility Systems "Avoidance Area" but corridors will be allowed in accordance with ANILCA, Title XI. Twelve river segments encompassing a total of 87.5 river miles are currently managed under this LUD (Table 3.21-2).

Recreational River LUD. Although hydroelectric power projects are not allowed, many other management activities are permitted in this LUD. Timber harvest is allowed if the adjacent LUD allows timber harvest. Major and minor recreational developments and NFS roads that make the river easily accessible are allowed. Mining and some fish and wildlife habitat enhancements are permitted. This is a Transportation and Utility Systems "Avoidance Area," but corridors will be allowed in accordance with ANILCA, Title XI. Seven river segments encompassing a total of 89 river miles are currently managed under this LUD (Table 3.21-2).

The LUDs for adjacent land can have significant influence on the management of resources inside Wild, Scenic, or Recreational River LUDs. Many of the corridors designated to the Wild River, Scenic River, or Recreational River LUD are narrow and include the width of the river plus 0.25 mile on each side. The most obvious example of adjacent LUD influence relates to timber, with harvest allowed in Scenic or Recreational River LUDs if it is allowed in the adjacent LUD. A total of 13 miles of recommended river are in this situation. Adjacent LUDs can also more indirectly influence other resources, such as scenery or recreation, particularly in Scenic or Recreational River LUDs. For example, if the surrounding land is designated Remote Recreation where no new roads are allowed, it is less likely that a road will be proposed for a Scenic or Recreational River area. New road construction is not allowed in the Wild River LUD.

Of the 536 miles of recommended Wild, Scenic, or Recreational Rivers, 221 miles of seven rivers (41 percent of the total recommended river miles) are located in Wilderness or National Monument Wilderness. Most of the remaining Wild, Scenic, or Recreational River miles outside of designated wilderness are surrounded by land currently in non-development LUD designations. Although there are differences in specific management prescriptions for each of the LUDs, there are some common directions. In general, non-development LUDs do not permit commercial timber harvest, and new roads are not allowed or are restricted to specific uses. While minor recreational development is consistent with most non-development LUDs, major recreational development is consistent only with Semi-Remote Recreation LUD. Generally, the non-development status and resulting management prescriptions in these adjacent lands tends to reduce the likelihood of development in Scenic or Recreational River LUDs.

Environmental Effects

Direct and Indirect Effects

Timber Harvest

There is no proposed old-growth harvest activity within special LUDs under any alternative. Any effects from old-growth harvest would be indirect effects associated with changes in areas adjacent to special LUDs. Alternatives 2 and 3 include young-growth harvest activity in a subset of special LUDs, including Special Interest Areas and Recreational and Scenic Rivers. The acreage of land suitable for young-growth timber production would be similar under both alternatives (Table 3.21-3). Alternatives 1, 4, and 5 do not include lands suitable for timber production for young-growth harvest in these areas; timber production would continue to be an allowed activity under the Forest Plan in Special Interest Areas and Recreational/Scenic River LUDs if they are adjacent to a Development LUD.

Table 3.21-3
Estimated Maximum Acres (with Full Plan Implementation) of Young-Growth Timber Harvest in Special LUDs by Alternative[1]

	Maximum 25-Year Harvest (acres)			Maximum 100-year Harvest (acres)		
Alternative	Special Interest Area	Recreational River	Scenic River	Special Interest Area	Recreational River	Scenic River
2	705	329	94	3,705	1,729	493
3	617	229	71	3,596	1,337	416

[1] No harvest is proposed in experimental forests, research natural areas, or LUD II areas.
[2] No harvest is proposed in Special Interest Areas or Recreational River or Scenic River LUD under Alternatives 1, 4, and 5. However, if a Special Interest Area or Recreational/Scenic River LUD is adjacent to a Development LUD, then timber harvest is an allowed activity.

LUD II Areas
There would be no land suitable for timber production for old- or young-growth harvest in LUD II areas under any alternative. Any potential effects of harvest would be indirect effects associated with changes in areas adjacent to LUD II areas. Depending on the location and extent of harvest, there could be edge-related effects, increasing the potential for impacts to portions of LUD II area boundaries. Such impacts could include introduced non-native or invasive plant species, vulnerability to windthrow events, noise from harvest activities, reduced scenic quality, and unauthorized recreation access. The effects of proposed harvest projects on LUD II areas would require assessment under the National Environmental Policy Act (NEPA).

Experimental Forests
There would be no land suitable for timber production for old- or young-growth harvest within experimental forests under any alternative. Any potential effects of harvest for commercial purposes would be indirect effects associated with changes in areas adjacent to the two experimental forests. Limited timber harvest could continue to occur within the experimental forests as part of approved research projects.

Research Natural Areas
There would be no land suitable for timber production for old- or young-growth harvest areas within RNAs under any alternative. Any potential effects of harvest would be indirect effects associated with changes in areas adjacent to RNAs. Indirect effects would be similar to those described above for LUD II areas.

Special Interest Areas
Alternatives 2 and 3 include acres that are suitable for harvest in Special Interest Areas. The 25-year and 100-year maximum young-growth harvest scenarios under Alternative 2 are 705 acres and 3,705 acres; the corresponding numbers for Alternative 3 are 617 and 3,596 acres (Table 3.21-3). These totals represent a small fraction of the total acreage dedicated to Special Interest Areas.

Potential direct effects to individual Special Interest Areas from proposed specific young-growth harvest would be subject to additional analysis under NEPA.

Alternatives 1, 4, and 5 do not include any lands suitable for timber production for young-growth harvest within Special Interest Areas; however, timber production would continue to be an allowed activity if the adjacent LUD is a Development LUD. This would also be the case with Alternatives 2 and 3. Further, limited salvage harvest is allowed in some Special Interest Areas. Any proposed harvest would be subject to additional analysis under NEPA.

The acreage of the Special Interest Areas is sufficient to include and protect the resources of interest for each respective unit. Therefore, none of the alternatives are expected to result in indirect effects associated with harvest activities that might occur adjacent to Special Interest Areas.

Wild and Scenic Rivers

All five alternatives include the Wild, Scenic, and/or Recreational River LUD designation recommendations for the 31 existing river segments designated as potential Wild, Scenic, and/or Recreational Rivers under the 2008 Forest Plan, and at their current respective acreages. These river segments would continue to be managed to protect the outstandingly remarkable values that make them eligible for designation as Wild, Scenic and/or Recreational Rivers by Congress.

Alternatives 1, 4, and 5 do not include any acres of suitable forest land for young-growth harvest within Wild, Scenic, or Recreational River LUDs. No acres of suitable forest land are proposed within Wild River LUDs under any alternative. In Scenic and Recreational River LUDs, timber production would continue to be an allowed activity in areas where the adjacent LUD is a Development LUD. Any proposed harvest would be subject to further analysis under NEPA.

Alternatives 2 and 3 include acres suitable for young-growth harvest within Recreational River and Scenic River LUDs. The 25-year and 100-year maximum young-growth harvest scenarios in Recreational River LUDs under Alternative 2 are 329 acres and 1,729 acres; the corresponding numbers for Alternative 3 are 229 and 1,337 acres (Table 3.21-3). The 25-year and 100-year maximum young-growth harvest scenarios in Scenic River LUDs under Alternative 2 are 94 acres and 493 acres; the corresponding numbers for Alternative 3 are 71 and 416 acres (Table 3.21-3). The presence of suitable acres for young-growth harvest does not guarantee harvest will take place in the future. Actual harvest locations will depend on the specific purpose and need for future harvest, and would be sited to avoid or minimize conflicts with Forest Plan standards and guidelines. Effects from harvest could include reduced scenic quality and recreation access restrictions, particularly during active harvest operations. Site-specific effects to Recreational or Scenic River segments from proposed young-growth harvest would be subject to further analysis under NEPA.

The majority of Wild, Scenic, or Recreational River miles are located in areas surrounded by land in non-development LUDs or designated Wilderness and National Monument Wilderness. Timber harvest is not generally allowed in the non-development LUDs, and new roads are not allowed or are restricted to specific uses. Therefore, none of the alternatives are expected to result in indirect effects associated with harvest activities in most parts of Wild, Scenic, or Recreational River LUDs. For the 13 miles of Scenic or Recreational Rivers adjacent to LUDs where harvest is allowed, indirect effects could occur if the proposed harvest is visible to visitors or otherwise impedes use of the area for its scenic or recreational purpose.

Renewable Energy

Alternative 1 (no action) would continue the current Transportation and Utility System (TUS) LUD system, under which all special LUDs are considered TUS "Avoidance Areas" and where feasible would be avoided through site-specific analysis during project-level planning. Under Alternatives 2 through 5, energy direction in Chapter 5 of the Forest Plan would be applied to the LUDs, similar to how the Forest-wide standards and guidelines in Chapter 4 of the Forest Plan are applied to the LUDs. This is discussed in more detail in the *Renewable Energy* section of this EIS.

The Forest Service has identified 11 proposed renewable energy projects in Southeast Alaska that are active (Table 3.12b-3). None of these projects are located within, or in the vicinity of, any special LUD areas. Should a project be proposed in the future that could affect a special LUD, it would be subject to further analysis under NEPA.

Cumulative Effects

Under all alternatives, there would be no change in the number of units or acres with special LUDs and no direct or indirect effects from proposed renewable energy projects. Under Alternatives 1, 4, and 5, there would be no land suitable for old-growth or young-growth timber production in special LUDs. Timber production would continue to be an allowed use if the adjacent LUD is a Development LUD. As a result, there may be cumulative effects associated with special LUDs under these alternatives if harvest is proposed at a future time. Cumulative effects of any harvest in special LUDs would be further assessed during a project-specific NEPA review process.

The main difference for Alternatives 2 and 3 are the lands suitable for timber production for young-growth harvest in Special Interest Areas and Scenic and Recreational River LUDs discussed above. The presence of land suitable for timber production does not guarantee that harvest will take place. In addition, no other reasonably foreseeable projects in special LUDs are known at this time. Given current management goals and regulatory protections in place for special LUDs, the potential for cumulative effects is considered low.

Appendix C of this FEIS provides a full list of all the projects considered in the cumulative effects analysis.

Economic and Social Environment

Introduction

The Tongass National Forest stretches roughly 500 miles northwest from Ketchikan to Yakutat and includes approximately 80 percent of the land area in Southeast Alaska. The region is sparsely settled with an estimated 74,280 people living in more than 30 towns and villages located in and around the Forest in 2014 (Alaska Department of Labor [DOL] 2014d). The communities of Southeast Alaska depend on the Tongass National Forest in various ways, including employment in the wood products, commercial fishing and fish processing, recreation, tourism, and mining and mineral development sectors. Many residents depend heavily on subsistence hunting and fishing to meet their basic needs. In addition, natural amenities and recreation activities associated with the Tongass National Forest form an important part of the quality of life for many residents of Southeast Alaska. Since there is very little private land in the region to provide these resources and opportunities, appropriate management of the Tongass National Forest is extremely important to local communities and the overall regional economy.

The Tongass National Forest is also an important national and international resource. An estimated 1,037,000 people visited Southeast Alaska in 2011, with cruise ship passengers accounting for 85 percent of this total (McDowell Group 2012a). For many, a visit to the Tongass is a once-in-a-lifetime experience and spending by these visitors helps drive the recreation and tourism sector. The Tongass National Forest contains large areas of essentially undisturbed forest lands, which represent increasingly scarce and, therefore, increasingly valuable ecosystems. These lands have value for many people who may never visit Southeast Alaska, but benefit from knowing that the Tongass National Forest is there. This type of value, often referred to as non-use value, includes existence, option, and bequest values. These values represent the value that individuals obtain from knowing that the Forest exists, knowing that it would be available to visit in the future should they choose to do so, and knowing that it will be left for future generations to inherit.

The economic and social assessment prepared for this Environmental Impact Statement (EIS) is divided into two main parts: 1) Regional and National Economy, and 2) Subregional Overview and Communities. The first part, Regional and National Economy, evaluates the potential regional and national economic effects of the proposed plan alternatives. The second part, Subregional Overview and Communities, assesses impacts to the economic and social environment at the subregional and community level.

Regional and National Economy

Affected Environment

Southeast Alaska is divided into eight boroughs and two census areas (CAs). The eight boroughs – Haines, Juneau, Ketchikan Gateway, Petersburg, Sitka, Municipality of Skagway, Wrangell, and Yakutat – correspond with the county governments found elsewhere in the United States. The remaining areas that are not part of a borough are allocated to two CAs: the Hoonah-Angoon CA and Prince of Wales-Hyder CA. CAs are only statistical units, but are widely recognized from a data reporting standpoint by federal agencies and most state agencies as county equivalents. Boroughs and CAs are collectively referred to as "boroughs" in the remainder of this section.

More than 74,000 people lived in the towns, communities, and villages of Alaska's southeastern panhandle in 2014, most of which are located on islands or along the narrow coastal strip (Alaska DOL 2014d). Only four of Southeast Alaska's 34 communities met the U.S. Census Bureau's 2010 definition of an urban cluster (population greater than 2,500) in 2014 (Juneau, Sitka, Ketchikan, and Petersburg). Juneau, which is the state capital and a regional trade center, accounted for 45 percent of Southeast Alaska's total population in 2013 (Alaska DOL 2014d). Ketchikan Gateway Borough, the second largest borough in Southeast Alaska, accounted for about 19 percent of the region's population in 2013. Ketchikan is a smaller regional trade center that serves Prince of Wales Island and the surrounding area. Population is discussed in more detail in the *Subregional Overview and Communities* section of this EIS.

The remote nature of the region is reflected in a population density of approximately two persons per square mile, which is much lower than the United States' average of 88.9 persons per square mile. Population densities by borough/census area in 2013 ranged from 0.1 in the City and Borough of Yakutat to 12.2 in the City and Borough of Juneau (Alaska DOL 2014e; U.S. Census Bureau 2014a). Many locations are accessible only by boat or plane, and landing strips or seaplane facilities are located in virtually all communities. The Alaska State ferry system transports people and vehicles between several ports in Southeast Alaska, and Prince Rupert, British Columbia, and Bellingham, Washington. Haines and Skagway, at the northern end of the Forest, and Hyder at the southern end, offer access to interior and Southcentral Alaska via the Alaska Highway, and Canada via the Cassiar Highway.

The following sections provide an overview of the social and economic conditions in Southeast Alaska and provide a baseline against which the potential effects of the proposed alternatives are measured.

Regional Economic Overview

Employment in Southeast Alaska increased by approximately 7 percent between 2000 and 2012, which translates into an annual growth rate of 0.5 percent (Table 3.22-1). This annual growth rate was less than half of the state average over this period (0.5 percent versus 1.2 percent), but more broadly comparable to the national average (0.6 percent). Data compiled by the Alaska DOL indicate that employment in Southeast Alaska has fluctuated over the last decade with a year of job growth often followed by a year of net job loss (Alaska DOL 2015b). The largest drop in annual employment occurred between 2008 and 2009, with a net decrease of 750 jobs, approximately 2 percent of total regional employment.

Adjusted for inflation, total personal income in Southeast Alaska increased by about 17 percent between 2000 and 2012, an annual growth rate of approximately 1.2 percent. This annual growth rate was less than half of the state average over this period (1.2 percent versus 2.5 percent), and more generally comparable to the national average (1.4 percent) (Table 3.22-1). Per capita income in Southeast Alaska was 16 percent higher in 2012 than 2000, increasing at a slightly slower annual rate than Alaska as a whole (1.2 percent versus 1.3 percent), about twice as fast as the national increase of 0.6 percent over this same period (Table 3.22-1). Average earnings per job in Southeast Alaska, adjusted for inflation, were 7 percent higher in 2012 than 2000, an increase of 0.5 percent per year, compared to state and U.S. annual growth rates of 0.8 percent and 0.5 percent over the same time period (Table 3.22-1).

Table 3.22-1
Southeast Alaska Economic Overview

			2000 to 2012			
	SE AK					
Economic Indicator	2000	2012	SE AK Percent Change	SE AK Growth Rate (%)	Alaska Growth Rate (%)	U.S. Growth Rate (%)
Total Personal Income (Million 2014 dollars)	3,452	4,054	17%	1.2	2.5	1.4
Population	72,937	73,687	1%	0.1	1.2	0.8
Average Annual Employment	50,276	53,833	7%	0.5	1.2	0.6
Per Capita Personal Income (2014 dollars)	47,325	55,016	16%	1.2	1.3	0.6
As percent of Alaska Average	109%	107%	-	-	-	-
As percent of U.S. Average	112%	120%	-	-	-	-
Average Earnings per Job (2014 dollars/year)	45,820	49,050	7%	0.5	0.8	0.5
As percent of Alaska Average	92%	88%	-	-	-	-
As percent of U.S. Average	95%	95%	-	-	-	-
Non-Job Related Earnings Per Capita (2014 dollars)	15,682	18,819	20%	1.4	0.9	1.4
As percent of Total Per Capita Income	33%	34%	-	-	-	-
SE Alaska Unemployment Rate	6.2	6.8	-	-	-	-
Alaska Unemployment Rate	6.2	6.9	-	-	-	-
U.S. Unemployment Rate	4.0	8.1	-	-	-	-

Notes:
SE AK = Southeast Alaska
[1] Income and earnings figures for 2000 and 2012 are adjusted for inflation and presented as the amount they would be worth in 2014.
[2] Full- and part-time employment includes self-employed workers. Employment data are by place of work, not place of residence, and therefore include people who work in Southeast Alaska but do not live there. The nonresident and nonlocal Alaska resident shares of total employment in Southeast Alaska in 2012 were estimated to be 24 percent and 12 percent, respectively (Kreiger et al. 2014). Employment is measured as the average annual number of jobs, full-time plus part-time, with each job that a person holds counted at full weight.

Source: Alaska DOL 2014e; U.S. Bureau of Economic Analysis 2014a, 2014b; U.S. Bureau of Labor Statistics 2014

Per capita income in Southeast Alaska was higher than both the statewide and national averages in 2012. Average earnings per job were lower in Southeast Alaska in 2012, equivalent to about 88 percent and 95 percent of the Alaska and national averages, respectively (Table 3.22-1). The region's unemployment rate (6.8 percent) was lower than the state (6.9 percent) and national (8.1 percent) averages in 2012 (Table 3.22-1). The unemployment rate in Southeast Alaska remained below the state and national averages in 2013, 6.4 percent versus 6.5 percent and 7.4 percent, respectively (Alaska DOL 2014f; U.S. Bureau of Labor Statistics 2014).

Southeast Alaska employment is summarized by sector in Table 3.22-2. State and local government, consumer services, and retail trade were the largest employers in 2001 and 2013. Total employment increased by 5,081 jobs or 11 percent between 2001 and 2013, with self-employed workers (proprietors) accounting for 71 percent of this increase. Large absolute growth occurred in the social services sector, primarily in health care and social assistance, with the largest relative increase occurring in the mining sector, with an 11-fold increase from 50 jobs in 2001 to 649 jobs in 2013. Mining and other natural resource-based industries are discussed in more detail below.

Table 3.22-2
Southeast Alaska Employment by Sector, 2001 and 2013

Economic Sector	Number of Jobs		Share of Total (percent)		Percent Change	2013 Location Quotient[4]
	2001	2013	2001	2013	2001 to 2013	
Total full-time and part-time employment[1]	**48,064**	**53,145**	**100**	**100**	**11**	**1.0**
Type of Employment						
Wage and salary employment	37,256	38,743	77.5	72.9	4	0.9
Proprietors employment	10,808	14,402	22.5	27.1	33	1.3
Wage and Salary Employment by Industry[2]						
Farming	70	59	0.1	0.1	-16	0.6
Forestry, fishing, related activities, and other	591	1,108	1.2	2.1	87	0.9
Mining	50	649	0.1	1.2	1198	0.3
Construction	2,465	2,660	5.1	5.0	8	0.9
Manufacturing	1,621	2,034	3.4	3.8	25	1.1
Wholesale trade	59	86	0.1	0.2	46	0.1
Retail trade	5,374	5,281	11.2	9.9	-2	1.0
Transportation and warehousing	2,699	2,524	5.6	4.7	-6	0.9
Finance and insurance	846	1,243	1.8	2.3	47	0.9
Real estate and rental and leasing	1,011	1,458	2.1	2.7	44	0.8
Services (Consumer)[3]	6,956	7,035	14.5	13.2	1	0.9
Services (Producer)[3]	2,092	3,124	4.4	5.9	49	0.5
Services (Social)[3]	3,316	4,721	6.9	8.9	42	0.7
Federal government	2,817	2,699	5.9	5.1	-4	0.5
State and local government	11,078	11,248	23.0	21.2	2	1.5

[1] See Table 3.22-1, note 2.
[2] These data were initially compiled at the borough level and combined here to form a regional overview. Employment counts are not provided for sectors with less than 10 jobs or for sectors where counts would disclose confidential information and employment counts were not provided for all sectors. These numbers are, however, included in the totals. As a result, employment by industry estimates do not sum to the total full- and part-time employment estimates, and the corresponding percentages do not sum to 100.
[3] Nine 2-digit North American Industry Classification System (NAICS) categories are combined into these three divisions for ease of presentation. Consumer service includes: other services; arts, entertainment, and recreation; and accommodation and food services. Producer services includes: information; professional and technical services; management of companies and enterprises; and administrative and waste services. Social services includes: educational services; and health care and social assistance.
[4] The location quotient is a relative measure of industry specialization that compares the percentage of employment concentrated in each sector in the study region with a benchmark region, in this case the State of Alaska. A location quotient of 1.0 indicates that the study region has the same percentage of employment in this sector as the benchmark region does. Location quotients above or below 1.0 indicate that the study region is over or under represented in this sector, respectively.
Source: U.S. Bureau of Economic Analysis 2014c.

The location quotients in Table 3.22-2 (see note 4) compare the regional employment distribution with the state average and indicate Southeast Alaska's economy is relatively specialized in the state and local government sector. The relative concentration in the government sector largely reflects the location of the state capital in Juneau, but the relatively high proportion of government employment in the other Southeast Alaska communities also plays a part. With the exception of manufacturing and retail trade, which have respective location quotients of 1.1 and 1.0, all other sectors in Southeast Alaska are relatively underrepresented.

The government sector is the main source of year round employment in all the communities in Southeast Alaska. In addition to direct employment in the government sector, many of the area's private sector jobs are also dependent on government funding and contracts. Private sector activities dependent on government funding include road construction and health services, with the region's largest private employer, Southeast Alaska Regional Health Corporation, relying heavily on government funding (Gilbertson 2004).

Recreation and tourism is an important part of the economy of Southeast Alaska. This is not readily apparent from Table 3.22-2 because recreation and tourism is not classified or measured as a standard industrial category and employment and income data are not specifically collected for this sector. Components of recreation and tourism activities are instead partially captured in other industrial sectors, mainly retail trade and consumer services. The share of the total workforce that is self-employed in Southeast Alaska is higher than the state average, 27 percent compared to 21 percent (location quotient of 1.3), and higher than the national average of 22 percent. Much of this self-employment is associated with the retail trade and consumer services sectors and is sensitive to recreation and tourism activity. Commercial fishing also accounts for a large share of self-employment in Southeast Alaska.

The following section discusses the relative contribution of natural resource-based industries to the regional economy.

Natural Resource-Based Industries

Direct Employment

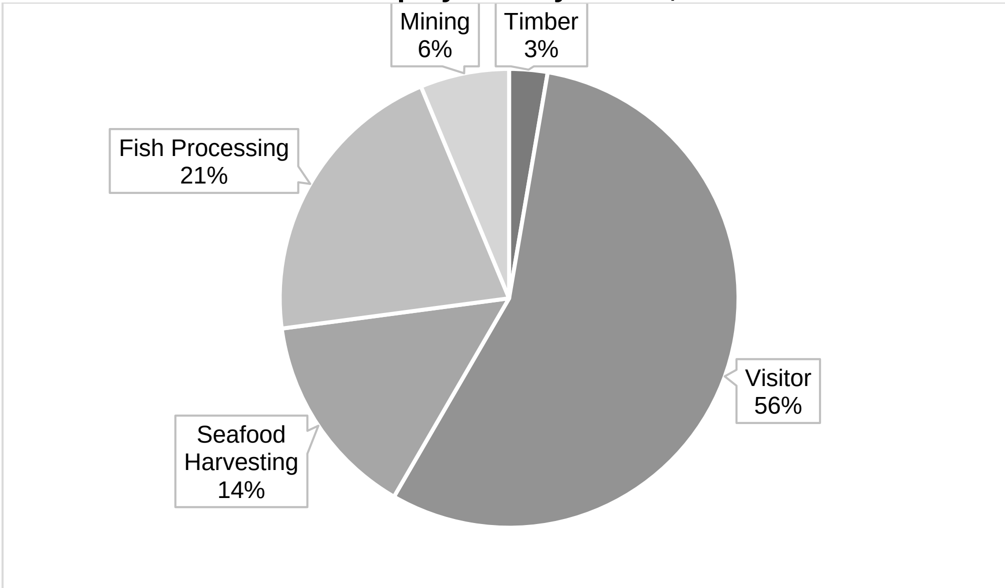
Direct employment in natural resource-based industries accounted for slightly more than one-quarter (26 percent) of total employment in Southeast Alaska in 2013 (Table 3.22-3). The estimated distribution of resource-dependent employment is shown by industry in Figure 3.22-1. The visitor industry (which is used to approximate the recreation and tourism sector) accounted for more than half (56 percent) of this total, followed by the fish processing and seafood harvesting sectors, which accounted for 21 percent and 15 percent of total resource-based employment, respectively (Table 3.22-3). Mining accounted for 6 percent and wood products made up 3 percent.

Table 3.22-3
Natural Resource-Based Employment by Sector, 2013

Industry	Direct Employment	Percent of Regional Total	Percent of Resource-Based Total
Timber	325	1%	3%
Visitor	6,707	15%	56%
Seafood Harvesting	1,750	4%	15%
Fish Processing	2,510	5%	21%
Mining	756	2%	6%
Total Resource-Based	**12,048**	**26%**	**100%**
Southeast Alaska Total	46,011	100%	na

Notes:
[1] These data were compiled on behalf of Southeast Conference based on data collected by the Alaska DOL and the U.S. Census Bureau. The Alaska DOL data are for 2013 for non-agricultural wage and salary employment. These data do not include proprietors or self-employed workers, and are, therefore, supplemented using data from the 2012 US Census Nonemployer Statistics, which specifically count proprietors and the self-employed. These numbers are collected in different ways and do not exactly match those compiled by the U.S. Bureau of Economic Analysis (Tables 3.22-1 and 3.22-2).
Source: Southeast Conference 2014

Figure 3.22-1
Natural Resource-Based Employment by Sector, 2013



Notes:
Total = 12,048 Employees
Source: See Table 3.22-3.

Nonresident and Seasonal Employment

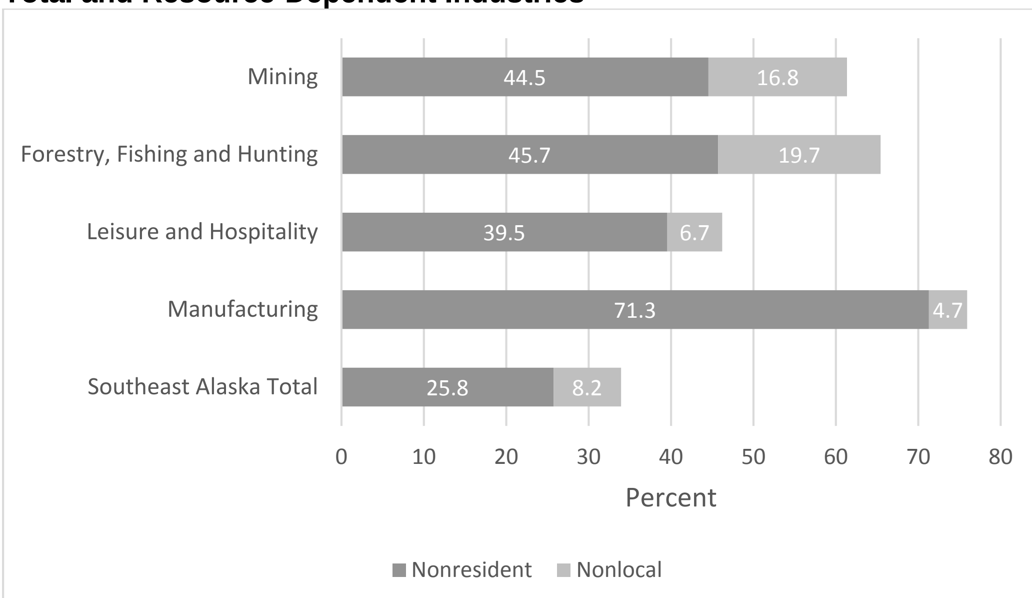
Nonresident and seasonal employment are two important and related aspects of resource-dependent employment in Southeast Alaska. Many nonresidents work a relatively short time in Alaska, often for just two or three months, generally spend the bulk of their earnings elsewhere, and, as a result, contribute less to the regional economy than resident workers.

Data compiled by the Alaska DOL indicate that nonresidents account for a relatively large share of resource-dependent employment in Southeast Alaska. These data are based on Alaska unemployment insurance records and Alaska Permanent Fund Dividend data and do not include federal employees or the self-employed. Estimates are worker counts not employment estimates. Worker counts identify the cumulative number of people working in an occupation over the course of a year; employment estimates identify the number of filled jobs. Worker counts are usually higher than annual job counts because a single position can be filled by more than one person over the course of a year and workers in seasonal industries are often employed for less than a year (Kreiger et al. 2015).

Nonresidents accounted for approximately 25.8 percent of employment in Southeast Alaska in 2013, compared to 20.6 percent for the state as a whole, with an additional 8.2 percent of non-local workers in Southeast who normally reside elsewhere in Alaska (Kreiger et al. 2015; Alaska DOL 2015c). Within Southeast Alaska, the nonresident share of employment ranged from 24.5 percent in Juneau to 68.7 percent in Skagway. The relatively low level of nonresident employment in Juneau reflects the importance of the government sector, which accounted for 35 percent of employment in Juneau in 2013 (U.S. Bureau of Economic Analysis 2014c).

Viewed by resource-dependent sector, nonresident and nonlocal employment combined ranged from 46 percent for the leisure and hospitality sector (used here to represent recreation and tourism) to 76 percent for the manufacturing sector compared to 34 percent region wide (Figure 3.22-2). Nonresident employment is high in the manufacturing sector because 80 percent of manufacturing employment in Southeast Alaska in 2013 was in the seafood processing sector. Seafood processing had the highest percentage of nonresident workers in Alaska in 2013, with almost three-quarters of the labor force (74.2 percent) comprising nonresidents (Krieger et al. 2015). Nonresidents accounted for approximately 67 percent of employment in the fish processing sector in Southeast Alaska in 2012, ranging from 35.7 percent of fish processing workers in Skagway to 90.3 percent in Haines Borough (Alaska DOL 2014f; Table 3.22-12).

Figure 3.22-2
2013 Nonresident Share of Direct Employment in Southeast Alaska. Total and Resource-Dependent Industries

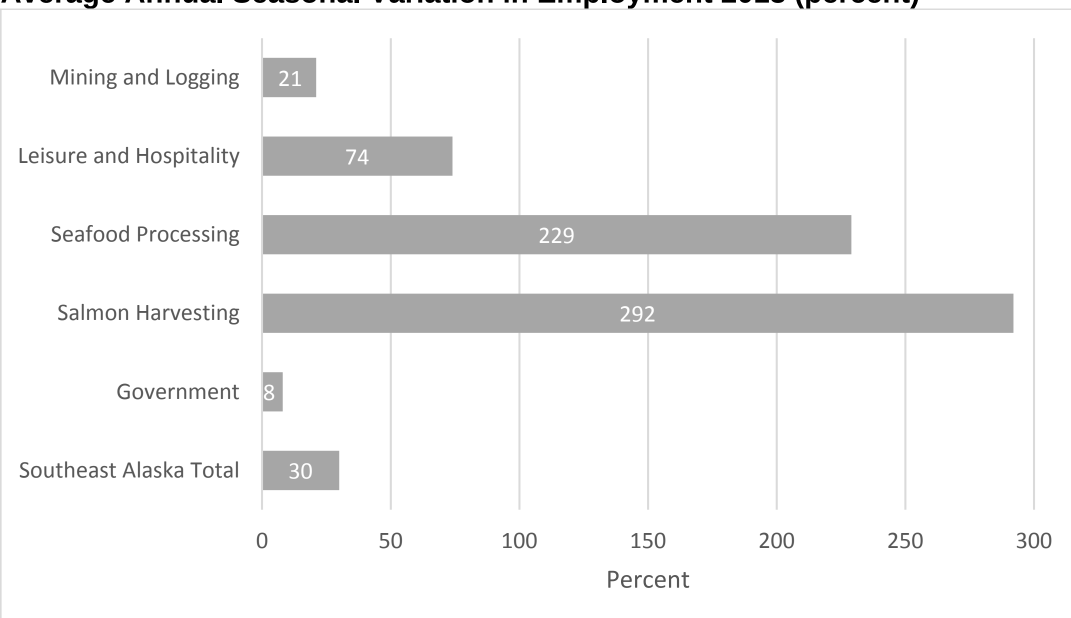


Notes:
1/ The forestry, fishing and hunting sector also includes agriculture, which employs very few people in Southeast Alaska.
2/ Leisure and hospitality consists of two sectors: Arts, Entertainment and Recreation, and Accommodation and Food Services. These sectors are used here to represent the recreation and tourism sector.
3/ Seafood processing accounted for 80 percent of employment in the manufacturing sector in 2013.
Source: Alaska DOL 2015c

Most salmon and other fish harvesters are self-employed and exempt from reporting employment and wages. As a result, information on the nonresident share of total employment in this sector in Southeast Alaska is not available. However, statewide, Alaska DOL estimates that nonresidents made up an estimated 51.3 percent of the fisheries harvest workforce in 2013 (Krieger et al. 2015).

Southeast Alaska's economy is highly seasonal. Average annual seasonal variations in employment are shown for the mining and logging, leisure and hospitality, seafood processing, salmon harvesting, and government sectors, and the region as a whole in Figure 3.22-3.[1] As shown in this figure, seasonal variations in resource-based employment—the difference between peak levels of employment in the summer and dips in the winter—are often quite pronounced. The measure shown in the figure is calculated by dividing the difference between summer maximum and winter minimum employment by annual average employment. Expressed as a percentage, this figure allows comparison between different industries and the regional economy as a whole. Salmon harvesting and seafood processing in particular show very high degrees of seasonal variation. Data presented for the Leisure and Hospitality sector in Figure 3.22-3 (as a proxy for recreation and tourism) show a degree of variation substantially lower than the salmon harvesting and seafood processing sectors, but more than twice the Southeast Alaska average. Annual seasonal variation for mining and logging was lower than the Southeast Alaska average. Data are also presented for the government sector, which showed much less seasonal variation than the Southeast Alaska average (Figure 3.22-3).

Figure 3.22-3
Average Annual Seasonal Variation in Employment 2013 (percent)



Notes:
1/ Average seasonal variation is calculated here by dividing the difference between summer maximum and winter minimum employment by annual average employment. The resulting measure is expressed as a percentage.
2/ Data for the Leisure and Hospitality sector are used here to represent recreation and tourism.
3/ Data for salmon harvesting are for 2012.
Source: Alaska DOL 2015b

Industry-Specific Descriptions

The following subsections contain more detailed descriptions of the following resource-dependent industries: wood products, recreation and tourism, commercial fishing and seafood processing, and mining and mineral development.

[1] Management decisions have the potential to affect salmon and, therefore, data are presented for the salmon fishery. Data available for the seafood processing industry do not allow for an easy distinction between salmon processors and other firms, and, therefore, data presented for the seafood processing sector include the entire seafood processing industry.

Wood Products

Employment

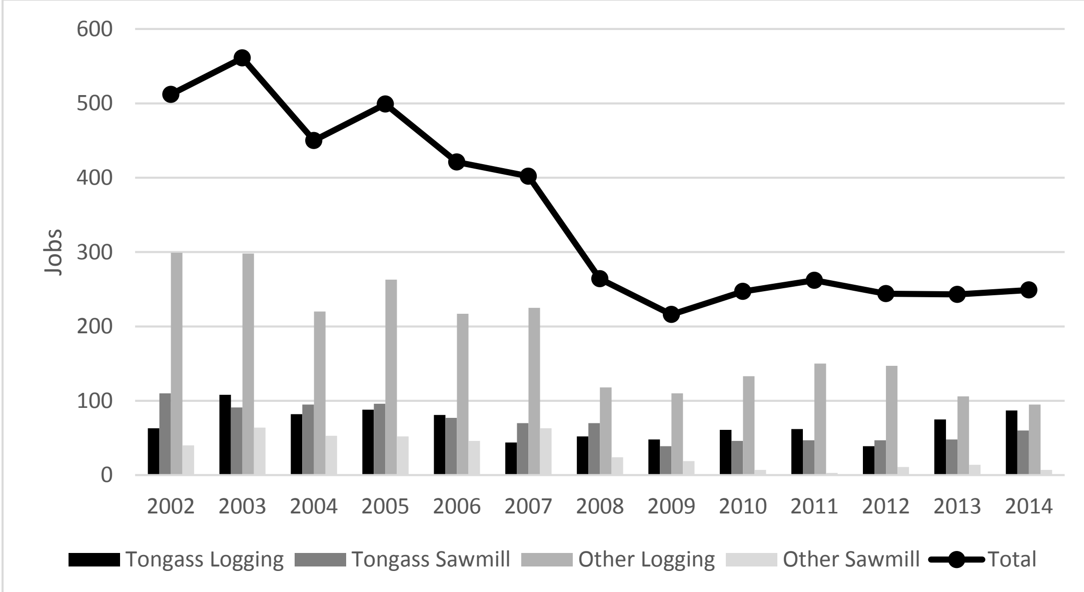
Timber employment in Southeast Alaska peaked at the end of the 1980s, with slightly more than 3,500 jobs in 1989 and 1990, before dropping sharply in the 1990s. Much of this job loss was associated with closure of the large pulp mills in Sitka (1993) and Ketchikan (1997), which together accounted for 899 jobs in 1990. Timber employment has continued to decline since the 1990s, falling from a recent high of 561 jobs in 2003 to 249 jobs in 2014, reaching a recent low of 216 jobs in 2009 (Table 3.22-4; Figure 3.22-4). Tongass National Forest-related employment in logging and sawmilling declined from 199 jobs in 2003 to 147 in 2014, with a low of just 86 jobs in 2012. Non-Tongass timber employment also declined over this period, falling from a recent high of 362 jobs in 2003 to 102 jobs in 2014, a decrease of 77 percent (Table 3.22-4). Sawmill employment has historically been supported by Forest Service timber sales, with state timber harvest also contributing. Logging employment is generated from all ownerships, including Native Corporation lands.

Table 3.22-4
Timber Industry Employment in Southeast Alaska, 2002-2014

Year[1]	Tongass Logging	Tongass Sawmill	Total Tongass-Related Employment	Other Logging	Other Sawmill	Total Other Timber Employment	Total Timber Industry Employment
2002	63	110	173	299	40	339	512
2003	108	91	199	298	64	362	561
2004	82	95	177	220	53	273	450
2005	88	96	184	263	52	315	499
2006	81	77	158	217	46	263	421
2007	44	70	114	225	63	288	402
2008	52	70	122	118	24	142	264
2009	48	39	87	110	19	129	216
2010	61	46	107	133	7	140	247
2011	62	47	109	150	3	153	262
2012	39	47	86	147	11	158	244
2013	75	48	123	106	14	120	243
2014	87	60	147	95	7	102	249
Average	**68**	**69**	**137**	**183**	**31**	**214**	**352**

Note::
[1] Data are presented by calendar year.
Source: USDA Forest Service 2015l

Figure 3.22-4
Timber Industry Employment in Southeast Alaska, 2002-2014



Harvest

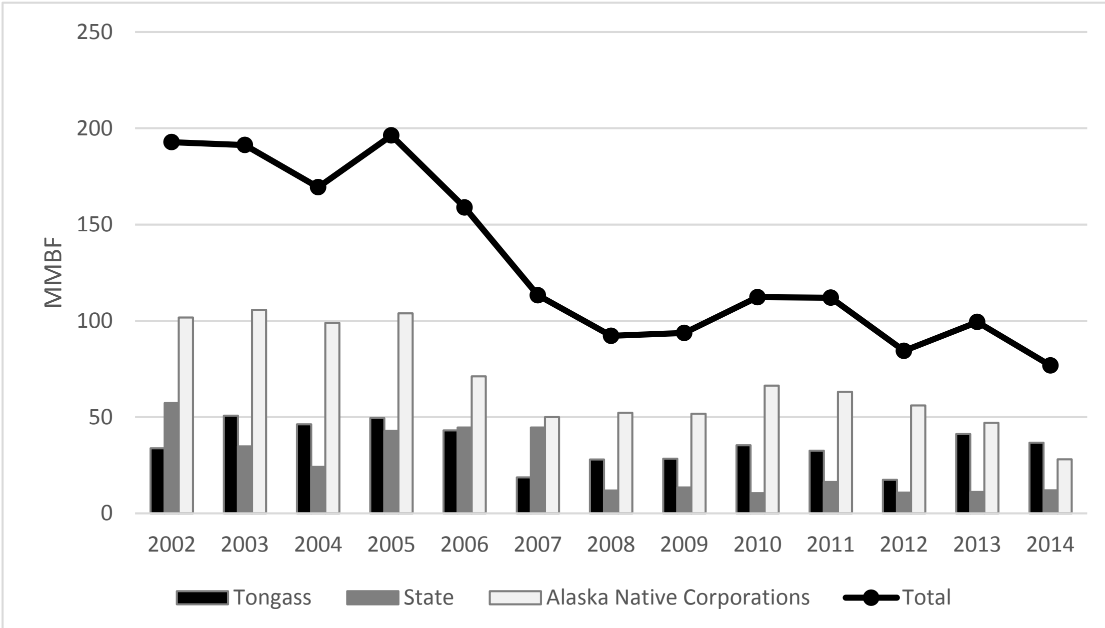
Timber harvest in Southeast Alaska also peaked in the late 1980s, with harvest levels slightly below 1,000 million board feet (MMBF) in 1989 and 1990. Total harvest in 2011 was 76.8 MMBF, about 8 percent of peak levels Harvest on the Tongass accounted for almost half (48 percent, 36.7 MMBF) of this total, with 37 percent (28.1 MMBF) of the total provided by Native Corporation lands and 16 percent (12.0 MMBF) provided by the State of Alaska (Table 3.22-5; Figure 3.22-5).

Table 3.22-5
Timber Harvest in Southeast Alaska by Ownership, 2002–2014

Year[1]	Tongass National Forest	State of Alaska[2]	Native Corporation	Total
2002	33.8	57.3	101.7	192.8
2003	50.8	34.8	105.7	191.3
2004	46.3	24.2	98.9	169.4
2005[3]	49.5	42.9	103.9	196.3
2006[3]	43.1	44.6	71.2	158.9
2007[3 4]	18.7	44.6	50.0	113.3
2008	28.0	11.9	52.3	92.2
2009	28.4	13.5	51.8	93.7
2010	35.4	10.5	66.4	112.3
2011	32.6	16.3	63.1	112.0
2012	17.5	10.8	56.1	84.4
2013	41.2	11.2	47.0	99.4
2014	36.7	12.0	28.1	76.8
Average	**35.5**	**25.7**	**68.9**	**130.2**

Notes:
[1] Timber harvest volume reported by calendar year, in million board feet (MMBF), and includes both sawlog and utility.
[2] State of Alaska includes Division of Forestry, Mental Health Trust, and University of Alaska public lands.
[3] The relative increase in State harvest was an effort to provide additional timber to make up for a shortfall in supply from the Tongass.
[4] The relative drop in Tongass harvest in 2007 was the result of an injunction that stopped Tongass logging over most of the operating season.
Source: USDA Forest Service 2015l

Figure 3.22-5
Timber Harvest in Southeast Alaska by Ownership, 2002-2014



Current Status of the Industry

Existing Sawmills

The wood products industry in Southeast Alaska in its current form consists of individual- and family-owned sawmills and independent logging businesses. The Forest Service has conducted an annual onsite survey of sawmills across the Tongass National Forest since 2000. The most recent available survey, conducted for calendar year 2013, identified 10 active and 2 inactive sawmills, with a total installed production capacity of 116.9 MMBF (Table 3.22-6). To maintain consistency, the only mills included in the survey are those assessed in previous survey years. The original list of mills to be surveyed, initially identified in 2000, consisted of 20 sawmills that regularly operated and met the criteria for medium to large size classification. Of these 20 mills (increased to 22 in 2007), 10 were active and 2 were inactive in 2013, as noted above; the other 10 had been decommissioned or were no longer in production (Parrent and Grewe 2014). No new sawmills of equal size classification have been established since 2000. However, many small sawmills that operate on a seasonal, part-time, or contingent basis operate across the region, each with varying degrees of success. These mills do not meet the criteria originally established for the mill survey and are, therefore, excluded from the annual Tongass Sawmill Capacity and Production Report.

Table 3.22-6
Forest Service Mill Survey: Estimated Mill Capacity, Production, and Utilization, 2013

Mill Name[1,]	Location	Estimated Capacity (MMBF)[2]	Estimated Production (MMBF)[3]	Percent Utilization
Icy Straits Lumber & Milling Co.[4]	Hoonah	3.0	0.4	13.3%
Viking Lumber Co.	Craig	80.0	15.0	18.8%
D&L Woodworks	Hoonah	1.8	0.1	3.1%
Western Gold Cedar Products	Thorne Bay	6.5	0.7	10.0%
Falls Creek Forest Products[5]	Petersburg	3.0	0.02	0.7%
Good Faith Lumber Co. LLC[6]	Thorne Bay	5.5	0.8	14.3%
Thuja Plicata Lumber	Thorne Bay	7.5	0.3	3.3%
Porter Lumber Co.	Thorne Bay	2.5	0.2	8.1%
St. Nick Forest Products[7]	Craig	1.2	0.2	14.8%
The Mill	Petersburg	6.0	0.1	1.0%
Total Active[8]	**Southeast Alaska**	**116.9**	**17.6**	**15.0%**
Northern Star Cedar (NSC)	Thorne Bay	2.5	Idle	NA
Thorne Bay Enterprises	Thorne Bay	1.0	Idle	NA
Total Idle	**Southeast Alaska**	**3.5**	**Idle**	**NA**
Overall Total[8]	Southeast Alaska	120.4	17.6	14.6%

Notes:
MMBF – million board feet
NA – not applicable
[1] Data is presented for those mills included in the Forest Service's annual onsite survey only.
[2] Estimated mill capacity is an estimate of the processing capability of the mill based on the amount of net sawlog volume (Scribner log scale) that could be utilized by the mill as currently configured, during a standard 250-day per year, two shifts per day, annual operating schedule, not limited by availability of employment, raw materials or market.
[3] Estimated Mill Production is the estimated net sawlog volume used during the year to manufacture sawn products.
[4] Estimated capacity for the Icy Straits mill was reduced from 21 MMBF as a result of a major mill fire in July 2010. Mill production occurred prior to the fire.
[5] Formerly Southeast Alaska Wood Products.
[6] Formerly Thorne Bay Wood Products.
[7] Formerly W.R. Jones & Son Lumber Co.
[8] Totals may not sum due to rounding.
Source: Parrent and Grewe 2014

Estimated total production for the mills included in the annual mill survey has decreased from 87.1 MMBF in 2000 to a low of 11.5 MMBF in 2011, a net reduction of 75.6 MMBF or 87 percent. Production has increased somewhat since 2011, with total production for these mills estimated to be 17.6 MMBF in 2013 (Parrent and Grewe 2014). This total (17.6 MMBF) represented 15.0 percent of total active processing capacity in 2013, and 14.6 percent of total active and idle capacity (Table 3.22-6). The capacity utilization rate of the last operating medium-sized sawmill in Southeast Alaska (Viking Lumber) in 2013 was estimated at about 19 percent (Table 3.22-6). By comparison, sawmills in Idaho, Oregon, California, and Montana generally utilize more than 80 percent of their capacity, unless there is a severe economic downturn (USDA Forest Service 2011c).

The Tongass National Forest supplied about 13.8 MMBF or 78 percent of the total volume processed by the mills identified in Table 3.22-6 in 2013 (17.6 MMBF), with State lands responsible for most of the remaining 22 percent (Parrent and Grewe 2014). The Tongass share of timber processed locally (13.8 MMBF) comprised 33 percent of the total volume harvested (41.2 MMBF) on the Tongass in 2013. Viking Lumber processed 15 MMBF or 85 percent of the total volume (17.6 MMBF) processed in 2013 (Table 3.22-6).

Additional Sawmills

As noted above, the annual mill survey discussed above is not a comprehensive inventory of all sawmills in Southeast Alaska. The number of active mills and timber operators in Southeast Alaska varies at any given time. A review of business licenses in January 2015, for example, identified 12 additional sawmills in Southeast Alaska that are not included in the survey summarized in Table 3.22-7. The additional mills identified through this business license review are listed in Table 3.22-7. The University of Montana's Bureau of Business and Economic Research (BBER), in conjunction with the Pacific Northwest Forest (PNW) Inventory and Analysis Program of the U.S. Forest Service, conducted a census of timber processors in Alaska in 2011 and identified 27 sawmills in Southeast Alaska, with almost half this total (12 facilities) located on Prince of Wales Island (Berg et al. 2014).

Table 3.22-7
Additional Sawmills in Southeast Alaska Based on a Review of Business Licenses, 2015

Mill Name[1]	Location
Cutting Edge Wood Products	Ketchikan
Dale R. Bakula Construction	Ketchikan
Eagle Wood Products	Craig
Fair & Square Milling	Coffman Cove
JR's Custom Lumber and Resaw	Thorne Bay
Mike Allen Enterprizes	Wrangell
Pacific Log and Lumber	Ketchikan
Peavey Log	Thorne Bay
Seakwood.com	Petersburg
The Woodshed	Petersburg
Windy Point Sawmill and Bobcat Service	Craig
Wood Marine	Klawock

Note:
[1] These businesses were identified through a review of business licenses in January 2015. This table identifies additional sawmills that are not included in the Forest Service's mill survey (see Table 3.22-6).

Data compiled by the Forest Service and the State of Alaska for the Big Thorne Project identified 25 mills and timber operators on Prince of Wales Island, including six of the active sawmills and two inactive sawmills identified in the 2013 mill survey (USDA Forest Service 2013d). The other, smaller mills on the island produce sawtimber and other value-added products. The highest concentration of small mills is in the Goose Creek Industrial Subdivision of Thorne Bay, but there are also operators in Craig, Klawock, Coffman Cove, and Edna Bay. These smaller operators included 14 businesses not included in the Tongass Sawmill Capacity and Production Report or identified in the January 2015 business license review. Smaller operators located elsewhere in the region, include small mills in the towns of Wrangell, Petersburg, Ketchikan, Juneau, Hoonah, Gustavus, and Tenakee Springs.

R10 Limited Export Shipment Policy

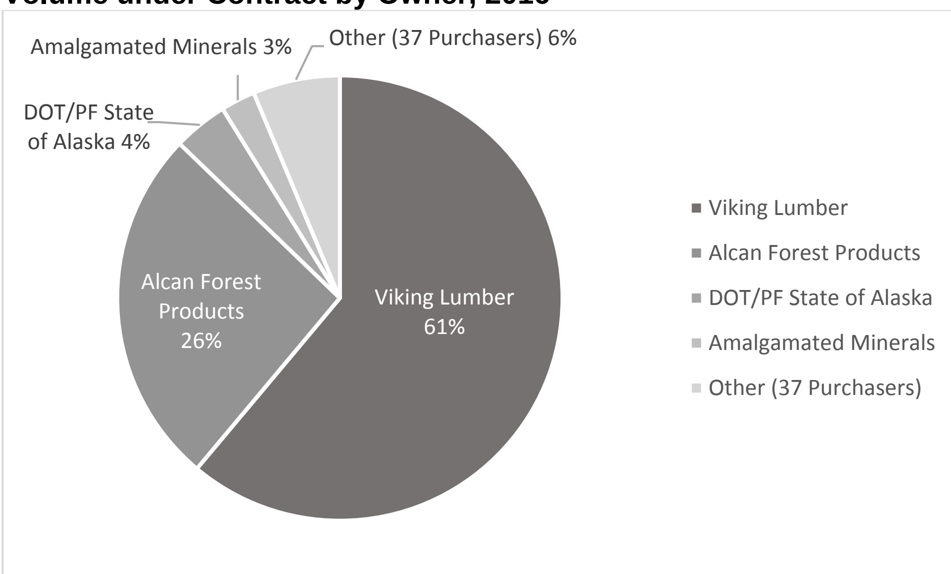
Initially established in 2007, the Limited Export Policy is intended to boost appraised timber values, provide economic sale opportunities for purchasers, and provide additional processing options for purchasers. The policy has continued since 2007 with modifications that have provided additional opportunities for purchasers. The limited export policy is reviewed on an annual basis. The Regional Forester noted in the 2015 review that, while improvements occurred nationally over the past three years, challenges continue for purchasers seeking domestic markets for Alaska timber. The current policy allows the limited export of unprocessed western hemlock and Sitka spruce logs up to 50 percent of the total sale sawtimber volume upon Regional Office approval. In 2012, the Regional Forester agreed to begin reviewing requests to allow increased export of these species on a case-by-case basis, in exchange for purchasers providing an equivalent amount of Alaska yellow-cedar to small business operators who would process the timber locally. The Limited Export Policy is discussed in detail in Appendix H to this EIS.

Volume Under Contract

Volume under contract refers to the volume included in timber sales that have been purchased, but not yet logged or only partially logged. Volume under contract is, therefore, essentially a measure of inventory that changes on a regular basis, increasing as timber is sold and added to the total and decreasing when sales are actually harvested.

Various purchasers had an estimated total of 90.8 MMBF of uncut timber under contract with the Forest Service in April 2016 (USDA Forest Service 2016b). Viking Lumber accounted for more than half (61 percent; 55.5 MMBF) of this total, followed by Alcan Forest Products LLP with 26 percent (23.7 MMBF), and the Alaska Department of Transportation and Public Facilities with 4 percent (3.6 MMBF) (Figure 3.22-6). Viking Lumber was the only one of these three purchasers operating a mill in Southeast Alaska in 2016. Alcan Forest Products, based in Ketchikan, does not operate a processing facility on the Tongass, but must follow the Limited Export Shipment Policy, and sell logs that cannot be exported to a processing facility in the state. Thirty-eight other purchasers had uncut volume under contract; in all cases but three, the amount under contract was less than 1 MMBF (USDA Forest Service 2016b).

Figure 3.22-6
Volume under Contract by Owner, 2016



Source: USDA Forest Service 2016

Demand Indicators

Demand can be thought of as the different amounts of a product buyers are willing to purchase at different prices. Demand is a series of price-quantity relationships, not a single number. The same is true of supply. The quantity and price of goods produced and consumed is determined by the combination of supply and demand. When we talk about timber on the Tongass we are talking about a range of products that are not necessarily interchangeable with one another or other sources of timber from non-NFS lands. Timber includes a number of different species and log types range from utility logs to high quality saw logs. Old-growth and young-growth timber also differ from one another.[2] Markets and demand and the associated prices for these timber products can vary substantially. The ability of timber to satisfy markets also differs based on the location of the stands relative to mills and other infrastructure.

Accurately projecting future demand is difficult, with the interaction between demand and supply ultimately determining trends in markets. Market demand for Southeast Alaska timber and wood products depends upon numerous difficult to predict factors, including changes in technology, growth and exchange rates in key markets, changes in consumer tastes and preferences, as well as developments in other producing regions whose products compete with those of Alaska.

Pacific Northwest Research Station Projections

For the past 25 years, the Forest Service has commissioned the PNW Research Station to prepare a number of long-term projections of demand for Tongass timber over time, including Brooks and Haynes (1990, 1994, 1997) and Brackley et al. (2006a, 2006b). The PNW Research Station has prepared a similar analysis in support of this proposed amendment of the Forest Plan (Daniels et al. 2016) to transition to young-growth timber. Using methods adapted from the previous PNW Research Station analyses, Daniels estimates demand for Tongass timber using a materials balance approach based on projected trends in product markets. The analysis projects future demand for timber ("derived demand") based on the overall end-market demand in foreign and domestic markets and the portion of that demand Alaska is likely to fill (based on historic trends).

<u>Timber Products and Existing Markets</u>

The 2015 PNW Research Station study identified five primary timber products harvested from Southeast Alaskan forests: softwood sawlogs, utility logs, softwood lumber, mill residue, and other products. The following subsections summarize the existing markets identified by the study for each product type.

Softwood sawlogs. The majority of timber harvested in Southeast Alaska is exported to Pacific Rim (China, Japan, South Korea) destinations as unprocessed sawlogs. More than 90 percent of exported logs were sent to Pacific Rim destinations in 2005 and 2011, mainly China. Modest shipments were also sent to Canada.

Utility logs. Much of the harvested volume of utility logs is left in the woods because of their low economic value. Daniels (2015) was unable to find evidence of any existing markets for this material.

Softwood lumber. Data from 2002 to 2013 showed that shipments of Southeast Alaskan lumber were sent to markets in the Pacific Rim, the lower 48 states, and remained locally in Alaska. Based on data compiled as part of the Forest Service's annual onsite survey of sawmills, the five year average share (2009 to 2013) of lumber production sent to these markets was 57 percent to the Lower 48 states, 32 percent to Pacific Rim, 10 percent to local Alaska markets, and 1 percent to Canada. While these data are for those mills included in the survey

[2] Young-growth timber refers to forest growth that has regenerated naturally or has been planted after some disturbance to the previous forest growth. Forms of disturbance include clearcut harvest, serious fire, catastrophic windthrow, and insect attack.

only (see the above discussion), Daniels (2015) note that these findings are consistent with the 2005 and 2011 BBER surveys.

Mill residue. Using data compiled as part of the BBER surveys, Daniels (2015) were able to identify the proportion of mill residues that were sold (88.2 percent) versus unsold (11.8 percent), and the portion of the sold residues that were sold for energy purposes (32.1 percent) versus other uses (56.0 percent). Daniels (2015) found little evidence that markets for residue from Alaska processors exist outside of Alaska.

Other products. Other products identified through the BBER surveys include bowls, furniture, house logs, molding, shakes, posts and poles, and siding, combined here as other to capture niche markets. The majority of these products remained in Alaska or were shipped to the Lower 48 States, with modest shipments sent to Canada and the Pacific Rim.

Baseline Model and Scenarios

The PNW Research Station study developed a baseline model that was then used to construct three potential scenarios representing different potential futures for timber harvest in Southeast Alaska (Daniels et al. 2016).

Baseline Model. Baseline demand projections Tongass timber were developed in three stages: 1) historic estimates of Alaska forest products output by product and destination were gathered and projected from 2015 to 2030; 2) the raw material requirements necessary to support this projected output were estimated by product type; and 3) the timber harvest equivalent was calculated and allocated by owner (Daniels et al. 2016). The resulting baseline projections of timber harvest by product are shown in Table 3.22-8. Projected baseline harvest by owner is shown in Table 3.22-9 and Figure 3.22-7. The majority of projected harvest is allocated to Native Corporation lands, followed by the Tongass and State of Alaska lands (Table 3.22-9; Figure 3.22-7).

Table 3.22-8
Projected Baseline Timber Harvest in Southeast Alaska by Product Type (MMBF) all owners

Year	Sawlog exports	Sawmills	Utility logs	Mill Residue	Other Products	Total
2015	84.5	12.9	7.5	12.1	1.5	118.7
2016	86.6	14.3	7.4	13.4	1.5	123.3
2017	88.7	14.5	7.3	13.5	1.6	125.6
2018	90.8	14.7	7.1	13.7	1.6	127.9
2019	92.9	14.9	7.0	13.8	1.6	130.2
2020	95.0	15.1	6.8	14.0	1.6	132.5
2021	97.1	15.3	6.7	14.2	1.6	134.8
2022	99.2	15.5	6.6	14.3	1.6	137.1
2023	101.3	15.6	6.4	14.5	1.6	139.4
2024	103.3	15.8	6.3	14.7	1.6	141.7
2025	105.4	16.0	6.1	14.8	1.6	144.0
2026	107.5	16.2	6.0	15.0	1.6	146.4
2027	109.6	16.4	5.9	15.2	1.7	148.7
2028	111.7	16.6	5.7	15.3	1.7	151.0
2029	113.8	16.8	5.6	15.5	1.7	153.3
2030	115.9	16.9	5.4	15.6	1.7	155.6

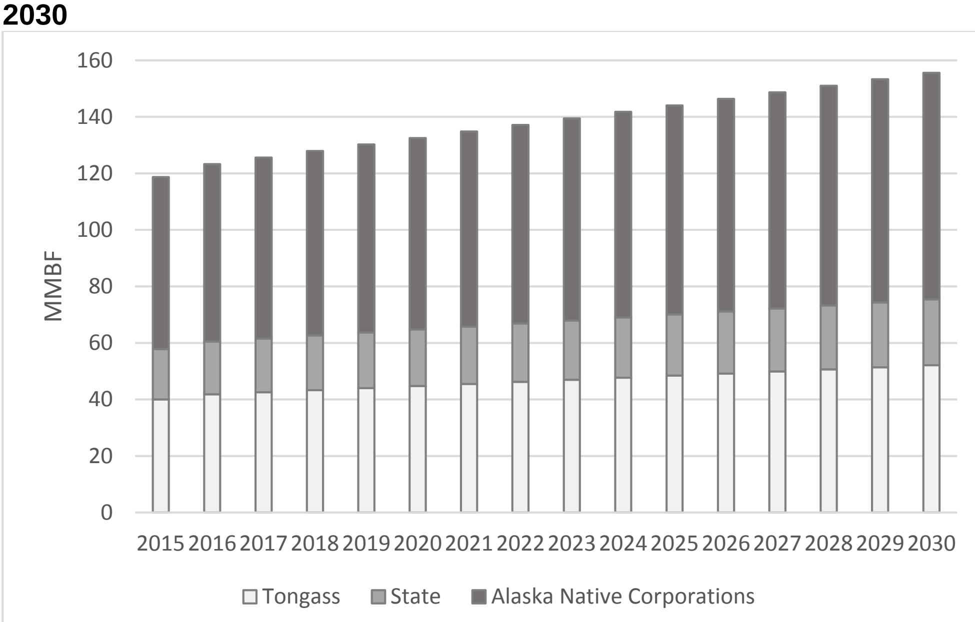
[1] Projected harvest levels by product type are based on projected overall end market demand and the portion of that demand Southeast Alaska is likely to fill.
[2] A summary overview of these product types is provided in the main text.
Source: Daniels et al. 2016

Table 3.22-9
Projected Baseline Timber Harvest in Southeast Alaska by Owner (MMBF)

Year	Tongass	State	Native Corporations	Total
2015	40.0	17.8	60.8	118.7
2016	41.8	18.7	62.8	123.3
2017	42.6	19.0	64.0	125.6
2018	43.3	19.3	65.3	127.9
2019	44.0	19.7	66.5	130.2
2020	44.8	20.0	67.7	132.5
2021	45.5	20.3	69.0	134.8
2022	46.2	20.6	70.2	137.1
2023	47.0	21.0	71.5	139.4
2024	47.7	21.3	72.7	141.7
2025	48.4	21.6	74.0	144.0
2026	49.2	22.0	75.2	146.4
2027	49.9	22.3	76.5	148.7
2028	50.7	22.6	77.7	151.0
2029	51.4	22.9	78.9	153.3
2030	52.1	23.3	80.2	155.6

[1] Projected harvest levels by owner are based on projected overall end market demand and the portion of that demand Southeast Alaska is likely to fill, allocated by land ownership.
Source: Daniels et al. 2016

Figure 3.22-7
Projected Timber Harvest in Southeast Alaska by Ownership, 2015-2030



The following sections discuss the three potential scenarios developed by Daniels (2015). The first scenario (Scenario 1) establishes a timeline for the young-growth transition and projects demand assuming the other conditions assumed in the Baseline Model remain unchanged. The second scenario builds upon the transition modeled in Scenario 1 by adding an expansion of bioenergy markets. Scenario 3 also builds on the transition modeled in Scenario 1, but assumes increased demand for lumber from the Lower 48 States.

Scenario 1. This scenario assumes that the transition to young growth will occur by 2025, with old-growth harvest constrained to 5 MMBF for small sales and micro-sales from that point onward. The key identified impact from a demand perspective would be on markets for high quality lumber. Daniels (2015) assumed that purchasers in the Pacific Rim would not be willing to substitute dimension grade lumber in place of shop grade.[3] They also assumed that U.S. demand for dimensional lumber from Southeast Alaska would remain unchanged from the baseline projections. The transition to young growth would in effect result in a reduction in Pacific Rim demand for lumber that would in turn cause a decline in harvest from the Tongass relative to the baseline rate. Total harvest on the Tongass is, as a result, projected to drop by 3.4 MMBF from 2024 to 2025. By 2030, Scenario 1 would see a 5.5 MMBF decline in harvest on the Tongass relative to the Baseline Model (Table 3.22-9; Figure 3.22-8).

Scenario 2. Scenario 2 builds upon Scenario 1 by adding markets for wood energy products based on the assumption that 30 percent of existing heating fuel use in Southeast Alaska would be replaced by wood based fuel over time (Daniels et al. 2016). This scenario is based on a Forest Service goal to support a transition of 30 percent of the heating oil use in Southeast Alaska to biomass over the next decade (Deering 2014). Timber harvest is assumed to provide two main sources of wood based fuel – sawmill residues and low- and utility-grade logs – that could be used to meet this 30 percent bioenergy conversion target. Logging slash is not considered a suitable potential source by Daniels (2015) because of its high moisture content and associated transport costs.

Based on an assumed 5 percent annual rate of conversion (starting in 2016), 65 percent combustion efficiency, and 10 percent moisture content, Daniels (2015) estimates that the wood-based fuel available under this scenario would be able to meet slightly more than two-thirds of the 30 percent conversion target by 2030. Harvest on the Tongass would be considerably higher than the baseline projection under this scenario based on the growth of markets for mill residues and low and utility grade logs (Table 3.22-10; Figure 3.22-8). Harvest under this scenario would also be substantially higher than the baseline projections for Native Corporation and State of Alaska lands.

Table 3.22-10
Projected Timber Harvest on the Tongass under the Baseline Model and Scenarios 1, 2, and 3 (MMBF)

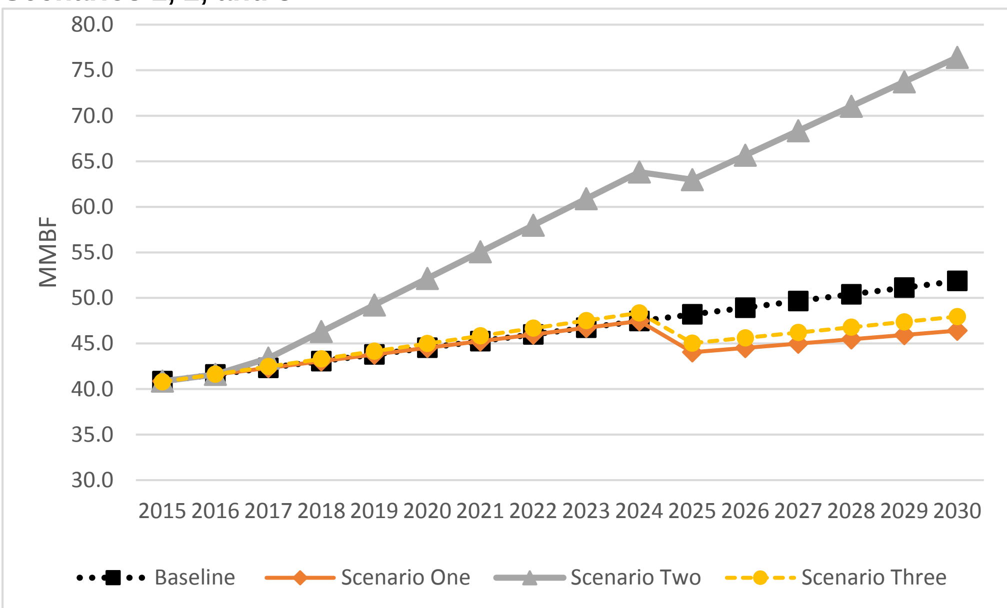
Year	Baseline	Scenario One	Scenario Two	Scenario Three
2015	40.9	40.9	40.9	40.8
2016	41.6	41.6	41.6	41.6
2017	42.3	42.3	43.4	42.5
2018	43.1	43.1	46.3	43.3
2019	43.8	43.8	49.2	44.1
2020	44.5	44.5	52.1	45.0
2021	45.3	45.3	55.1	45.8
2022	46.0	46.0	58.0	46.7
2023	46.7	46.7	60.9	47.5
2024	47.5	47.5	63.8	48.4

[3] Using definitions from the Western Wood Products Association, Daniels (2015) characterize dimension lumber as a structural framing product graded for strength and other properties, with appearance of secondary importance. Shop lumber is characterized as an industrial product graded for the recovery of clear pieces typically available from old-growth logs. Shop lumber is characterized as generally higher quality and worth more than dimension lumber. Data from the 2011 BBER survey indicate that Alaska lumber shipments to Pacific Rim markets consisted entirely of higher quality shop grade lumber (Daniels 2015).

Table 3.22-10 (continued)
Projected Timber Harvest on the Tongass under the Baseline Model and Scenarios 1, 2, and 3 (MMBF)

Year	Baseline	Scenario One	Scenario Two	Scenario Three
2025	48.2	44.0	63.0	45.0
2026	48.9	44.5	65.7	45.6
2027	49.7	45.0	68.4	46.2
2028	50.4	45.5	71.0	46.8
2029	51.1	45.9	73.7	47.4
2030	51.9	46.4	76.4	47.9

Figure 3.22-8
Projected Timber Harvest on the Tongass under the Baseline Model and Scenarios 1, 2, and 3



Scenario 3. Scenario 3 differs from Scenario 1 by using a different rate of projected growth for domestic lumber consumption based on the growth rate prior to the 2007-2009 recession, rather than the more conservative (post-recession) growth rate employed in the Baseline Model and Scenarios 1 and 2. Adjusting demand in this way affects Southeast Alaska harvest and production by increasing domestic demand for both lumber and unprocessed logs. Market shares for Southeast Alaska producers are assumed to remain constant. The results of this scenario are more similar to the baseline projections than the other two scenarios, with increased domestic demand partially offsetting the projected young-growth-related reductions described above for Scenario 1 (Table 3.22-10; Figure 3.22-8).

Sensitivity of the Model. As part of their analysis, Daniels et al. (2016) incorporated and addressed uncertainty in two primary ways: 1) by developing three management scenarios; and 2) by conducting a sensitivity analysis that examined the effects of changes in individual elements of the projections. This is discussed further in Daniels et al. (2016, p.45).

Other Potential Demand Indicators
Another way to consider the potential timber volumes that might be demanded up to and following the young-growth transition is to consider: 1) existing sawmills and demand, and 2) potential lumber and non-lumber applications identified in previous studies.

Existing Sawmills and Demand
The existing mills in Southeast Alaska are generally configured to process old-growth timber, which has been the mainstay of the local industry. Viking Lumber is the largest sawmill presently operating in the region (Table 3.22-6). Viking is also the most modern sawmill in the region, with two processing lines: a large log side that uses a carriage and band mill setup typical of most large log mills in North America; and a small log side that uses an "end-dogging circle saw" as the primary breakdown (Beck Group 2009). In a study conducted for The Nature Conservancy, the Beck Group (2009) indicated that Viking Lumber's current small log line processes approximately 8 MMBF of logs annually, running one shift per day, 40 hours per week. The Beck Group identified three primary modifications to Viking's current small log line that would improve productivity (the volume of lumber produced per hour) and recovery rates (the board feet of lumber produced per board feet of lumber used), reduce manufacturing costs, and allow the small log side to process at least twice the current amount of volume using the same schedule. They also noted that young-growth logs could be run through Viking's small log side as presently configured without much modification, and the proposed modifications could be phased in over time as the supply of young growth increases.

The Viking mill is the only facility in Southeast Alaska with small diameter processing capabilities. Other existing regional sawmills have equipment designed for relatively large-diameter material and cannot efficiently process smaller, young growth timber (Alexander et al. 2010). Manufacturing costs are typically higher for smaller mills because they have lower productivity rates relative to larger more complex mills, especially when sawing smaller logs. As a result, smaller mills in Southeast Alaska tend to process larger logs and produce high value products such as appearance grade lumber and cedar shingles. These mills are typically very simple in design and cannot be practically modified to process young-growth logs (Beck Group 2009). The Beck Group (2009) noted that, combined, these smaller mills on Prince of Wales Island processed around 5 MMBF a year, and observed that the Forest Service should be able to supply a sufficient volume of logs for these operations from salvage and micro-sales for the foreseeable future.

Potential Lumber Markets
Old-growth trees on the Tongass typically yield significant volumes of clear or nearly clear lumber with tight grain suitable for appearance grade lumber and other high value applications. In contrast, young-growth trees typically grow faster and have wide growth rings, as well as more limbs, which results in lumber with many small knots. These characteristics made young growth less desirable for appearance grade lumber, but do not restrict its use in structural lumber applications, such as dimension lumber for house building (Beck Group 2009). Citing work by the Forest Service's Sitka Wood Utilization Center, the Beck Group (2009) identifies a potential local market for structural lumber in Alaska of approximately 100 MMBF per year. This potential market could be served by products using locally processed young-growth timber at some point in the future but obstacles to bringing Alaskan structural lumber to Alaska markets at competitive prices currently exist, including the lack of grading agency support in Southeast Alaska, and the existing transportation infrastructure in Southeast Alaska.

Information on existing facilities in the Lower 48 states provides general insight regarding the volume of timber that new or modified young-growth facilities could potentially process. As part of their evaluation for The Nature Conservancy, the Beck Group (2009) identified sawmills in the coastal regions of Oregon and Washington that currently process western hemlock for framing lumber production, using comparable equipment configurations as Viking Lumber to process logs of comparable size and quality. These generally comparable sawmills processed on average 23 MMBF of logs per year, based on operating a single shift per day (Beck Group 2009). Another young-growth evaluation identified the Vaagen Brothers mill in Colville in eastern Washington as an example of the type of facility that could be developed to process young-growth timber in Southeast Alaska. In 2014, the Vaagen Brothers mill in Colville produced a total of 273 MMBF of lumber; approximately 135 to 140 MMBF of this total was also sawn at the Colville mill. The remainder was sawn at one of Vaagen Brothers' other facilities in Midway, British Columbia or Usk, Washington and transported to the Colville facility for surfacing. The overrun for the Colville sawmill is approximately 1.2, meaning that approximately 113 to 117 MMBF of timber was required to produce this volume (135 to 140 MMBF) (Vaagen 2015).

Non-Lumber Applications

Potential non-lumber applications of young-growth material, including logging debris (tops, limbs, and unmerchantable stems), that have been identified in past studies include the production of wood pellets and briquettes for home and industrial heating use, electrical cogeneration uses, and biomass for central heating. Drawing mainly from the scenarios evaluated in the young-growth study prepared by the Beck Group (2009), potential raw material requirements to operate new facilities that would manufacture wood pellets and briquettes and generate electricity using cogeneration technology are summarized in Table 3.22-11. The sizes of these facilities are based on the scenarios evaluated in the Beck Group report. Larger facilities could be developed if markets were to develop and a sufficient supply of young-growth material were available. The following sections provide a brief overview of these potential non-lumber applications.

Table 3.22-11
Potential Non-Lumber Applications of Young Growth Timber in Southeast Alaska

Product	Raw Material Requirements			Final Product (Pellets/ Briquettes/ Electricity)
	Green (MBF) 1/	Green (tons) 2/	Bone Dry (tons)	
Wood Pellets	2,944	18,400	7,700	7,573 tons
Briquettes	3,097	19,356	8,100	8,604 tons
Electrical Cogeneration	2,485	15,532	6,500	1,950 MWh

MWh – megawatt hours
1 Assumes 1 green ton = 160 board feet
2 Assumes green material has 58 percent moisture content

Wood Pellets. Most wood pellet plants in the U.S. have historically relied on sawmill residues (sawmill dust and planer shavings) for their raw materials, but other pellet plants that rely on roundwood have recently started operation, including facilities in British Columbia, Colorado, and Arizona. Existing facilities in the United States typically range from about 10,000 tons to more than 500,000 tons of wood pellet production per year (Beck Group 2009). Using information from surveys conducted by the Forest Service's Sitka Wood Utilization center and the University of Alaska, the Beck Group estimated that current annual demand for wood pellets from households in Southeast Alaska is approximately 5,400 tons. For the purposes of analysis, the Beck Group evaluated the feasibility of a potential wood pellet facility capable of producing about 7,500 tons of wood pellets a year, which would require about 18,400 tons of green material to operate (assuming 58 percent average moisture content). Their analysis found that this size facility would return a positive value to the raw material, but this value would be less than the delivered cost of forest residues (logging debris and slash). This finding, they concluded, suggests that this type of facility were it to be established would likely seek lower cost mill residues (sawdust, bark, shavings, and chips), rather than roundwood or forest residues that would require transport.

Briquettes. Wood briquettes, also known as firelogs or biobricks, are another non-lumber product that could be produced using young-growth material. Unlike wood pellets, briquettes do not require a specialized heating appliance for use in residential or other heating systems. Briquettes can be burned in regular household wood stoves and fireplaces, as well as industrial and institutional boiler systems. Recognizing that markets would need to be developed over time, the Beck Group evaluated the feasibility of a briquette plant capable of producing 8,600 tons of briquettes per year, which would require about 8,100 tons of bone dry material to operate. Similar to their conclusion with respect to wood pellets, the Beck Group found that this size briquette facility would return a positive value to the raw material, but this value would be less than the delivered cost of logging residues, again suggesting that were this type of facility to be developed, it would likely seek lower cost mill residues.

Electrical Cogeneration. Electrical cogeneration is an established technology that yields both electricity and heat. Two common sources of biomass for cogeneration fuels are forest residues (logging debris and slash) and mill residues (sawdust, bark, shavings, and chips). For the purposes of analysis, the Beck Group evaluated the feasibility of a 275 kilowatt (KW) woody biomass fueled steam turbine generator, which they identified as the smallest practical capacity for this type of facility. A 275 KW turbine operating 8,500 hours a year would generate about 1,950 megawatt-hours (MWh) of electricity. Annual operation of this facility would require an estimated 15,500 tons of green material (Beck Group 2009). The analysis prepared by the Beck Group found that this size facility would return a positive value to the raw material, but would still likely seek lower cost materials where possible.

Biomass Central Heating. Several programmatic efforts have been initiated to explore opportunities to increase the utilization of wood for energy and bio-fuels production in Alaska, including the Alaska Wood Energy Development Task Group and the Southeast Alaska Wood-to-Energy Initiative, the latter initiated as part of the Tongass Transition Framework. Wood biomass systems have already been successfully installed in non-industrial facilities in Alaska. Systems presently operating in Southeast Alaska include the system used to heat the Craig, Alaska elementary and middle schools and the nearby community pool, which operates on mill residues. Other operating systems in Southeast Alaska include those serving schools at Thorne Bay and Coffman Cove on Prince of Wales Island, the Forest Service's Southeast Alaska Visitor Information and Discovery Center and the GSA Federal office building in Ketchikan, the Ketchikan Public Library, and the U.S. Coast Guard facility in Sitka (USDA Forest Service 2013g). As noted with respect to the PNW Research Station's Scenario 2 (above), the Forest Service has a goal to support a transition of 30 percent of the heating oil use in Southeast Alaska to biomass over the next decade (Deering 2014).

Recreation and Tourism

Recreation and Tourism in Southeast Alaska

Trends in Visitation. Summer visitors to Southeast Alaska more than doubled between 1993 and 2006, increasing from 502,800 in 1993 to 1,160,000 in 2006 (McDowell Group et al. 2007). Statewide, the total number of visitors increased by 40 percent over the same period. The relatively large increase in visitation to Southeast Alaska over this period reflects the dramatic growth in the number of cruise ship passengers visiting the region. An estimated 1,037,000 people visited Southeast Alaska in 2011, with most of these visitors (85 percent) arriving by cruise ship (McDowell Group 2012a). Additional information on trends in visitation is provided in the *Recreation and Tourism* section of this EIS.

Employment and Contribution to the Regional Economy. Recreation and tourism-related employment is difficult to accurately quantify because visitors spend their money throughout the local economy. As noted above, recreation and tourism is not classified or measured as a standard industrial category. Components of travel and tourism activities are instead partially captured in other economic sectors, such as retail trade (e.g., grocery stores and gift shops), transportation, hotels and other lodging places, and amusement and recreation services.

According to the Alaska DOL, visitor-related jobs accounted for 11 percent of the summer economy in Southeast Alaska in 2014, compared to 4 percent statewide (Bell 2015). Visitor-related jobs in Southeast Alaska are concentrated in Juneau, Ketchikan, and Skagway, which together accounted for more than three-quarters of the regional total in 2014. Transportation is the largest visitor-related economic sector in Southeast Alaska making up about one-third of visitor-related employment, with jobs ranging from whale watching boats, to tour buses, to airlines (Bell 2015). The highest paying visitor-related occupations are also in the transportation sector, including captains and mates of water vessels (Bell 2015).

In a separate study prepared on behalf of the Alaska Department of Commerce, Community, and Economic Development (DCCED), the visitor industry supported 10,800 jobs and $405 million in labor income in Southeast Alaska from May 2013 through April 2014 based on total visitor industry spending of $1.09 billion (McDowell Group 2015). These estimates are for total employment and labor income, meaning that they include workers employed directly by the visitor industry (direct jobs and income), as well as jobs and income supported elsewhere in the economy (indirect and induced jobs and income).[4] A separate estimate of direct employment developed from Alaska DOL and U.S. Census data identified a total of 6,707 direct jobs supported by the visitor industry in 2012/2013 (Table 3.22-3).

Nature-Based Tourism. A study prepared by the Institute of Social and Economic Research at the University of Alaska Anchorage provides insight into the contribution of nature-based tourism to the regional economy. This study, which involved field research conducted in the summers of 2005, 2006, and 2007, focused on a limited number of communities and sought to provide insight into revenues generated, the types of nature-based activities attracting tourists, and the resulting flows of money through the economy (Dugan et al. 2009). The findings of the study indicate that nature-based tourism generates substantial revenues in the region, with an estimated $277 million generated in annual direct

[4] Economic activity in one sector generates activity in others as firms purchase services and materials as inputs (termed "indirect" effects) and employees spend their earnings within the local economy ("induced" effects).

business revenues for the companies surveyed in Sitka, Juneau, Chichagof Island, Prince of Wales Island, Petersburg, and Wrangell (Dugan et al. 2009).

Dugan et al. (2009) also found that nature-based tourism takes a number of different forms and the ratio of cruise ship passengers to independent travelers varies by location. Most nature-based activities that originate in Ketchikan, for example, fell into four general categories: flightseeing, marine charters, adventure experiences, and general sightseeing. In all cases, the majority of clients participating in these activities were cruise ship passengers. Nature-based tourism on Chichagof Island, on the other hand, included a mix of cruise ship passengers and independent travelers, depending on the location and activity involved (Dugan et al. 2009).

Another study conducted on behalf of ADF&G estimated that residents and visitors to Southeast Alaska spent $363 million hunting and viewing wildlife in 2011, with visitors viewing wildlife accounting for an estimated 59 percent of this total (ECONorthwest 2014). Estimated expenditures fell into four categories: trip-related goods and services (lodging, meals, transportation, licenses); trip package expenditures, such as guided trips; hunting and wildlife viewing gear and equipment (guns, ammunition, clothing, all-terrain vehicles, sleeping bags); and expenditures to purchase or maintain hunting- or wildlife viewing-related real estate. Based on these estimated expenditures, the study estimated that hunting and wildlife viewing, respectively, supported 390 and 1,390 direct jobs and a combined total of $107 million in labor income in Southeast Alaska in 2011, with additional indirect and induced jobs and income supported elsewhere in the economy (ECONorthwest 2014).

Recreation on the Tongass National Forest

While it is reasonable to assume that the majority of visitor recreation and tourism activity in the region is related to the natural environment, not all of the activity generating this employment can be directly linked to the Tongass National Forest. Many visitors experience the Tongass from the deck of a cruise ship without directly using the forest for recreation purposes. In addition, while the Tongass includes approximately 80 percent of the land area in Southeast Alaska, there are other lands that offer wildland recreation opportunities in the region, including 3.3 million acres of National Park Service (NPS) lands, and recreation lands managed by the State of Alaska. Further, other popular recreation and tourism activities, such as saltwater fishing, sea kayaking, and shopping, do not take place on the Tongass.

The Alaska Region of the Forest Service (Region 10) has been participating in the Forest Service's National Visitor Use Monitoring (NVUM) program since 2000. Based on the results of the NVUM program and supplemental survey results for 2008 and 2009, White and Stynes (2010) calculated a visitation estimate of 1,885,500 annual visits to the Tongass National Forest, with 71 percent of these visits made by local residents.[5] Half of Alaska residents surveyed who live in Southeast Alaska reported using a boat or plane to access the national forest. Almost half (49.7 percent) of non-resident visits to the Tongass National Forest involved the use of a guide or outfitter at some point, with local cruises, wildlife viewing, and flightseeing reported most frequently. Alaska residents in contrast were found to very rarely use outfitters or guides (White and Stynes 2010). More detailed information on recreation use on the Tongass is presented in the *Recreation and Tourism* section of this EIS.

[5] More recent estimates based on NVUM Round 3 (2010 to 2014) surveys are discussed in the Recreation and Tourism section of this EIS. Based on these surveys, an estimated total of 1,836,000 annual visits were identified (USDA Forest Service 2015n).

Spending profiles were estimated for residents and non-residents visiting the Forest based on data compiled during the NVUM surveys. Average spending per Forest visit was estimated to be $46.03 and $341.58 for residents and non-residents, respectively, with every 10,000 visits (a mix of residents and non-residents) supporting 13.7 direct jobs and 3.9 jobs elsewhere in the regional economy. Using these coefficients, White and Stynes (2010) estimated that 1,885,513 annual visits generated about $250 million in spending and supported 2,589 direct jobs and an additional 728 jobs elsewhere in the regional economy. This overall estimate is equivalent to about 30 percent of the regional visitor estimate developed for Alaska DCCED (McDowell Group 2015), and the direct component is about 38 percent of the direct jobs estimated by Southeast Conference (2014).

Commercial Fishing and Seafood Processing

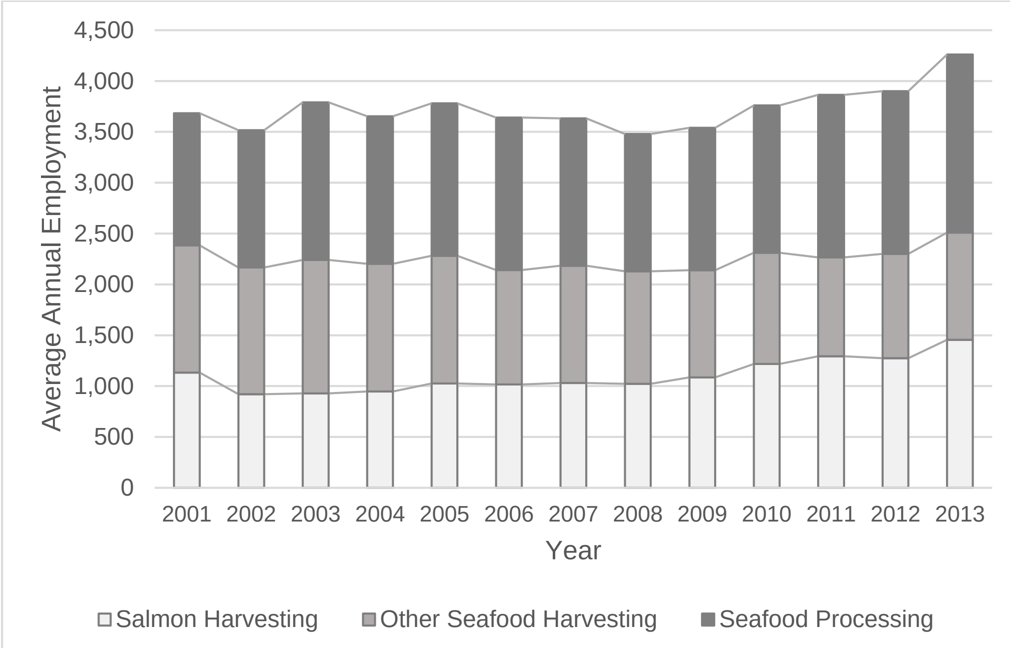
Salmon accounted for more than half (58 percent) of the total commercial catch in Southeast Alaska in 2013, with the remainder divided among halibut (15 percent), sablefish (9 percent), crab (6 percent), herring (4 percent), and shellfish (7 percent) (Warren 2014). There is an important connection between salmon and other wildlife and fish species on the Tongass. Crab, halibut, herring, bears, eagles, and other species depend on the juvenile salmon produced in the Tongass streams and lakes and the annual return of millions of salmon. As a result, management decisions that affect salmon indirectly affect other species that are commercially fished. These relationships are, however, poorly understood and difficult to quantify. The commercial fishing discussion presented in this section, therefore, focuses on the salmon fishery. Data available for the seafood processing industry, however, do not allow for an easy distinction between salmon processors and other firms. Data presented for the seafood processing sector, therefore, include the entire seafood processing industry.

Commercial fish harvest in the waters of Southeast Alaska can fluctuate widely from year to year. Overall, recent commercial salmon harvest (since early to mid-1990s) has generally been high but with large fluctuations in the last decade due to the relatively weak returns of pink salmon in even years. Pink salmon have averaged 76 percent of total commercial harvest since 1962 (Conrad and Gray 2014) (see Figures 3.6-1 and 3.6-2 in the *Fish* section of this EIS). Record harvest of salmon occurred in 2013, with 112 million salmon captured.

Based on the estimate of salmon produced from streams originating in the Tongass National Forest, estimated annual commercial salmon harvest from 1984 to 2013 has averaged over 176 million pounds, with a wholesale value (ex-vessel value) of more than $93 million (adjusted to 2013 dollars) (Figure 3.6-3 in the *Fish* section of this EIS). More than 335 million pounds of salmon were harvested in Southeast Alaska in 2013 with a wholesale value of more than $153 million (Figure 3.6-3).

Employment in the seafood harvesting and processing sectors varies from year-to-year, but remains relatively stable compared to the fluctuations in the volumes and value of salmon harvested each year. Salmon harvesting employed 1,456 people in Southeast Alaska in 2013, with an additional 1,054 people employed harvesting other fish. A further 1,750 people were employed in fish processing for a combined total of 4,260 jobs, an increase of 360 jobs or 9 percent from the preceding year (Figure 3.22-9). As indicated in Figure 3.22-3, employment in the seafood harvesting and processing sectors is highly seasonal.

Figure 3.22-9
Seafood Harvesting and Fish Processing Employment in Southeast Alaska, 2000 to 2013



Note:
1/ Other seafood harvesting includes crab, groundfish, halibut, herring, shellfish, and sablefish.
Source: Alaska DOL 2014f, 2015b; Warren 2014

Unlike other basic sectors of Southeast Alaska's economy, components of the seafood industry are spread throughout the region with an important presence in virtually every community. Seafood processing workers, for example, were employed in all of the boroughs in 2012, ranging from 14 workers in Skagway to 1,041 workers in Ketchikan Gateway Borough (Table 3.22-11). The commercial fishing and seafood processing industries are generally characterized by high degrees of nonresident participation. As noted above in the *Nonresident and Seasonal Employment* subsection, information on the nonresident share of employment in the fish harvesting sector is not available for Southeast Alaska. Statewide, ADOL estimates that nonresidents accounted for an estimated 51.3 percent of the fish harvesting workforce in 2013 (Krieger et al. 2015).

Nonresidents accounted for approximately 67 percent of employment in the fish processing sector in Southeast Alaska in 2012, ranging from 35.7 percent of workers in Skagway to 90.3 percent in Haines Borough (Table 3.22-12). Local processing workers defined as those who claimed residency in the same borough as the employer comprised 27.1 percent of the processing workforce in 2012 (Alaska DOL 2014f).

In addition to high seasonality and low resident hire, the seafood processing sector is generally characterized by low hourly wages with a median annual wage of $24,689 in 2013 (Strong 2014). The industry does, however, have a number of higher paid occupations, including ship engineers, captains, mates, boat pilots, and general and operations mangers, which accounted for just 1.2 percent total employment, but 6 percent of wages, with a median annual wage of $66,720 (Strong 2014).

Table 3.22-12
Seafood Processing Workforce by Borough, 2012

Borough	Processing Workers	Percent of Workers Nonresident
Haines Borough	257	90.3
Hoonah-Angoon Census Area	41	36.6
Juneau City and Borough	549	64.5
Ketchikan Gateway Borough	1,041	75.8
Petersburg Census Area	683	63.3
Prince of Wales-Hyder Census Area	471	53.9
Sitka City and Borough	769	63.3
Skagway Municipality	14	35.7
Wrangell City and Borough	260	69.2
Yakutat City and Borough	80	42.5
Southeast Total[1/]	**4,106**	**67.0**

Notes:
[1] Workers were counted by place of work. Some workers worked in more than one borough or census area in 2012, but were only counted once in the regional total. As a result, the number of workers by borough and census total do not sum to the total shown here.
Source: Alaska DOL 2014e

Mining and Mineral Development

Mineral exploration and mining have been a part of life in Southeast Alaska for more than a century. Data compiled by the U.S. Bureau of Economic Analysis for 2013 indicated that at least 649 workers were directly employed by the mining industry (Table 3.22-2). This may, however, underestimate total direct employment in the mining industry in Southeast Alaska because data were withheld for the mining sector for several of the boroughs that comprise the region.

Separate estimates developed using Alaska DOL data found that a total of 756 workers were employed in the mining sector in Southeast Alaska in 2013 (Southeast Conference 2014). According to a recent economic impact study prepared for Alaska's mining industry, the Greens Creek and Kensington mines employed 390 workers and 300 workers in 2012, respectively (McDowell Group 2013a). Average annual wages in the mining sector were $98,000 in 2011, with these high wages reflecting the skilled nature of the job, as well as the demands of working in remote locations (Abrahamson 2013).

According to Southeast Conference (2014), employment in the mining sector in Southeast Alaska has more than doubled over the past decade, increasing from 291 jobs in 2003 to a peak of 815 jobs in 2012, before dropping to 756 jobs in 2013. Much of this increase was due to the opening of the Kensington Mine, which began operations in 2010. The region's mining industry is closely tied to global metal prices, which peaked in 2011 after 11 years of growth, and have since declined. Despite falling metal prices, production was higher in 2013 than the preceding year in both of the region's large mines (Greens Creek and Kensington) (Southeast Conference 2014).

The nonresident share of mining employment in Alaska has increased along with overall employment, with 35 percent of mine employees identified as nonresidents in 2011 (Abrahamson 2013). Both the Greens Creek and Kensington mines are located in the City and Borough of Juneau. Greens Creek Mine is located on Admiralty Island; Kensington Mine is located on the mainland approximately 45 miles north of Juneau. Alaska resident employees of both mines live throughout the region. About two-thirds of Greens Creek employees live in Juneau. The other one-third live in other Southeast Alaska communities or elsewhere in the region (McDowell Group 2012b).

Two proposed underground mine projects on Prince of Wales Island received approval for financial assistance through the Alaska Industrial Development and Export Authority in June 2014 (Bradner 2014). Senate Bill 99 authorized $145 million and $125 million in infrastructure and construction financing, respectively, for the proposed Bokan Mountain and Niblack projects.

The Bokan Mountain project is a rare earths mine that would include on-site ore processing facilities. The McDowell Group (2013b) in a study prepared for the Bokan Mountain project estimated that construction of the project would last 2 years and employ an average construction workforce of 200, with peak employment potentially reaching 300 workers. Operation would be expected to employ 190 workers with approximately $18 million in annual payroll (McDowell Group 2013b). The Niblack Project is a proposed underground copper-gold-zinc-silver mine. The project owners estimate that the construction and operation phases of the project would both employ approximately 200 workers (Niblack Project LLC 2015).

Natural Amenities and Quality of Life

Natural amenities and local quality of life have been recognized as important factors determining the economic prospects of many rural communities in the American West and elsewhere (Rudzitis and Johnson 2000). While local amenities and life quality do not directly generate income in the same sense as, say, a sawmill or tourist lodge, they do act to attract and keep residents. This, in turn, supports communities and their economies in several ways. First, many of these residents may earn a substantial proportion of their income from non-job related sources that are independent of local economic activity. Much of this income will then be spent locally, resulting in additional employment and income in the community. Second, residents bring with them important skills and energy that constitute valuable assets for the community. Broadly termed “human capital” by economists, these skills (and the energy with which residents apply them) can earn additional outside income as well as provide essential social resources to the community. These residents may also help attract and retain businesses that are dependent on a skilled labor force, but otherwise relatively footloose from a location standpoint.

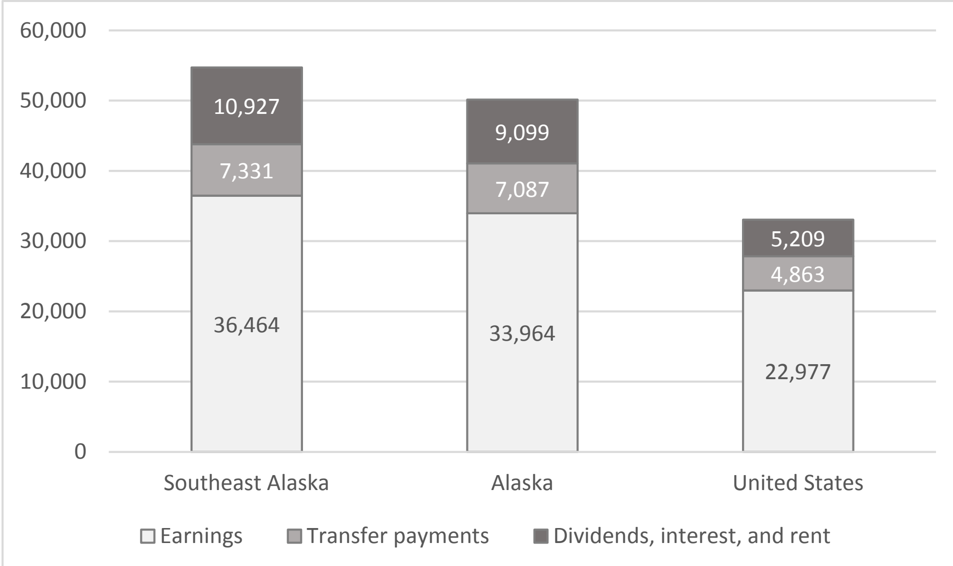
Since it is tracked as a separate category in standard income statistics, non-wage income and its contribution to local economies is directly measurable. Investment income (dividends, interest, and rent) and transfer payments from government are the two major categories of non-wage income. Non-job related income (i.e., transfer payments and dividends, interest, and rent) accounted for 33 percent of total income in Southeast Alaska in 2013, 32 percent statewide, and 36 percent for the United States as a whole (Table 3.22-13; Figure 3.22-10).

Table 3.22-13
Components of Per Capita Income 2013

	Southeast Alaska		Alaska		United States	
Per Capita Income	Total ($)	Percent of Total	Total ($)	Percent of Total	Total ($)	Percent of Total
Total	54,722	100	50,150	100	44,765	100
Earnings[1]	36,464	67	33,964	68	22,977	64
Transfer payments[2]	7,331	13	7,087	14	4,863	17
Dividends, interest, and rent	10,927	20	9,099	18	5,209	19

Notes:
1 Earnings includes wages and salaries, other labor income, and proprietors’ income.
2 Transfer payments consist mainly of government payments to individuals, including retirement, disability, and unemployment insurance benefit payments, income maintenance payments, and veterans benefit payments. Government payments to individuals in Alaska include Alaska Permanent Fund benefits, which are derived from oil revenues and paid to every resident.
Source: U.S. Bureau of Economic Analysis 2014a

Figure 3.22-10
Components of Per Capita Income 2013



Source: U.S. Department of Commerce, Bureau of Economic Analysis 2014a

Transfer payments consist mainly of government payments to individuals, with social security payments and medical benefits being among the most important (Table 3.22-14). Transfer payments per capita in 2013 comprised a smaller share of total income in Southeast Alaska and Alaska than they did in the U.S. as a whole (Table 3.22-12). Per capita transfer payments were, however, higher in absolute terms in Southeast Alaska and Alaska than the U.S., and this was also the case with dividends, interest, and rent (Table 3.22-14; Figure 3.22-10).

Compared to the U.S. as a whole, retirement and disability and medical components comprised a smaller share of total transfer payments in Southeast Alaska, and still smaller shares of the state as a whole (Table 3.22-14). The "other payments" category, which includes Alaska Permanent Fund dividend payments, in contrast, comprised a much larger share of transfer payments in Alaska, accounting for 11 percent of total transfer payments in Southeast Alaska and the state as a whole compared to less than 1 percent nationwide (Table 3.22-14).

Retirees comprise the most common source of non-wage income in many rural communities (Colt 2001). In fact, this has given rise in some places to local marketing strategies specifically aimed at attracting retirees and thereby developing the local "retirement industry." The growing economic importance of retirees was not readily apparent in Southeast Alaska in Tables 3.22-13 and 3.22-14 because the relatively large size of the "other payments" category tends to overshadow the other categories. However, although retirement and disability payments and medical payments comprise a relatively small share of total income by national standards, both increased as a share of transfer payments in Southeast Alaska between 2000 and 2013 accounting for a combined total of 66 percent of transfer payments in 2013 compared to 41 percent in 2000. This is partially the result of natural aging processes, as the median age in Southeast Alaska has continued to increase since 2000, but may also indicate that Alaska is becoming more attractive for people as a place to live and not merely as a place to earn money.

Table 3.22-14
Components of Per Capita Transfer Payments, 2013

	Southeast Alaska		Alaska		USA	
	Total ($)	Percent of Total	Total ($)	Percent of Total	Total ($)	Percent of Total
Retirement and disability	1,985	27%	1,608	23%	1,678	35%
Medical payments	2,829	39%	2,624	37%	2,096	43%
Income maintenance benefits	964	13%	1,124	16%	539	11%
Unemployment insurance	285	4%	267	4%	126	3%
Other payments[1]	793	11%	782	11%	7	0%
Miscellaneous other[2]	475	6%	682	10%	415	9%
Total transfer payments	**7,331**	**100%**	**7,087**	**100%**	**4,863**	**100%**

Notes:
[1] Consists largely of Bureau of Indian Affairs payments, education exchange payments, Alaska Permanent Fund dividend payments, compensation of survivors of public safety officers, compensation of victims of crime, disaster relief payments, compensation for Japanese internment, and other special payments to individuals.
[2] Miscellaneous other includes veterans benefit payments, Federal education and training assistant payments (excluding veterans), payments to nonprofit institutions, and business payments to individuals.
Source: U.S. Bureau of Economic Analysis 2014b

Although it is difficult to directly measure the importance of natural amenities in attracting and keeping residents, proximity to natural environments and the recreational activities they support are undeniably a benefit enjoyed by residents, especially in the more rural communities of Southeast Alaska. A recent survey conducted on behalf of ADF&G, for example, found that 60 percent of surveyed residents in Southeast Alaska identified wildlife as extremely (27 percent) or very (33 percent) important to their quality of life, with a similar share (58 percent) identifying wildlife as an extremely (30 percent) or very (28 percent) important reason influencing their decision to live in Alaska (ECONorthwest 2014),

At the same time, the atmosphere of a community also constitutes an important amenity, and this may often be linked to more traditional forms of economic activity, such as fishing or timber. In other words, changes in the local economy such as a shift to tourism may impact local atmosphere and amenities even if the surrounding natural environment remains essentially unchanged. These impacts are often assumed to be negative as tourism leads to crowding and the loss of traditional charm, but this need not always be the case. Certain tourism establishments, such as restaurants, meeting centers, or entertainment facilities, may often serve local residents as well, thus adding to the amenities available to them. Finally, the size of a community also has important effects on the local amenities available. If a community is too small, or too poor, it cannot provide many of the basic social and economic amenities many residents require, local natural amenities notwithstanding.

Environmental Consequences

This section describes the potential direct, indirect, and cumulative economic and social effects of the five alternatives examined in detail in the EIS.

Direct and Indirect Effects

Wood Products

The Secretary of Agriculture directed the Forest Service in Memorandum 1044-009 (July 2013) to transition to a young-growth-based timber management program on the Tongass National Forest over the next 10 to 15 years, so that at the end of this period the vast majority of timber sold by the Tongass will be young growth. The Secretary's memorandum indicates that this transition should be implemented in a manner that preserves a viable timber industry that provides jobs and opportunities for Southeast Alaska residents.

Comments received during public scoping were concerned that a premature transition to young growth would result in mill closures because it would not allow existing mills sufficient time to retool so that they can process young-growth logs. Commenters stated that if existing mills were to close, it would not be possible to maintain the economies of scale and infrastructure necessary to support a viable timber industry. Other comments emphasized that the transition should support local jobs through local, value-added manufacturing, and end existing export policies on the Tongass that allow unprocessed logs to be exported.

Using methods adapted from previous PNW Research Station analyses (Brooks and Haynes 1990, 1994, 1997; Brackley et al. 2006a, 2006b), the PNW Research Station developed a baseline projection of annual demand for Tongass timber for 2015 to 2030 (Daniels et al. 2016). This baseline projection anticipates that demand would gradually increase from an estimated 40.0 MMBF in 2015 to 52.1 MMBF in 2030 (Table 3.22-10; Figure 3.22-8). All five alternatives evaluated in this EIS would provide an annual average harvest of 46 MMBF prior to the transition. This harvest volume would consist of old-growth and young-growth harvest, with old growth decreasing as a share of this total volume (46 MMBF) over time as more young growth becomes economic to harvest. Old-growth volume offered would continue to decrease until it reaches 5 MMBF per year, at which point it would be stabilized at 5 MMBF per year to support a small sale and micro sale industry, and would remain at that level for the remainder of the planning period.[6] Once this point is reached, the amount of timber offered for sale would be allowed to increase above 46 MMBF as more young growth becomes economic to harvest. The speed of the transition (i.e., how many years it would take for the young-growth supply to reach 41 MMBF) and the amount of young-growth timber available following the transition would vary by alternative.

Estimated Tongass timber supply, assuming maximum harvest levels, is presented by alternative for Years 1 to 100 in Table 3.22-15. Estimated volumes are expressed as average annual volumes in 5-year increments. This table shows how many 5-year periods it would take for average annual young-growth harvest to reach 41 MMBF. The shaded cells indicate the 5-year increment when the transition to young-growth harvest is expected to be completed. Table 3.22-15 also shows the amount of young-growth timber that would be available following the transition.

Maximum young-growth harvest is shown graphically by alternative for the 100-year study period in 5-year increments in Figure 3.22-11. The available volume would increase over time under all of the alternatives with the highest available volumes, once they are reached, expected to remain constant and extend over several decades (Figure 3.22-11).

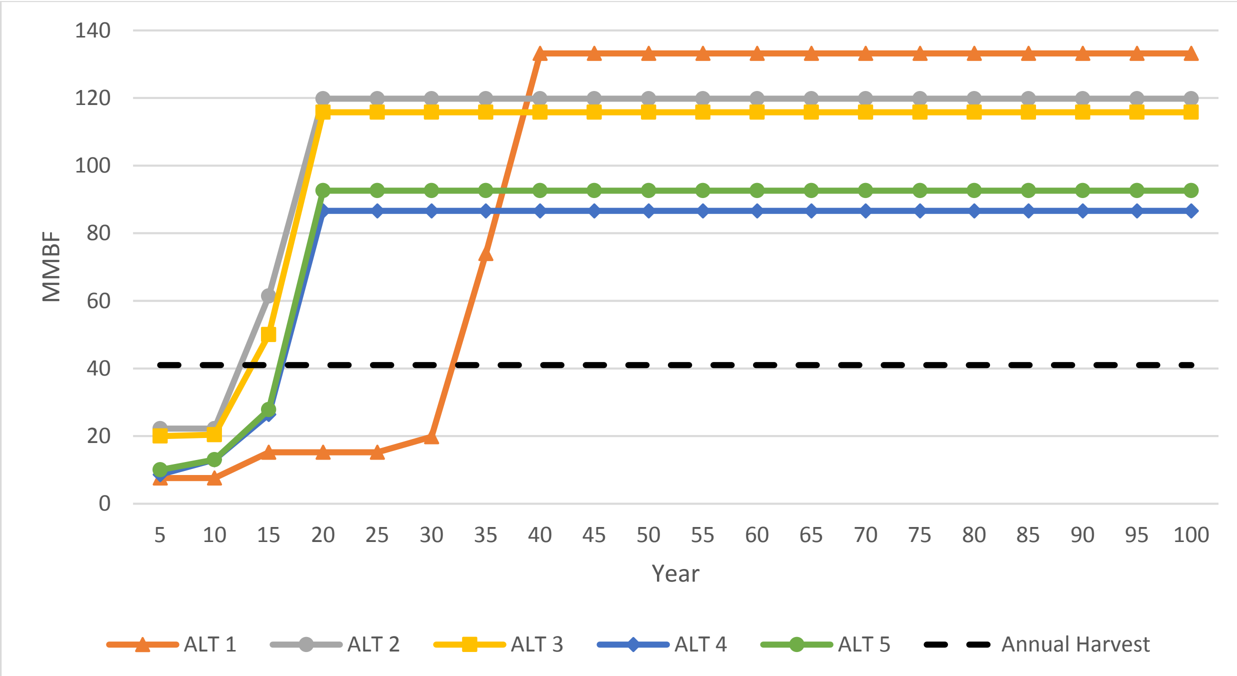
[6] The current sawmills that comprise the small sale and micro sale industry tend to process larger logs and produce high value products such as appearance-grade lumber and cedar shingles. These mills could continue to process up to 5 MMBF of old-growth timber following the transition. However, there may not be enough old-growth timber to support the current small mill industry. If this were the case and not enough old-growth timber was made available, mills would either have to scale back, switch to young growth timber or close. See Forest Plan Appendix B.

Table 3.22-15
Estimated Maximum Timber Harvest on the Tongass by Alternative, Year 1 to 100

5-Year		Alternative 1			Alternative 2			Alternative 3			Alternative 4			Alternative 5		
Period	Years	YG	OG	Total	YG	OG	Total	YG	OG	Total	YG	OG	Total	YG	OG	Total
1	1-5	7.6	38.4	46.0	22.2	23.8	46.0	20.0	26.0	46.0	8.6	37.4	46.0	10.0	36.0	46.0
2	6-10	7.6	38.4	46.0	22.2	23.8	46.0	20.4	25.6	46.0	13.0	33.0	46.0	13.0	33.0	46.0
3	11-15	15.2	30.8	46.0	61.4	5.0	66.4	50.0	5.0	55.0	26.4	19.6	46.0	27.8	18.2	46.0
4	16-20	15.2	30.8	46.0	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
5	21-25	15.2	30.8	46.0	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
6	26-30	19.8	26.2	46.0	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
7	31-35	74.0	5.0	79.0	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
8	36-40	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
9	41-45	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
10	46-50	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
11	51-55	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
12	56-60	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
13	61-65	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
14	66-70	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
15	71-75	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
16	76-80	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
17	81-85	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
18	86-90	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
19	91-95	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6
20	96-100	133.2	5.0	138.2	119.8	5.0	124.8	115.8	5.0	120.8	86.6	5.0	91.6	92.6	5.0	97.6

Notes:
YG = young growth OG = old growth
[1] The shaded cells indicate the 5-year increment when the transition to young-growth harvest is expected to be completed.
[2] These volumes are maximum harvest levels and include grade 1, 2, and 3 logs only.

Figure 3.22-11
Estimated Maximum Young-Growth Timber Supply on the Tongass by Alternative, Year 1 to 100



Note:
1/ The annual harvest level shown is 41 MMBF, the point at which the transition to young-growth harvest is expected to be completed.

Demand Indicators

Pacific Northwest Research Station Projections
The Affected Environment part of this section provides an overview of current conditions for the Southeast Alaska wood products industry and discusses projected demand, as identified by Daniels (2015). Projections were developed for 2015 to 2030 for a Baseline Model that was then used to evaluate three potential scenarios representing different potential futures for timber harvest in Southeast Alaska (see Table 3.22-9 and Figure 3.22-8). These scenarios provide a basis for discussion of where the industry currently is, and provide insight into what that industry could look like in the future given various assumptions about industry investment and end markets.

Baseline Model
The Baseline Model developed by Daniels (2015) projected demand for Tongass timber assuming that historical trends in imports, consumption, and market share will remain constant. Total derived demand for timber harvested on the Tongass was projected to gradually increase from 40.0 MMBF in 2015 to 52.1 MMBF in 2030. All five alternatives were designed to correspond with these projections and supply 46 MMBF per year until the young-growth transition occurs (Table 3.22-15).

Alternatives 1, 4, and 5. The young-growth transition is expected to occur in Years 31 through 35 for Alternative 1 and Years 16 through 20 for Alternatives 4 and 5 (Table 3.22-15). Although the relative share of total harvest made up by young growth would increase under these alternatives from 2015 through 2030

(Years 1 through 15), the PNW Research Station modeling suggests that projected harvest volumes under these alternatives would have sufficient old-growth volume to meet market demand as projected in the PNW Research Station's Baseline Model.

Alternatives 2 and 3. Under these alternatives, the young-growth transition is expected to occur in Years 10 through 15 (Table 3.22-15). This generally approximates the young-growth transition period of 10 years employed in the PNW Research Station analyses for Scenarios 1 through 3. These three scenarios are all based on the assumption that the young-growth transition would occur in 2025 (Year 10) and are more representative of Alternatives 2 and 3 than the Baseline Model.

Scenario 1

This scenario assumes that the young-growth transition would occur by 2025, with the transition expected to result in a reduction in Pacific Rim demand for lumber that would in turn cause a decline in harvest from the Tongass relative to the baseline rate (Table 3.22-10; Figure 3.22-8).

Alternatives 1, 4, and 5. The young-growth transition is expected to occur later than 2025 under these alternatives. As a result, the projected reduction in Pacific Rim demand anticipated following a transition in 2025 would not be expected occur under these alternatives. The Baseline Model projections developed by the PNW Research Station are more representative of the modeled period (2015 to 2030; Years 1 to 15) for Alternatives 1, 4, and 5.

Alternatives 2 and 3. Under these alternatives, the young-growth transition would occur in Years 10 through 15, which generally approximates to the timeframe (2015) assumed for this scenario. As a result, Scenario 1 represents one alternative future for timber harvest under these alternatives.

Scenario 2

Scenario 2 builds upon Scenario 1 by adding markets for wood energy products based on the assumption that 30 percent of existing heating fuel use in Southeast Alaska would be replaced by wood based fuel over time (Table 3.22-10; Figure 3.22-8). Daniels (2015) assumed an annual conversion rate of 5 percent starting in 2016 for the purposes of analysis.

Alternatives 1, 4, and 5. Timber supply would remain at 46 MMBF for the duration of the period modeled by PNW Research Station (2015 to 2030; Years 1 through 15) and, as modeled, these alternatives would be unable to meet increased wood energy-related demand.

Alternatives 2 and 3. Derived demand for Tongass timber under Scenario 2 would start to exceed 46 MMBF prior to the anticipated young-growth transition under these alternatives and demand in excess of 46 MMBF would not be met. Following the transition, total annual harvest for Alternative 2 would be 52.5 MMBF, which would meet a larger share of the anticipated demand under this scenario than the other alternatives, including Alternative 3, but would be equivalent to 69 percent of projected demand in 2030. While Scenario 2 represents an alternative future for timber harvest under Alternatives 2 and 3, as currently configured (with old-growth harvest constrained to 5 MMBF), neither of these alternatives would be able to fully meet the total demand projected under Scenario 2.

It may, however, be noted that the total amount available for harvest after 2030 (Years 16-20) under Alternatives 2 and 3 would increase dramatically as additional young-growth timber becomes available for harvest and would be about equivalent to 1.5 times the projected demand for 2030 under this scenario.

Scenario 3
Scenario 3 differs from Scenario 1 by using a different rate of projected growth for domestic lumber consumption based on the growth rate prior to the 2007-2009 recession, rather than the more conservative (post-recession) growth rate employed in the Baseline Model and Scenarios 1 and 2 (Table 3.22-10; Figure 3.22-8).

Alternatives 1, 4, and 5. The young-growth transition would not occur during the period modeled by the PNW Research Station under these alternatives and the amount of timber available to be harvested would be limited to 46 MMBF per year. Without the transition, there would be no drop in demand from the Pacific Rim markets, and any additional demand associated with increased domestic lumber consumption would go unmet.

Alternatives 2 and 3. Like Scenarios 1 and 2, Scenario 3 represents an alternative future for timber harvest under Alternatives 2 and 3. Projected harvest under Alternatives 2 and 3 following the transition would be sufficient to meet projected demand for this scenario.

Summary
As presently configured, Alternatives 1, 4, and 5 most closely correspond with the Baseline Model developed by the PNW Research Station. Because total supply is capped at 46 MMBF until the young-growth transition, these alternatives would not be able to meet potential increases in demand like those assumed for Scenarios 2 and 3 (increased wood energy and domestic demand, respectively) were they to occur independent of the young-growth transition.

Under Alternatives 2 and 3, the young-growth transition would occur in Years 10 through 15, which generally approximates the young-growth transition period of 10 years assumed in Scenarios 1 through 3 modeled by the PNW Research Station. Scenarios 1 and 3 represent alternative futures for the 2015 to 2030 timeframe that could be potentially realized under these alternatives. Projected demand under Scenario 2 would exceed available supply under both of these alternatives as currently configured.

Other Demand Indicators
The relative speed of the transition (i.e., the number of years it would take the young growth supply to reach 41 MMBF) would affect the amount of time available for existing mills to retool or modify existing operations to adapt to the changing supply of timber. It would also affect the amount of time available for existing mills and other potential operators to evaluate markets for young-growth timber and wood products harvested and produced in Southeast Alaska. For existing mills, this timeframe would also be affected by the existing volume under contract. Existing volume under contract does not vary by alternative, but would influence the adjustment period in all cases. As discussed in the Affected Environment section, above, various purchasers had an estimated total of 90.8 MMBF of uncut timber under contract with the Forest Service in April 2016, with Viking Lumber accounting for more than half (61 percent; 55.5 MMBF) of this total (USDA Forest Service 2016b).

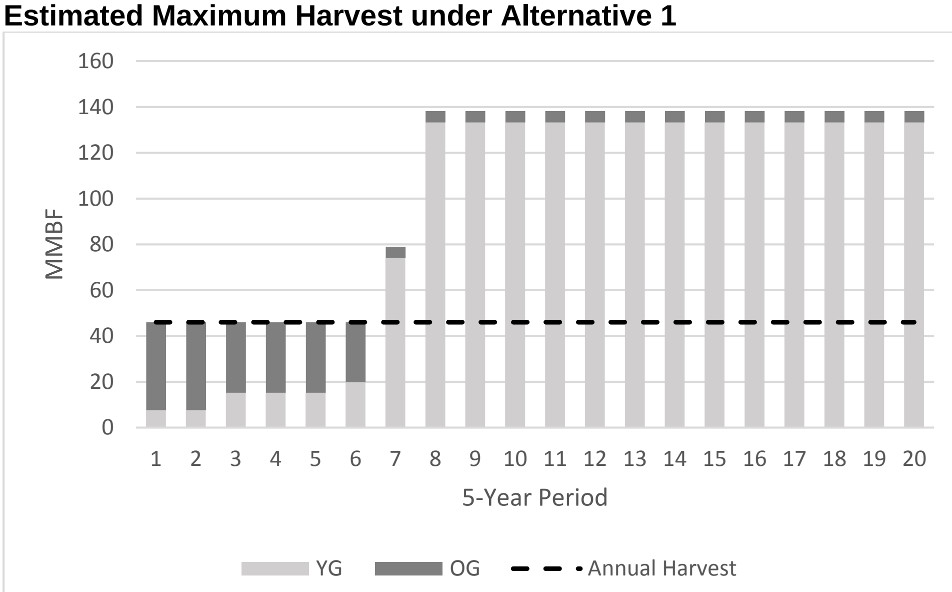
Following the transition, the timber industry in Southeast Alaska would be primarily oriented toward young growth. The form this industry might take would be potentially influenced by a range of factors, including industry investment and end markets. The potential supply of timber from the Tongass National Forest will also play an important role in shaping the future industry. An economically viable and stable young-growth timber supply is expected to be available in the long-term under all five alternatives, but annual estimated volumes would vary by alternative. An annual old-growth volume of 5 MMBF would be available to support a limited small operator industry under all alternatives for the 100-year study period.

Alternative 1

Under this alternative, an estimated annual average of 7.6 MMBF of young growth would be available in Years 1 through 10, increasing to 15.2 MMBF in Years 11 through 25, and 19.8 MMBF in Years 26 through 30, with available young growth expected to exceed 41 MMBF in Years 31 through 35 (Table 3.22-15). The transition to young growth would be the slowest under this alternative occurring 15 years later than it would under Alternatives 4 and 5, and 20 years later than under Alternatives 2 and 3 (Figure 3.22-12). The continued availability of old-growth timber under this alternative would allow a period of several decades for the existing industry to retool or new facilities to develop and come online.

The relatively limited volumes of young growth available during the 25 years following implementation would be sufficient to supply all or part of the estimated annual demand of Viking Lumber's small log line (8 MMBF). Smaller volumes of material may also be available for bioenergy uses, but potential investment in new facilities designed to process young-growth material would be unlikely to occur until larger volumes became available after year 30.

Figure 3.22-12
Estimated Maximum Harvest under Alternative 1

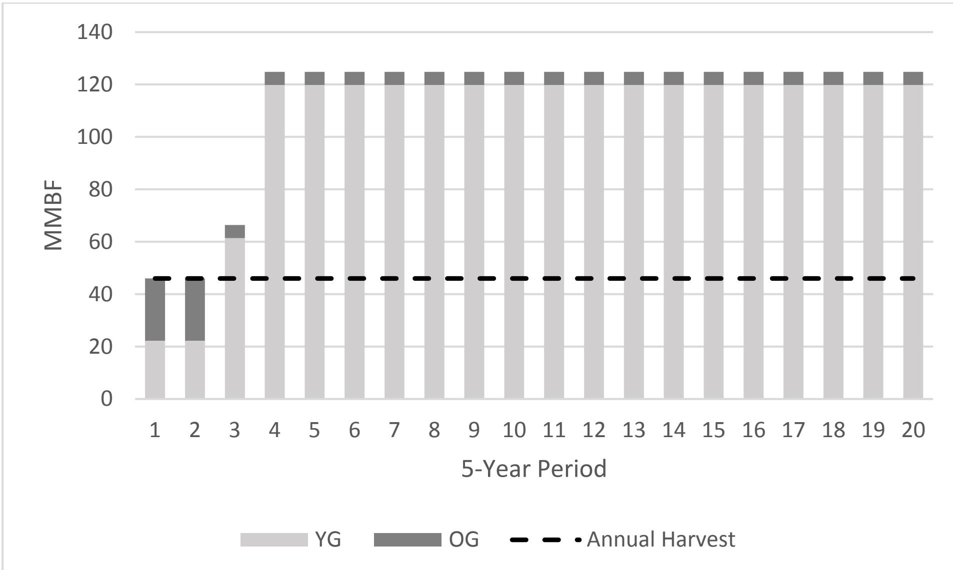


Once the transition is finally reached, the volume of young-growth harvest available for harvest rapidly increases, jumping from an annual average of 19.8 MMBF for Years 26 through 30 to 74.0 MMBF for Years 31 through 35 and then 133.2 MMBF in the next 5-year period and for the remainder of the study period, through Year 100 (Figure 3.22-12). The final annual available young-growth volume (133.2 MMBF) would be the highest under this alternative, but would be available for fewer years than the highest volumes under the other alternatives (Figure 3.22-11).

Alternative 2
Under this alternative, an estimated annual average of 22.2 MMBF of young growth would be available in Years 1 through 10, the highest amount under any of the alternatives, with available young growth expected to exceed 41 MMBF as soon as Years 11-15, and available annual young-growth volume increasing to the maximum amount under this alternative (119.8 MMBF) in Years 16-20 (Table 3.22-14; Figure 3.22-13). The transition to young growth would be quickest under this alternative and Alternative 3, and the final annual available young-growth volume (119.8 MMBF) would be second highest under this alternative (Figure 3.22-11).

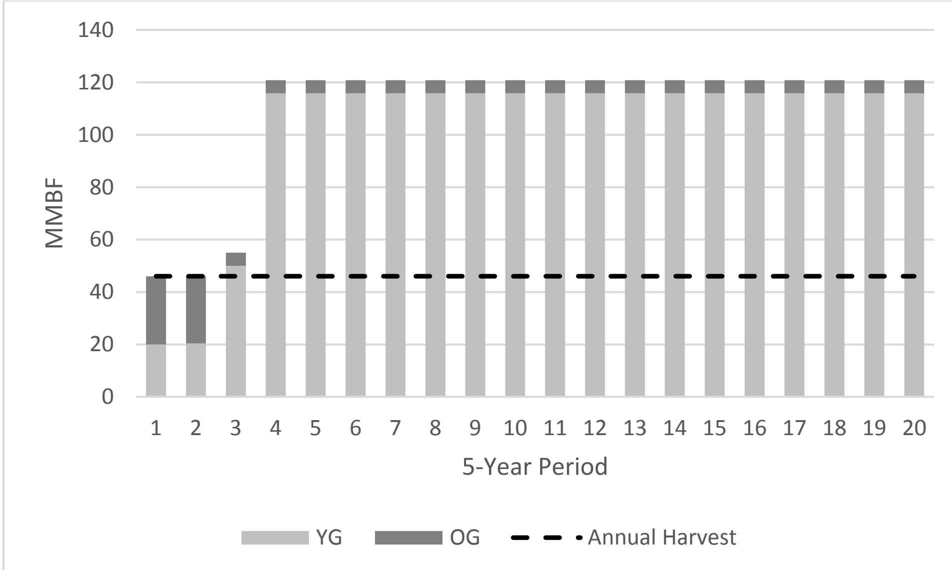
The young-growth volumes initially available in Years 1 through 10 (22.2 MMBF) would be sufficient to supply all or part of the estimated annual demand of Viking Lumber's small log line (8 MMBF), as well as increased demand if the existing facility was modified. There would also be sufficient supply to support bioenergy uses. Following the transition in Years 11-15, sufficient volume would be available to supply additional demand from sawmills, as well as bioenergy uses.

Figure 3.22-13
Estimated Maximum Harvest under Alternative 2



Alternative 3
Under this alternative, an estimated annual average of 20.0 to 20.4 MMBF of young growth would be available in Years 1 through 10, the second highest amount under any of the alternatives, with available young growth expected to exceed 41 MMBF as soon as Years 11-15, and available annual young-growth volume increasing to the maximum amount under this alternative (115.8 MMBF) in Years 16-20 (Table 3.22-14; Figure 3.22-14). The timing and available volumes under this alternative are very similar to those estimated for Alternative 2. The transition to young growth would be quickest under Alternatives 2 and 3, and the final annual available young-growth volume (115.8 MMBF) would be third highest under this alternative, just slightly lower than the volume available under Alternative 2 (Figure 3.22-11).

Figure 3.22-14
Estimated Maximum Harvest under Alternative 3

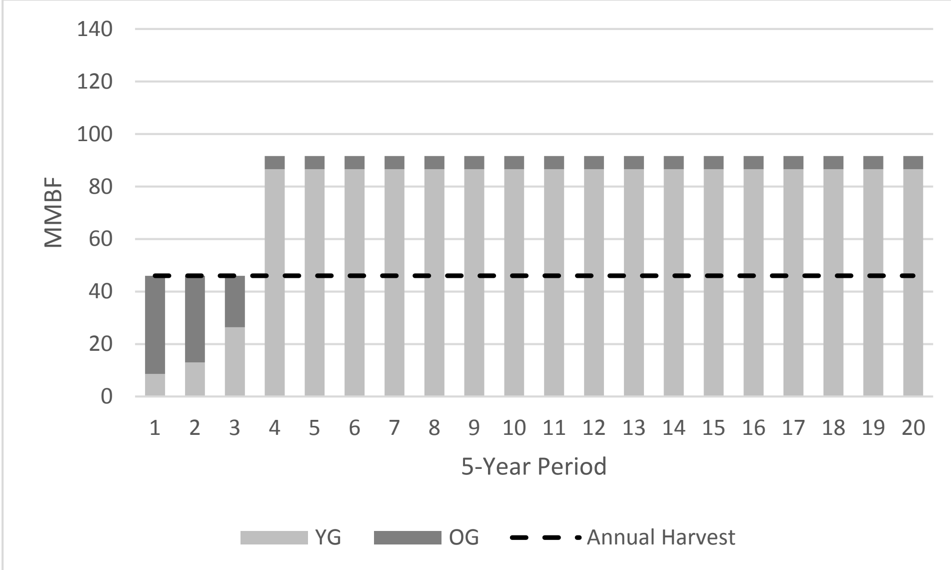


Alternative 4

Under this alternative, an estimated annual average of 8.6 MMBF of young growth would be available in Years 1-5, increasing to 13.0 MMBF for Years 6-10, and then 26.4 MMBF in Years 11-15. Available young growth is expected to exceed 41 MMBF in Years 16-20, with the available annual young-growth volume increasing to the maximum amount under this alternative (86.6 MMBF) during this period (Table 3.22-14; Figure 3.22-15). The transition to young growth would be slower than Alternatives 2 and 3 under this alternative, but still 15 years ahead of Alternative 1. The final available young-growth volume (86.6 MMBF) would be the lowest under this alternative (Figure 3.22-11).

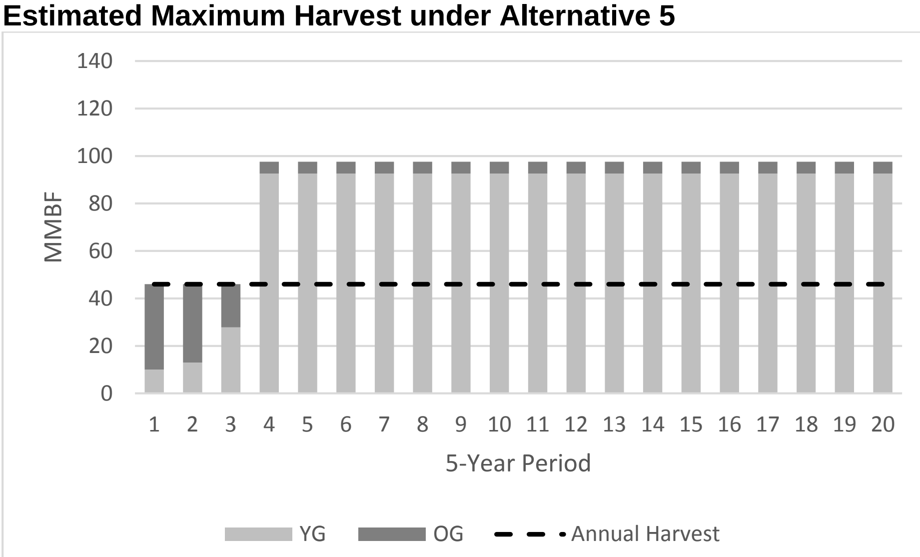
The young-growth volumes initially available in Years 1 through 10 (8.6 to 13.0 MMBF) would be sufficient to supply all or part of the estimated annual demand of Viking Lumber's small log line (8 MMBF). Increased supply in Years 11-15 would be sufficient to support increased demand from Viking Lumber were the facility to be modified, as well as additional bioenergy uses. Following the transition in Years 16-20, sufficient volume would be available to supply additional demand from sawmills, as well as bioenergy uses.

Figure 3.22-15
Estimated Maximum Harvest under Alternative 4



Alternative 5
The timing and available volumes under this alternative are very similar and slightly higher than those estimated for Alternative 4. Under this alternative, an estimated annual average of 10.0 MMBF of young growth would be available in Years 1-5, increasing slightly to 13.0 MMBF for Years 6-10, and then 27.8 MMBF in Years 11-15. Available young growth is expected to exceed 41 MMBF in Years 16-20, with the available annual young-growth volume increasing to the maximum amount under this alternative (92.6 MMBF) during this period (Table 3.22-14; Figure 3.22-16). The transition to young growth would be slower than Alternatives 2 and 3 under this alternative, but still 15 years ahead of Alternative 1. The final available young-growth volume (92.6 MMBF) would be the second lowest under this alternative (Figure 3.22-11).

Figure 3.22-16
Estimated Maximum Harvest under Alternative 5



Financial Analysis

Total discounted net revenues are presented for each alternative for three time periods – 15 years, 25 years, and 100 years – in Table 3.22-16. These estimates developed as part of the Woodstock model analysis are the sum of annual values expressed in current dollars using a 4 percent discount rate. Annual values are estimated pond log values that were developed using Forest Service Region 10 appraisal rates for different species and log grades. Value estimates are based on tree size, species composition, amount of defect, and assumptions about domestic manufacture and export. Pond log values used in the Woodstock model are the estimates of price a timber buyer would pay for a log at the mill site, less the markup charged by the logger (profit and risk).

The net revenues or stumpage values shown in Table 3.22-16 represent the estimated pond log value less the estimated costs that are incurred to get the log to the mill. These costs, which are subtracted from the pond log value, include yarding and logging costs, as well as felling and bucking costs. The resulting stumpage value is assumed to be the price the timber buyer pays for the log (bid price).

Table 3.22-16
Discounted Net Revenues by Alternative for 15, 25, and 100 Years

Alternative	Years 1-15	Years 1-25	Years 1-100
1	$63.84	$101.16	$204.83
2	$11.50	($20.11)	$23.91
3	$20.54	($2.85)	$37.40
4	$47.70	$40.66	$83.88
5	$46.15	$42.22	$81.19

Note:
[1] Discounted net revenues are presented in $ million

The Woodstock model analysis that generated the values shown in Table 3.22-16 involved first maximizing young-growth harvest under a non-declining even flow and then adding old-growth volume to reach the annual average harvest of 46 MMBF and maximizing the net present value. Modeling assumed that all western redcedar is processed domestically and that all Alaska yellow-cedar is sent to markets outside of Alaska. Western hemlock and Sitka spruce volumes and other species were assumed for the purpose of this analysis to be divided equally between domestic production and export in accordance with the current limited export shipment policy. The limited export shipment policy is discussed in the Affected Environment portion of this section (see Appendix H and the R10 Limited Export Shipment Policy subsection, above). The Woodstock model analysis developed for this Forest Plan amendment is discussed in detail in Appendix B to this EIS.

Viewed over 15-year and 100-year planning horizons, all five alternatives would result in positive net revenues (stumpage values) since a higher volume of old-growth will be harvested. Alternatives 1, 4, and 5 also would result in modeled positive net revenues over the 25-year planning period; Alternatives 2 and 3 would result in negative net revenues for the 25-year period.

Discounted net revenues for the 25-year period range from -$20.1 million (Alternative 2) to $101.1 million (Alternative 1) (Table 3.22-16). Net revenues were estimated for 5-year increments and all of the alternatives, with the exception of Alternative 1, had 5-year periods where net revenues would be negative (Table 3.22-17). Positive values for the 5-year increments that comprise years 1 to 25 are in most cases due to the old-growth component of projected harvest. The old-growth component generates net positive revenue for all alternatives and 5-year increments over the 25-year planning horizon (Figure 3.22-17). In contrast, in nearly all cases net revenues generated by the young-growth component are negative (Figure 3.22-18).

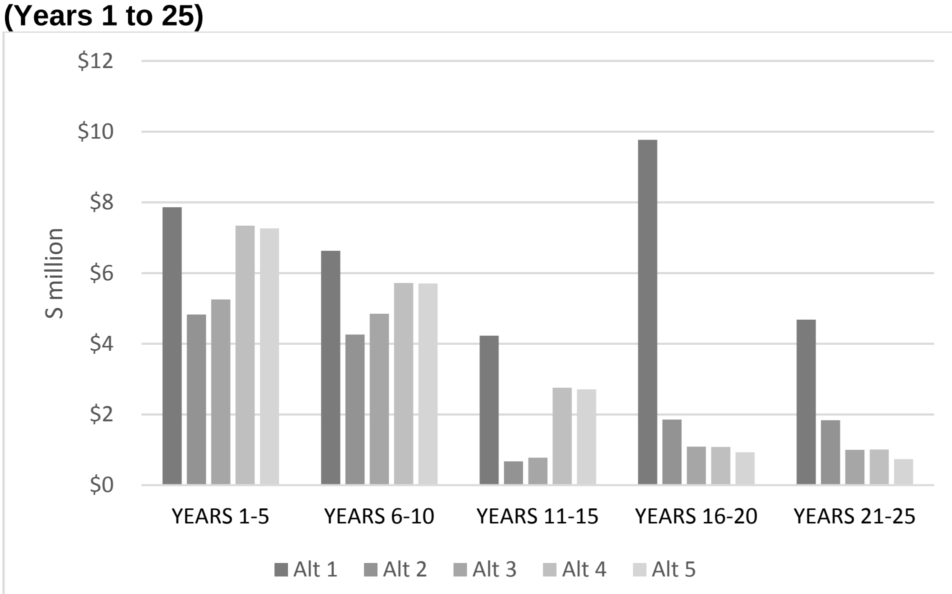
This programmatic analysis suggests that individual timber sales offered under any of the alternatives in the first 25 years of the planning period will likely need to include a mix of old growth and young growth to appraise positive as required by Public Law 112-74, House Report 2055-257, Section 414.

Table 3.22-17
Discounted Net Revenues by Alternative for 5-Year Increments (Years 1 to 25)

	Years				
Alternative	**1-5**	**6-10**	**11-15**	**16-20**	**21-25**
1	$32.4	$23.4	$8.1	$29.5	$7.9
2	$20.1	$8.3	($16.9)	($20.9)	($10.7)
3	$20.6	$11.9	($12.0)	($17.2)	($6.2)
4	$29.9	$16.5	$1.3	($5.7)	($1.3)
5	$28.2	$17.1	$0.8	($2.3)	($1.7)

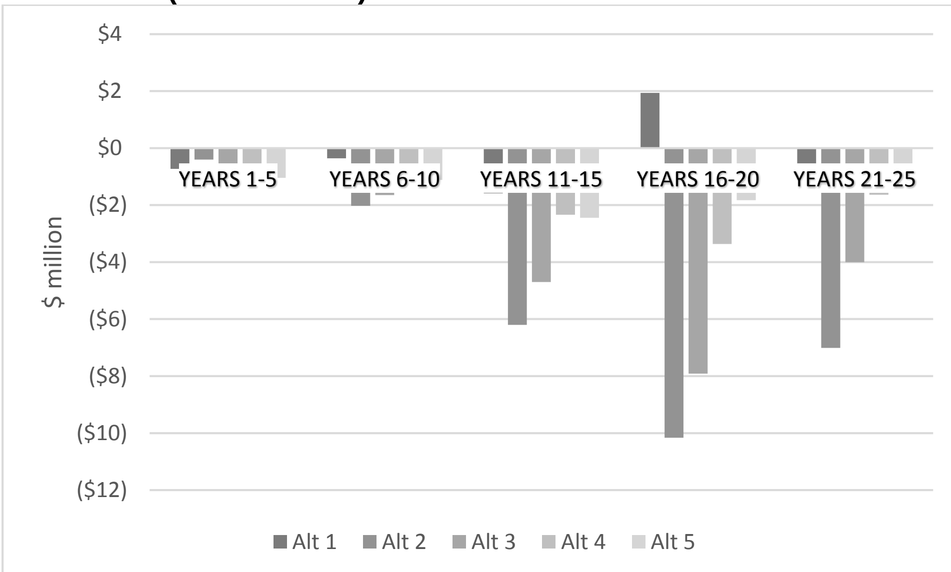
Note:
[1] Discounted net revenues are presented in $ million

Figure 3.22-17
Net Revenues for Old Growth by Alternative for 5-Year Increments (Years 1 to 25)



Note: Values shown are 5-year totals and are not discounted.

Figure 3.22-18
Net Revenues for Young Growth by Alternative for 5-Year Increments (Years 1 to 25)



Note: Values shown are 5-year totals and are not discounted.

Over time, the young-growth component also generates positive revenues (stumpage values) under all alternatives, which is reflected in the discounted net revenues presented for the 100 year planning horizon in Table 3.22-16. Discounted net revenues for the 100-year period range from $23.91 million (Alternative 2) to $204.83 million (Alternative 1) (Table 3.22-16).

As discussed above, the net revenues presented in Table 3.22-16 are stumpage values and represent the estimated pond log value less the estimated costs that are incurred to get the log to the mill. These values are assumed to be the price the timber buyer pays for the log (bid price). These values represent revenue that would be generated for the federal government, but do not take into account the administrative costs incurred by the Forest Service to offer this timber for sale.

Total Forest Service administrative costs are $104 per MBF, broken down as follows: $48 per MBF for environmental analysis and documentation (NEPA planning), $21 per MBF for sale preparation, $12 per MBF for sale administration and $23 per MBF for engineering support (USDA Forest Service 2014f). Environmental analysis and documentation costs including field inventory, data analysis, public involvement, and preparation of documents that satisfy the requirements of NEPA. Sale preparation costs include unit layout, cruising, appraisal, and contract development. Sale administration consists of administering the timber sale contract from the time the sale is awarded until the sale is completed. Engineering support consists of planning and timber sale contract administration activities associated with new facility and road construction, use of existing facilities and road maintenance.

Total estimated administrative costs are presented by alternative in Table 3.22-18. Presented for each alternative for three time periods – 15 years, 25 years, and 100 years – these estimates are the sum of annual costs expressed in current dollars using a 4 percent discount rate. Annual costs were estimated using the total Forest Service administrative cost of $104 per MBF and the projected volumes by alternative identified in Table 3.22-15.

Table 3.22-18
Discounted Administrative Costs by Alternative for 15, 25 and 100 Years

Alternative	Years 1-15	Years 1-25	Years 1-100
1	$52.99	$74.45	$177.26
2	$59.34	$117.57	$232.42
3	$55.79	$112.15	$223.32
4	$52.99	$95.72	$180.02
5	$52.99	$98.52	$188.34

Note:
[1] Discounted net costs are presented in $ million

Forest Service administrative costs were not part of the net revenue calculation developed as part of the Woodstock modeling (see Table 3.22-16), but these costs were part of the Woodstock modeling analysis, along with agency pre-commercial thinning (PCT) and planting costs that would be incurred. Agency PCT and planting costs are not included in the administrative cost comparison presented in Table 3.22-18.

Employment and Income

Projected levels of annual employment and income are presented by alternative in Table 3.22-19. These estimates are based on the maximum annual average harvest that could occur over the first decade following implementation (Years 1

Table 3.22-19
Estimated Timber Industry Employment and Income by Alternative (First Decade, Annual Average)

	Alternative				
Volume/Jobs/Income	1	2	3	4	5
Total Sawlog Volume (MMBF)[1]	40.2	42.4	42.1	40.7	40.8
Utility Volume (MMBF)[2]	5.8	3.6	3.9	5.3	5.2
Jobs Related to Logging[3]	91	96	95	92	92
Jobs Related to Sawmilling[3,4]	48-97	53-107	52-106	49-100	49-100
Jobs Related to Transportation and other Services[3,4,5]	28-45	29-47	29-47	29-46	29-46
Total Direct Jobs	**184-217**	**196-231**	**194-229**	**187-220**	**187-221**
Direct Income ($ million)[6]	9.6-10.3	10.2-10.9	10.1-10.8	9.8-10.4	9.8-10.4

Notes:
[1] Total sawlog volume is the estimated sawlog component of the annual average harvest (46 MMBF) based on the projected young growth and old growth volumes identified in Table 3.22-15. Total volumes vary based on the relative share of old-growth timber.
[2] Assumes that 15 percent of old-growth harvest consists of utility volume. Young-growth volumes are expressed in sawlogs and do not include logging residues and other biomass.
[3] Employment and income by alternative are estimated based on employment coefficients from 2007 to 2010 (Alexander 2012).
[4] Local sawmilling and transportation-related employment estimates are based on a range, from maximum possible shipment out of state (export of all Alaska yellow cedar plus hemlock and Sitka spruce export equal to 50% of total sale net sawlog volume), to no shipment of hemlock and Sitka spruce and export of 100% Alaska yellow cedar.
[5] Transportation and other services include water transportation, independent trucking, stevedoring, scaling, and export marking and sort yard employment for export volume, and water transportation, scaling, and independent trucking for locally sawn volume. Export employs more workers in transportation and other services per MMBF harvested than domestic production. This is reflected in the range of values presented above.
[6] Sawmill and transportation-related income estimates are based on the same assumptions as employment and are presented as a range.

to 10). All five alternatives are based on an annual average harvest of 46 MMBF, with the proportion of the total that is made up of young growth increasing over time, and the share made up of old growth decreasing. The ratio of young growth to old growth varies by alternative and over time in the years prior to the transition to young growth (defined as the time that the young-growth supply reaches 41 MMBF). The young-growth volumes presented in Table 3.22-15 consist of sawlogs only. Based on the average composition of past harvest on the Tongass, the old-growth volume is assumed to consist of 15 percent utility volume (USDA Forest Service 2008a). The average composition by species would also vary by harvest type (old growth versus young growth), with Alaska yellow-cedar and Western redcedar making up a larger share of old-growth volume. The differences between old-growth and young-growth volumes and their relative shares by alternative are reflected in the employment and income estimates presented in Table 3.22-19.

Direct employment and income estimates are presented as a range in Table 3.22-19. These estimates are for employment that would take place in Southeast Alaska. Although estimates of value for timber in the various alternatives are based on maximizing shipments of timber sold out of state (Table 3.22-17), purchasers have the choice to sell as much as they can to other markets as allowed under the limited export policy, or process part or all of the material in local sawmills. Actual employment and income in Southeast Alaska would depend on choices made by purchasers; those choices may change as markets and prices shift. Under current market conditions, purchasers are likely to export as much as they can while processing enough material locally to keep manufacturing facilities open, and take advantage of opportunities to produce high value sawn material in Southeast Alaska. In addition, the Regional Forester has allowed increased export on a case-by-case basis, as explained in Appendix H. If purchasers were allowed on a case-by-case basis to export a larger share of a particular sale in unprocessed form, there would be a commensurate reduction in sawmilling jobs and an increase in transportation-related jobs.

Jobs are presented in Table 3.22-19 as “annualized” job-years. Annualized jobs are employment estimates adjusted to be based on a full year even though the employment may be seasonal. The resulting employment estimates would not necessarily all occur in one year and estimated job-years do not directly translate into numbers of affected workers. While the employment would not necessarily occur in one year, these are annual estimates, meaning that these levels of employment would be supported each year the estimated timber volumes shown in Table 3.22-17 are harvested.

The job and income estimates presented in Table 3.22-19 are approximate numbers based on average jobs per MMBF ratios that were estimated using harvest and employment data from 2007 to 2010. These numbers allow a comparison of the different alternatives based on total volume harvested. Actual numbers would vary under each alternative as timber offerings are packaged and individual sales targeted for different sized operators are developed. They would also likely vary based on the relative age composition of the offered sale (old growth versus young growth, or more likely, some combination of the two).

Indirect employment effects are not estimated in Table 3.22-19 because, while indirect employment coefficients can be estimated at large scales, they are less useful at small local scales and can be misleading. Indirect effects include jobs and income associated with industries that supply inputs to the harvest and processing sectors, as well as those supported by spending elsewhere in the local economy.

Renewable Energy

All renewable energy development projects built and operated in Southeast Alaska have to meet local, state and, in most cases, federal laws, regulations, and requirements. Projects are also subject to Tongass National Forest Plan standards and guidelines. The Forest Plan identifies three types of area related to energy development on the Tongass based on the existing Land Use Designations (LUDs): windows, which represent areas potentially available for energy development; avoidance areas; and exclusion areas. There are no exclusion areas on the Tongass. Avoidance areas are those LUDs where development of energy projects is not considered desirable. A search for "windows" should be exhausted before facilities are considered in avoidance areas.

These classifications and the standards and guidelines in the current Forest Plan would continue to apply under Alternative 1. Energy projects would be managed under the new Renewable Energy Plan Components identified in Chapter 5 of the amended Forest Plan. These new components would replace the current management approach, and renewable energy projects would be considered on all Forest lands regardless of the LUD. Implementation of the new Renewable Energy Plan Components under Alternatives 2 through 5 could potentially simplify the development process for projects proposed for LUDs that are presently classified as "avoidance areas" and could help facilitate the provision of lower cost electricity to communities that are currently dependent on relatively high cost diesel generation (see the *Renewable Energy* section of this EIS). Potential effects by community are addressed below in the *Communities* section.

Recreation and Tourism

Potential impacts to recreation and tourism are assessed in the *Recreation and Tourism* section of this EIS. Potential impacts are evaluated with respect to Recreation Opportunity Spectrum (ROS) settings, recreation places, and developed recreation facilities. The mix of primitive and roaded recreation opportunities would remain largely unchanged under all alternatives, with most projected harvest expected to occur in ROS settings where some modification of the natural environment is expected. Less than 1 percent of the acres currently allocated to Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized ROS settings would be harvested after 100 years, assuming the maximum allowable levels of harvest were to occur.

Recreation places are identified in the *Recreation and Tourism* section as areas that are relatively easy to access, primarily areas near communities, protected boat anchorages, boat landings, aircraft landing sites, and road systems, and include approximately 3.6 million acres or 22 percent of the Forest, with some areas being identified as important for more than one type of recreation activity. Recreation places include a range of LUD classifications and timber harvest would occur in areas identified as recreation places under all of the alternatives, with the maximum amount of harvest varying by type of recreation place and alternative. None of the alternatives are expected to result in long-term impacts to recreationists and visitors wishing to use these areas, but may temporarily displace some use.

The *Recreation and Tourism* section also identifies the number of developed recreation facilities within 0.5 mile of suitable old-growth and young-growth acres by alternative, which ranges from 171 for Alternative 4 to 206 for Alternative 1. Areas in relative proximity to timber harvest could be negatively impacted during harvest, but impacts would localized and often limited to the harvest duration.

Project-level impacts to facilities and other recreation uses would be assessed as part of separate NEPA processes.

These potential impacts are discussed in more detail in the Recreation and Tourism section. Viewed in terms of recreation and tourism employment over the next decade, there would be very little difference between the alternatives.

Salmon Harvesting and Processing

There is not expected to be any significant change to the commercial fishing or fish processing industries over the planning period as a result of National Forest activities. The future of the fishing industry in Southeast Alaska is more likely to depend upon occurrences outside of the Tongass National Forest such as hatchery production, off-shore harvest levels, and changes in ocean conditions. In addition, a large segment of the commercial fishing industry operates under a limited entry harvest system. New permit holders are not quickly added to the market during high fish harvest years, nor are they removed during periods of low harvest. The result in either case is the same number of commercial fishers catching either more or less fish.

The 1997 FEIS noted that the amount of acreage of timber harvest was at most less than 20,000 acres per year, representing approximately 0.5 percent of the total remaining productive old growth (or 5 percent over the next decade) and less than 0.02 percent of the entire Forest. That EIS concluded that this was not expected to result in a significant change to commercial fishing employment. All of the alternatives that are presently being evaluated in this EIS would allow considerably less timber harvest and new road construction than the alternatives evaluated in the 1997 FEIS. Total annual harvest allowed over the 100 year planning period would range from 2,666 acres (Alternative 4) to 3,605 acres (Alternative 2). These potential levels of harvest, which are substantially lower than the maximum proposed in the 1997 FEIS, when viewed in conjunction with the Riparian Management standards and guidelines established in the current Forest Plan are not expected to have a significant effect on commercial fisheries employment. The current Riparian Management standards and guidelines would remain unchanged under all alternatives,

Natural Amenities and Quality of Life

As discussed in the Affected Environment portion of this section, natural amenities and local quality of life are generally recognized as important factors that serve to attract and retain residents. It is, however, very difficult to determine the effect of the different alternatives on local amenities and, further, on the economic activity that these amenities are believed to indirectly generate. In most cases and localities, the difference between the alternatives with respect to natural amenities is not expected to be significant enough to result in measurable changes in economic activity.

Ecosystem Services

Ecosystem services are the products of functioning ecosystems that often are available without direct costs to people who benefit from them (Kline 2006). These services have been described in a number of different ways including the typology developed by the Millennium Ecosystem Assessment (2005), which is featured on the Forest Service's Ecosystem Services web site (http://www.fs.fed.us/ecosystemservices/) and identifies four general categories of ecosystem services: provisioning, regulating, cultural, and supporting. Provisioning services include wild food, fresh water, and fiber. Regulating services are the benefits obtained from ecosystem impacts on natural processes, such as air quality, climate stabilization, water quality, and erosion. Cultural services include recreation, aesthetic, educational, and spiritual and religious benefits. Supporting services are the underlying processes that maintain the conditions for life on Earth, such as nutrient cycling and soil formation (Smith et al. 2011).

The concept of ecosystem services has emerged as a way of framing and describing the comprehensive set of benefits that people receive from nature. The Forest Service has been exploring use of these concepts to describe the benefits provided by forests, but the ecosystem service approach has not been applied operationally in a management context. The Forest Service's Pacific Northwest Research Station issued a technical report that attempts to define an economics research program to describe and evaluate ecosystem services (Kline 2006). More recently, the Pacific Northwest Research Station and the Deschutes National Forest have partnered to develop a place-based application to explore how this type of approach might be implemented by a national forest to enhance forest stewardship. Ecosystem services are discussed at the forest planning level for the Tongass National Forest in the 2008 Forest Plan EIS (USDA Forest Service 2008b, p. 3-544 to 3-556). The 2008 Forest Plan EIS also discusses non-use values, including existence, option, and bequest values (USDA Forest Service 2008b, p. 3-551 to 3-552).

Under the 2008 Forest Plan, timber management activities are governed by a large number of rules and regulations designed to protect or mitigate negative impacts to natural resources that provide ecosystem services. This is discussed further in the 2008 Forest Plan EIS (USDA Forest Service 2008b, p. 3-553 to 3-556). These rules and regulations would remain in place under all of the alternatives evaluated in this EIS. Further, the maximum amounts of timber that could be harvested under these alternatives (see Table 3.22-13) is substantially lower than the range of Allowable Sale Quantity volumes evaluated in the 2008 Forest Plan EIS. The effects of the alternatives on these types of services are assessed in the sections of this EIS that address watersheds, fisheries, soils, wildlife and subsistence use, heritage resources, and timber and vegetation, among others. Monetary values are not assigned to these services, but this does not lessen their importance in the decision making process. Decision-makers will consider the economic values presented in elsewhere in this section within the context of the information presented elsewhere in this document, much of which cannot readily be translated into economic terms.

Cumulative Effects

This section considers the incremental effects of the alternatives when added to other past, present, and reasonably foreseeable actions. The effects of past and present actions on the economic and social environment are included in the Affected Environment portion of this section, which discusses the regional economy, as well as providing a subregional overview, and assessing potential impacts at the community level. These sections summarize current employment levels and other key aspects of natural resource-based industries, and also assess recent trends.

Reasonably foreseeable actions on National Forest System lands include the projected levels of future timber harvest and renewable energy development that are used in the preceding analysis to assess the potential impacts of the alternatives on the regional and local economies. Other reasonably foreseeable actions include regional transportation development as defined by the State Transportation Plan and the Forest Service Alaska Region Long Range Transportation Plan, as well as road paving on Prince of Wales Island, the closing of roads, and construction of the Angoon Airport. In addition, the expansion of cities like Juneau and Ketchikan, recreational cabin development, and land auctions by the State could include additional road construction. Appendix C provides a full list of all the projects considered in the cumulative effects analysis.

It is not possible at this time to predict exactly which roads would be developed or their likely impact on future recreation and other activities and associated employment. None of the alternatives are expected to affect this type of future road development, which would be expected to go forward regardless of the selected alternative. The overall cumulative effect of new regional road corridors viewed in conjunction with the proposed Forest Plan alternatives would be a trend toward more developed recreation opportunities that would be relatively high under Alternative 2 and relatively low under Alternative 1. Planned timber harvest activities on adjacent private and Native Corporation lands would also result in a cumulative trend toward more developed recreation opportunities that would be most pronounced under Alternative 2 and least pronounced under Alternative 1.

Mining activities are expected to expand at existing sites, including Greens Creek on Admiralty Island and Kensington Gold Mine north of Juneau, as well as possible future sites, including the Bokan Mountain and Niblack sites on the southern end of Prince of Wales Island. Continued mining at existing sites and ongoing exploration efforts would likely support existing levels of mining employment and income. This employment and income would increase if there were an increase in exploration and development.

Subregional Overview and Communities

Introduction

The preceding section of this document addressed the potential impacts of the proposed alternatives upon the regional economy as a whole. Potential impacts would not, however, be experienced similarly by all boroughs or communities in Southeast Alaska or distributed equally among them. It is, therefore, important to consider the potential effects at a more detailed geographic scale. The following section is divided into two parts. The first part, entitled Subregional Overview, addresses the economic and social composition of the boroughs that comprise Southeast Alaska. This discussion provides an important perspective on the likely distribution of the potential effects identified in the regional economy analysis, as well as setting the stage for the second part of this section, which discusses the potential effects of the alternatives on each of Southeast Alaska's 32 communities.

Subregional Overview

There are large differences in the economic structure and development of the boroughs that comprise Southeast Alaska. A common problem encountered in the analysis of the Southeast Alaska economy is that, owing to its relative size, Juneau dominates statistics at the regional level. As a result, regional trends in population, employment, or income tend to closely represent developments in Juneau and often do not reflect changes in other boroughs. By analyzing certain demographic and economic statistics at the borough level, differences in social and economic characteristics and trends that are obscured at the regional level, are more apparent. The following sections discuss population, employment, and income and poverty trends at the borough level.

As previously noted in the *Regional and National Economy* section, above, a significant portion of Southeast Alaska is not located within the boundaries of a borough. Communities that are located outside of a borough do not have a regional form of government, however, socioeconomic data is readily available by census area (CA) as established by the U.S. Census Bureau. The remaining areas that are not part of a borough are allocated to two CAs: the Hoonah-Angoon and Prince of Wales-Hyder CAs. CAs are only statistical units, but are widely recognized from a data reporting standpoint by federal agencies and most state agencies as county equivalents. Boroughs and CAs are collectively referred to as "boroughs" in this section.

Population

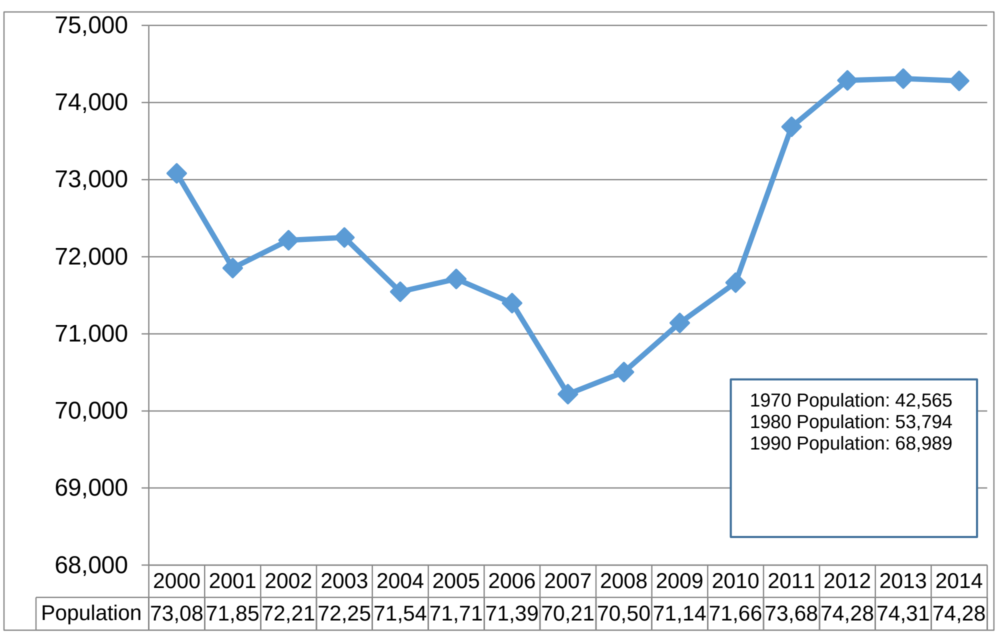
Alaska's statewide population has grown since 2000, increasing from about 627,000 in 2000 to approximately 710,000 in 2010, an increase of 13 percent, and has continued to increase since 2010, with a total estimated population of 736,000 in 2014 (Table 3.23-1). Southeast Alaska has not experienced similar growth and in fact lost population between 2000 and 2010, with a net decrease of 1,418 people or 2 percent. Total population in Southeast Alaska has fluctuated since 2000, reaching its lowest point in 2007. Population has increased each year from 2008 through 2013, before dropping slightly in 2014 (Figure 3.23-1).

Table 3.23-1
Borough/Census Area Population, 2000, 2010, and 2014

				2000 to 2010		2010 to 2014	
Area Name	**2000**	**2010**	**2014**	**Net Change**	**Percent Change**	**Net Change**	**Percent Change**
Northern Boroughs							
Haines Borough	2,392	2,508	2,537	116	5%	29	1%
Hoonah-Angoon CA	2,574	2,150	2,128	-424	-16%	-22	-1%
City and Borough of Juneau	30,711	31,275	33,026	564	2%	1,751	6%
City and Borough of Sitka	8,835	8,881	9,061	46	1%	180	2%
Municipality of Skagway Borough	862	968	1,031	106	12%	63	7%
City and Borough of Yakutat	808	662	631	-146	-18%	-31	-5%
Southern Boroughs							
Ketchikan Gateway Borough	14,067	13,477	13,825	-590	-4%	348	3%
Petersburg Borough	4,260	3,815	3,209	-445	-10%	-606	-16%
Prince of Wales-Hyder CA	6,125	5,559	6,426	-566	-9%	867	16%
City and Borough of Wrangell	2,448	2,369	2,406	-79	-3%	37	2%
Southeast Alaska	**73,082**	**71,664**	**74,280**	**-1,418**	**-2%**	**2,616**	**4%**
Alaska	626,932	710,231	735,601	83,299	13%	25,370	4%

CA = Census Area
Source: Alaska DOL 2010a, 2014d

Figure 3.23-1
Southeast Alaska Population, 1970, 1980, 1990, and 2000 through 2014



Changes from 2000 to 2010 at the borough level ranged from large relative decreases of 16 percent and 18 percent for Hoonah-Angoon and Yakutat, respectively, to a net increase of 12 percent for Skagway. All of the southern boroughs lost population over this period, as did two of the six northern boroughs (Table 3.23-1).

Population has continued to decline in three of the boroughs since 2010, with Petersburg experiencing the largest absolute and relative decrease, with a net loss of 606 people, a drop of 16 percent. The other seven boroughs experienced net increases in population from 2010 to 2014, with the largest absolute increases occurring in Juneau and Prince of Wales-Hyder. The net population gain in Juneau (1,751 people) was equivalent to two-thirds of Southeast Alaska's population increase over this period; the net gain in Prince of Wales-Hyder (867 people) was equal to one-third (Table 3.23-1).

Components of regional population change for 2010 through 2014 indicate that all of the boroughs in Southeast Alaska experienced natural increase (more births than deaths) over this period (Alaska DOL 2014d). Half of the boroughs also experienced net in-migration over this period, with the largest gain in Juneau where 800 more people moved to the borough than left.

Population projections developed by the State of Alaska anticipate continued growth statewide, but generally expect population to decline in Southeast Alaska (Howell 2014). Southeast Alaska is the only region in Alaska where population is expected to decline over the forecast period (2012 to 2042). Past State projections have anticipated that population will decline in Southeast Alaska because low birth rates and the highest median age in the state mean that a sharp rise in net in-migration would be required for growth to occur in the future (Mercer 2010). Current projections anticipate that the population of Alaska will increase by 26 percent between 2012 and 2042, while the population of Southeast Alaska is expected to decrease by 4 percent (Howell 2014). Viewed at the borough level, population is expected to decrease in seven of the 10 boroughs over the forecast period, with projected decreases ranging from 6 percent (Prince of Wales-Hyder) to 31 percent (Hoonah-Angoon). Projected increases range from 1 percent (Haines) to 5 percent (Skagway), with the population of Juneau expected to increase by 2 percent from 2012 to 2042 (Howell 2014).

Age

Median age in the state of Alaska was 34.4 years in 2014, slightly lower than the national average of 37.6 years. The median age was higher than the state and national average in all of the boroughs that make up Southeast Alaska, ranging in the northern boroughs from 37.7 years in Juneau to 48.5 years in Haines; median age in the southern boroughs ranged from 39.3 years in Ketchikan to 47.2 years in Wrangell (Table 3.23-2). The median age stayed relatively constant in Alaska as a whole over the last decade, increasing by just 0.7 year from 2005 to 2014. Skagway and Juneau saw similar modest increases over this period, while most other boroughs in Southeast Alaska aged more rapidly, with the largest increases occurring in Yakutat (+3.9 years), Petersburg (+4 years), and Hoonah-Angoon (+5.4 years) (Table 3.23-2).

In 2014, 14.5 percent of the U.S population was 65 years and over compared to just 9.7 percent in Alaska and 12.4 percent in Southeast Alaska (Table 3.23-2). The share of the population 65 years and above in the northern boroughs ranged from 10.5 percent in Juneau to 17.9 percent in Haines; in the southern boroughs, the share of the population 65 years and above ranged from 12.3 percent (Prince of Wales-Hyder) to 18.2 percent (Wrangell) (Table 3.23-2).

The age dependency ratio is the ratio of the non-working (dependent) population – those younger than 15 years or older than 64 years – to the working-age population – those ages 16 to 64 years old. Expressed as the number of dependents per 100 working age people, the national age-dependent ratio in the U.S. in 2014 was 51 percent. The age dependency ratio in 2014 in Alaska and Southeast Alaska was 45.3 percent in both cases (Table 23-2). Viewed by borough, age-dependency ratios in Southeast Alaska ranged from 34.8 percent in Skagway to 56.3 percent in Wrangell.

Table 3.23-2
Age by Borough

	Median Age (Years)		Population by Age 2014 (Percent)			
Area Name	**2014**	**Net Change 2005-2014**	**0-14**	**15-64**	**65 and Over**	**2014 Dependency Ratio[1]**
Northern Boroughs						
Haines Borough	48.5	3.0	14.9	67.2	17.9	48.9
Hoonah-Angoon CA	47.8	5.4	16.8	65.8	17.4	52.0
City and Borough of Juneau	37.7	0.7	18.7	70.8	10.5	41.2
City and Borough of Sitka	38.8	1.9	19.2	67.3	13.5	48.6
Municipality of Skagway Borough	42.4	0.4	13.2	74.2	12.6	34.8
City and Borough of Yakutat	43.9	3.9	17.0	68.5	14.6	46.1
Southern Boroughs						
Ketchikan Gateway Borough	39.3	1.1	18.8	68.3	12.9	46.5
Petersburg Borough	42.3	4.0	19.6	65.4	15.0	52.9
Prince of Wales-Hyder	40.2	1.6	21.3	66.4	12.3	50.5
City and Borough of Wrangell	47.2	2.3	17.9	64.0	18.2	56.3
Southeast Alaska	**na**	**na**	**18.7**	**68.8**	**12.4**	**45.3**
Alaska	34.4	0.7	21.5	68.8	9.7	45.3

[1] The age dependency ratio is calculated by dividing the combined under 18 and 65-and-over population by the 18 to population and multiplying by 100.
Source: Alaska DOL 2010b, 2014d

Employment

Employment data by sector are presented for 2013 by borough and for Southeast Alaska and Alaska in Table 3.23-3. The self-employed (identified as proprietors in Table 3.23-3) make up a larger share of total employment in Southeast Alaska than in the state as a whole, 27.1 percent versus 20.8 percent (Table 3.23-3). Viewed by borough, self-employment as a share of total employment ranged from 4.9 percent (Yakutat) to 71.1 percent (Haines). Sectors with high shares of self-employment include commercial fishing, recreation and tourism, and logging. Government is a major employer in the two boroughs (Yakutat and Juneau) with the lowest relative shares of self-employment (Table 3.23-3).

Annual employment data are presented for 2005 through 2014 by borough and for Southeast Alaska and Alaska in Table 3.23-4. These data are also shown graphically in Figures 3.23-2 through 3.23-4. Annual unemployment rates were 6.8 percent in Alaska and 7.1 percent Southeast Alaska in 2014, compared to a national average of 6.2 percent (Table 3.23-4, Figure 3.23-2). Viewed by northern borough, annual unemployment rates in 2014 ranged from 5.1 percent in Juneau and Sitka to 15.5 percent in Hoonah-Angoon (Table 3.23-4, Figure 3.23-3). Annual unemployment rates in 2014 in the southern boroughs ranged from 7.6 percent in Ketchikan to 13.5 percent in Prince of Wales-Hyder (Table 3.23-4, Figure 3.23-4).

Table 3.23-3
Employment by Sector by Borough 2013

Economic Sector	Northern Boroughs						Southern Boroughs					
	Haines Borough	Hoonah-Angoon CA	Juneau City and Borough	Sitka City and Borough	Municipality of Skagway Borough	Yakutat City and Borough	Ketchikan Gateway Borough	Peters-burg Borough	Prince of Wales-Hyder CA	Wrangell City and Borough	Southeast Alaska	Alaska
Total full-time and part-time employment[1]	3,606	1,384	20,640	6,687	1,567	329	10,482	3,108	3,611	1,731	**53,145**	461,935
Type of Employment (Percent of Total)												
Wage and salary	28.9	54.6	90.8	69.6	53.1	95.1	74.5	48.6	60.7	52.3	**72.9**	79.2
Proprietors	71.1	45.4	9.2	30.4	46.9	4.9	25.5	51.4	39.3	47.7	**27.1**	20.8
Wage and Salary Employment by Industry (Percent of Total)[2]												
Farming	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	0.2
Forestry, fishing, related activities, and other	(D)	(D)	(D)	(D)	(L)	(D)	4.5	(D)	10.5	14.7	**2.1**	2.4
Mining	(D)	0.0	(D)	2.2	5.7	(L)	1.6	(D)	5.2	3.5	**1.2**	4.9
Construction	6.1	3.5	4.4	7.0	4.1	(D)	5.8	2.9	4.8	4.3	**5.0**	5.3
Manufacturing	6.3	(D)	1.8	(D)	4.5	(D)	6.4	11.9	5.1	8.4	**3.8**	3.6
Wholesale trade	0.7	(D)	(D)	0.6	(L)	0.0	(D)	0.6	(D)	(D)	**0.2**	1.6
Retail trade	7.8	6.3	10.5	8.3	14.4	(D)	11.5	9.6	9.1	7.2	**9.9**	9.6
Transportation and warehousing	(D)	4.6	5.5	5.5	(D)	(D)	7.5	2.8	2.2	(D)	**4.7**	5.2
Finance and insurance	3.1	0.0	1.5	1.3	(D)	(L)	2.9	(D)	10.6	2.3	**2.3**	2.5
Real estate	6.4	(D)	2.3	2.2	(D)	(D)	4.1	(D)	4.1	2.5	**2.7**	3.4
Services (Consumer)[3]	23.0	(D)	13.1	13.5	20.9	(D)	14.0	11.3	10.3	4.2	**13.2**	14.1
Services (Producer)[3]	12.3	(D)	6.6	3.6	3.4	(D)	2.3	2.2	1.1	0.0	**4.6**	9.9
Services (Social)[3]	13.7	(D)	9.7	12.7	1.7	(L)	11.3	(D)	4.5	(D)	**8.9**	12.2
Federal government	0.8	8.6	6.0	5.7	3.4	7.6	4.8	5.0	3.6	3.9	**5.1**	9.3
State and local government	5.6	19.1	29.8	15.6	7.5	36.8	17.1	12.8	24.2	15.9	**21.2**	13.9

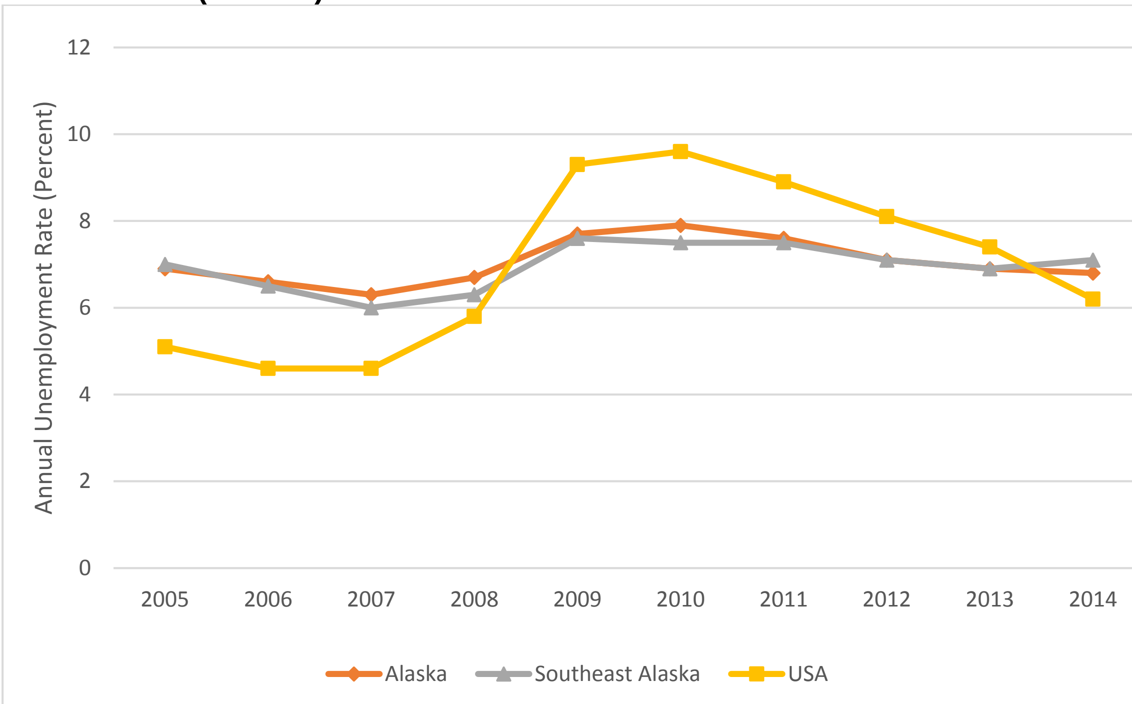
Notes:
[1] Total employment includes self-employed individuals. Employment data are by place of work, not place of residence, and, therefore, include people who work in the area but do not live there. Employment is measured as the average annual number of jobs, both full- and part-time, with each job a person holds counted at full weight.
[2] Percentages for the counties do not sum to 100 because employment counts are not provided for sectors with less than 10 jobs or for sectors where counts would disclose confidential information. These sectors are identified by (D) or (L) in the above table. These numbers are, however, included in the totals.
[3] Nine 2-digit North American Industry Classification System (NAICS) categories are combined into these three divisions for ease of presentation. Consumer service includes: other services; arts, entertainment, and recreation; and accommodation and food services. Producer services includes: information; professional and technical services; management of companies and enterprises; and administrative and waste services. Social services includes: educational services; and health care and social assistance.
Source: U.S. Bureau of Economic Analysis 2014d

Table 3.23-4
Annual Unemployment Rates, 2005 to 2014 (Percent)

Region	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Northern Boroughs										
Haines Borough	9	7.9	7.1	8.5	9	10.6	10.1	10	9.9	10.3
Hoonah-Angoon CA[1]	13.3	12.5	12	12.4	14.7	14.1	15.2	14.4	14.6	15.5
City and Borough of Juneau	5.3	4.8	4.3	4.6	5.9	5.9	5.6	5.1	5	5.1
City and Borough of Sitka	5.5	5.3	4.9	5.6	6.2	6.3	6.1	5.7	5.4	5.1
Municipality of Skagway Borough[1]	13.3	12.5	12	12.4	14.7	14.5	16.2	13.8	12.1	11.6
City and Borough of Yakutat	10.6	9.6	6.5	7.2	11.5	10.8	10.7	9.7	9.4	9.8
Southern Boroughs										
Ketchikan Gateway Borough	6.7	6	5.4	5.7	7.1	8.8	8.5	7.9	7.5	7.6
Petersburg Borough[2]	10.1	9.4	9.3	10.2	10.4	7.9	8.4	8.3	9.2	9.8
Prince of Wales-Hyder CA[3]	13.1	14.1	13.1	13.3	15.2	10.5	12.4	13.3	11.9	13.5
City and Borough of Wrangell[2]	10.1	9.4	9.3	10.2	10.4	8	7.5	8.3	8	8.9
Southeast Alaska	**7**	**6.5**	**6**	**6.3**	**7.6**	**7.5**	**7.5**	**7.1**	**6.9**	**7.1**
Alaska	6.9	6.6	6.3	6.7	7.7	7.9	7.6	7.1	6.9	6.8

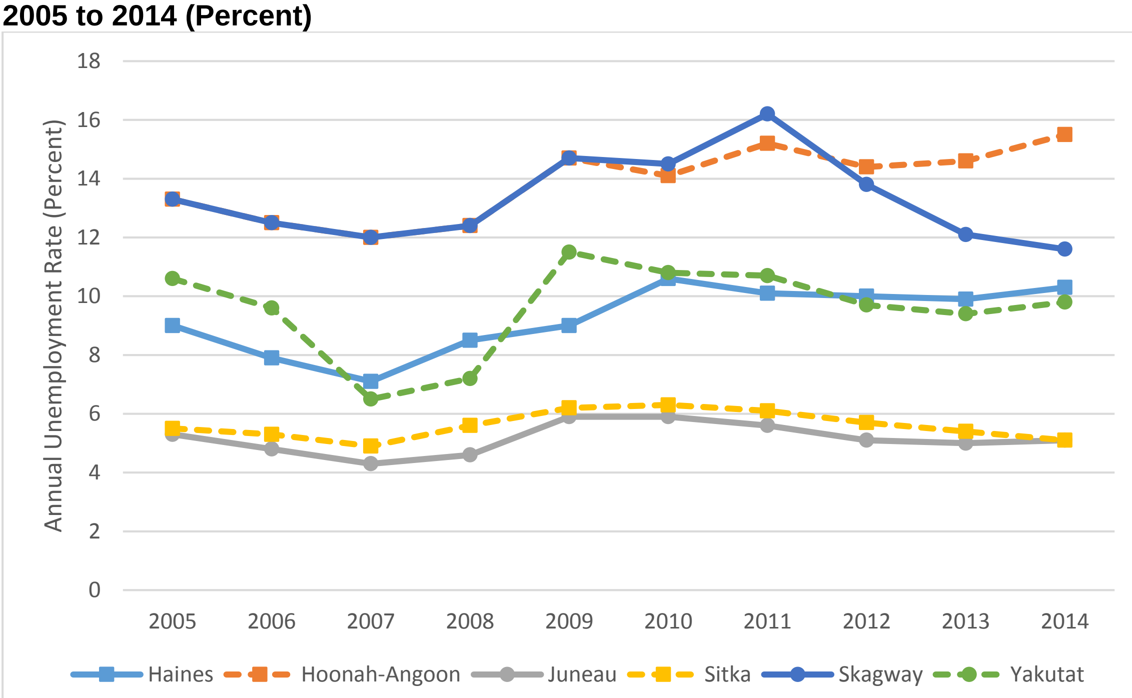
Notes:
[1] Data for 2005 through 2009 are for the Skagway-Hoonah-Angoon CA.
[2] Data for 2005 through 2009 are for the Wrangell-Petersburg CA.
[3] Data for 2005 through 2009 are for the Prince of Wales-Outer Ketchikan CA.
Source: Alaska DOL 2015b

Figure 3.23-2
Annual Unemployment Rates in Southeast Alaska, Alaska, and the United States, 2005 to 2014 (Percent)



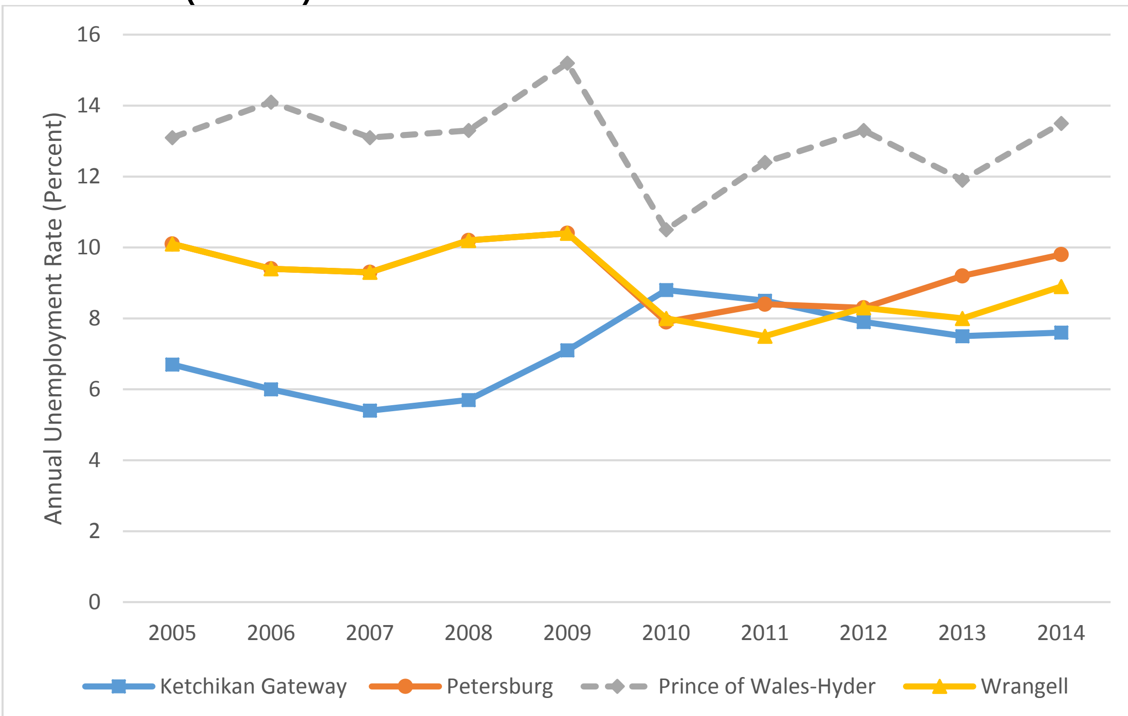
Source: Alaska DOL 2015b; U.S. Bureau of Labor Statistics 2015

Figure 3.23-3
Annual Unemployment Rates in the Northern Boroughs of Southeast Alaska, 2005 to 2014 (Percent)



Note:
[1] Data shown for the Hoonah-Angoon CA and Municipality of Skagway for 2005 through 2009 are for the Skagway-Hoonah-Angoon CA
Source: Alaska DOL 2015b; U.S. Bureau of Labor Statistics 2015

Figure 3.23-4
Annual Unemployment Rates in the Southern Boroughs of Southeast Alaska, 2005 to 2014 (Percent)



Notes:
[1] Data shown for the Petersburg CA and City and Borough of Wrangell for 2005 through 2009 are for the Wrangell-Petersburg CA.
[2] Data shown for the Prince of Wales-Hyder CA for 2005 through 2009 are for the Prince of Wales-Outer Ketchikan CA.
Source: Alaska DOL 2015b; U.S. Bureau of Labor Statistics 2015

Income and Poverty

Per capita income in Southeast Alaska in 2013 was $54,722, approximately 9 percent higher than the state per capita ($50,150) (Table 3.23-5). Viewed by borough, per capita income in 2013 ranged from $36,354 in Prince of Wales-Hyder to $85,326 in Haines, ranging from the equivalent of 72 percent to 170 percent of the state per capita. Per capita income was higher than the state per capita in 6 of the 10 boroughs in Southeast Alaska (Table 3.23-5).

Labor earnings accounted for slightly more than two-thirds of per capita income in Southeast Alaska (67 percent) and Alaska as a whole (68 percent). Labor earnings as a share of per capita income by borough ranged from 55 percent (Wrangell) to 77 percent (Haines), and was below the state share (68 percent) in seven of the 10 Southeast Alaska boroughs (Table 3.23-5; Figure 3.23-5).

Transfer payments accounted for 13 percent and 14 percent of regional and statewide per capita income in 2013. Viewed by borough, the share ranged from just 9 percent in Skagway to 23 percent in Hoonah-Angoon and Wrangell, and was above the state share in six of the 10 Southeast Alaska boroughs (Table 3.23-5; Figure 3.23-5). As discussed in the Regional and National Economy section, above, transfer payments consist mainly of government payments to individuals, including retirement, disability, and unemployment insurance benefit payments, income maintenance payments, and veterans benefit payments.

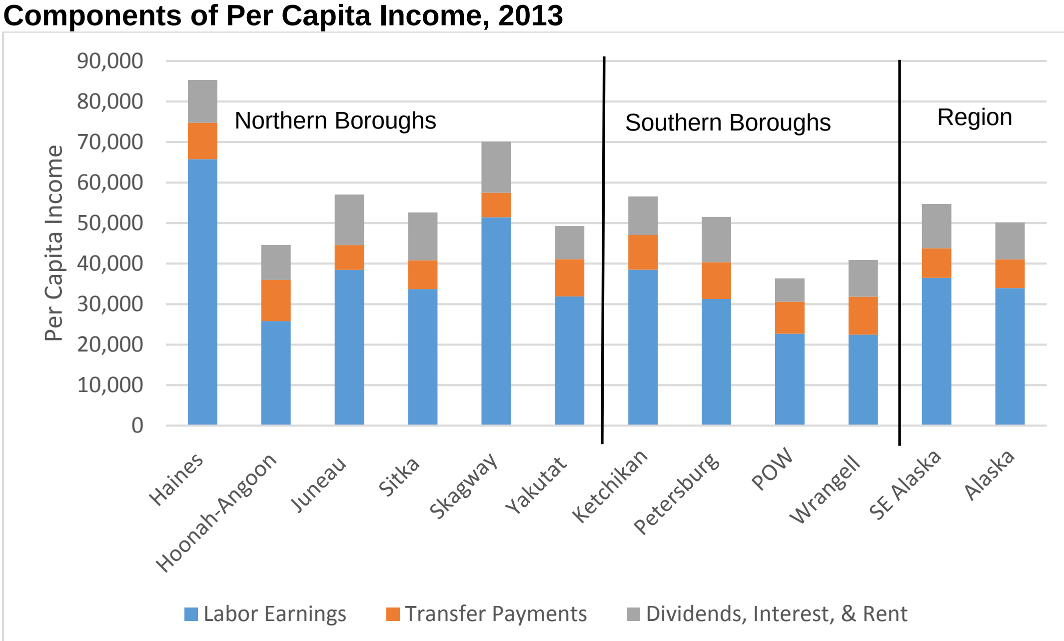
Table 3.23-5
Components of Per Capita Income, 2013

Area Name	Labor Earnings[1] Dollars	Labor Earnings[1] Percent of Total[3]	Transfer Payments[2] Dollars	Transfer Payments[2] Percent of Total[3]	Dividends, Interest, and Rent Dollars	Dividends, Interest, and Rent Percent of Total[3]	Per Capita Income Total Dollars	Per Capita Income Total Percent of State Per Capita
Northern Boroughs								
Haines Borough	65,773	77	8,948	10	10,605	12	85,326	170
Hoonah-Angoon CA	25,820	58	10,127	23	8,671	19	44,618	89
City and Borough of Juneau	38,440	67	6,121	11	12,473	22	57,034	114
City and Borough of Sitka	33,734	64	7,074	13	11,800	22	52,608	105
Municipality of Skagway Borough	51,461	73	6,011	9	12,593	18	70,065	140
City and Borough of Yakutat	31,898	65	9,206	19	8,165	17	49,269	98
Southern Boroughs								
Ketchikan Gateway Borough	38,477	68	8,589	15	9,525	17	56,591	113
Petersburg Borouigh	31,282	61	9,069	18	11,189	22	51,540	103
Prince of Wales-Hyder CA	22,713	62	7,875	22	5,766	16	36,354	72
City and Borough of Wrangell	22,482	55	9,331	23	9,077	22	40,890	82
Southeast Alaska	**36,464**	**67**	**7,331**	**13**	**10,927**	**20**	**54,722**	**109**
Alaska	33,964	68	7,087	14	9,099	18	50,150	100

Notes:
[1] Earnings includes wages and salaries, other labor income, and proprietors' income.
[2] Transfer payments consist mainly of government payments to individuals, including retirement, disability, and unemployment insurance benefit payments, income maintenance payments, and veterans benefit payments. Government payments to individuals in Alaska include Alaska Permanent Fund benefits, which are derived from oil revenues and paid to every resident.
[3] Percent of total per capita income.
Source: U.S. Bureau of Economic Analysis 2014e

The final broad component of per capita income – dividends, interest, and rent – made up 20 percent and 18 percent of regional and statewide per capita income in 2013. Dividends, interest, and rent as a share of per capita income by borough ranged from 12 percent (Haines) to 22 percent (Juneau, Sitka, Petersburg, and Wrangell) (Table 3.23-5; Figure 3.23-5).

Figure 3.23-5
Components of Per Capita Income, 2013



Notes:
1/ See footnotes to Table 3.23-5
Source: U.S. Bureau of Economic Analysis 2014e

Median household income in 2013 ranged from $42,276 in Hoonah-Angoon to $83,642 in Juneau, ranging from the equivalent of 60 percent to 119 percent of the state median, respectively (Table 3.23-6). Median household income was lower than the state median in all of the boroughs in Southeast Alaska with the exception of Juneau. The share of the population below the poverty level in the northern boroughs in 2013 ranged from 4.2 percent in Skagway to 19.2 percent in Hoonah-Angoon compared to the statewide average of 10.1 percent; in the southern boroughs, the share of the population below the poverty level ranged from 10.3 percent in Ketchikan to 17.4 percent in Prince of Wales-Hyder (Table 3.23-6). The share of children aged 5 to 17 in families below the poverty line in households in the northern boroughs in 2013 ranged from 6.8 percent in Skagway to 26.8 percent in Hoonah-Angoon compared to a statewide average of 12.5 percent; in the southern boroughs, the corresponding shares ranged from 12.9 percent in Ketchikan to 22.0 percent in Prince of Wales-Hyder (Table 3.23-6).

School enrollment and the number of students eligible for free and reduced-price lunch (FRPL) is summarized by borough for 2015 in Table 3.23-7. The number of students eligible for FRPL may be used as a way of evaluating poverty in school districts. The National School Lunch Program (NSLP) is administered by the USDA, Food and Nutrition Service, which provides free meals to eligible children in households with income at or below 130 percent of the federal poverty guidelines, and reduced-price meals to eligible children in households with income between 130 and 185 percent of these guidelines (Cruse and Powers 2006). Viewed as a share of total school enrollment, students eligible for FRPL in the northern boroughs in 2015 ranged from 29 percent in Juneau to 86 percent in Yakutat compared to a statewide share of 50 percent. In the southern boroughs, the share of students eligible for FRPL ranged from 41 percent in Ketchikan to 79 percent in Prince of Wales-Hyder (Table 3.23-7).

Table 3.23-6
Median Household Income and Poverty, 2013

Geographic Area	Median Household Income	Percent of State Median	Percent Below the Poverty Line	
			Total Population	Age 5 to 17 in Families
Northern Boroughs				
Haines Borough	55,295	78.9	11.4	16.3
Hoonah-Angoon CA	42,276	60.3	19.2	26.8
City and Borough of Juneau	83,642	119.4	7.5	8.1
City and Borough of Sitka	66,038	94.3	9.8	10.9
Municipality of Skagway Borough	63,930	91.3	4.2	6.8
City and Borough of Yakutat	56,365	80.5	16.7	25.8
Southern Boroughs				
Ketchikan Gateway Borough	62,619	89.4	10.3	12.9
Petersburg Borough	58,176	83	10.7	11.4
Prince of Wales-Hyder	48,175	68.8	17.4	22.0
City and Borough of Wrangell	49,039	70	13.9	17.6
Alaska	**70,058**	**100**	**10.1**	**12.5**
United States	52,250	74.6	15.8	20.8

Source: U.S. Census Bureau 2014c

Table 3.23-7
School Enrollment and Number of Students Eligible for Free and Reduced-Price Lunch by Borough, 2015

Geographic Area	Total Enrolled Students	Students Qualifying for: Free Lunch	Students Qualifying for: Reduced-Price Lunch	FRPL Total	FRPL as a Percent of Total Enrolled Students
Northern Boroughs					
Haines Borough	275	108	15	123	45
Hoonah-Angoon CA	194	131	19	150	77
City and Borough of Juneau	5,056	1,249	214	1,463	29
City and Borough of Sitka	1,491	394	110	504	34
Municipality of Skagway Borough[1]	62	1	2	3	5
City and Borough of Yakutat	96	74	9	83	86
Southern Boroughs					
Ketchikan Gateway Borough	2,347	785	178	963	41
Petersburg Borough	431	190	35	225	52
Prince of Wales-Hyder CA	1,200	890	59	949	79
City and Borough of Wrangell	272	112	35	147	54
Alaska	**115,431**	**51,640**	**6,275**	**57,915**	**50**

Notes:
FRPL –Free and Reduced-Price Lunch
[1] Data for the Skagway School District are for 2013, the last year that these data were compiled for this district.
Source: Alaska Department of Education & Early Development 2015

This page is intentionally left blank.

Communities

Community is a concept with multiple dimensions and definitions. Basic definitions of community include: 1) a geographic/political entity, such as a town or village; 2) a network of people with shared values, world views, or identities (sometimes called a community of meaning), such as an ethnic or racial group (e.g., Native Alaskans) or an occupational group (e.g., loggers); 3) a working social system; 4) a rural social landscape, which would include the first three definitions in a rural setting; and 5) a community of interest, or people with a common stake, profession, interest, activity, or set of values, who may live far apart (e.g., anglers, environmentalists, off-road-vehicle operators).

This section uses the geographic/political community—towns and villages—as its basis for several reasons. There are relatively few communities in Southeast Alaska, they are typically isolated geographically, most are recognized as being unique, and data are more commonly available at this level. Geographic/ political communities represent an aggregate of individuals and it is important to remember that residents within the same community may be affected differently by the same action. Potential effects that do not appear that significant when viewed at a community level may be very significant for the individuals that are directly affected.

Community Assessments

The 1997 Forest Plan EIS included discussions of 32 Southeast Alaska communities with a state land selection base. In addition, the city of Kupreanof is included as part of the discussion of Petersburg and Klukwan is part of the discussion of Haines. These discussions provided brief descriptions of each community, including aspects of their histories, population trends, economic bases, and the subsistence resources used by each community. Each community discussion also included a summary of the public comments and testimony received by the Forest Service on the 1990 Draft Environmental Impact Statement (DEIS), 1991 Supplemental DEIS, and the 1996 Revised Supplement. Much of the baseline community information provided in those discussions was taken from the Alaska Department of Community and Regional Affairs (Alaska DCRA) *Community Profiles* (1996) and 1990 U.S. Census data. Subsistence information was mainly based on the findings of the 1989 Tongass Resource Use Cooperative Survey (TRUCS). Updated summary data are presented by community in Table 3.23-8. These data suggest that these communities are diverse in terms of population, income, and subsistence use. There is also a good deal of variation within many of the communities, as reflected by the range of public comments received during preparation of the 1997 Forest Plan EIS, the 2003 SEIS, and the 2008 Forest Plan Amendment EIS (USDA Forest Service 1997a; 2003b).

This document provides brief updates of the affected environment sections of the community discussions, where applicable. The reader is referred to the 1997 Tongass Forest Plan EIS for more detailed information on community history, economic base, and subsistence resources. The 1987 TRUCS data used in the 1997 Forest Plan EIS discussions is still the most current consistent source of subsistence information available. Updated information from the Alaska Department of Fish and Game (ADF&G) Subsistence Community Profile Database is provided in the following discussions, where available.

Data from the 2010 Census as well as more recent data available from the U.S. Census Bureau's 2009-2013 5-year American Community Survey (ACS) and the Alaska Department of Labor (DOL) have been incorporated in the community discussions. These include data maintained by the state for the number of people who work in different industries. These data are direct counts for each community; however, self-employed residents (often in commercial fishing) and federal employees (e.g., Forest Service) are not included. Fishing, other self-employment, and federal government work are noted separately where appropriate.

The community of Meyers Chuck was incorporated into the City and Borough of Wrangell in June 2008; therefore, many of the statistics reported in this section are no longer collected or estimated for this area individually. Data for Meyers Chuck are from the 2000 Census and other sources as available.

The effects of the alternatives considered in the 1997 Forest Plan EIS were evaluated in terms of community use area effects. Community use areas depict the approximate extent of each community's day-to-day use area. Potential community effects were also estimated with the help of a Socioeconomic Panel and Subsistence Workshop, which were convened to assess the potential effects of the planning alternatives for the 1997 Forest Plan EIS. The Socioeconomic Panel assessed these potential effects in terms of timber employment, tourism/recreation employment, mining employment, economic structure/diversity, community stability, quality of life, recreation opportunities, and access to traditional lifestyles. The Subsistence Workshop involved a group of subsistence specialists who met to offer professional judgement regarding the potential effects of planning alternatives on 30 selected subsistence communities (Juneau and Ketchikan do not meet the federal definition of subsistence community). In addition, the Sitka black-tailed deer habitat capability model output was analyzed for the Wildlife Analysis Areas (WAAs) where each community obtained approximately 75 percent of their average annual deer harvest. This analysis is discussed further in the 1997 Forest Plan EIS. An updated deer habitat capability model-based analysis is used here and is presented in the Wildlife section.

The analysis presented here draws upon these information sources to assess the effects of the five alternatives under consideration by community. Each community discussion includes a map of that community's use area, as defined by the 1997 Forest Plan revision EIS. These maps are accompanied by tables that summarize the estimated maximum harvest by acres that could occur in the community's use area over the 100-year planning horizon. Whether any timber harvesting would actually take place on the suitable lands within the community use area over the next decade would depend on the timber sales that are actually carried out during plan implementation. All proposed timber sales would be evaluated on a project-specific basis in accordance with the National Environmental Policy Act (NEPA). The community use area maps and tables are intended to help community residents (and other readers) gain a better understanding of what management direction is proposed for their immediate surroundings under each alternative.

Table 3.23-8
Southeast Alaska Community Statistics

	Population			Median Household Income in 2013[1]	Percent of People Below Poverty Line in 2013	Percent of Labor Force Unemployed in 2013[1]	Subsistence Use (lbs per capita)[2]
	2014	Percent Change 2000 to 2014	Percent Native in 2010				
Angoon	416	-27	76	32,250	23	19	182
Coffman Cove	174	-13	4	31,250	10	12	276
Craig	1,198	-14	20	59,643	18	10	232
Edna Bay	46	-6	0	NA	0	NA	383
Elfin Cove	16	-50	5	43,125	19	32	263
Gustavus	516	20	3	52,188	11	7	241
Haines	1,805	0	11	54,267	8	5	137
Hollis	94	-32	4	33,500	19	33	169
Hoonah	787	-8	53	50,714	17	16	343
Hydaburg	405	6	77	37,361	6	17	531
Hyder	91	-6	1	21,944	5	0	345
Juneau	33,026	8	12	81,490	6	5	NA
Kake	626	-12	69	38,750	28	21	179
Kasaan	75	92	35	43,750	4	19	452
Ketchikan	8,314	0	17	52,266	14	11	NA
Klawock	802	-6	48	37,083	20	16	350
Metlakatla	1,480	8	83	49,663	13	15	70
Meyers Chuck[3]	11	-48	0	64,375	0	0	414
Naukati Bay	121	-10	6	45,750	10	0	242
Pelican	75	-54	34	89,167	5	31	355
Petersburg	2,964	-8	7	66,125	13	4	161
Point Baker	13	-63	0	18,906	78	0	289
Port Alexander	45	-44	4	56,250	0	0	312
Port Protection	56	-11	19	27,875	0	0	451
Saxman	419	-3	51	46,250	31	22	217
Sitka	9,061	3	17	69,405	10	5	205
Skagway	967	19	4	71,435	6	8	48
Tenakee Springs	128	23	1	62,813	14	5	330
Thorne Bay	530	-5	2	49,323	20	8	118
Whale Pass	39	-33	0	NA	58	100	247
Wrangell	2,406	-2	16	45,841	10	8	168
Yakutat	631	-7	36	72,500	6	7	386

Notes:
NA = not available
[1] Data estimated as part of the 2009-2013 5-year American Community Survey (ACS); the 10-year census no longer collects this information. The ACS defines “families” as households consisting of a householder and one or more other people living in the same household who are related to the householder by birth, marriage, or adoption. “People” includes all individuals in the population.
[2] The year these data were collected varies by community, as follows:
1987: Elfin Cove, Gustavus, Hyder, Metlakatla, Meyers Chuck, Pelican, Port Alexander, Skagway, and Tenakee Springs;
1996: Kake, Point Baker, Port Protection, and Sitka.
1997: Craig and Klawock.
1998: Coffman Cove, Edna Bay, Hollis, Kasaan, Naukati Bay, and Thorne Bay.
1999: Saxman
2000: Petersburg, Wrangell, and Yakutat.
2012: Angoon, Haines, Hoonah, Hydaburg, and Whale Pass.
[3] Meyers Chuck was incorporated into the Wrangell City and Borough Census Area, effective June 1, 2008. The most recent data available for this community as a separate area are presented in the table as follows: 2006 Population, Population Percent Change 2000 to 2006, Percent Native in 2000, 2000 Median Household Income, Percent of Households Below the Poverty Line in 2000, Percent of Labor Force Unemployed in 2000, and Subsistence Use in 1987.
Sources: Alaska DOL 2015b; U.S. Census Bureau 2014b; U.S. Census Bureau 2011; ADF&G 2014

Analyzing Impacts to Communities

Small, rural communities are seldom self-contained economic units. Although it is possible to describe a community's economic structure, complex social and economic forces, many of which are outside the control of community residents, have great influence on community economics. This makes it difficult to precisely predict the effects of forest-wide management alternatives on individual communities. Forest Service activities provide economic opportunities to the private sector. How that sector and the various industries that comprise it respond depends on many variables in addition to Forest Service management.

Forest plans are programmatic, meaning that they establish direction and allowable activities for broad land areas, rather than schedule specific activities on specific patches of land. This also makes it difficult to predict effects on individual communities. This is a common source of frustration to local residents, who want to know exactly how they and the places they care about could be affected. While many outputs of forest management, such as scheduled timber harvest, generally translate into social and economic activity, such as employment in the timber industry, it is difficult to predict which communities would benefit the most from that activity. Communities may even compete with each other in many instances. Communities that rely on a given resource-related industry would, however, be expected to be the first to benefit or lose from significant changes in planned output levels affecting that industry.

Another factor affecting the accuracy of predicting specific impacts at the community scale is that people and businesses have proven themselves highly adaptable. Researchers have used the term community resiliency (Harris 1996) or community capacity (FEMAT 1993) to describe a community's ability to weather significant changes. Some of the factors judged important for small, rural communities include community infrastructure, the presence of amenities, social cohesion and effective community leadership, and economic diversity. Some communities will be more effective than others in coping with changes that do result. While information such as population size can be used as a rough proxy for resiliency (generally, larger communities tend to be more resilient than smaller ones), this is not always the case. However, analyses have not been conducted regarding the resiliency of Southeast Alaska communities, and we do not know how well information gained elsewhere applies to understanding Southeast communities. It is also worth noting that while a community as a whole may be resilient to change, individuals within that community could still be negatively affected.

Given these considerations, it is more accurate to identify areas of concern for which the risks of effects from a given alternative are higher or lower, rather than say, "Here is what we know will happen to each and every community." One of the hazards associated with such attempts to assess impacts is that analyses tend to view social and economic conditions as static, failing to consider that economies are dynamic, and adjust to different impacts in different ways.

Population and School Enrollment

Twenty-two out of the 32 Southeast communities identified in Table 3.23-8 (69 percent) lost population between 2000 and 2014, with decreases ranging from -2 percent (Wrangell) to -63 percent (Point Baker). Population in the remaining 10 communities either remained more or less constant (Haines and Ketchikan) over this period or increased, with gains ranging from 3 percent (Sitka) to 92 percent (Kasaan) (Table 3.23-8). Viewed as a region, total population in Southeast Alaska increased by about 2 percent between 2000 and 2014, with relatively large gains in population in Juneau overshadowing losses elsewhere (Table

3.23-1). The following community discussions present annual population estimates for 2000 to 2014 for each community, along with census counts for 1970, 1980, and 1990.

Loss of population is often accompanied by declining school enrollments and decreasing municipal tax bases. Nearly all Southeast communities[1] have had a public community school at one point in time (Table 3.23-9). School enrollment has typically declined as population has decreased. Total school enrollment in Southeast Alaska decreased by 15 percent between 1990 and 2014, with the majority of that decline taking place between 2000 and 2010, with total enrollment in the region as a whole actually increasing slightly from 2010 to 2014 (Table 3.23-9).

Six communities—Edna Bay, Elfin Cove, Hyder, Kasaan, Meyers Creek, and Whale Pass—have seen their school close since 1990, with all but one of these closures occurring since 2000. Three of these schools— Hyder, Kasaan, and Whale Pass—have since re-opened, and were open for the 2014 school year. All but three of the remaining communities—Craig, Kasaan, and Port Protection—had fewer enrolled students in 2010 than two decades earlier in 1990. From 2010 to 2014, enrollment declined in 10 communities, ranging from an absolute loss of 1 student (Klukwan) to 217 students (Juneau). Increases in enrollment ranged from 1 student (Angoon and Port Protection) to 244 students (Ketchikan) (Table 3.23-9).

Several schools that are currently open are hovering on the verge of closure due to enrollments that barely meet the State of Alaska's ten-student minimum requirement including Hollis, Kasaan, Klukwan, Pelican, Port Alexander, Port Protection, Tenakee Springs, and Whale Pass. In these communities, one family can make the difference between an open or closed school.

Table 3.23-9
School Enrollment by Community, 1990, 2000, 2010, and 2014

	School Enrollment				Percent Change		
Community	**1990**	**2000**	**2010**	**2014**	**1990 - 2000**	**2000 - 2010**	**2010 - 2014**
Angoon	189	154	77	78	-19%	-50%	1%
Coffman Cove	47	31	11	24	-34%	-65%	118%
Craig	308	551	630	573	79%	14%	-9%
Edna Bay	15	Closed	9	10	-	-	-
Elfin Cove	9	Closed	Closed	Closed	-	-	-
Gustavus	76	48	57	65	-37%	19%	14%
Haines	470	402	304	276	-14%	-24%	-9%
Hollis	16	14	10	14	-13%	-29%	40%
Hoonah	237	226	123	114	-5%	-46%	-7%
Hydaburg	109	91	61	70	-18	-30	9
Hyder	Closed	12	Closed	10	-	-	-
Juneau	5,081	5,483	4,968	4,751	8%	-9%	-4%
Kake	177	165	85	110	-7%	-48%	29%
Kasaan	10	11	14	12	10%	27%	-14%
Ketchikan	2,799	2,469	2,116	2,360	-12%	-14%	12%
Klawock	203	190	136	121	-6%	-28%	-11%
Klukwan[1]	36	15	14	13	-58%	-7%	-7%
Kupreanof[1 2]	-	-	-	-	-	-	-
Metlakatla	378	325	272	359	-14%	-16%	32%

[1] The 34 communities referenced here are the 32 communities identified in Table 3.23-8 plus Kupreanof and Klukwan. Kupreanof is discussed with Petersburg in the following descriptions; Klukwan is referenced in the discussion of Haines.

Table 3.23-9 (continued)
School Enrollment by Community, 1990, 2000, 2010, and 2014

	School Enrollment				Percent Change		
Community	**1990**	**2000**	**2010**	**2014**	**1990 - 2000**	**2000 - 2010**	**2010 - 2014**
Meyers Chuck[3]	4	Closed	Closed	Closed	-	-	-
Naukati	25	36	19	19	44%	-47%	0%
Pelican	51	23	12	13	-55%	-48%	8%
Petersburg	678	678	487	436	0%	-28%	-10%
Point Baker[2]	-	-	-	-	-	-	-
Port Alexander	25	18	10	10	-28%	-44%	0%
Port Protection	9	27	10	11	200%	-63%	10%
Saxman[2]	-	-	-	-	-	-	-
Sitka	2,008	1,945	1,749	1,796	-3%	-10%	3%
Skagway	148	132	82	86	-11%	-38%	5%
Tenakee Springs	10	11	8	12	10%	-27%	50%
Thorne Bay	168	136	73	76	-19%	-46%	4%
Whale Pass	11	Closed	Closed	11	-	-	-
Wrangell	498	491	344	275	-1%	-30%	-20%
Yakutat	145	167	117	109	15%	-30%	-7%
Total	**13,940**	**13,851**	**11,798**	**11,804**	**-1%**	**-15%**	**0%**

Notes:
[1] Klukwan and Kupreanof are included in the below community discussions for Haines and Petersburg, respectively.
[2] Children attend school in a neighboring community (i.e., Kupreanof to Petersburg, Saxman to Ketchikan, and Point Baker to Port Protection).
[3] Meyers Chuck consolidated with the City of Wrangell when the City and Borough of Wrangell incorporated in 2008.

Energy Generation and Use

Southeast Alaska has a wet, relatively temperate climate, and the combination of high precipitation rates and mountainous terrain provides considerable opportunity for hydroelectric generation. In 2011, hydroelectric power accounted for 96 percent of the region's net power generation, with diesel supplying the other four percent (Fay et al. 2013).

Although it accounts for most of the region's net power generation, hydroelectric power is not evenly distributed among the region's communities. As communities moved toward electrification, hydropower projects were developed in locations near the region's main load centers (i.e., the larger communities). Diesel generation was developed to supplement and backup hydroelectric generation, where it existed, and for communities that could not economically access hydroelectric power. Although relatively easy and inexpensive to install, high fuel costs and the operations and maintenance expenses associated with diesel generators make them expensive to operate.

The existing transmission system in Southeast Alaska is limited, but electric systems in several communities are currently interconnected, as indicated in the *Renewable Energy* section of this EIS. Summarized by region, these interconnected areas are as follows:

- Southeast Alaska Power Agency (SEAPA) Region—The SEAPA system connects Ketchikan, Petersburg, and Wrangell.
- Juneau Area—The Alaska Electric Light & Power (AEL&P) system connects Juneau, Douglas Island, Auke Bay, and Greens Creek.

- Prince of Wales Island—The Alaska Power & Telephone (AP&T) system connects the communities of Coffman Cove, Craig, Hollis, Hydaburg, Kasaan, Klawock, and Thorne Bay.
- Upper Lynn Canal Region—A separate AP&T system connects Haines and Skagway in the Upper Lynn Canal Region and is connected via an intertie to the existing Inside Passage Electrical Cooperative (IPEC) system that serves Klukwan and Chilkat Valley.

The energy requirements of the larger communities in Southeast Alaska, including Juneau, Ketchikan, Sitka, Petersburg, Wrangell, Skagway, and Haines, are met by relatively low cost hydroelectric generation, with diesel generation used as a back-up. This is also the case with a number of smaller communities, including Craig, Hollis, Hydaburg, Kasaan, Klawock, and Thorne Bay on Prince of Wales Island, Metlakatla, Saxman, Gustavus, and Pelican.

Fourteen of the remaining 32 communities within or adjacent to the Tongass National Forest are completely dependent upon diesel-generated electricity. Nine of these communities (Angoon, Coffman Cove, Elfin Cove, Hoonah, Kake, Naukati Bay, Tenakee Springs, Whale Pass, and Yakutat), ranging in population in 2014 from 16 to 787, have central electric utility systems that rely on diesel generation. The other five communities that are dependent on diesel generation (Edna Bay, Meyers Chuck, Point Baker, Port Alexander, and Port Protection with 2014 populations ranging from 13 to 56) have no central utility system and residents rely upon individual generators (USDA Forest Service 2010; Alaska DOL 2015d).

Residents in communities in Southeast Alaska that rely primarily on hydroelectric power to generate electricity have the lowest residential rates in the State, with rates as low as 9 cents/kilowatt hour (kWh) in 2011. Rates are much higher in smaller, more remote communities that rely on diesel, with rates ranging up to 75 cents/kWh (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). The State helps to lower the price of electricity for residential customers and community facilities in most of these communities through the Power Cost Equalization (PCE) program. Residential rates for 2011 before and after the application of PCE payments are shown in Table 3 of the Energy Resource Report (Tetra Tech 2015) and discussed in more detail in the *Renewable Energy* section of this EIS.

Commercial and other customers, including community and governmental facilities and industrial customers, are not eligible to participate in the PCE program and there is no comparable program for these customers. These customers pay the full retail cost for power in all communities, including those where residential rates are lowered by the PCE program. Commercial rates in Southeast Alaska communities in 2011 ranged from 9 cents/kWh (Sitka) to 75 cents/kWh (Elfin Cove) (see Table 3 in the Energy Resource Report [Tetra Tech 2015]).

According to the 2012 Southeast Alaska Integrated Resource Plan, the reliance on diesel generation in communities where hydroelectric power is not available has “created a gap or chasm between communities, where stable and “well-to-do” communities exist near struggling communities and a notable absence of private sector economic activity are the norm” (Black & Veatch 2012, p. 1-4). Alexander et al. (2010, p. 8) found that “the high cost of energy in the communities that rely on diesel generation impedes economic development, as decisions to locate new commercial and industrial developments are influenced by the availability of reliable low-cost power.”

Potential Effects by Resource Area

The alternatives have implications for specific places on the Forest and particular parts of the community use areas of various communities. They also have potential implications in terms of employment in resource dependent industries and the availability of subsistence resources. The following paragraphs discuss the potential implications for wood products, recreation and tourism, and subsistence in general terms to provide some background to the reasoning employed in the community effects discussions presented in the following sections.

Wood Products

Based on the analysis presented in the preceding section, projected direct wood products employment in the first decade of implementation would be very similar under all five alternatives (Table 3.22-17). Estimated employment is presented as a range from a maximum allowable export of timber scenario based on the existing R10 limited export policy to a maximum domestic processing scenario that assumes only Alaska yellow cedar would be exported unprocessed.

Renewable Energy

The 2008 Forest Plan identifies three types of area related to energy development on the Tongass based on the existing Land Use Designations (LUDs): windows, which represent areas potentially available for energy development, avoidance areas, and exclusion areas. Avoidance areas are those LUDs where development of energy projects is not considered desirable. Exclusion areas preclude Transportation and Utility Systems. LUDs classified as windows and avoidance areas make up 38 percent and 62 percent of the Forest, respectively. There are no exclusion areas on the Forest due to special authorities provided in the Alaska National Interest Lands Conservation Act (ANILCA), Title XI. These classifications and the standards and guidelines in the 2008 Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, renewable energy sites would be managed under the Renewable Energy Plan Components identified in Chapter 5 of the proposed Forest Plan amendment. The revised components may affect the timing and rate that new projects are proposed and developed on National Forest System (NFS) lands. This is discussed in detail in the *Renewable Energy* section of this EIS. The individual community assessments below include information about currently proposed renwable energy projects, as appropriate.

Recreation and Tourism

The mix of primitive and roaded recreation opportunities would remain largely unchanged under all alternatives, with most projected harvest expected to occur in Recreation Opportunity Spectrum (ROS) settings where some modification of the natural environment is expected (see Table 3.15-19 in the *Recreation and Tourism* section). Viewed in terms of recreation and tourism employment over the next decade, there would be very little difference between the alternatives.

Subsistence

Among the subsistence resources of greatest importance (salmon, other finfish, marine invertebrates, and deer), deer is the only one that is potentially significantly affected by the alternatives. Therefore, the subsistence analysis presented here uses deer as a key indicator for potential subsistence resource consequences concerning the abundance and distribution of the resources. Timber harvest tends to affect deer-related subsistence activities in two ways. In the short run, approximately 20 to 30 years following harvest, deer populations tend to increase in harvested areas. In the long run, populations tend to decline as the canopy in even-aged forest stands closes, resulting in lower habitat quality. Reductions in habitat quality can be reduced through management (e.g., thinning) of young-growth stands. Deer populations in unharvested areas are likely to remain at fairly constant levels that are typically lower than a comparable harvested area in the short run, but higher in the long run. Road construction also affects subsistence by providing subsistence hunters with ready access to areas that may have been previously inaccessible. This effect may be perceived as either positive or negative depending on the parties involved, as increased access may lead to increased competition for resources. Potential effects are likely to vary by community and may be perceived differently by members of the same or neighboring communities.

While there would be some new road access under all alternatives in the long run, nearly all new roads constructed under the alternatives would be closed following harvest. These roads would, therefore, not be available for use by highway vehicles or high-clearance vehicles. They would, however, be available for access by other methods and would, as a result, have the potential to affect existing subsistence patterns.

Individual Community Assessments

The following sections present socioeconomic descriptions and assessments of impact for 32 Southeast Alaska communities with a state land selection base. These are presented in alphabetical order. Additional information on the history, economy, and subsistence use is presented by community in the 1997 Forest Plan EIS (USDA Forest Service 1997a).

Angoon

Affected Environment

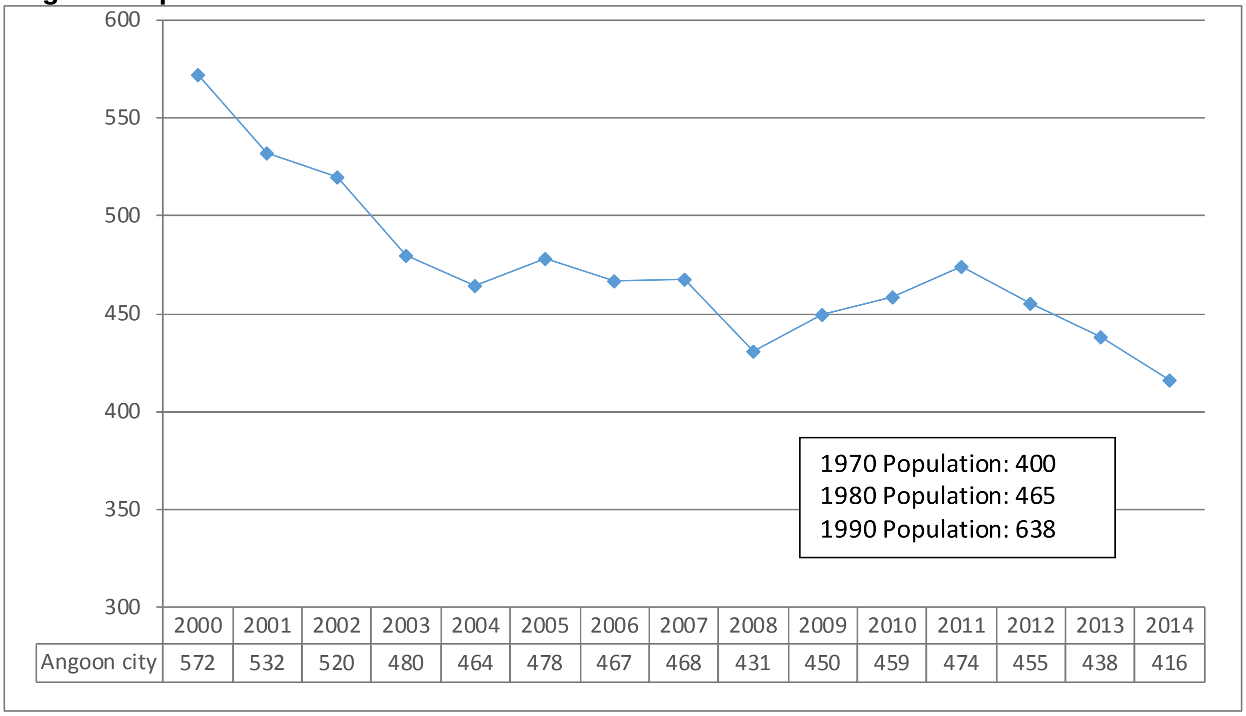
Overview and Demographic Characteristics

Angoon, located on the west coast of Admiralty Island at the mouth of Kootznoowoo Inlet, has been there so long that no precise date can be established for its original occupation. In 1882, the U.S. Navy—then the only governmental authority in Alaska—shelled and burned the village of Angoon after a dispute and alleged hostage situation. The village of Angoon was left homeless. The event became known as the "1882 Bombardment of Angoon."

As the only permanent community on Admiralty Island, Angoon had a population of about 459 in 2010. It remains a traditional Tlingit Alaska Native village with 76 percent of its population identified as Alaska Native in the 2010 Census (Table 3.23-8). Angoon has a local Fish and Game Advisory Committee; however, it is currently inactive (ADF&G 2015a).

Angoon's population increased 37 percent between the 1970 and 1990 census. The population was, however, approximately 13 percent below the 1990 level in 2000 and continued to decline, decreasing by 27 percent between 2000 and 2014. Total estimated population was 416 in Angoon in 2014 (Figure 3.23-6).

Figure 3.23-6
Angoon Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

The general overall decline in population since 1990 has been matched by a decline in school enrollment, with the number of enrolled students decreasing from 189 in 1990 to 78 in 2014 (Table 3.23-9).

Economic Conditions

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Local government, including the Chatham School District, and other educational and health services provide the majority of employment for Angoon, followed by leisure and hospitality. In addition, commercial fishing is a major source of income for self-employed residents, and state and federal grants recently funded a new shellfish farm in the area (Himes-Cornell et al. 2013). In 2013, 15 residents held 15 commercial fishing permits (ACFEC 2015). Three of these permits were used for commercial landings for crab, halibut, and salmon.

Tourism is a growing source of seasonal work opportunities, including a destination sportfishing lodge on Killisnoo Island that employs approximately 75 seasonal employees. Logging on Prince of Wales Island also provides limited seasonal employment (Himes-Cornell et al. 2013).

An estimated 19 percent of the labor force in Angoon was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Other estimates place the unemployment rate at more than 60 percent (Alexander et al. 2010). Median household income in 2013 was $32,250, less than half of the state median of $70,760; the corresponding median for the Hoonah-Angoon Census Area (CA) was $49,545 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	14	7
Construction	7	4
Manufacturing	1	1
Trade, Transportation and Utilities	19	10
Information	1	1
Financial Activities	11	6
Professional and Business Services	1	1
Educational and Health Services	29	15
Leisure and Hospitality	20	10
State Government	1	1
Local Government	95	48
Other	0	0
Unknown	0	0
Total Employment	**199**	**100**

Source: Alaska DOL 2015d

Angoon has some of the highest electric rates in Alaska due to the use of diesel-generated power. Residential rates for 2011 before and after the application of PCE payments were 63 cents/kWh and 23 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 63 cents/kWh. Kootznoowoo, Inc., the Alaska Native Claims Settlement Act Corporation for the City of Angoon, has proposed to develop a 1 megawatt (MW), run-of-river hydroelectric facility on Thayer Creek to replace the use of diesel generators (Table 3.12b-3).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Angoon in their local day-to-day work, recreational, and subsistence activities is shown in Figure 3.23-7. This area contains 1,083,231 acres of NFS land (among other land ownerships). Table 3.23-10 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Angoon, ranging from about 2.6 percent (Alternative 1) to 3.4 percent (Alternative 2). Harvest activities could have localized effects if they coincide with a particular location favored by Angoon residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 5; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old growth harvest in this area (see Table 3.23-10).

Figure 3.23-7
Angoon's Community Use Area

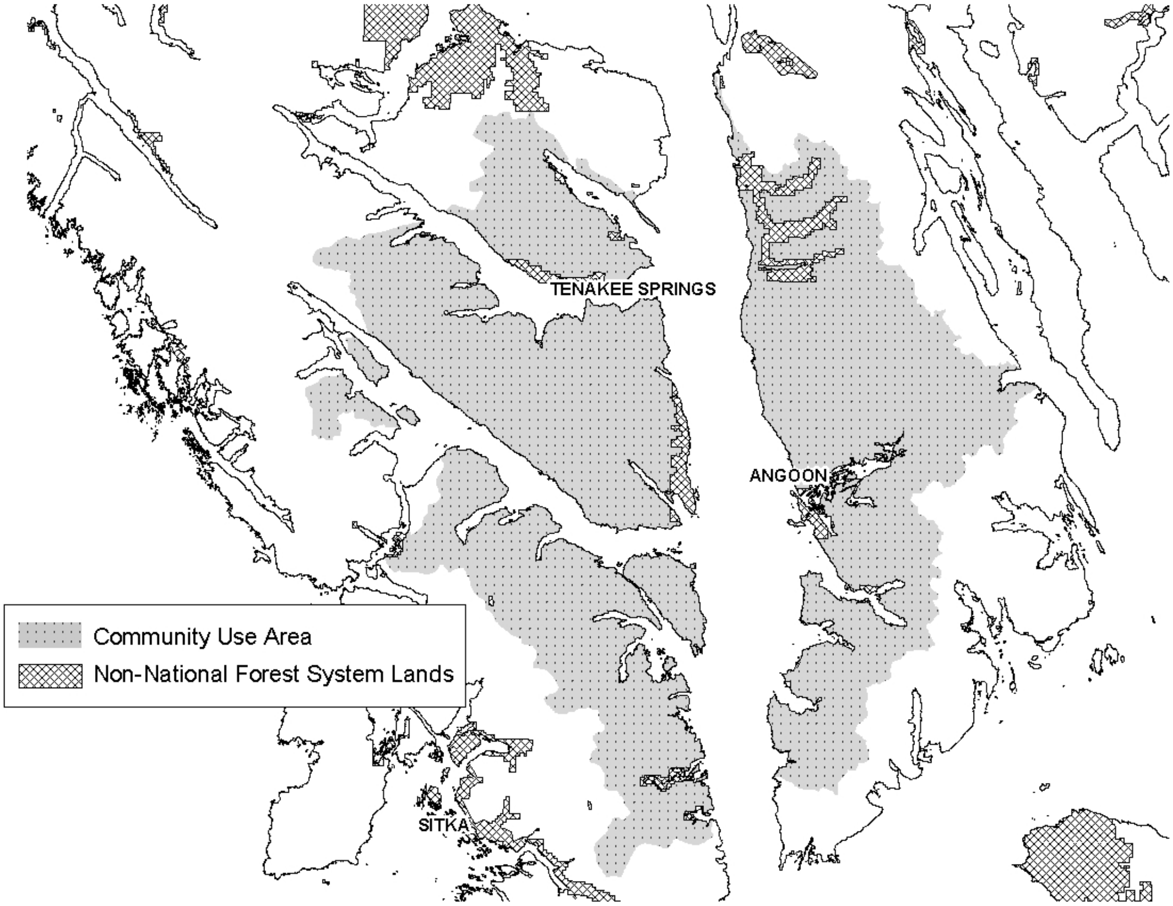


Table 3.23-10
Estimated Maximum Harvest (acres) over 100 Years in Angoon's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	19,233	32,724	28,379	23,739	29,493
Old Growth	8,603	4,181	4,511	5,634	4,894
Total	**27,836**	**36,906**	**32,890**	**29,373**	**34,386**
Harvest as a Percent of Total NFS Lands in the Community Use Area	2.6%	3.4%	3.0%	2.7%	3.2%

Economy

Angoon is a traditional native community. Commercial fishing and subsistence use are the primary factors influencing Angoon. For subsistence use, Admiralty and Catherine Islands are especially important to Angoon. No timber harvest would occur on the NFS land within the Angoon community use area on Admiralty Island under any of the alternatives. Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

ANILCA section 506(a)(3)(B) granted Kootznoowoo, Inc. the right to develop hydroelectric resources on Admiralty Island subject to such conditions as the Secretary of Agriculture shall prescribe for the protection of water, fishery, wildlife, recreational, and scenic values. As directed by ANILCA, the Forest Service will issue special use permits, with specified conditions, to allow construction and operation of the project under the terms of the May 2009 Record of Decision for the project.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 52 percent of the total edible pounds of subsistence resources harvested by Angoon households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates), primarily salmon, accounted for the majority (62 percent) of per capita subsistence harvest in Angoon in 2012 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 30 percent of the total edible pounds of subsistence resources harvested by Angoon households (Kruse and Frazier 1988). Deer accounted for 28 percent of per capita subsistence harvest by Angoon residents in 2012 (ADF&G 2014).

The WAAs used by Angoon residents for hunting deer lie within Game Management Unit (GMU) 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Angoon residents, however, total annual deer harvest has fluctuated and was lower in 2013 than 2004 by about 47 percent (79 fewer deer) (ADF&G 2015b).

Angoon residents take the majority (59 percent) of their deer from three WAAs on Admiralty Island (4042, 4054, and 4055). As shown in Table 3.23-11, these three WAAs will not be affected by any of the alternatives. The next two WAAs in importance contribute 12 percent of Angoon's deer harvest and would also not be affected under any of the alternatives. WAA 3308 would be minimally affected by Alternatives 1, 4, and 5, each decreasing deer habitat capability by one percent after 100 years. Therefore, all alternatives should be able to provide habitat capability for deer hunted by Angoon residents, as well as for all deer hunted within the WAAs, over the course of Forest Plan implementation.

Table 3.23-11
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Angoon Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Angoon Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
4042	31	32	41	100%	100%	100%	100%	100%	100%
4055	28	33	48	99%	99%	99%	99%	99%	99%
4054	18	19	21	100%	100%	100%	100%	100%	100%
3939	9	71	105	100%	100%	100%	100%	100%	100%
4041	6	16	19	91%	91%	91%	91%	91%	91%
3308	4	61	107	66%	65%	66%	66%	65%	65%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Coffman Cove

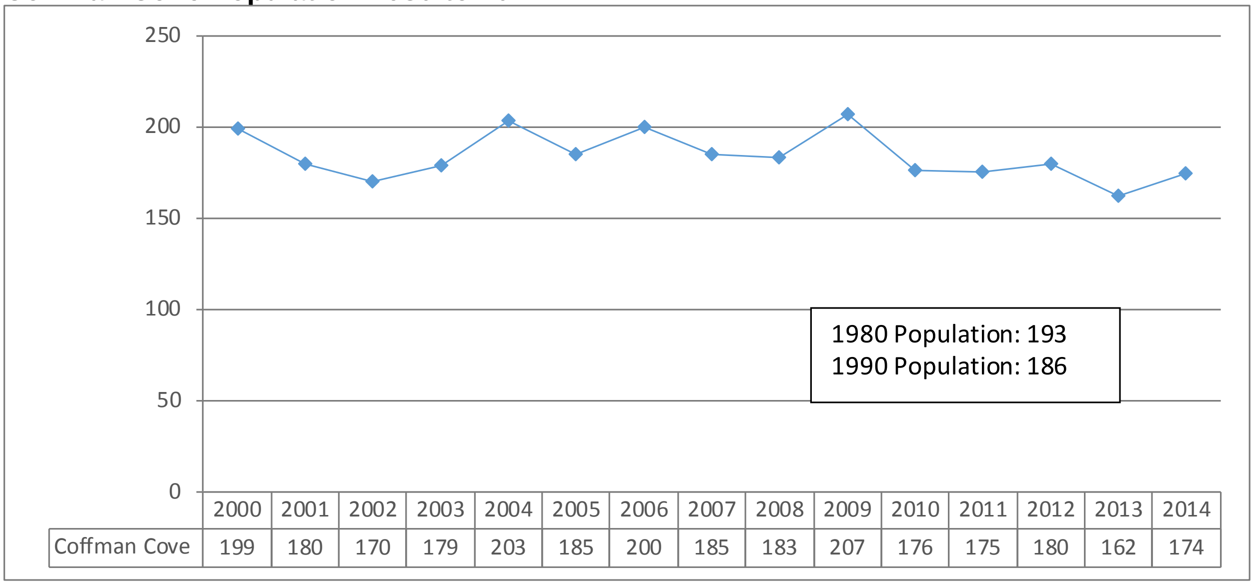
Affected Environment

Overview and Demographic Characteristics
Coffman Cove is located on northeast Prince of Wales Island. Settlement of Coffman Cove began in 1956 with development of a logging camp. A road connecting Coffman Cove to the larger community of Craig was built in the 1980s. In 2015, the Rainforest Islands Ferry started providing ferry service four times a week between Coffman Cove, Wrangell, and Petersburg. The city was incorporated in 1989.

Population has fluctuated over recent decades, but has not declined dramatically (Figure 3.23-3). According to the 2010 Census, Coffman Cove had a population of 176, with Alaska Natives comprising 4 percent of the total (Table 3.23-8). Total estimated population was 174 in Coffman Cove in 2014 (Figure 3.23-8).

School enrollment in Coffman Cove dropped from 47 students in 1990 to just 11 students in 2010, and has since increased to 24 students (Table 3.23-9). The community has at times struggled to maintain the minimum 10 students required by Alaska state law (Alexander et al. 2010).

Figure 3.23-8
Coffman Cove Population 1980 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Coffman Cove	199	180	170	179	203	185	200	185	183	207	176	175	180	162	174

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Construction and local government provide the majority of employment for Coffman Cove.

Logging support services historically provided the majority of employment in Coffman Cove. One of the major log transfer sites on Prince of Wales Island is located at Coffman Cove. Logging support services still provide some employment, but most employment is now recreation and tourism-based. A review of business licenses in January 2015 indicated two small sawmills remain active in the community. Tourism facilities include fishing lodges, bed and breakfast inns, apartment/bunkhouse facilities, and rental cabins, as well as fishing day charter operations (Dugan et al. 2009). Commercial fishermen also operate out of the cove and the local school system, library, general store, and gas station also provide employment, as well as services to community residents and the north part of the island. In 2013, six residents held seven commercial fishing permits, two of which were used for shellfish and salmon catches (ACFEC 2015).

An estimated 12 percent of the labor force in Coffman Cove was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $43,750, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	7	10
Construction	18	26
Manufacturing	0	0
Trade, Transportation and Utilities	7	10
Information	0	0
Financial Activities	0	0
Professional and Business Services	1	1
Educational and Health Services	4	6
Leisure and Hospitality	0	0
State Government	4	6
Local Government	29	41
Other	0	0
Unknown	0	0
Total Employment	**70**	**100**

Source: Alaska DOL 2015d

Coffman Cove is part of the AP&T system that connects the community with the communities of Craig, Hollis, Hydaburg, Kasaan, Klawock, and Thorne Bay. Electricity is diesel generated. Residential rates for 2011 before and after the application of PCE payments were 47 cents/kWh and 18 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 47 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Coffman Cove in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-9. This area contains 1,228,787 acres of NFS land (among other land ownerships). Table 3.23-12 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 8.8 percent of the Coffman Cove community use area under Alternative 1 to 11.6 percent under Alternative 2. Harvest activities could have localized effects if they coincide with areas favored by Coffman Cove residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area; as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of total potential suitable acres) would have the largest potential old-growth harvest in this area (see Table 3.23-12).

Figure 3.23-9
Coffman Cove's Community Use Area

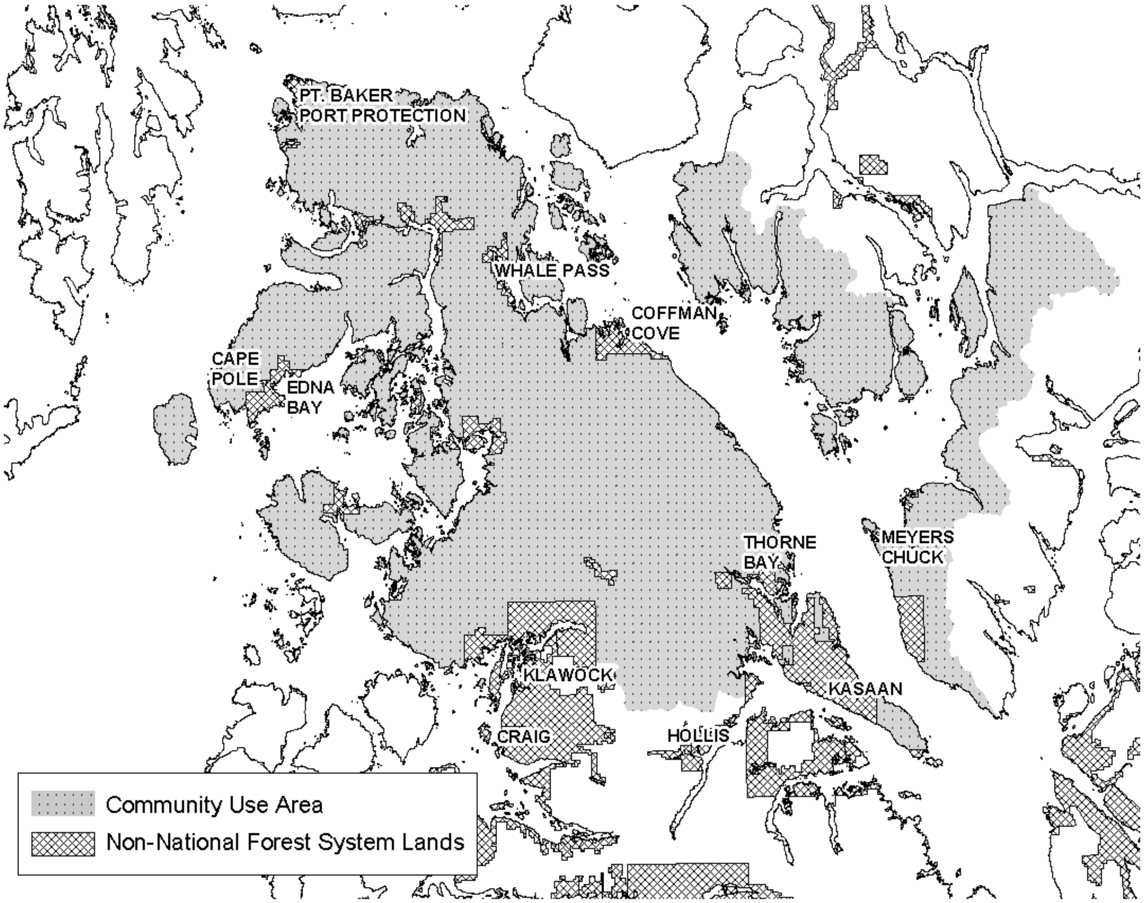


Table 3.23-12
Estimated Maximum Harvest (acres) over 100 Years in Coffman Cove's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	89,985	131,000	124,956	103,466	113,809
Old Growth	15,757	7,886	7,483	11,731	12,033
Total	**105,742**	**138,887**	**132,439**	**115,197**	**125,842**
Harvest as a Percent of Total NFS Lands in the Community Use Area	8.8%	11.6%	11.1%	9.6%	10.5%

Economy

Logging support services historically provided the majority of employment in Coffman Cove and still provide some employment, but most employment is now recreation and tourism-based. Timber harvest in the community use area could potentially support employment in logging support services. Recreation and tourism and commercial fishing activities are not expected to be affected by any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 65 percent of the total edible pounds of subsistence resources harvested by Coffman Cove households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for the majority (71 percent) of per capita subsistence harvest in the community in 1998 (ADF&G 2014).

The 1998 TRUCS study found that deer accounted for 32 percent of the total edible pounds of subsistence resources harvested by Coffman Cove households (Kruse and Frazier 1988). Deer accounted for 20 percent of per capita subsistence harvest by Coffman Cove residents in 1998 (ADF&G 2014).

Coffman Cove residents harvest deer almost entirely on Prince of Wales Island, which is included in GMU 2. Following a deer population decline from 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Coffman Cove residents, total annual deer harvest in 2013 was about double the 2004 harvest level (72 more deer) (ADF&G 2015b).

Residents of Coffman Cove harvest the majority (70 percent) of their deer from two WAAs in the eastern half of north-central Prince of Wales Island (1420 and 1421). As shown in Table 3.23-13, the Coffman Cove portion represents about one-quarter of the total harvest and about one-third of the rural hunter harvest in these WAAs. About 38 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

All of the WAAs used by Coffman Cove residents occur in an area with substantial past timber harvest and, therefore, deer habitat capabilities are currently estimated to be considerably below 1954 levels (Table 3.23-13). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 4 to 5 percent of 1954 levels in WAA 1420, 4 to 6 percent in WAA 1421, and 5 to 6 percent in WAA 1315 (Table 3.23-13).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives except for Alternative 7 and 9 should be able to provide sufficient habitat capability over the long term for deer hunted by Coffman Cove residents. All of the 1997 alternatives included substantially higher levels of timber harvest in Coffman Cove's community use area than the alternatives considered in this EIS (approximately 61 to 230 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Coffman Cove residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all rural hunters in the long term and for all hunters in both the short and long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Coffman Cove residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction on hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Coffman Cove's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Table 3.23-13
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Coffman Cove Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Coffman Cove Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1420	59	158	276	49%	45%	45%	45%	45%	44%
1421	31	76	102	68%	62%	63%	63%	63%	64%
1315	7	201	317	56%	50%	51%	50%	51%	50%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Craig

Affected Environment

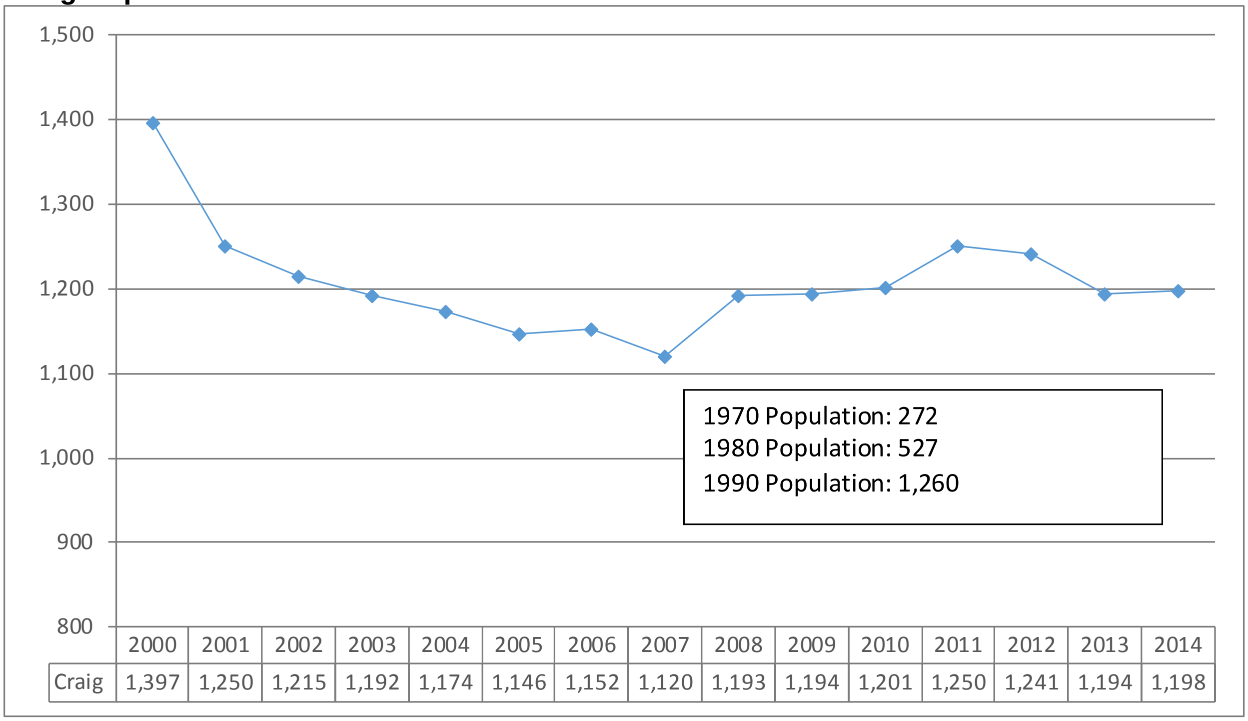
Overview and Demographic Characteristics

Craig is partially situated on an island connected to the west coast of Prince of Wales Island by a causeway and is the largest community on Prince of Wales Island. Tlingit fish camps and seasonal villages originally occupied the present location of Craig. The city is named for its contemporary founder, Craig Miller, who in 1907, with the help of local Haidas, established a saltery at Fish Egg Island.

The Forest Service established a permanent ranger station here around 1919. The City of Craig was incorporated in 1922 as a second-class city under the laws of the territory of Alaska and became a first-class city in 1973. Shaan-Seet Inc. (the village corporation established under the Alaska Native Claims Settlement Act of 1971 [ANCSA]) received an interim conveyance of 20,852 acres in 1979 (ADF&G 1994). The community has an active local Fish and Game Advisory Committee (ADF&G 2015a).

The population of Craig increased more than fivefold between 1970 and 2000 (Figure 3.23-10). According to the 2010 Census, Craig had a population of 1,201, with Alaska Natives comprising 20 percent of the total (Table 3.23-8). The total population decreased by an estimated 199 residents or 14 percent from 2000 to 2014. Total estimated population was 1,198 in Craig in 2014 (Figure 3.23-10). A total of 573 students were enrolled in the Craig City School District in 2014, down from 630 students in 2010 (Table 3.23-9).

Figure 3.23-10
Craig Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Craig economy is primarily based on the fishing and timber industry with commercial fishing, fish processing, logging, sawmill operations, government and retail/wholesale businesses providing the majority of employment. Columbia Ward Fisheries, a fish buying station, and a major cold storage plant are located in Craig and 145 residents hold commercial fishing permits (ACFEC 2015). Estimated gross fishing earnings of local residents reached nearly $11 million in 2013. The Viking Lumber sawmill, St. Nick Forest Products, and one smaller sawmill are located near Craig. According to the 2013 mill survey conducted for the USDA Forest Service, the Viking Lumber mill, which has an installed production capacity of 80 million board feet (MMBF), processed approximately 15 MMBF in 2013 and employed 34 people (Parrent and Grewe 2014). Shaan-Seet Village Corporation timber operations is also a major employer of local residents.

As Craig has grown as a regional center for Prince of Wales Island communities, employment opportunities in tourism and service-related industries have also increased (Himes-Cornell et al. 2013). Most visitors come to Craig for sport fishing and other recreational boating. There are also a number of fishing lodges in and near town, as well independent operators offering package trips that include guided fishing, meals, and lodging (Cerveny 2005; Dugan et al. 2009). A field study of nature-based tourism in Southeast Alaska found that during the summer of 2007, Craig had 2,592 visitors bringing in approximately $6.4 million in revenue (Dugan et al. 2009).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 10 percent of the labor force in Craig was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau

2014b; Alaska DOL 2015d). Median household income was $45,298, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Craig is part of the AP&T system that connects the community with the communities of Coffman Cove, Hollis, Hydaburg, Kasaan, Klawock, and Thorne Bay. Craig is served by hydroelectric generation, with diesel generation used as a back-up. Residential rates for 2011 before and after the application of PCE payments were 24 cents/kWh and 16 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 24 cents/kWh.

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	39	7
Construction	45	8
Manufacturing	29	5
Trade, Transportation and Utilities	139	26
Information	1	< 1
Financial Activities	12	2
Professional and Business Services	23	4
Educational and Health Services	46	9
Leisure and Hospitality	47	9
State Government	18	3
Local Government	128	24
Other	9	1
Unknown	0	0
Total Employment	**536**	**100**

Source: Alaska DOL 2015d

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Craig in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-11. This area contains 766,933 acres of NFS land (among other land ownerships). Table 3.23-14 shows the estimated maximum acres of young-growth and old-growth potentially available for harvest by alternative. Total areas available for harvest range from about 7.7 percent of the Craig community use area under Alternative 1 to 10.6 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular area favored by Craig residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old growth harvest in this area (see Table 3.23-14).

Economy

Craig is primarily a commercial fishing, retail trade, and timber community. It is most likely to be affected by changes in timber employment, commercial fishing, and retail services. Viking Lumber, the largest and most modern sawmill in the region, is located between Craig and Klawock. The alternatives would all supply old-growth volume to support operations at Viking Lumber in the short-term, but the amount of old-growth timber available for sale would decrease over time, as the Forest Service completes the transition to young-growth. The speed of the transition and the relative and absolute volumes of young-growth would vary by alternative as discussed in the *Regional and National Economy* section, above.

Several small timber operators produce value-added products in Craig. These value added products include music wood, cabinets, and other products. These operators process relatively low volumes of timber, but require specific species and grades to meet their needs. All alternatives would supply old-growth volume (5 MMBF) to support the small operators in Southeast Alaska, including those located in and and around Craig.

Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

Figure 3.23-11
Craig's Community Use Area

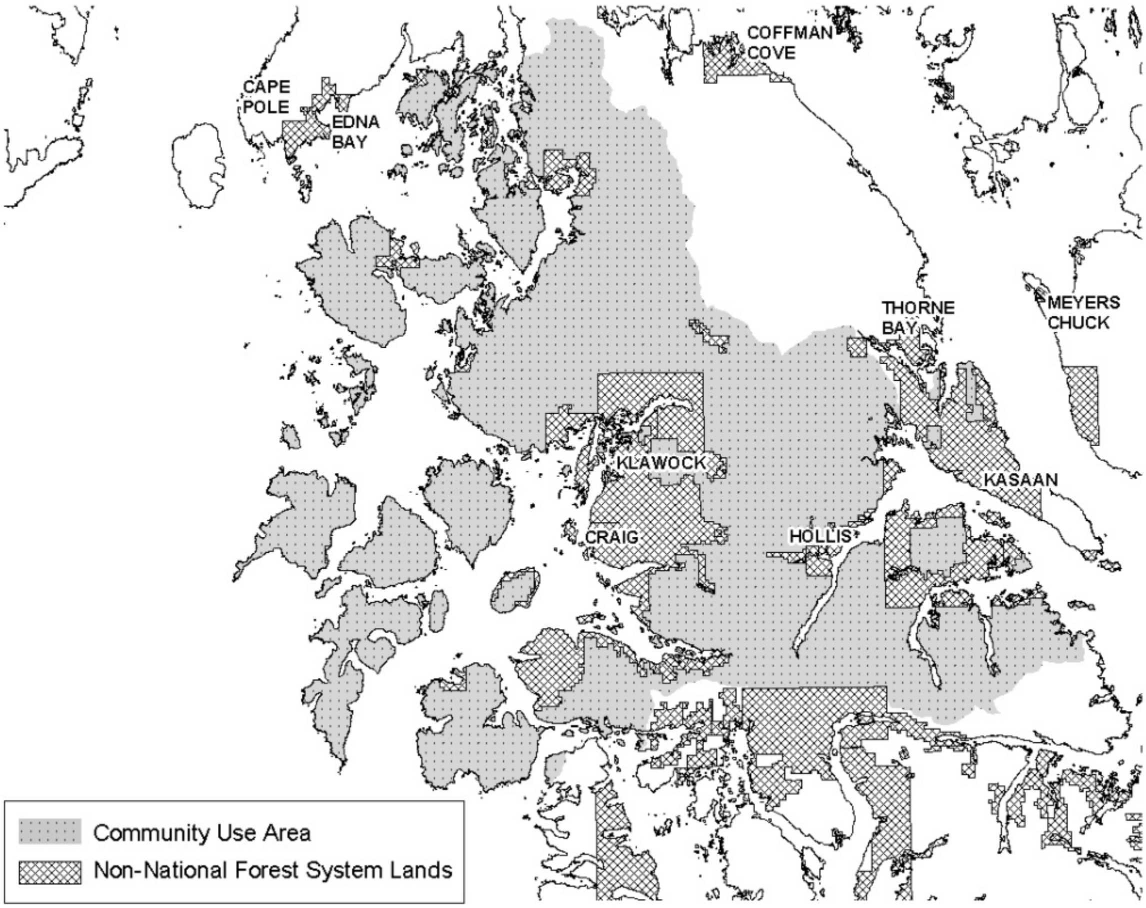


Table 3.23-14
Estimated Maximum Harvest (acres) over 100 Years in Craig's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	47,273	73,058	68,617	56,495	60,686
Old Growth	9,442	4,955	5,525	7,505	7,738
Total	**56,715**	**78,013**	**74,142**	**64,000**	**68,424**
Harvest as a Percent of Total NFS Lands in the Community Use Area	7.7%	10.6%	10.1%	8.7%	9.3%

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 70 percent of the total edible pounds of subsistence resources harvested by Craig households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 67 percent of per capita subsistence harvest in Craig in 1997 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 22 percent of the total edible pounds of subsistence resources harvested by Craig households (Kruse and Frazier 1988). Deer accounted for 19 percent of per capita subsistence harvest by Craig residents in 1997 (ADF&G 2014).

Craig residents harvest deer almost entirely on Prince of Wales and adjacent islands, which are included in GMU 2. Following a deer population decline 2006-2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Craig residents, total annual deer harvest in 2013 was about double the 2004 harvest level (380 more deer) (ADF&G 2015b).

Deer harvest by Craig residents is spread over many WAAs, but the majority (55 percent) of their deer are harvested from six WAAs in central and northern Prince of Wales Island (the top six WAAs in Table 3.23-15). The Craig portion of the harvest in these six WAAs represents about one-third of the total harvest and about one-half of the rural hunter harvest (Table 3.23-15). About 32 percent of the combined harvest in these WAAs is by non-rural hunters, indicating that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

The majority of the WAAs used heavily by Craig residents are in areas with substantial past timber harvest and deer habitat capabilities are currently estimated to be below 1954 levels (Table 3.23-15). Under each of the alternatives, additional harvest would reduce habitat capabilities by 1 to 8 percent after 100 years, except for two WAAs where there would be no effect (0902 and 1107). Reductions would be broadly similar across all alternatives.

Table 3.23-15
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Craig Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

WAA	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
	Craig Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1422	106	247	383	57%	50%	52%	51%	50%	50%
1318	70	159	198	90%	83%	85%	84%	84%	84%
1214	60	120	235	77%	71%	72%	71%	72%	71%
1332	56	67	76	88%	87%	88%	87%	87%	87%
0902	55	65	82	100%	100%	100%	100%	100%	100%
1317	51	93	133	58%	56%	56%	56%	56%	56%
0901	43	56	66	95%	91%	95%	93%	92%	93%
1319	40	169	226	74%	67%	67%	69%	69%	69%
1107	30	99	130	99%	99%	99%	99%	99%	99%
1315	29	201	317	56%	50%	51%	50%	51%	50%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 Alternatives should be able to provide sufficient habitat capability in both the short and long terms for deer hunted by Craig residents. All of the 1997 Alternatives included substantially higher levels of timber harvest in Craig's community use area than the alternatives considered in this EIS (approximately 107 to 325 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability for deer hunted by Craig residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all rural hunters in the long term and for all hunters in both the short and long terms. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Craig residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Craig's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Edna Bay

Affected Environment

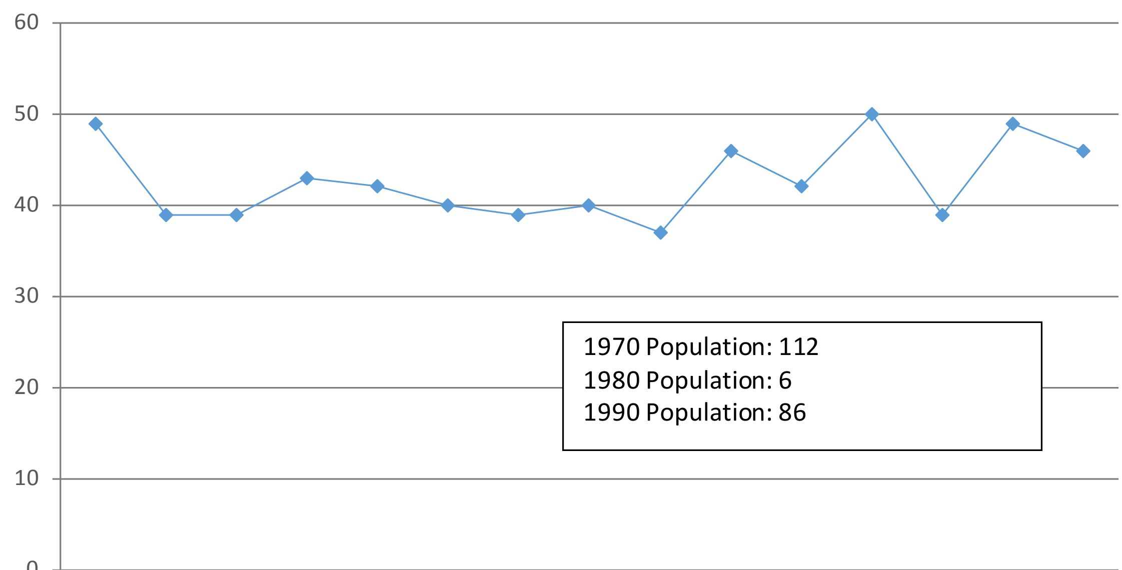
Overview and Demographic Characteristics
Edna Bay is located on southeast Kosciusko Island, west of Prince of Wales Island, and north of Sea Otter Sound. Originally, Tlingit Indians from west Prince of Wales Island used Edna Bay on a seasonal basis. In 1943, a logging camp was established when the demand for aircraft-quality spruce was high. The camp closed in the late 1960s and the buildings were burned and the site cleaned. In 1977, the State selected part of the Tongass National Forest at Edna

Bay, with the USDA Forest Service reserving two administrative sites. In 1982, the State sold several lots around Edna Bay to private landowners. A small community developed as families, mainly those involved in commercial fishing, moved to Edna Bay. A school was constructed and a road connecting dispersed segments of the community was completed (ADF&G 1994).

Edna Bay remains an unincorporated city. The community has an active local Fish and Game Advisory Committee and has shown a strong commitment to protecting local commercial fishing and subsistence resources (ADF&G 1994, 2015). Edna Bay is accessible by water or by float plane from Ketchikan. Most households own skiffs for transportation around the bay and to other near shore areas not accessible by road (ADF&G 1994).

Edna Bay's population fluctuated a great deal between 1970 and 1990, primarily due to the transition away from timber harvesting as a main economic activity (Himes-Cornell et al. 2013). By 2000, the population had decreased again, by about 40 percent, and has since remained relatively consistant (Figure 3.23-12). According to the 2010 Census, Edna Bay had a population of 42, with no Alaska Native population (Table 3.23-8). Total estimated population was 46 in Edna Bay in 2014 (Figure 3.23-12). The Edna Bay School has struggled to maintain the required minimum of 10 students and was not open in 2014 (Table 3.23-9).

Figure 3.23-12
Edna Bay Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Edna Bay	49	39	39	43	42	40	39	40	37	46	42	50	39	49	46

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Edna Bay is characterized by its fishing and subsistence culture (Himes-Cornell et al. 2013). The majority of employment in Edna Bay is provided by commercial fishing, construction, the local school district, and one local sawmill. Many residents are self-employed (Himes-Cornell et al. 2013). In 2013, 11 residents held commercial fishing licences, primarily used for halibut and salmon. Estimated gross income for these two fisheries that year was over $115,000 (ACFEC 2015).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Due to method limitations of the ACS, no data were available for the 2013 unemployment rate or median household income. State data indicate that there were seven unemployment insurance claimants in 2013, and annual wages among workers ranged from under $5,000 (4 residents) to over $50,000 (5 residents) (Alaska DOL 2015f).

Edna Bay has no central utility system and residents rely upon individual generators.

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	2	13
Construction	4	27
Manufacturing	2	13
Trade, Transportation and Utilities	0	0
Information	1	7
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	1	7
Leisure and Hospitality	0	0
State Government	0	0
Local Government	5	33
Other	0	0
Unknown	0	0
Total Employment	**15**	**100**

Source: Alaska DOL 2015d

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Edna Bay in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-13. This area contains 665,386 acres of NFS land (among other land ownerships). Table 3.23-16 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 7.8 percent of the Edna Bay community use area under Alternative 1 to 10.7 percent under Alternative 2. Harvest activities could have localized effects if they coincide with an area favored by Edna Bay residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old growth harvest in this area (see Table 3.23-16).

Economy

Edna Bay is primarily a commercial fishing and subsistence community. Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources accounted for 59 percent of the total edible pounds of subsistence resources harvested by Edna Bay households based on the 1998 TRUCS study (Kruse and Frazier

1988). Marine resources (fish and marine invertebrates) accounted for 67 percent of per capita subsistence harvest in Edna Bay in 1998 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 21 percent of the total edible pounds of subsistence resources harvested by Edna Bay households (Kruse and Frazier 1988). Deer accounted for 23 percent of per capita subsistence harvest by Edna Bay residents in 1998 (ADF&G 2014).

Four WAAs have been identified as most important to Edna Bay residents for deer harvest (Table 3.23-17). About 68 percent of Edna Bay's harvest is derived from the first two WAAs, which are included in GMU 2. Following a deer population decline from 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Edna Bay residents, total annual deer harvest was 36 percent higher (9 more deer) in 2013 than in 2004 (ADF&G 2015b).

Residents of Edna Bay are responsible for the majority (79 percent) of the deer harvested on Kosciusko Island (WAA 1525), but only a small portion of the deer harvested on Heceta Island (WAA 1003) and in other WAAs. As shown in Table 3.23-17, the Edna Bay portion represents about 8 percent of the total harvest and about 11 percent of the rural hunter harvest in these WAAs. About 23 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Figure 3.23-13
Edna Bay's Community Use Area

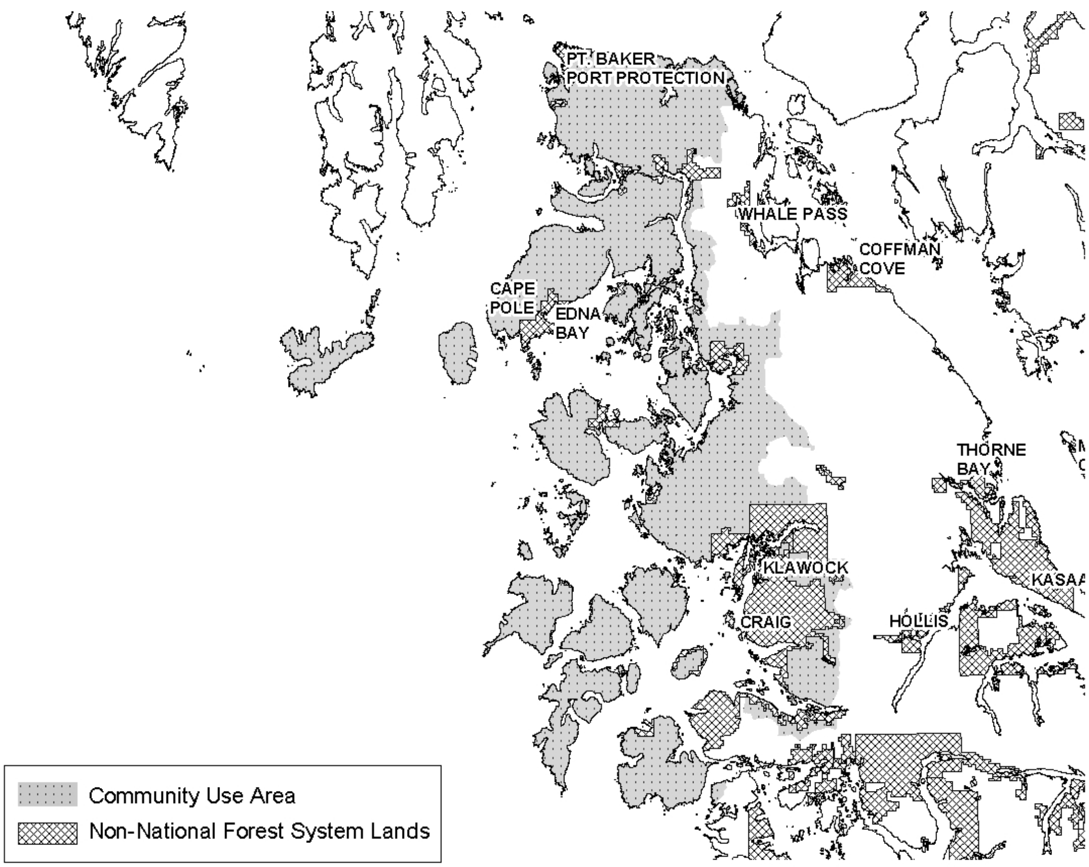


Table 3.23-16
Estimated Maximum Harvest (acres) over 100 Years in Edna Bay's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	41,562	63,836	61,246	50,101	53,223
Old Growth	7,955	3,873	4,261	6,125	5,880
Total	**49,517**	**67,709**	**65,507**	**56,226**	**59,103**
Harvest as a Percent of Total NFS Lands in the Community Use Area	7.8%	10.7%	10.4%	8.9%	9.3%

Table 3.23-17
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Edna Bay Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013[2]			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	**Edna Bay Residents**	**All Rural Hunters[3]**	**All Hunters**	**2014**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**
1525	18	18	18	59%	58%	58%	58%	57%	58%
1003	3	28	44	59%	55%	58%	58%	54%	55%
1318	1	159	198	90%	83%	85%	84%	84%	84%
1526	1	9	18	91%	91%	91%	91%	91%	91%

[1] Calculated based on harvest where location is known.
[2] 2004 and 2006 data not available for Edna Bay residents.
[3] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding Juneau and Ketchikan.

The two WAAs used most heavily by Edna Bay residents are in areas with substantial past timber harvest and deer habitat capabilities are currently estimated to be considerably below 1954 levels (Table 3.23-17). The next two important WAAs have been less affected by past harvest, though are still under 1954 levels. Under each of the alternatives, additional harvest would further reduce habitat capabilities in three of the four WAAs, by 1 to 7 percent (Table 3.23-17). Reductions would be broadly similar across alternatives.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all of the alternatives should be able to provide habitat capability for deer hunted by Edna Bay residents, all rural hunters, and all hunters, within the WAAs where Edna Bay hunters derive most of their deer harvest. As all of the 1997 alternatives proposed substantially higher levels of harvest in Edna Bay's community use area (approximately 95 to 318 percent higher) than currently under consideration, all alternatives in this EIS should be able to provide habitat capability for deer hunted by Edna Bay residents, as well as for all deer hunted within the WAAs.

In summary, use of most subsistence resources by Edna Bay residents (fish and marine resources) is not expected to be affected under any of the alternatives. In addition, subsistence use of deer by Edna Bay households is unlikely to be directly affected by any of the alternatives. Future young-growth management (e.g., thinning) would further reduce the potential for effects on local hunters. It is possible, however, that additional timber harvest throughout Prince of Wales and adjacent islands would create increased competition for deer within Edna Bay's subsistence use areas if hunters from other communities were displaced due to timber harvest activity. These impacts are estimated to be relatively minor based on the limited accessibility of these island areas to non-local hunters.

Elfin Cove

Affected Environment

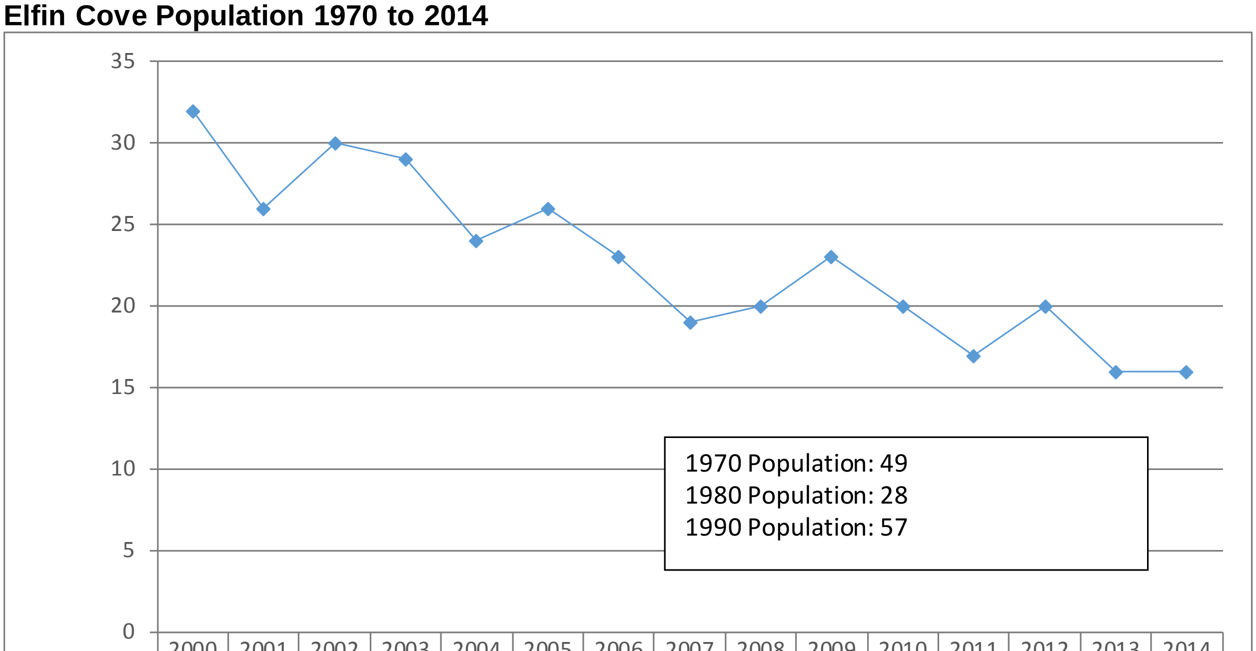
Overview and Demographic Characteristics

Elfin Cove is an unincorporated small fishing town located on northwest Chichagof Island, accessible by floatplane from Juneau. Prior to its development as a community, Native Tlingit groups, now based largely in Hoonah, used the Elfin Cove area for hunting, fishing, and gathering, as well as a safe harbor.

A fish buyer established a business here in 1927. The opening of a cold storage plant at Pelican, less than 20 miles from Elfin Cove in Lisianski Inlet, meant that fish no longer had to be hauled all the way to Juneau. Today, the cove still serves as a key stopover and supply center for fishermen and the year-round community is made up largely of fishing households. The community has a local Fish and Game Advisory Committee, however it is currently inactive (ADF&G 2015a).

The population fluctuated between 1970 and 1990, and has since been in decline (Figure 3.23-14). According to the 2010 Census, Elfin Cove had a population of 20, one of whom was an Alaska Native (Table 3.23-8). As of 2014, an estimated 16 residents live in Elfin Cove (Figure 3.23-14). The school closed in 1999 and any school age children resident in the community are homeschooled (Alexander et al. 2010).

Figure 3.23-14
Elfin Cove Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Elfin Cove	32	26	30	29	24	26	23	19	20	23	20	17	20	16	16

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The economy of Elfin Cove is highly seasonal and primarily based on the fishing industry. It is a fish buying and supply center for fishermen and residents participate in commercial fishing, sport fishing, and charter services (Himes-Cornell et al. 2013). In 2013, there were 24 commercial fishing permit holders who self-identified as Elfin Cove residents[2], earning an estimated gross $1.6 million primarily from salmon and halibut fisheries (ACFEC 2015). No timber resources are harvested commercially in the area (Himes-Cornell et al. 2013).

A study of nature-based tourism in Southeast Alaska found that although Elfin Cove had been dependent on the commercial fishing industry for decades, the focus of the town's economy has shifted toward tourism and sportfishing (Dugan et al. 2009). In 2005, 1,528 people visited Elfin Cove bringing in nearly $5 million in revenue. This study also found that the community's population ranged from 12 in the winter to 200 in the summer, with much of the summer increase associated with employment in nine sport fishing lodges. The study estimated that 54 people, almost all non-residents, were employed by these lodges during the summer. Small cruise ships, mostly carrying 60 to 70 passengers, dock at Elfin Cove, with 30 dockings in 2005 (Dugan et al. 2009). Permanent residents have noted that the community does not benefit to the extent it could if more tourism businesses were owned and operated by locals (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 32 percent of the labor force in Elfin Cove was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $43,125, compared to the state median of $70,760; the corresponding median for the Hoonah-Angoon CA was $49,545 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	0	0
Construction	0	0
Manufacturing	0	0
Trade, Transportation and Utilities	10	71
Information	0	0
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	0	0
Leisure and Hospitality	0	0
State Government	3	21
Local Government	1	7
Other	0	0
Unknown	0	0
Total Employment	**14**	**100**

Source: Alaska DOL 2015d

Elfin Cove has a central electric utility system that relies on diesel generation with the highest electric rates in the region. Residential rates for 2011 before and after the application of PCE payments were 75 cents/kWh and 36 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 75 cents/kWh and 73 cents/kWh, respectively. The Community of Elfin Cove filed a Notice of Intent to File a License Application

[2] The permit holders' city of residence is as reported on ACFEC licensing forms. It is likely that people living in remote areas in the vicinity of Elfin Cove also list it as their city of residence (or have a Post Office box in town).

for the Crooked Creek and Jim's Lake Hydroelectric Project with the Federal Energy Regulatory Commision in February 2015. The proposed project located about one mile from the community would have an installed capacity of 10 MW or less. The project site is located in a Semi-Remote Recreation LUD and Inventoried Roadless Area 311.

Potential Effects

Community Use Area

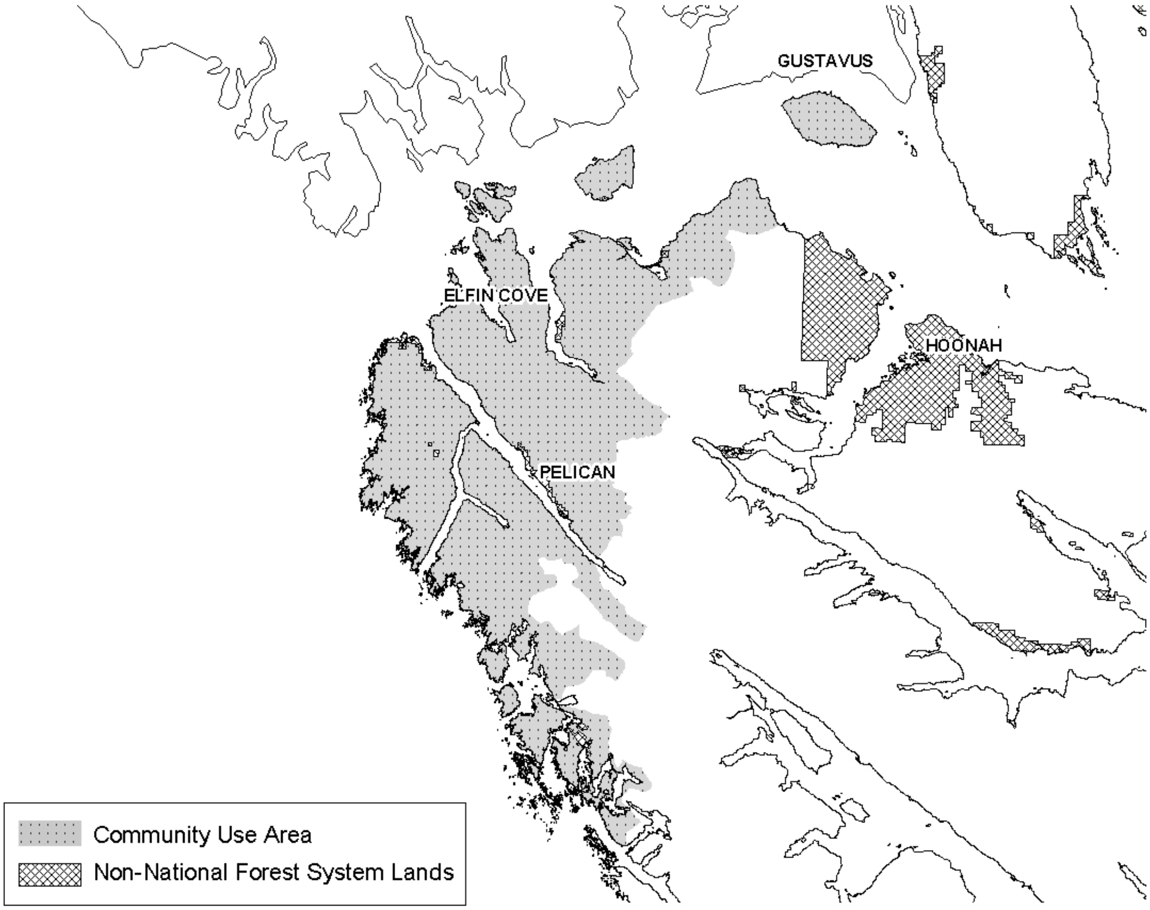
The general area commonly used or related to by many of the residents of Elfin Cove in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-15. This area contains 357,385 acres of NFS land (among other land ownerships). No young-growth or old-growth harvest is projected to take place in the community use area for Elfin Cove over the next 100 years under any alternative; therefore no timber-harvest-related effects to this area are expected.

Economy

Commercial fishing, recreation and tourism, and subsistence use are important to Elfin Cove. The acreage in the Elfin Cove community use area is either Wilderness or natural setting LUD allocations. Local timber harvest is not a significant part of the local economy. Employment in the commercial fishing sector is not expected to be affected under any of the alternatives. Tourism, especially sportfishing, is becoming increasingly important to Elfin Cove. A number of lodges operate out of the community. Recreation and tourism based on sportfishing is expected to increase by the same amount under all of the alternatives.

The proposed Crooked Creek and Jim's Lake Hydroelectric Project is located in a Semi-Remote Recreation LUD and Inventoried Roadless Area 311. Semi-Remote Recreation is considered a Transportation and Utility System (TUS) "window" under the 2008 Forest Plan, an area potentially available for the location of transportation or utility corridors and sites. This classification and the standards and guidelines in the current Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, energy projects would be managed under theRenewable Energy Plan Components identified in Chapter 5 of the proposed Forest Plan amendment.

Figure 3.23-15
Elfin Cove's Community Use Area



Subsistence
No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources accounted for 63 percent of the total edible pounds of subsistence resources harvested by Elfin Cove households based on the 1988 TRUCS study (Kruse and Frazier 1988). The 1988 TRUCS study found that deer accounted for 27 percent of the total edible pounds of subsistence resources harvested by Elfin Cove households (Kruse and Frazier 1988).

The WAAs used by Elfin Cove residents for hunting deer lie within GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). However, deer harvest by Elfin Cove residents has generally declined over the past decade, with about 51 percent lower total annual harvest (or 20 fewer deer) in 2013 than in 2004 (ADF&G 2015b).

Elfin Cove residents take the majority (82 percent) of their deer from two WAAs (3421 and 3420). As shown in Table 3.23-18, these WAAs would not be affected by any of the alternatives as no timber harvest is proposed in these areas. It is also unlikely that Elfin Cove residents would be affected by increased competition because of the limited access and the lack of activities under the alternatives in this area.

Table 3.23-18
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Elfin Cove Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Elfin Cove Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3421	13	42	66	100%	100%	100%	100%	100%	100%
3420	2	19	52	100%	100%	100%	100%	100%	100%

[1] Calculated based on harvest where location is known.
[2] The category “All Rural Hunters” includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Gustavus

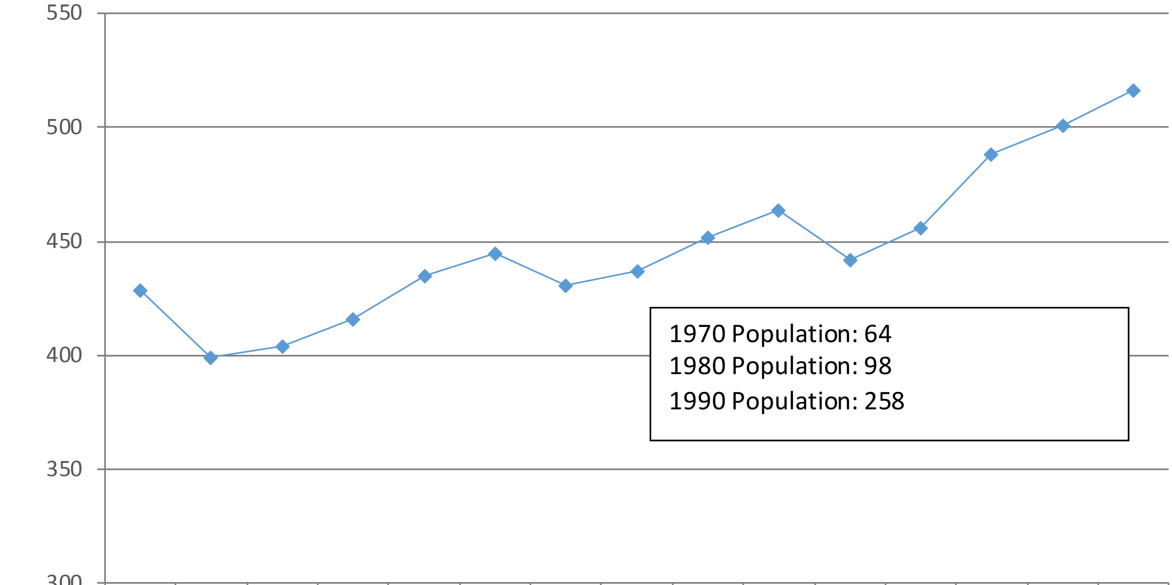
Affected Environment

Overview and Demographic Characteristics
Gustavus is located in northern Southeast Alaska on the north shore of Icy Straits, east of the entrance to Glacier Bay. Prior to the founding of the present community, Huna Tlingit used the land and resources in the immediate vicinity of the community site. Use of a salmon camp near the mouth of the Salmon River was noted by early Gustavus settlers; however, after a short period of settlement by the new community, the Huna Tlingit generally discontinued use of the camp (ADF&G 1994).

Gustavus was settled and named “Strawberry Point” in 1914 by a small group of immigrants from the lower 48 planning to develop the land as agricultural homesteads. World War II brought development to Gustavus in the form of an airstrip and Federal Aviation Administration communications facilities. Nearby Glacier Bay National Monument was established in 1925, and became a National Park in 1980 (ADF&G 1994; Himes-Cornell et al. 2013). The City of Gustavus was incorporated as a second-class city in 2004.

The population of Gustavus quadrupled between 1970 and 1990 (primarily after the establishment of the National Park), and increased by 66 percent between 1990 and 2000 (Figure 3.23-16). The community has continued to grow since 2000, with an estimated total population of 516 in 2014 (Alaska DOL 2015b). According to the 2010 Census, Alaska Natives comprised 3 percent of the total population (Table 3.23-8). A total of 65 students were enrolled in the Gustavus School in 2014, up from 48 students in 2000 (Table 3.23-9).

Figure 3.23-16
Gustavus Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gustavus	429	399	404	416	435	445	431	437	452	464	442	456	488	501	516

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Gustavus is known as a "Gateway to Glacier Bay National Park," which contributes to its highly seasonal local economy (Himes-Cornell et al. 2013). The park and its lodge attract tourists and recreation enthusiasts during the summer months with the population doubling during the visitor season. Gustavus has many seasonal homes for residents of Juneau (Alexander et al. 2010).

In 2013, 35 residents held commercial fishing permits and earned an estimated gross $1.3 million from salmon and halibut fisheries (ACFEC 2015). In addition, many local residents practice subsistence harvest (Himes-Cornell et al. 2013). Several lodges and bed and breakfasts, an airport, school, small businesses, and the Park Service are primary employers of local residents (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 7 percent of the labor force in Gustavus was identified as unemployed and seeking work in 2010, similar to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $52,188, compared to the state median of $70,760; the corresponding median for the Hoonah-Angoon CA was $49,545 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	4	3
Construction	18	12
Manufacturing	0	0
Trade, Transportation and Utilities	51	34
Information	1	1
Financial Activities	3	2
Professional and Business Services	3	2
Educational and Health Services	6	4

Employment by Industry in 2013	Number	Percent of Total
Leisure and Hospitality	13	9
State Government	11	7
Local Government	32	22
Other	2	1
Unknown	5	3
Total Employment	**149**	**100**
Source: Alaska DOL 2015d		

The Gustavus Electric Company provides electricity to Gustavus, operating a diesel powerhouse, with electricity also generated by the Falls Creek Hydroelectric Facility, which was completed in 2009. Residential rates for 2011 before and after the application of PCE payments were 45 cents/kWh and 28 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 45 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Gustavus in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-17. This area contains 480,541 acres of NFS land (among other land ownerships). Table 3.23-19 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest areas represent a small portion of the community use area for Gustavus, ranging from 1.4 percent (Alternative 4) to 2.5 percent (Alternatives 2 and 5). Harvest activities could have localized effects if they coincide with an area favored by Gustavus residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 5; however, it may be noted that Alternative 1 (which would have less potential total suitable harvest compared to Alternatives 2 and 5) would have the largest potential old growth harvest in this area (see Table 3.23-19).

Economy

Gustavus is a small community located near Glacier Bay National Park. Recreation and tourism are important to Gustavus, especially in relation to use of the National Park. Commercial fishing and subsistence use are also important to the community. These uses are not expected to be affected under any of the alternatives.

Figure 3.23-17
Gustavus' Community Use Area

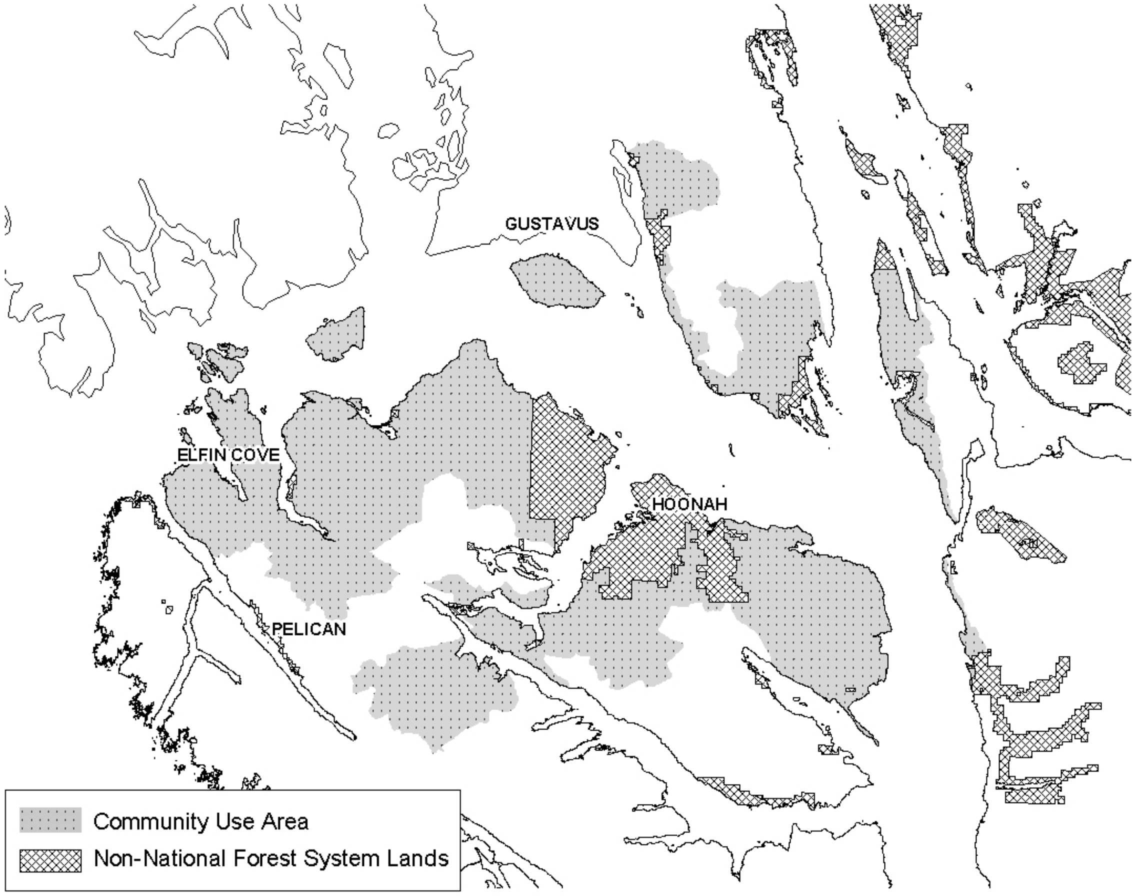


Table 3.23-19
Estimated Maximum Harvest (acres) over 100 Years in Gustavus' Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	4,964	10,257	9,514	4,789	9,385
Old Growth	3,325	1,612	1,888	2,210	2,589
Total	**8,289**	**11,869**	**11,403**	**6,999**	**11,975**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.7%	2.5%	2.4%	1.4%	2.5%

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. Marine resources (fish and marine invertebrates) accounted for 69 percent of per capita subsistence harvest in Gustavus in 1987 (Kruse and Frazier 1988).

The 1988 TRUCS study found that deer accounted for 70 percent of the total edible pounds of subsistence resources harvested by Gustavus households (Kruse and Frazier 1988).

The primary WAAs used by Gustavus residents for hunting deer lie within GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Gustavus residents, total annual deer harvest appears to have followed a corresponding pattern, with a dip following 2006 and increasing in recent years. In 2013, total annual deer harvest by Gustavus residents was 23 percent higher (19 more deer) than in 2004 (ADF&G 2015b).

Gustavus residents take the majority (73 percent) of their deer from two WAAs on northern Chichagof Island and Pleasant, Lemesurier, and Inian Islands (4256 and 4222). As shown in Table 3.23-20, WAA 4256, which provides over half of Gustavus' harvest, would not be affected by any of the alternatives because it is in wilderness. WAA 4222 would be affected by timber harvest, further reducing habitat capability by one percent under all alternatives (Table 3.23-20).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all of the alternatives should be able to provide habitat capability for deer hunted by Gustavus residents, all rural hunters, and all hunters within the WAAs where Gustavus hunters derive most of their deer harvest in the short term. In the long term, sufficient habitat would be provided for Gustavus residents and all rural hunters, but not for all hunters. The predicted deficit for all hunters in the long term would be a natural condition, but would occur earlier with timber harvest in the area. All 1997 alternatives included substantially higher levels of timber harvest in Gustavus' community use area than the alternatives considered in this EIS (over twice to 16 times as high). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability for Gustavus residents and all rural hunters, though all hunters may still face a deficit depending on how conditions change independent from proposed timber harvest. This may lead to some restriction in hunting by non-rural hunters over the long term.

Table 3.23-20
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Gustavus Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Gustavus Residents	All Rural Hunters[2/]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
4256	47	52	68	100%	100%	100%	100%	100%	100%
4222	10	32	44	97%	96%	96%	96%	96%	96%

[1/]Calculated based on harvest where location is known.

[2/]The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

In summary, use of most subsistence resources (fish and marine invertebrates) by Gustavus residents is not expected to be affected under any of the alternatives. In addition, while subsistence use of deer by Gustavus households is not likely to be affected, overall subsistence use of deer in the primary WAAs used by Gustavus residents may be slightly affected to the point that some restriction in hunting by non-rural hunters might be necessary over the long term, under all alternatives. It is also unlikely that Gustavus residents would be affected by increased competition because of the limited access and the lack of activities under the alternatives in this area.

Haines

Affected Environment

Overview and Demographic Characteristics

Haines is located in the northern portion of Southeast Alaska, near the north end of Lynn Canal on the Chilkat Peninsula. Haines is one of three Southeast communities connected by road to Canada. According to the 2010 Census, Haines had a population of 1,713 with Alaska Natives comprising 11 percent of the total (U.S. Census Bureau 2011).

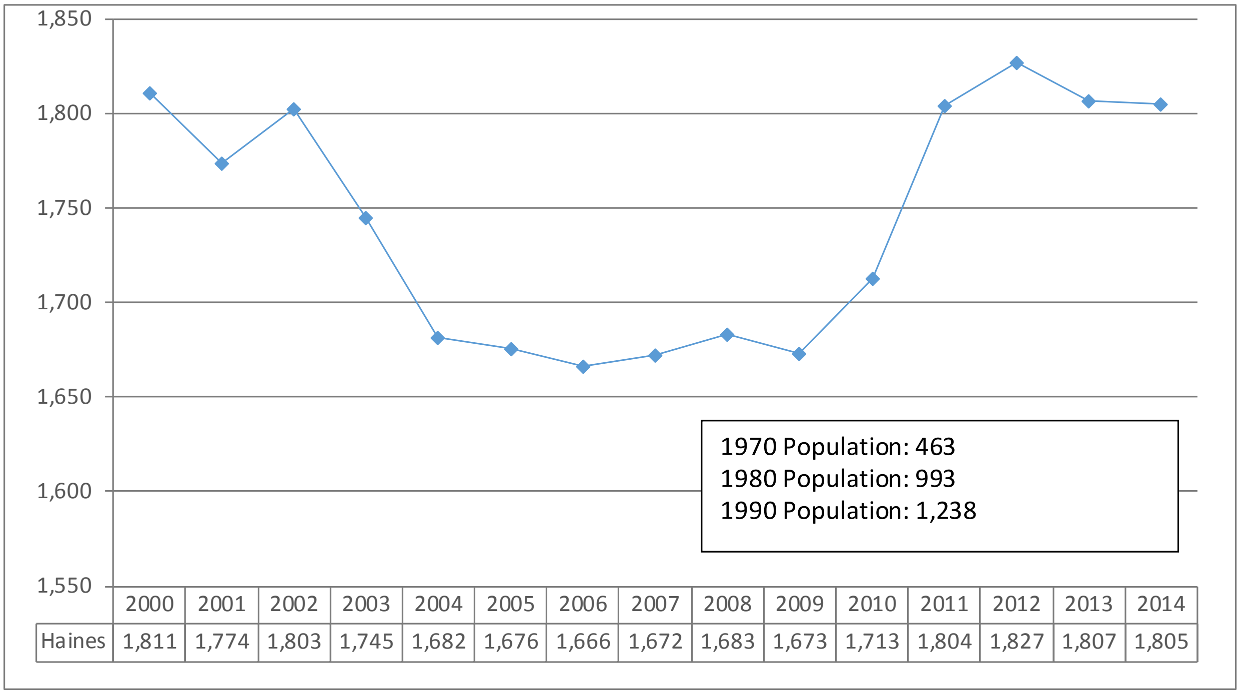
The Haines area was originally settled by the Chilkat Tlingits. The Chilkat Tlingits are now considered as two groups: the Chilkats of the Chilkat River, with Klukwan being the major population center, and the Chilkoots living in and near Haines. Haines itself was a trade center and mission site (ADF&G 1994). Klukwan, a Chilkat Indian Village near the Chilkat River and 22 miles north of Haines, had an estimated population of 84 in 2014. The village is known for its woven artwork of cedar bark and mountain goat hair. The area is host to the largest concentration of bald eagles in the world during the fall and winter at the nearby Chilkat Bald Eagle Reserve. Klukwan is located in the Hoonah-Angoon CA.

Settlement did not concentrate in Haines until the late 1800s. The commercial fishing industry located several canneries in the Chilkat Inlet area near Haines beginning in 1882; the Klondike gold rush brought thousands of prospectors to the town in the late 1890s; and the Dalton Trail was established as an open access route into the interior in the 1890s. Haines incorporated as a city in 1910 and as a third class borough in 1968 (ADF&G 1994). The community participates as the majority member of the Upper Lynn Canal Fish and Game Advisory Committee (ADF&G 2015a).

Haines is a major trans-shipment point because of its ice-free, deep-water port and dock, and year-round road access to Canada and Interior Alaska on the Alaska Highway. It is a northern terminus of the Alaska Marine Highway System and a hub for transportation to and from Southeast Alaska (Alaska DCED 2006).

The population of Haines increased steadily between 1970 and 2000, increasing almost threefold, with a net gain of 1,348 residents (Figure 3.23-18). Population has fluctuated since 2000, dropping to a low of 1,666 residents in 2006. Total estimated population was 1,805 in Haines in 2014 (Alaska DOL 2015b). School district enrollment has declined, dropping from 470 students in 1990 to 276 students in 2014 (Table 3.23-9).

Figure 3.23-18
Haines Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The economy of Haines is highly seasonal, based primarily on the commercial fishing and tourism industries (Himes-Cornell et al. 2013). Government, construction, and transportation are also important sectors for the community. Estimated gross fishing earnings of local residents neared $7 million in 2013 and 110 residents hold commercial fishing permits (ACFEC 2015). In 2001, Royal Caribbean Cruise Lines ceased serving Haines as a port of call. Still, around 45,000 cruise ship passengers visit each year, as well as many independent travelers through the Alaska Marine Highway System and by land along Haines Highway (Himes-Cornell et al. 2013).

Employment by industry data, as compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 5 percent of the labor force in Haines was identified as unemployed and seeking work in 2010, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $54,267, compared to the state median of $70,760; the corresponding median for the Haines Borough was $52,866 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	35	5
Construction	44	6
Manufacturing	14	2
Trade, Transportation and Utilities	169	22
Information	10	1
Financial Activities	15	2
Professional and Business Services	28	4
Educational and Health Services	94	12
Leisure and Hospitality	115	15
State Government	65	9

Employment by Industry in 2013	Number	Percent of Total
Local Government	152	20
Other	17	2
Unknown	2	< 1
Total Employment	**760**	**100**
Source: Alaska DOL 2015d		

Haines is part of an AP&T system that connects Haines and Skagway in the Upper Lynn Canal Region, and is connected via an intertie to the existing Inside Passage Electric Cooperative system that serves Klukwan and Chilkat Valley. The existing AP&T Goat Lake hydropower project is the main source of power for Haines (Table 3.12b-2). Residential rates for 2011 before and after the application of PCE payments were 22 cents/kWh and 15 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 22 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of the Haines Borough in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-19. This area contains 232,496 acres of NFS land (among other land ownerships). Table 3.23-20 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Harvest areas represent a very small portion of the community use area for Haines, ranging from less than 0.1 percent (Alternative 4) to 0.5 percent (Alternative 2). Harvest activities could have localized effects if they coincide with an area favored by Haines residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber harvest.

Figure 3.23-19
Haines' Community Use Area

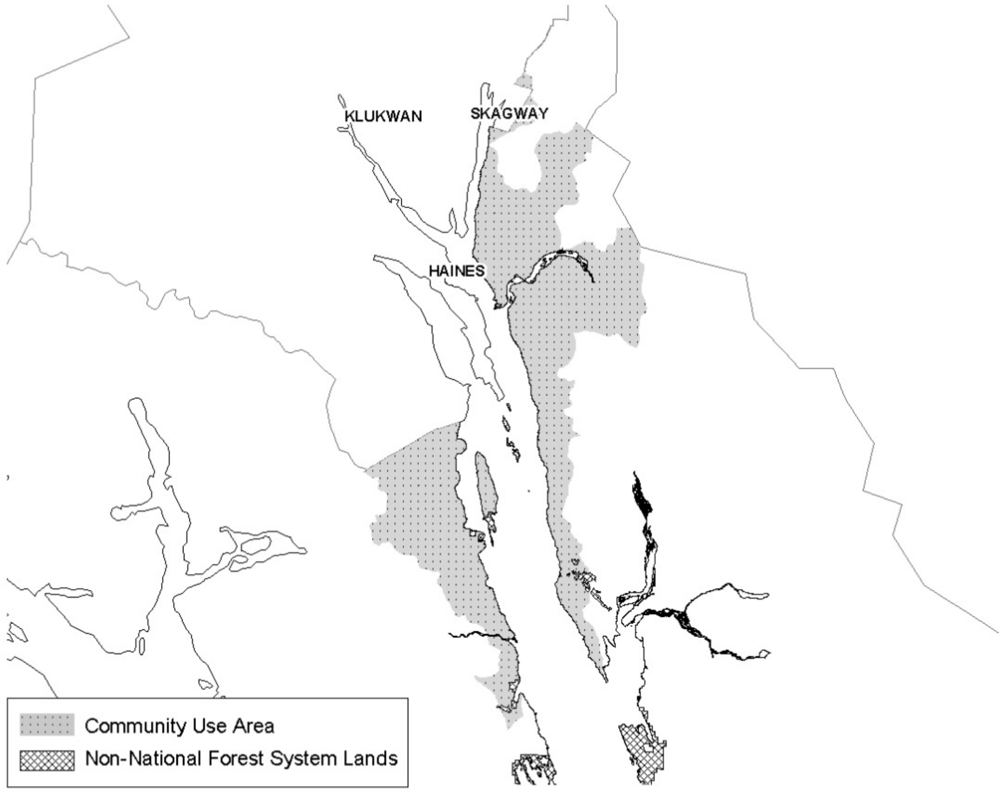


Table 3.23-21
Estimated Maximum Harvest (acres) over 100 Years in Haines' Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	219	1,223	921	23	1,126
Old Growth	121	59	0	0	0
Total	**340**	**1,282**	**921**	**23**	**1,126**
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.14%	0.54%	0.39%	0.01%	0.48%

Economy
Commercial fishing, recreation and tourism, and subsistence use are important to Haines. Haines has an Alaska Marine Highway System ferry terminal and provides road access into Interior Alaska. Although timber harvest on State land and wood processing were historically a major sector of the Haines economy, wood products employment accounted for less than 10 jobs in Haines in 2012 (see Figure 3.23-5). Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

Subsistence
No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for

68 percent of the total edible pounds of subsistence resources harvested by Haines' households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 72 percent of per capita subsistence harvest in Haines in 2012 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 15 percent of the total edible pounds of subsistence resources harvested by Haines households (Kruse and Frazier 1988). Deer accounted for 5 percent of per capita subsistence harvest by Haines residents in 2012, with moose more important at 11 percent per capita (ADF&G 2014). Moose availability would not be significantly affected under any of the alternatives.

Haines residents mainly harvest deer in GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Haines residents, total annual deer harvest has fluctuated over the past decade and in 2013 was about 26 percent lower (57 fewer deer) than in 2004 (ADF&G 2015b).

Twenty-three WAAs account for about 75 percent of deer harvest by Haines residents. The three most heavily used WAAs—3421, 2202, and 3836—accounted for about 28 percent of total deer harvest by Haines residents. As these numbers suggest, deer harvest by Haines residents is spread over a fairly wide area in GMU 4 (Table 3.23-22). As a result, Haines residents tend to comprise a relatively small share of total harvest by WAA, with one main exception—WAA 2202 on Sullivan Island, which has a low level of deer harvest but nearly all by Haines residents.

In 17 of the 23 WAAs, there would be no effect to deer habitat capability under any of the alternatives. Reductions in habitat capability in the eight affected WAAs would range from 1 to 8 percent, and would be similar under each alternative (Table 3.23-22). About 41 percent of the combined harvest in the 23 WAAs used by Haines residents is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Table 3.23-22
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Haines Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Haines Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3421	20	42	66	68%	62%	64%	63%	63%	63%
2202	18	18	18	91%	91%	91%	91%	91%	91%
3836	10	16	210	100%	100%	100%	100%	100%	100%
4252	9	51	72	92%	92%	92%	92%	92%	92%
3420	9	19	52	100%	100%	100%	100%	100%	100%
3938	7	41	75	100%	100%	100%	100%	100%	100%
1106	7	17	33	100%	100%	100%	100%	100%	100%
3416	6	78	88	100%	100%	100%	100%	100%	100%
4222	5	32	44	97%	96%	96%	96%	96%	96%
3524	5	51	82	99%	93%	98%	89%	97%	98%
3418	4	18	26	100%	100%	100%	100%	100%	100%
4253	3	48	66	84%	84%	84%	84%	83%	84%
3417	3	60	115	100%	100%	100%	100%	100%	100%
3525	3	56	118	75%	68%	70%	71%	70%	70%
4256	3	52	68	100%	100%	100%	100%	100%	100%
3002	3	272	299	69%	69%	72%	69%	69%	69%
3001	2	338	361	82%	82%	82%	82%	82%	82%
4041	2	16	19	91%	91%	91%	91%	91%	91%
2722	2	6	302	100%	100%	100%	100%	100%	100%
3309	2	72	81	100%	100%	100%	100%	100%	100%
3551	2	48	67	83%	75%	78%	75%	76%	77%
4146	2	4	28	100%	100%	100%	100%	100%	100%
3419	2	23	40	100%	100%	100%	100%	100%	100%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 Alternatives should be able to provide sufficient habitat capability for deer hunted in the Haines community use area by Haines residents, all rural hunters, and all hunters in the short term, and for Haines residents in the long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Haines' community use area than the alternatives considered in this EIS (5 to over 1,000 times as high). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long term for deer hunted by Haines residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all rural hunters and all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Haines residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer in some of the WAAs hunted by Haines residents may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Haine's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Hollis

Affected Environment

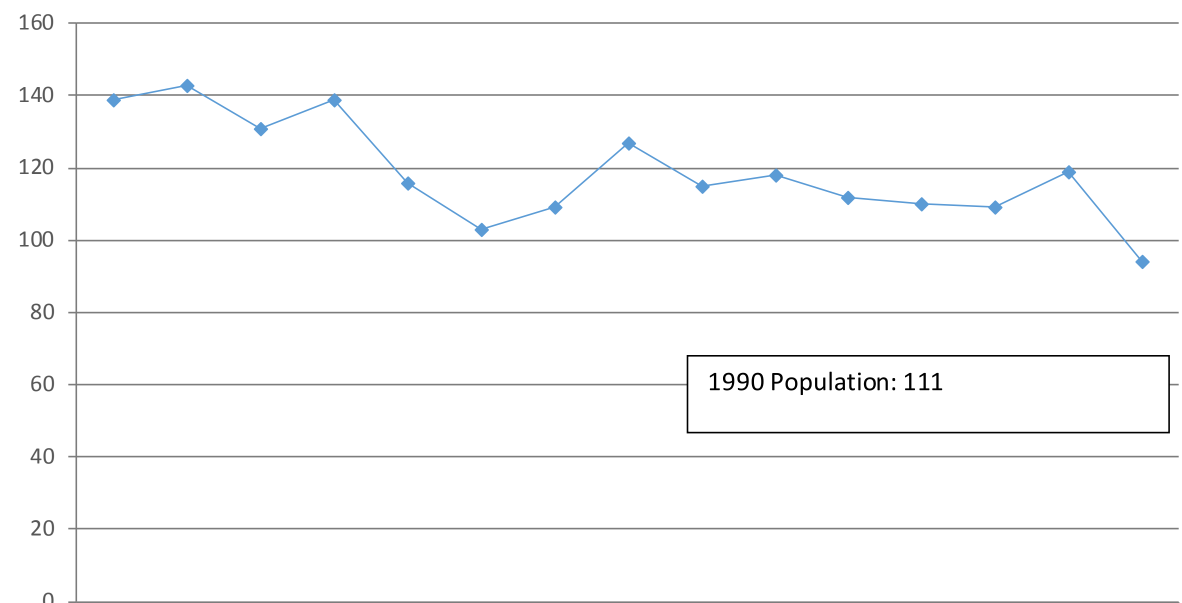
Overview and Demographic Characteristics

Hollis is located on east Prince of Wales Island, 19 miles east of Craig. According to the 2010 Census, Hollis had a population of 112, with Alaska Natives comprising 4 percent of the total (U.S. Census Bureau 2011).

Hollis, initially settled as a mining camp at the turn of the century, developed into a logging camp in the mid-1950s. In 1960, when Thorne Bay became center of the logging industry on central Prince of Wales Island, most Hollis residents moved to Thorne Bay. Hollis grew as a community during the 1990s, due in part to an Alaska Marine Highway terminal there. The Inter-Island Ferry Authority provides daily ferry service between Ketchikan and Hollis. Roads now connect Hollis with most other communities on Prince of Wales Island. A State land sale at Hollis in 1980 led to its present status as a permanent community (ADF&G 1994).

The population of Hollis increased by 28 people or 25 percent between 1990 and 2000. Peaking at 143 residents in 2001, the population of Hollis has since fluctuated, while generally trending downward (Figure 3.23-20). Total estimated population in Hollis was 94 in 2014 (Alaska DOL 2015b). School enrollment has remained relatively constant, with 14 students enrolled in 2014 (Table 3.23-9).

Figure 3.23-20
Hollis Population 1990 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hollis	139	143	131	139	116	103	109	127	115	118	112	110	109	119	94

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Support services for the timber industry, the ferry authority, the Forest Service, and local government provide the majority of employment to the residents of Hollis. While the timber industry is prevalent on the Prince of Wales Island, it does not occur directly in the Hollis community (Alaska DCED 2002). Viking Lumber, the largest sawmill presently operating in the region, is located nearby between Craig and Klawock. According to the 2013 mill survey conducted for the Forest Service, this mill, which has an installed production capacity of 80 MMBF, processed approximately 15 MMBF in 2013 and employed 34 people (Parrent and Grewe 2014).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 33 percent of the labor force in Hollis was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $33,500, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	6	11
Construction	4	7
Manufacturing	3	5
Trade, Transportation and Utilities	13	23
Information	0	0
Financial Activities	1	2
Professional and Business Services	1	2
Educational and Health Services	3	5
Leisure and Hospitality	6	11
State Government	5	9
Local Government	14	25
Other	1	2
Unknown	0	0
Total Employment	**57**	**100**

Source: Alaska DOL 2015d

Hollis is part of the AP&T system that connects the community with the communities of Coffman Cove, Craig, Hydaburg, Kasaan, Klawock, and Thorne Bay. Hollis is served by hydroelectric generation, with diesel generation used as a back-up. Residential rates for 2011 before and after the application of PCE payments were 24 cents/kWh and 16 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 24 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Hollis in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-21. This area contains 289,873 acres of NFS land (among other land ownerships). Table 3.23-23 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest areas represent a relatively small portion of the community use area for Hollis, ranging from 3.6 percent (Alternative 1) to 6.6 percent (Alternative 2). Harvest activities could have localized effects if they coincide with an area favored by Hollis residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old growth harvest in this area (see Table 3.23-23).

Figure 3.23-21
Hollis' Community Use Area

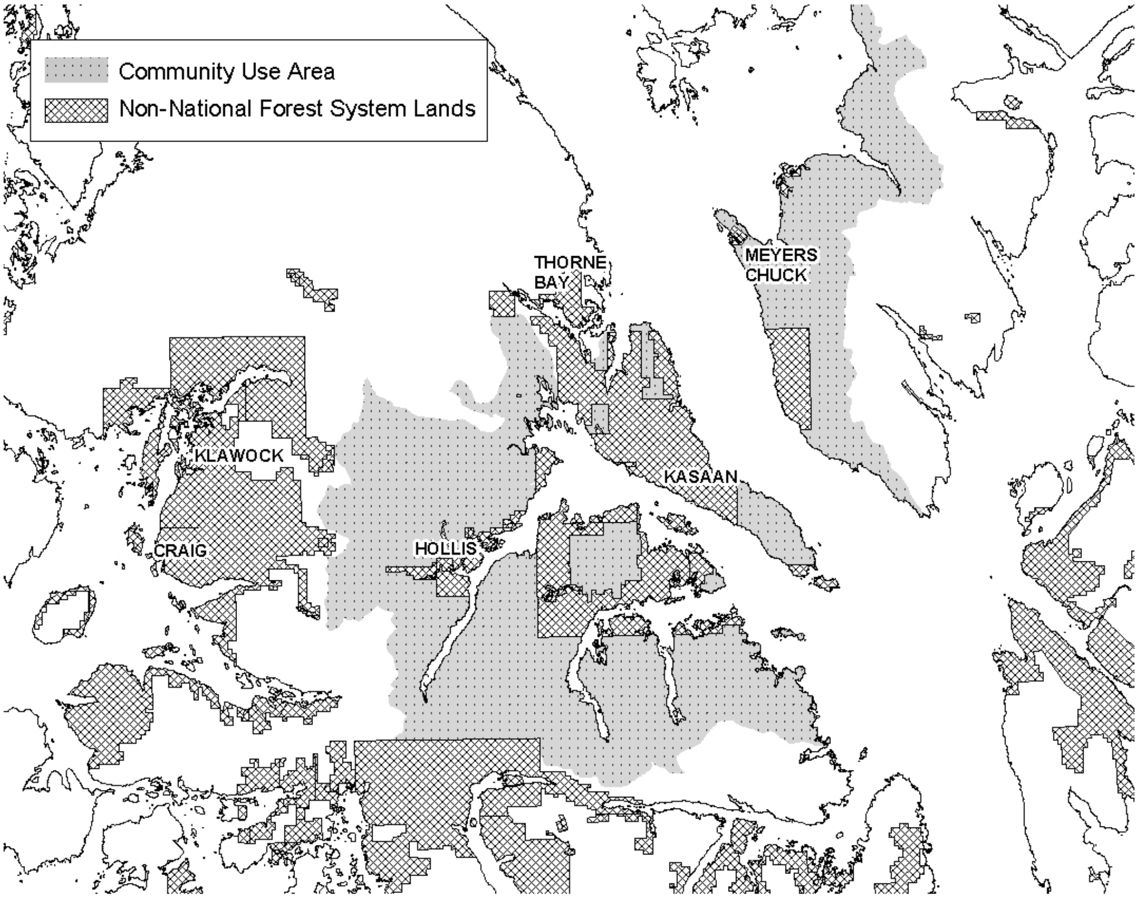


Table 3.23-23
Estimated Maximum Harvest (acres) over 100 Years in Hollis' Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	8,120	16,747	15,636	9,738	11,008
Old Growth	1,873	1,205	1,318	1,416	1,653
Total	**9,993**	**17,953**	**16,955**	**11,154**	**12,660**
Harvest as a Percent of Total NFS Lands in the Community Use Area	3.6%	6.6%	6.2%	4.1%	4.6%

Economy

Hollis is the site of the Inter-Island Ferry Authority terminal that provides daily access between Ketchikan and Hollis, and greater Prince of Wales Island. As such, transportation is a major component of the community's economy. Subsistence and timber also play important roles. The ferry terminal would continue to provide important access to Prince of Wales Island under all alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 65 percent of the total edible pounds of subsistence resources harvested by Hollis households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 73 percent of per capita subsistence harvest in Hollis in 1998 (ADF&G 2014).

The 1988 TRUCS study found that deer account for 23 percent of the total edible pounds of subsistence resources harvested by Hollis households (Kruse and Frazier 1988). Deer accounted for 18 percent of the per capita subsistence harvest by Hollis residents in 1998 (ADF&G 2014).

Hollis residents harvest deer primarily from within GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Hollis residents, total annual deer harvest has generally declined, and in 2013 was about 75 percent lower (33 fewer deer) than in 2004 (ADF&G 2015b).

Each of the three WAAs most used by Hollis residents occur in an area with substantial past timber harvest and, therefore, deer habitat capabilities are currently estimated to be well below 1954 levels (Table 3.23-24). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 5 to 6 percent in WAA 1214, 1 to 2 percent in WAA 1317, and 5 to 7 percent in WAA 1422 (Table 3.23-24).

Table 3.23-24
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Hollis Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1/]

	Average Deer Harvest from 2004 to 2013[2/]			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Edna Bay Residents	All Rural Hunters[3/]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1214	11	121	235	77%	71%	72%	71%	72%	71%
1317	10	95	133	58%	56%	56%	56%	56%	56%
1422	3	247	383	57%	50%	52%	51%	50%	50%

[1/] Calculated based on harvest where location is known.
[2/] 2004 data not available for Hollis residents.
[3/] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 Alternatives should be able to provide habitat capability for deer hunted in the Hollis community use area by Hollis residents and all rural hunters in both the short term and long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Hollis' community use area than the alternatives considered in this EIS (approximately 198 to 839 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long term for deer hunted by Hollis residents and all rural hunters. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all hunters in both the short and long term. This may still be the case under all alternatives.

In summary, use of most subsistence resources by Hollis residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Hoonah

Affected Environment

Overview and Demographic Characteristics

Hoonah is located on Port Frederick, along Icy Strait on the northeast shore of Chichagof Island, 40 air miles west of Juneau. Hoonah is predominantly a Native community and has been the principal village for the Hoonah Tlingit Clans since the late 1800s. According to the 2010 Census, Hoonah had a population of 760, with Alaska Natives comprising 53 percent of the total (U.S. Census Bureau 2011). Whitestone Logging Camp, with a population of 17 (U.S. Census Bureau 2011), is adjacent to Hoonah. The community of Game Creek is located 2.6 miles southwest of Hoonah.

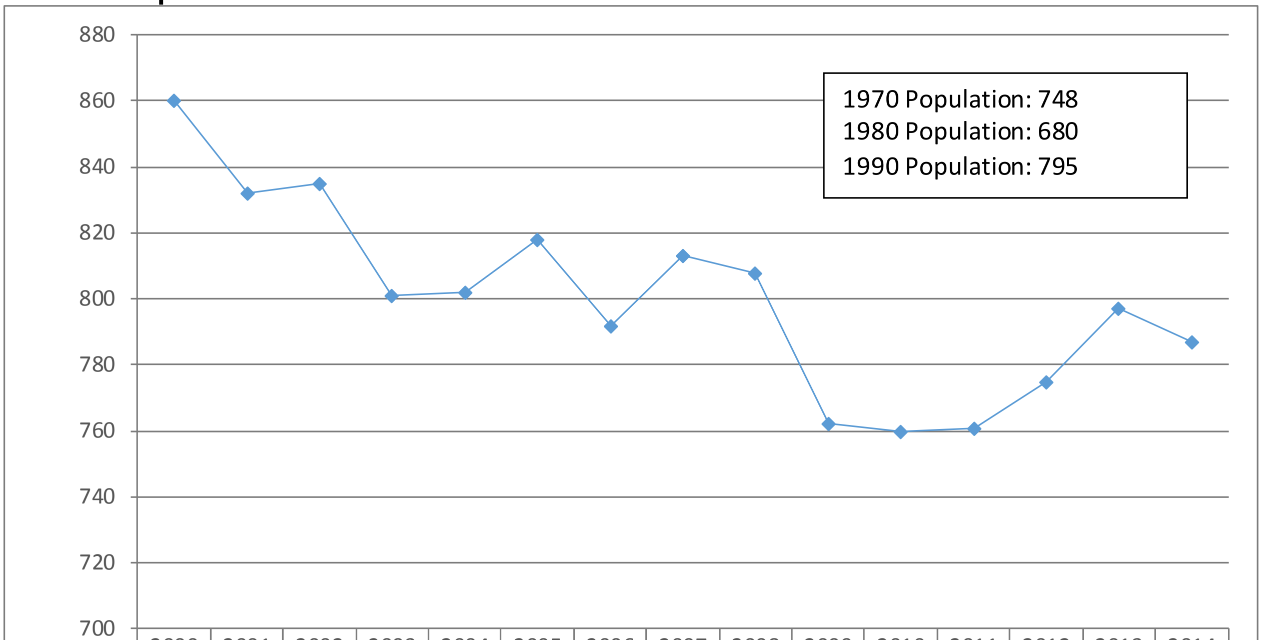
The village of Hoonah has been occupied since prehistoric times by the Tlingit people. Groups of Huna Tlingit lived all or part of the year at seasonal camps and small winter settlements throughout the Huna territory. Dozens of camps and settlements have been documented through archaeological surveys. The Hoonah Tlingit have very close ties to the Glacier Bay area across Icy Strait.

In 1880, the Northwest Trading Company built a store in Hoonah. The following year, missionaries settled in the town and established the Presbyterian Home Mission church and school. By 1887, about 500 people were wintering in the village. When the post office was established in 1901, the village was officially named Hoonah, which means “village by the cliff” in Tlingit. In 1944, fire burned many homes in Hoonah and destroyed the many traditional ceremonial costumes and keepsakes of the villagers. The town was rebuilt and became a center for logging operations on northern Chichagof Island (ADF&G 1994). The community has a local Fish and Game Advisory Committee, shared with Gustavus as the “Icy Straits” advisory committee (ADF&G 1994; ADF&G 2015a).

Icy Strait Point, an old cannery located approximately 1.5 miles north of Hoonah opened in 2004 as Alaska’s first cruise destination built specifically for tourists. As noted below, this has contributed to a general shift in the economy towards tourism related businesses.

The population of Hoonah increased by 180 people or 26 percent between 1980 and 2000. Population estimates have fluctuated from year-to-year since, with the population generally exhibiting a downward trend (Figure 3.23-22). Total estimated population in Hoonah was 787 in 2014 (Alaska DOL 2015b). The general overall decline in population has been accompanied by a much larger decline in school enrollment, with the number of enrolled students dropping by almost 50 percent from 2000 to 2014, decreasing from 226 in 2000 to 114 in 2014 (Table 3.23-9).

Figure 3.23-22
Hoonah Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hoonah	860	832	835	801	802	818	792	813	808	762	760	761	775	797	787

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Hoonah's economy is primarily based on commercial fishing, timber, tourism, and sport hunting and fishing (Himes-Cornell et al. 2013). In 2013, a total of 82 residents held commercial fishing permits and estimated gross earnings exceeded $3.6 million (ACFEC 2015). Fish processing occurs at plants in Hoonah and nearby Excursion Inlet. The City of Hoonah and the school district are the major local government employers (Alaska DCED 2002). In addition, most Hoonah residents maintain a subsistence lifestyle based on salmon, halibut, shellfish, deer, waterfowl and berries (Himes-Cornell et al. 2013).

The Icy Straits Lumber Company and D&L Woodworks are both located in Hoonah. According to the 2013 mill survey conducted for the Forest Service, the Icy Straits mill, which has an installed production capacity of 3 MMBF, processed approximately 0.4 MMBF in 2013 and employed 8 people (Parrent and Grewe 2014). D&L Woodworks has an installed production capacity of 1.8 MMBF and processed 0.1 MMBF in 2013, supporting 2 employees (Parrent and Grewe 2014). This processing total represented 13 percent and 3 percent of the existing capacity at the Icy Straits and D&L Woodworks facilities, respectively.

The economy of Hoonah has undergone a major transformation in recent years with the completion of Icy Strait Point, the historic cannery (Dugan et al. 2009). Icy Strait Point is the largest single employer in Hoonah, with 124 employees, mostly Hoonah residents, working there three to four days a week. Icy Strait Point includes a museum and serves as a base for tours, including forest tours, whale watching, and fishing charters. These tours served an estimated 30,000 people in 2005 (Dugan et al. 2009). Icy Strait Point is also a cruise ship port of call, with over 50 cruise ships carrying tens of thousands of passengers visiting each year (Himes-Cornell et al. 2013; Cruise Line Agencies of Alaska 2006).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 16 percent of the labor force in Hoonah was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). However, due to tourist activities, unemployment drops substantially during summer months. Median household income was $50,714, compared to the state median of $70,760; the corresponding median for the Hoonah-Angoon CA was $49,545 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	17	4
Construction	20	5
Manufacturing	24	6
Trade, Transportation and Utilities	58	14
Information	11	3
Financial Activities	0	0
Professional and Business Services	7	2
Educational and Health Services	35	9
Leisure and Hospitality	115	28
State Government	12	3
Local Government	111	27
Other	3	1
Unknown	0	0
Total Employment	**413**	**100**

Source: Alaska DOL 2015d

Hoonah has some of the highest electric rates in Alaska due to the use of diesel generated power. Residential rates for 2011 before and after the application of PCE payments were 62 cents/kWh and 22 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 62 cents/kWh. In early August 2015, the Gartina Falls hydropower project began generating electricity. The city of Hoonah is hoping this new hydropower usage can cut diesel usage by about 30 percent.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Hoonah in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-23. This area contains 583,825 acres of NFS land (among other land ownerships). Table 3.23-25 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest areas represent a small portion of the community use area for Hoonah, ranging from 2.2 percent (Alternative 4) to 3.6 percent (Alternatives 2 and 5). Harvest activities could have localized effects if they coincide with an area favored by Hoonah residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 5; however, it may be noted that Alternative 1 (which would have less potential total suitable harvest compared to Alternatives 2 and 5) would have the largest potential old growth harvest in this area (see Table 3.23-25).

Economy

Commercial fishing, logging, and subsistence use are important to Hoonah. The Icy Straits sawmill, which is located in Hoonah, employed 15 people in 2006. Hoonah residents are also employed by the recently opened Icy Strait Point development. Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

The Gartina Falls and Water Supply Creek projects are both located on non-NFS lands and would not be directly affected by the Renewable Energy Plan Components identified in Chapter 5 of the proposed Forest Plan amendment.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 59 percent of the total edible pounds of subsistence resources harvested by Hoonah households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 68 percent of per capita subsistence harvest in Hoonah in 2012 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 23 percent of the total edible pounds of subsistence resources harvested by Hoonah households (Kruse and Frazier 1988). Deer accounted for 15 percent of per capita subsistence harvest by Hoonah residents (ADF&G 2014).

Figure 3.23-23
Hoonah's Community Use Area

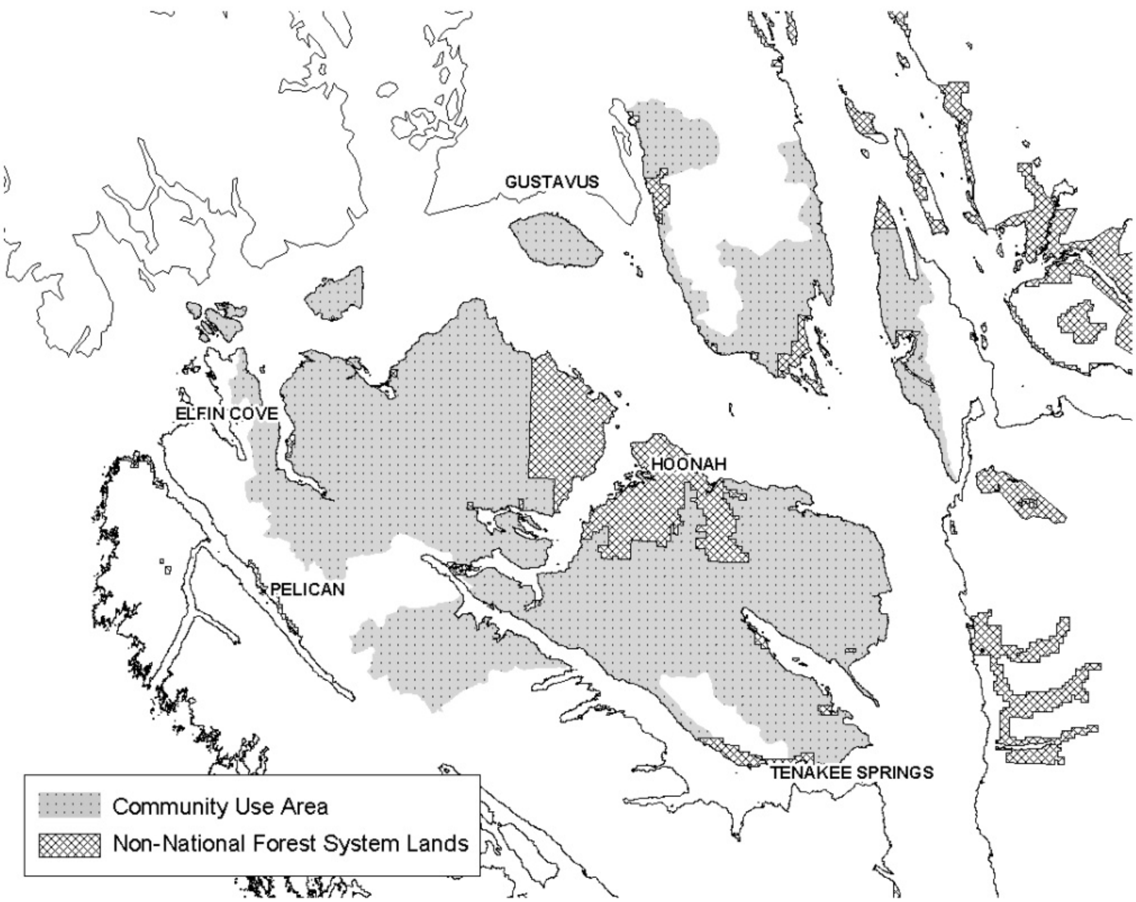


Table 3.23-25
Estimated Maximum Harvest (acres) over 100 Years in Hoonah's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	9,363	18,518	16,008	9,283	16,903
Old Growth	5,734	2,785	3,050	3,845	4,505
Total	**15,096**	**21,302**	**19,058**	**13,128**	**21,408**
Harvest as a Percent of Total NFS Lands in the Community Use Area	2.6%	3.6%	3.2%	2.2%	3.6%

Hoonah residents mainly harvest deer on Chichagof Island, which is included in GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Hoonah residents, total annual deer harvest dropped substantially in 2006 and continues to be much lower than it was in 2004 and 2005. While harvest appears to be recovering, in 2013 Hoonah residents total harvest was about 48 percent lower (354 fewer deer) than in 2004 (ADF&G 2015b).

Six WAAs account for the majority (73 percent) of deer harvest by Hoonah residents (Table 3.23-26). The Hoonah portion represents about 89 percent of the combined average rural hunter harvest and 57 percent of the total harvest in these WAAs. About 36 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Table 3.23-26
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Hoonah Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Hoonah Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3523	60	62	88	79%	73%	76%	75%	74%	75%
3524	45	51	82	99%	93%	98%	89%	97%	98%
3551	45	48	67	83%	75%	78%	75%	76%	77%
3525	44	56	118	75%	68%	70%	71%	70%	70%
4253	43	48	66	84%	84%	84%	84%	83%	84%
4252	42	51	72	92%	92%	92%	92%	92%	92%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

All of the WAAs identified in Table 3.23-26 are in areas with at least some past timber harvest and deer habitat capabilities are currently estimated to be below 1954 levels. Under each of the alternatives, additional harvest would further reduce habitat capabilities after 100 years by 1 to 10 percent.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Hoonah residents in the short term. However, projected deer harvest in the Hoonah community use area would exceed the capability of the habitat to produce sufficient deer populations to avoid effects for all rural hunters and all hunters in the short term, as well as Hoonah residents in the long term. The FEIS analysis concluded that at some point a restriction in hunting might be necessary. All of the 1997 alternatives included substantially higher levels of timber harvest in Hoonah's community use area than the alternatives considered in this EIS (approximately 3 to 14 times as high). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short term and potentially over the long term for deer hunted by Hoonah residents. At some point, a resctriction in hunting, particularly for non-rural hunters, may still be necessary under all current alternatives.

In summary, use of most subsistence resources by Hoonah residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Hoonah's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Hydaburg

Affected Environment

Overview and Demographic Characteristics

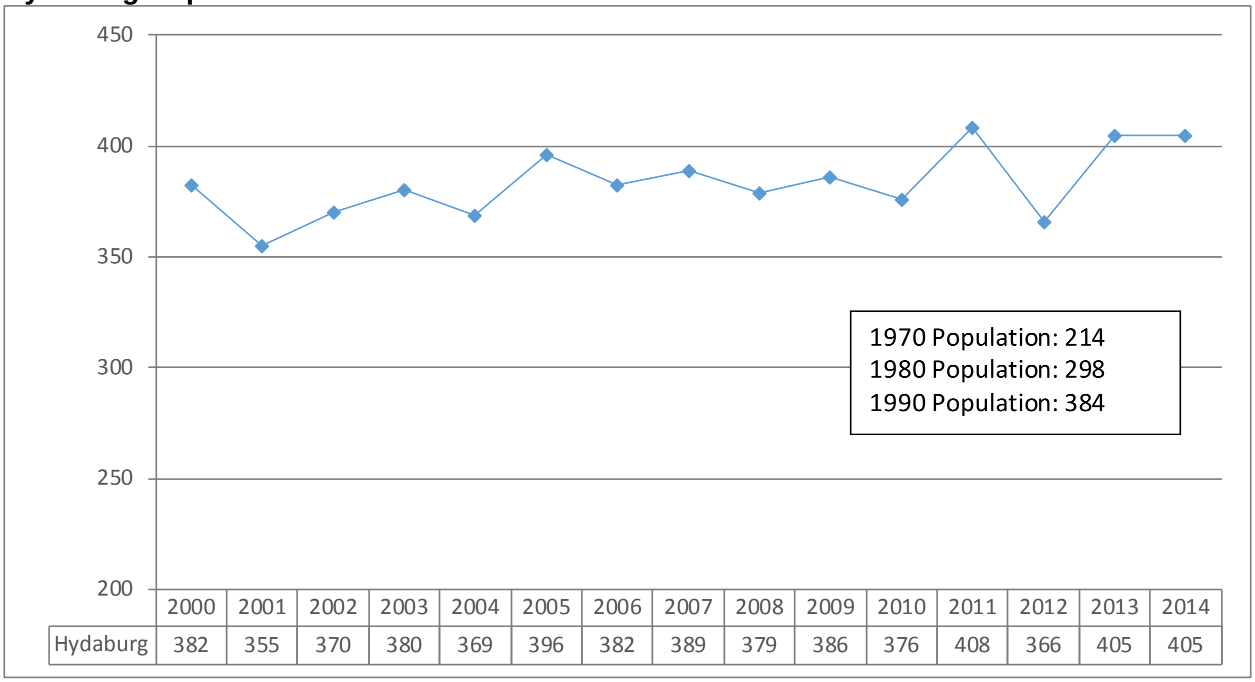
Hydaburg is located on the southwest side of Prince of Wales Island, 45 air miles northwest of Ketchikan. According to the 2010 Census, Hydaburg had a population of 376, with Alaska Natives comprising 77 percent of the total (U.S. Census Bureau 2011). Hydaburg is the largest Haida village in Alaska (Himes-Cornell et al. 2013).

The Haida Indians migrated to Prince of Wales Island, a predominantly Tlingit area, from Graham Island, Canada. After combining three villages, the present site was chosen initially as the Hydaburg Indian Reservation in 1912. It became a fishing village with the first fish processing plant opening in 1927, and three other canneries operating through the 1930s. Seafood processing was active until 1984 when a fire destroyed the cannery (ADF&G 1994). Hydaburg is connected by road to Craig, Klawock, Hollis, and northern parts of the Island.

In 1936, Hydaburg became the first Alaskan Native village to form an Indian Reorganization Act Council. In 1972, Hydaburg incorporated as a first class city. The community has a local Fish and Game Advisory Committee that became active in 2013 after having been inactive since 1987 (ADF&G 2015a). The committee members are focused on sport and personal use fishing, hunting, and subsistence issues (ADF&G 2015a).

Hydaburg's population increased by 79 percent between 1970 and 1990, then remained fairly constant between 1990 and 2000. Population has fluctuated somewhat from year-to-year since 2000, but generally remained fairly constant (Figure 3.23-24). The City of Hydaburg had an estimated population of 405 in 2014 (Alaska DOL 2015b). School enrollment has dropped since 2000, decreasing from 91 students in 2000 to 70 students in 2014 (Table 3.23-9).

Figure 3.23-24
Hydaburg Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Hydaburg's economy is based primarily on subsistence, commercial fishing, timber, and government (Himes-Cornell et al. 2013). A total of 20 residents held commercial fishing permits in 2013, with estimated gross earnings of $2.6 million from salmon and herring fisheries (ACFEC 2015). The Haida Corporation has a substantial timber holding, a log storage facility, and a sort yard. It suspended logging in 1985 due to a decline in the timber market and leases the storage facility and sort yard to Sealaska Corporation. The tribal council, city, school, and the Southeast Alaska Regional Health Consortium are leading employers, and the log transfer facility and sort yard still provide part-time and seasonal employment (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 17 percent of the labor force in Hydaburg was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $37,361, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	4	3
Construction	19	14
Manufacturing	1	1
Trade, Transportation and Utilities	8	6
Information	1	1
Financial Activities	8	6
Professional and Business Services	3	2
Educational and Health Services	22	16
Leisure and Hospitality	1	1
State Government	4	3

Employment by Industry in 2013	Number	Percent of Total
Local Government	69	49
Other	1	1
Unknown	0	0
Total Employment	**141**	**100**
Source: Alaska DOL 2015d		

Hydaburg is part of the AP&T system that connects the community with the communities of Coffman Cove, Craig, Hollis, Kasaan, Klawock, and Thorne Bay. Hydaburg is served by hydroelectric generation, with diesel generation used as a back-up. Residential rates for 2011 before and after the application of PCE payments were 24 cents/kWh and 16 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 24 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Hydaburg in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-25. This area contains 764,430 acres of NFS land (among other land ownerships). Table 3.23-27 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest areas represent a small portion of the community use area for Hydaburg, ranging from 1.9 percent (Alternative 1) to 3.1 percent (Alternative 2). Harvest activities could have localized effects if they coincide with an area favored by Hydaburg residents, and roject-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-27).

Figure 3.23-25
Hydaburg's Community Use Area

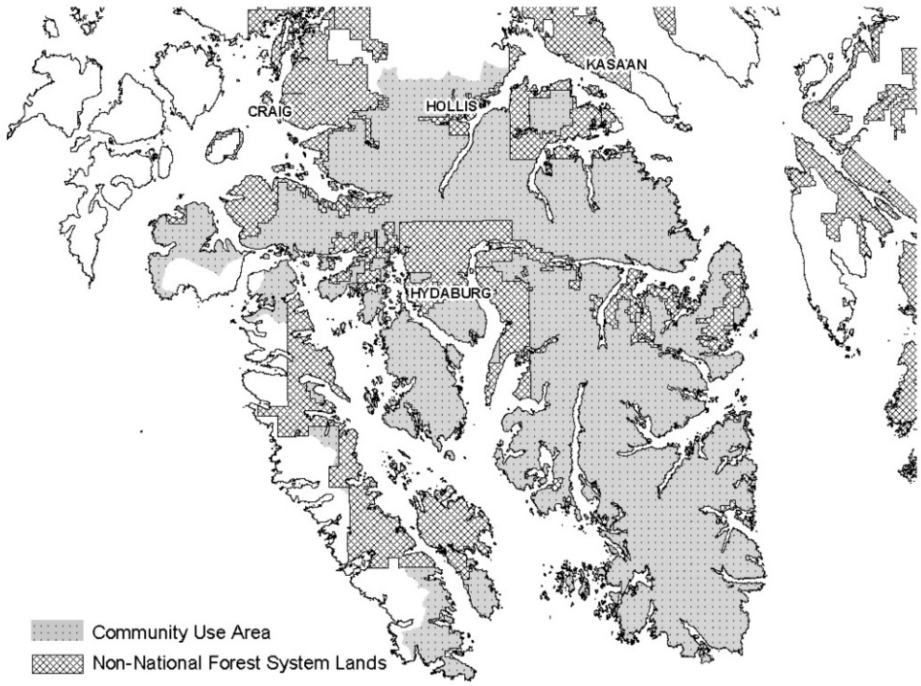


Table 3.23-27
Estimated Maximum Harvest (acres) over 100 Years in Hydaburg's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	10,292	20,614	18,823	12,337	14,166
Old Growth	3,557	2,068	2,619	2,838	2,409
Total	**13,848**	**22,681**	**21,442**	**15,175**	**16,575**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.9%	3.1%	2.9%	2.1%	2.3%

Economy

Subsistence use and commercial fishing are the primary elements of Hydaburg's economy. Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 80 percent of the total edible pounds of subsistence resources harvested by Hydaburg households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for the majority (81 percent) of per capita subsistence harvest in Hydaburg in 2012 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 13 percent of the total edible pounds of subsistence resources harvested by Hydaburg households (Kruse and Frazier 1988). Deer accounted for 13 percent of per capita subsistence harvest by Hydaburg residents in 2012 (ADF&G 2014).

Hydaburg residents primarily harvest deer on south Prince of Wales Island, which is included in GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Hydaburg residents, total annual deer harvest has fluctuated over the years and in 2013 was about 18 percent lower (7 fewer deer) than in 2004 (ADF&G 2015b).

Residents of Hydaburg harvest the majority (73 percent) of their deer from three WAAs (Table 3.23-28). The Hydaburg portion represents about 19 percent of the combined average rural hunter harvest and 11 percent of all harvest in these WAAs. About 41 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Only one of the three WAAs would be affected under all of the alternatives (Table 3.23-28). In WAA 1214, where past timber harvest has already reduced deer habitat capability well below 1954 levels, additional harvest would occur that would reduce habitat capabilities by a further 5 to 6 percent (Table 3.23-28).

Table 3.23-28
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Hydaburg Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

WAA	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
	Hydaburg Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1107	34	99	130	99%	99%	99%	99%	99%	99%
1214	6	120	235	77%	71%	72%	71%	72%	71%
1106	4	17	33	100%	100%	100%	100%	100%	100%

[1] Calculated based on harvest where location is known
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Hydaburg residents, as well as for all deer hunted within the WAAs of the Hydaburg community use area in both the short and long term. Given the small effect to WAAs under the current alternatives, which include substantially less proposed timber harvest than considered in 1997, it is likely all of the current alternatives would also provide sufficient habitat capability for deer hunted by Hydaburg residents as well as all hunters using the area.

In summary, use of most subsistence resources by Hydaburg residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. Subsistence use of deer is also not likely to be directly affected at a level that would require hunting restrictions. Indirect effects associated with increased competition for deer within Hydaburg's subsistence use areas could occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Hyder

Affected Environment

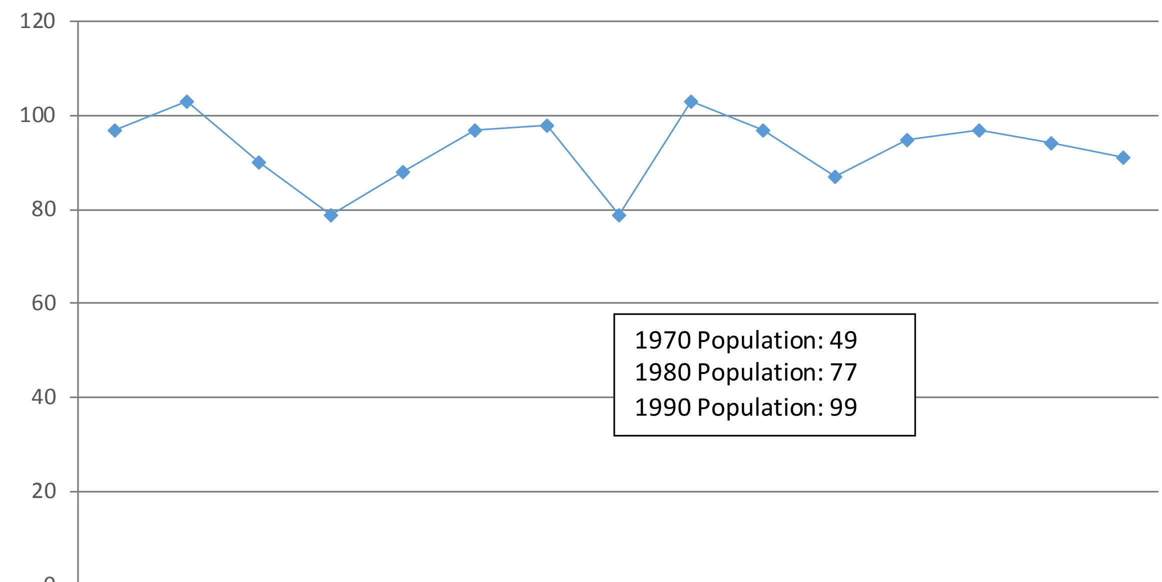
Overview and Demographic Characteristics

Hyder is a community located at the head of Portland Canal, a 70-mile-long fjord that forms part of the United States/Canadian border. Hyder is just 2 miles from Stewart, British Columbia, and 75 air miles from Ketchikan. Hyder is one of three Southeast Alaska communities connected by road to Canada. According to the 2010 Census, Hyder had a population of 87, with one person identifying as an Alaska Native (U.S. Census Bureau 2011).

Nass River Tsimshians inhabited the area, which they called Skam-a-Kounst, “a safe place,” prior to the coming of white prospectors in the late 1890s. The first official exploration and building at the town site occurred in 1896 by the U.S. Army Corps of Engineers. Stewart also became settled at this time, as gold, silver, and other mineral mining operations developed. The two towns grew together with an initial economic base in mining (ADF&G 1994).

The population of Hyder, which slightly more than doubled between 1970 and 1990, has since remained relatively stable (Figure 3.23-26). Total estimated population was 91 in Hyder in 2014 (Alaska DOL 2015b). Hyder School had 10 students enrolled in 2014 (Table 3.23-9).

Figure 3.23-26
Hyder Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hyder	97	103	90	79	88	97	98	79	103	97	87	95	97	94	91

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Hyder’s economy is primarily based on tourism, mining, logging, fishing, and sport hunting/fishing, and, as such, is largely seasonal (Himes-Cornell et al. 2013). Four of the five largest employers are tourist related. Many tourists enter Hyder from Canada. Stewart, British Columbia, located only 2 miles from Hyder, is Canada’s northernmost year-round ice-free port and the two towns share visitor services. The construction industry also provides employment in Hyder, and two residents held commercial fishing permits in 2013 (ACFEC 2015).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. While the ACS estimated that no adults in Hyder were unemployed and seeking work in 2013, an estimated 70 percent of the population was not in the labor force, which includes seasonal workers interviewed during the off season who were not looking for work (U.S. Census Bureau 2014b). Median household income was $21,944, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	1	3
Construction	12	40
Manufacturing	0	0
Trade, Transportation and Utilities	5	17
Information	0	0
Financial Activities	0	0
Professional and Business Services	1	3
Educational and Health Services	1	3
Leisure and Hospitality	2	7
State Government	8	27
Local Government	0	0
Other	0	0
Unknown	0	0
Total Employment	**30**	**100**

Source: Alaska DOL 2015d

Hyder receives electricity services from BC Hydro via nearby Stewart, B.C., Canada (Himes-Cornell et al. 2013). In 2012, energy sales to Hyder totaled 1 gigawatt per hour and were forecasted to remain at that level through 2033 (BC Hydro 2012). Rate information was not available for Hyder.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Hyder in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-27. This area contains 108,809 acres of NFS land (among other land ownerships). Table 3.23-29 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. The potential harvest levels represent a small portion of the community use area for Hyder. The harvest levels are about 0.1 percent of the total NFS lands in the Hyder community use area under Alternatives 1 and 2, and no harvesting would occur in the Hyder community use area under Alternatives 3, 4, and 5. Harvest activities could have localized effects if they coincide with a particular location favored by Hyder residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 1 and 2.

Figure 3.23-27
Hyder's Community Use Area

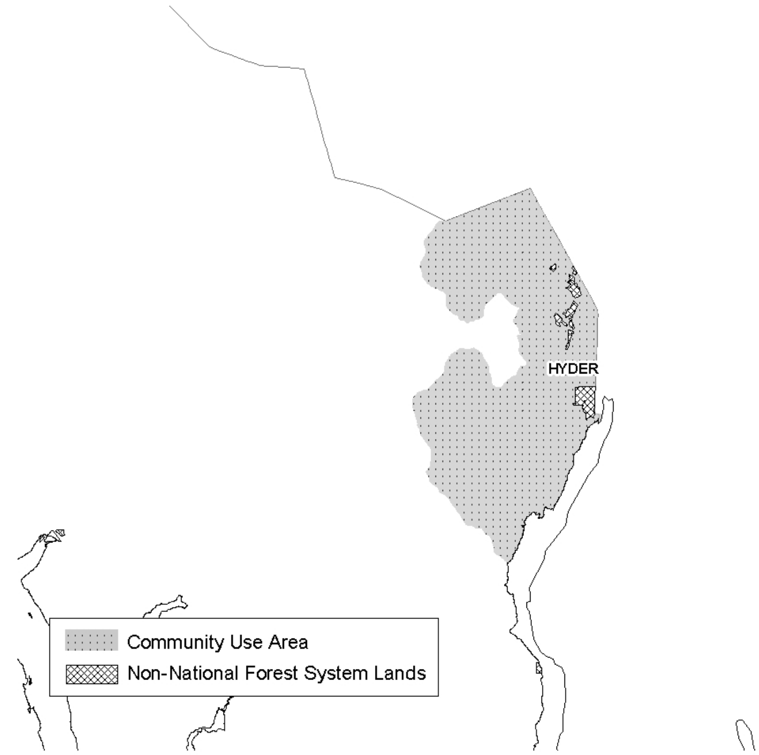


Table 3.23-29
Estimated Maximum Harvest (acres) over 100 Years in Hyder's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	0	0	0	0	0
Old Growth	120	58	0	0	0
Total	**120**	**58**	**0**	**0**	**0**
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.1%	0.1%	0.0%	0.0%	0.0%

Economy
Hyder is a small former mining town that now relies upon tourism and commercial fishing for the majority of its income. These activities are not expected to be affected under any of the alternatives.

Subsistence
No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 80 percent of the total edible pounds of subsistence resources harvested by Hyder households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for the majority (85 percent) of per capita subsistence in Hyder in 1987 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for only a fraction of the total edible pounds of subsistence resources harvested by Hyder households (Kruse and Frazier

1988). Bear, moose, and goat made up the land mammal subsistence harvest (ADF&G 2014).

Bear, moose, and goat availability would not be significantly affected under any of the alternatives.

Data were not provided for Hyder in the ADF&G deer harvest reports for 2004 to 2013. The majority of deer harvest by Hyder residents likely takes place in GMU 1A. As of 2013, deer numbers were at very low levels throughout most of GMU 1A and were no longer meeting local hunter demands or established deer harvest objectives (Harper 2013). Though not closed, starting in 2011 the deer hunting season was shortened to August 1 through November 30 instead of continuing through December. Hunters are known to be shifting efforts to other more productive areas, such as nearby GMU 2, leading to less hunter effort and fewer deer harvested in GMU 1A (Harper 2013).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted in Hyder's community use area by Hyder residents, all rural hunters, and all hunters in the short term. In the long term projected harvest for all rural hunters and all hunters in the Hyder community use area would exceed the capability of habitat to support deer populations sufficient to avoid effects on hunter success. As noted above, deer populations in the area are currently not sufficient to meet local demand. Under the alternatives in this EIS, proposed suitable acres have been reduced to either zero or a very small fraction of Hyder's community use area. Therefore, additional impacts to deer subsistence use by Hyder residents or other hunters using the area are unlikely.

In summary, use of most subsistence resources by Hyder residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. Subsistence use of deer is unlikely to be affected by any of the alternatives; however, further hunting restrictions are possible due to existing conditions. It is unlikely that Hyder residents would be affected by increased competition in WAA 826, which surrounds their community, because of the limited access to this area and current low deer numbers, noted above.

Juneau and Vicinity

Affected Environment

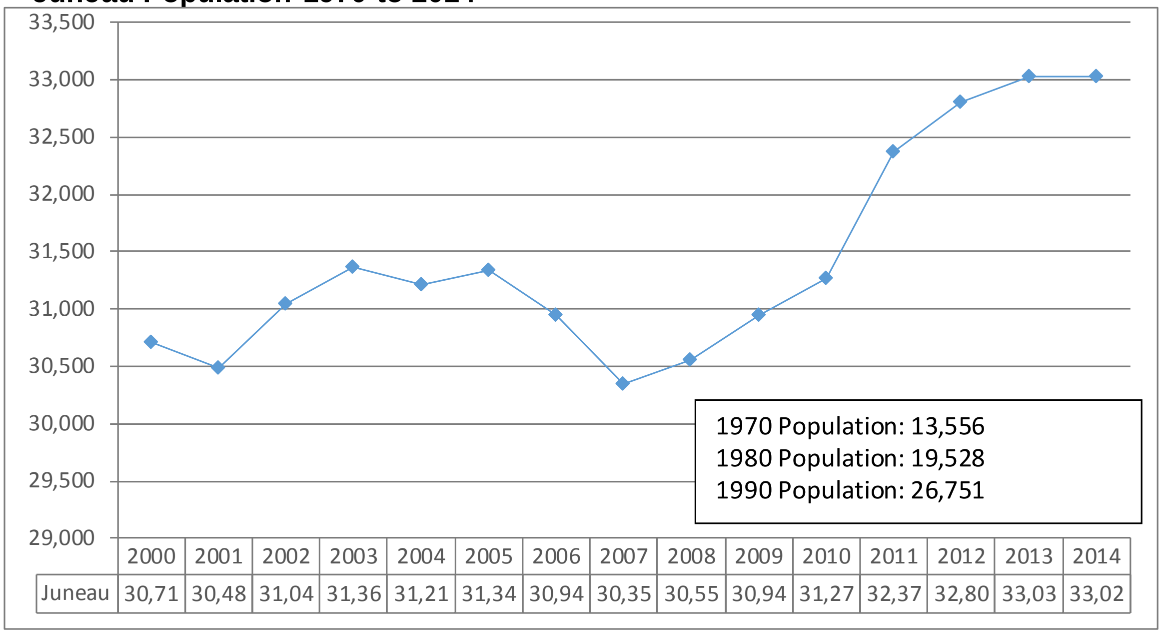
Overview and Demographic Characteristics

The City and Borough of Juneau surrounds the Gastineau Channel in Southeast Alaska. Juneau, Alaska's state capital, lies approximately 900 air miles northwest of Seattle and 600 air miles southeast of Anchorage. The City and Borough is comprised of three communities: Juneau, Auke Bay, and Douglas. According to the 2010 Census, the City and Borough of Juneau had a population of 31,275, accounting for 43 percent of the population in Southeast Alaska. Alaska Natives comprised almost 12 percent of the total population (U.S. Census Bureau 2011).

Originally, Tlingit Indians made seasonal and permanent villages along the north and south coast near the present site of Juneau. Gold discovered in the Juneau area started the mining town in 1880 and the settlement grew rapidly. Two of the world's largest lode gold mines produced over $180 million in gold before finally closing in 1944. The state capital was moved from Sitka to Juneau in 1906 while Alaska was still a territory. Alaska became the 49th State in 1959. Juneau has developed as a government and regional services center, with added economic contributions from fishing and tourism. Juneau and Douglas participate in an active local Fish and Game Advisory Committee (ADF&G 2015a).

The population of Juneau has grown steadily since 1970, almost doubling between 1970 and 1990 and increasing a further 15 percent between 1990 and 2000. The population in Juneau has fluctuated since 2000 but generally continued to grow, increasing by approximately 8 percent between 2000 and 2014 (Figure 3.23-28). Total estimated population was 33,026 in Juneau in 2014 (Alaska DOL 2015b). A total of 4,751 students were enrolled in the Juneau School District in 2014. Despite the continued growth in population, school enrollment in Juneau has decreased since 2000, dropping from 5,483 enrolled students (Table 3.23-9).

Figure 3.23-28
Juneau Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Juneau economy is primarily based on government, tourism, support services for logging, commercial fishing and fish processing, and mining (Himes-Cornell et al. 2013). The State, City and Borough of Juneau, the Juneau School District, tribal government, and federal agencies provide over half of the employment in the community (Himes-Cornell et al. 2013; Alaska DOL 2015d). As the State capital, Juneau is the home of the State legislators and their staff during the legislative season (January to April).

With over one million visitors between May and September, Juneau is the most-visited community in the region (Dugan et al. 2009). Tourism is thus a significant part of the economy during the summer months providing an estimated $130 million in income. Juneau is an important cruise ship docking location due to the local attractions: Mendenhall Glacier, Juneau Icefield, Tracy Arm Fjord Glacier, and the Mount Roberts Tram. While tourism in Juneau is dominated by cruise ships, a recent study noted that a substantial number of independent unguided travelers also make their way through Juneau in pursuit of hiking, kayaking, boating, hunting, and other outdoor activities (Dugan et al. 2009). The six major cruise lines who dock at Juneau each offer 34 to 37 shore excursions for purchase on the ship or before the cruise begins.

Estimated gross fishing earnings of local residents exceeded $20 million in 2013 (ACFEC 2015). Fish processing facilities in Juneau handled over 7 million pounds of seafood in 2008, and the Macaulay Salmon Hatchery produces over 52 million salmon annually (Himes-Cornell et al. 2013). The Hecla Mining

Company's Greens Creek Mine, the largest silver mine in North America, produces gold, silver, lead and zinc. In addition, Coeur Mining's Kensington Gold Mine north of Juneau, located on private and NFS lands within the City and Borough of Juneau, produces gold—approximately 5,130 pounds in 2012 (Alaska DNR 2015).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 5 percent of the labor force in Juneau was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $81,490, compared to the state median of $70,760 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	401	3
Construction	803	5
Manufacturing	260	2
Trade, Transportation and Utilities	2961	19
Information	255	2
Financial Activities	559	4
Professional and Business Services	850	5
Educational and Health Services	1570	10
Leisure and Hospitality	1282	8
State Government	4009	25
Local Government	2270	14
Other	538	3
Unknown	7	0
Total Employment	**15,765**	**100**

Source: Alaska DOL 2015d

Juneau is connected to the Alaska Electric Light and Power Company (AEL&P) system that also includes Douglas Island, Auke Bay, and Greens Creek. Five hydropower projects feed into the AEL&P grid serving Juneau, including Salmon Creek, Gold Creek, Annex Creek, Lake Dorothy, and Snettisham (Table 3.12b-2). Residential rates for 2011 before and after the application of PCE payments were the same at 12 cents/kWh (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 10 cents/kWh and 9 cents/kWh, respectively. Juneau Hydropower, Inc. has proposed a hydroelectric project on Sweetheart Lake (Table 3.12b-3).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Juneau in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-29. This area contains 2,013,397 acres of NFS land (among other land ownerships). Table 3.23-30 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Juneau, with Alternatives 1, 2, 3, and 5 potentially harvesting less than 0.1 percent of the total NFS lands in the Juneau community use area, and no harvesting in this area occurring under Alternative 4. Harvest activities could have localized effects if they coincide with a particular location favored by Juneau residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case for all of the alternatives except for Alternative 4.

Figure 3.23-29
Juneau's Community Use Area

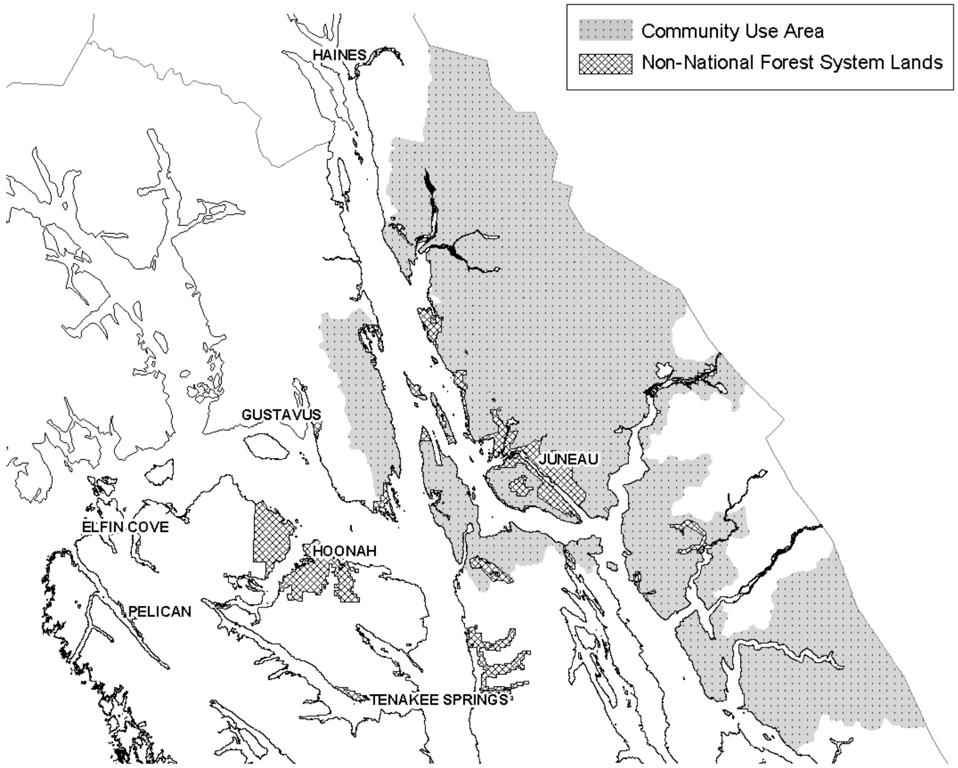


Table 3.23-30
Estimated Maximum Harvest (acres) over 100 Years in Juneau's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	16	620	418	0	518
Old Growth	635	307	0	0	0
Total	**650**	**927**	**418**	**0**	**518**
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.03%	0.05%	0.02%	0.00%	0.03%

Economy

As the State capital, government is important to Juneau. Besides changes in government employment, Juneau is most likely to be affected by changes in mining, recreation and tourism, and commercial fishing. None of the alternatives are expected to affect these aspects of the local economy.

The proposed hydroelectric projects (Annex Creek and Sweetheart Lake) that would serve Juneau are located in a Semi-Remote Recreation LUD and Inventoried Roadless Area 302. Semi-Remote Recreation is considered a TUS "window" under the 2008 Forest Plan, an area potentially available for the location of transportation and utility corridors and sites. This classification and the standards and guidelines in the 2008 Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, energy projects would be managed under the Renewable Energy Plan Components identified in Chapter 5 of the proposed amended Forest Plan.

Subsistence

Juneau is not classified as a subsistence community; however, many residents use the surrounding Tongass for sport hunting and fishing. The City and Borough of Juneau had a total estimated population of 33,026, accounting for approximately 44 percent of the population in Southeast Alaska (Alaska DOL 2014d). Given the non-subsistence status of the community and its large size, no attempt is made here to summarize the WAAs that community residents use to hunt deer. The following paragraphs do, however, summarize the findings of the 1997 EIS and provide a general overview of the likely impacts of the current alternatives.

The majority of deer harvest by Juneau residents likely takes place within the community's identified use area (Figure 3.23-29), which is mainly located within GMU 1C. Deer populations in GMU 1C have historically fluctuated with periodic severe winter weather, most recently during the winter of 2006-2007. The snow pack led to a substantial deer die off, and opportunities to harvest deer will likely improve in the coming years if winter weather isn't too severe (Harper 2013).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by all rural hunters in the short and long terms. However, adding Juneau residents and other non-rural hunters, demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success in both the short and long terms. The Final EIS analysis concluded that at some point a restriction in hunting might be necessary, and would target urban residents before any restrictions were considered for rural hunters.

In summary, use of most subsistence resources by Juneau residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term under all alternatives.

Kake

Affected Environment

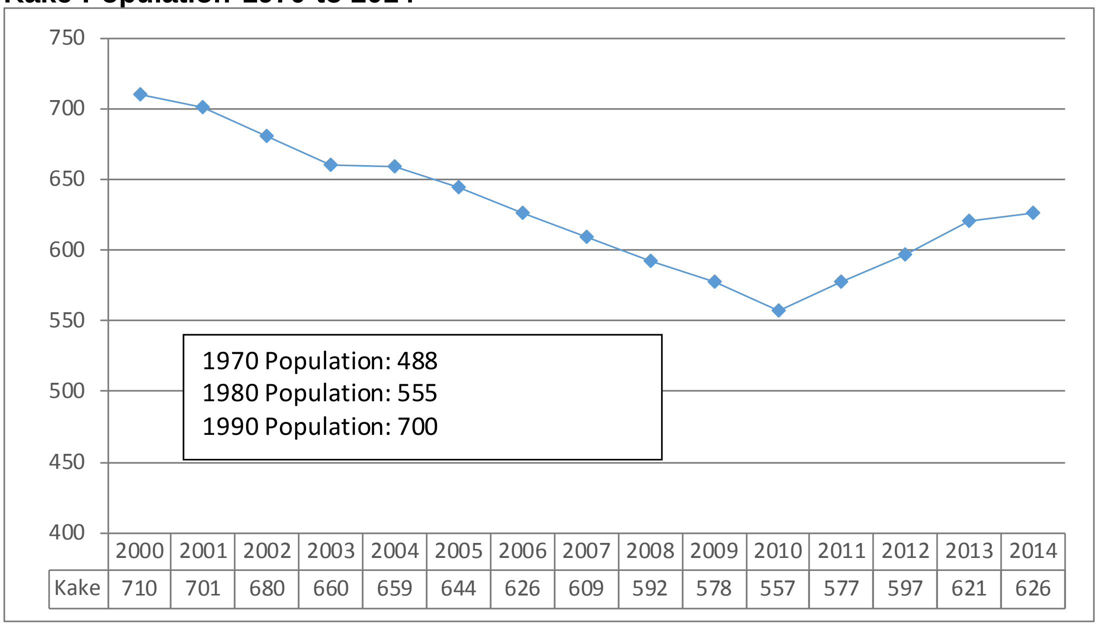
Overview and Demographic Characteristics

Kake is located on west Kupreanof Island, along Keku Strait, 38 air miles northwest of Petersburg. Historically, Tlingit people of the Kake (Keex) Kwaan claimed 2,003,000 acres of territory, including the upper halves of Kuiu, Kupreanof, and Mitkof Island, the eastern shore of Baranof Island and the southern shore of Admiralty Island. The arrival of early European explorers and traders resulted in occasional confrontations between Native Tlingits and foreigners. Escalating tensions led to the U.S. Navy shelling several Kake villages and destroying their homes, boats, and stored foods. The inhabitants of multiple villages subsequently consolidated at the current site of Kake, with further consolidation of Kake villages taking place in the 1880s.

A government school and store and Society of Friends mission were established in Kake in 1891. A post office followed in 1904 and the first cannery was built near Kake in 1912. Today, Kake remains a primarily Tlingit village with a fishing, logging, and subsistence lifestyle. Traditional customs are important to the Kake people. The world's largest totem pole stands on a bluff overlooking town (Himes-Cornell et al. 2013). Kake is a first-class city and is not located in an organized borough.

The population of Kake, which increased by 56 percent between 1970 and 1990, remained fairly constant between 1990 and 2000, and decreased by an estimated 153 people or 22 percent between 2000 and 2010 (Figure 3.23-30). Population estimates developed by the Alaska DOL (2015a) suggest that the population in Kake has increased since 2010, with a total estimated population of 626 in 2014. A total of 110 students were enrolled in the Kake City School District in 2014, up from 85 students in 2010 (Table 3.23-9).

Figure 3.23-30
Kake Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Kake's economy has been traditionally based on forest and fisheries resources and subsistence activities. According to a survey conducted by the Alaska Fisheries Science Center in 2011, community leaders indicated that this continues to be the case with the current economy dependent on logging, fishing, ecotourism, and sport hunting and fishing. Subsistence remains an essential part of the local way of life, with deer, halibut, salmon, and black sea weed identified as the most important subsistence resources (Himes-Cornell et al. 2013). Shellfish, bear, waterfowl, and berries are also important food sources. The City of Kake, the school district, and Kake Tribal Corporation are the largest employers in the community. The Gunnock Creek Hatchery, a non-profit organization, operates a salmon hatchery to assist in sustaining the salmon fishery in the area and provides some local employment (Himes-Cornell et al. 2013).

Community leaders indicated in a recent survey by the Alaska Fisheries Science Center that current challenges for Kake's fishing economy include high costs of electricity, fuel, and labor, and shipping constraints for delivering fresh products to market ((Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 21 percent of the labor force in Kake was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S.

Census Bureau 2014b; Alaska DOL 2015d). Median household income was $38,750, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	24	9
Construction	18	7
Manufacturing	39	15
Trade, Transportation and Utilities	36	14
Information	2	1
Financial Activities	9	4
Professional and Business Services	4	2
Educational and Health Services	26	10
Leisure and Hospitality	1	0
State Government	2	1
Local Government	91	35
Other	6	2
Unknown	0	0
Total Employment	**258**	**100**

Source: Alaska DOL 2015d

Kake has some of the highest electric rates in Alaska due to the use of diesel generated power. Residential rates for 2011 before and after the application of PCE payments were 62 cents/kWh and 22 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 62 cents/kWh (Table 3.12b-3). The proposed Kake to Petersburg Intertie Project, which is currently undergoing NEPA review, would connect Kake to the SEAPA system. The SEAPA system is sourced primarily from hydroelectric power (Swan Lake and Tyee Lake) and connects Ketchikan, Petersburg, and Wrangell.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Kake in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-31. This area contains 454,186 acres of NFS land (among other land ownerships). Table 3.23-31 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Kake, ranging from about 4.3 percent (Alternative 4) to 5.2 percent (Alternative 2). Harvest activities could have localized effects if they coincide with a particular location favored by Kake residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2, 3, and 5; however, it may be noted that Alternative 1 (which would have less potential total suitable harvest compared to Alternatives 2, 3, and 5) would have the largest potential old-growth harvest in this area (see Table 3.23-31).

Figure 3.23-31
Kake's Community Use Area

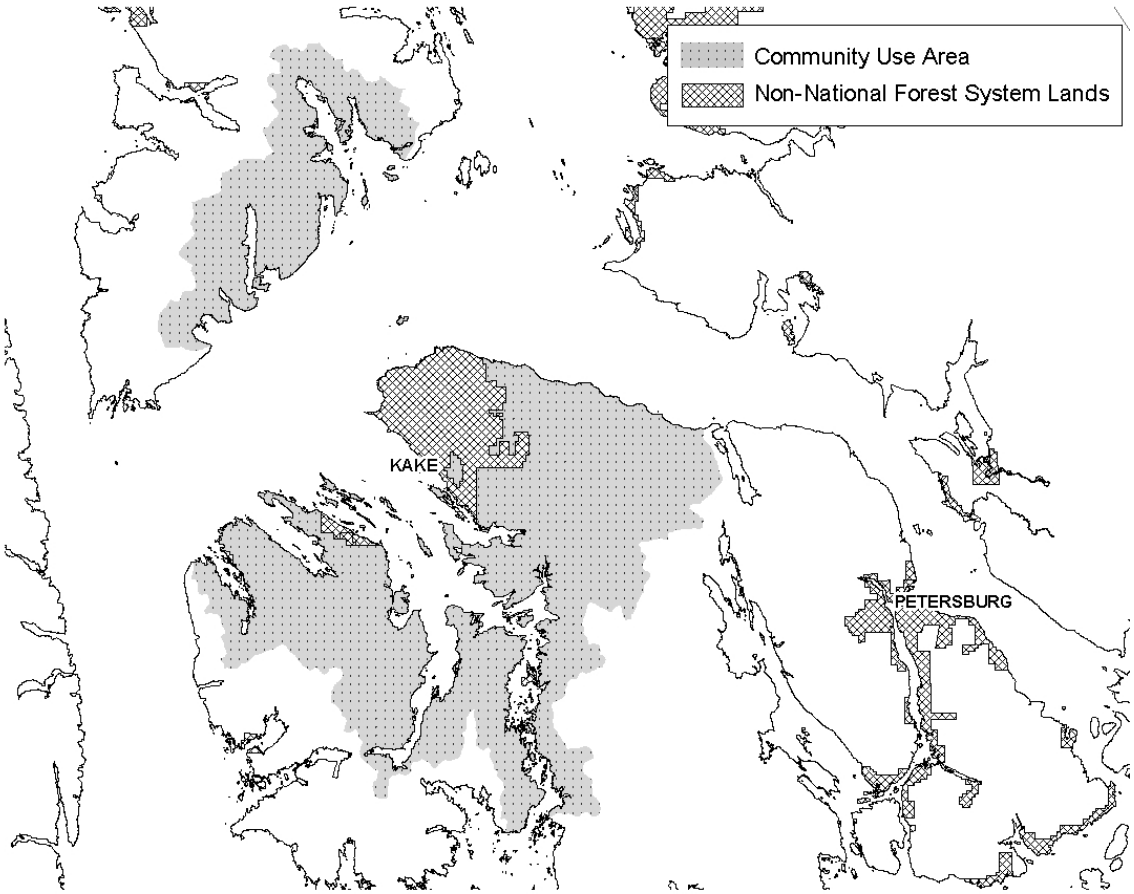


Table 3.23-31
Estimated Maximum Harvest (acres) over 100 Years in Kake's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	15,927	20,462	19,814	15,449	18,274
Old Growth	5,973	3,120	2,808	4,214	2,466
Total	**21,900**	**23,582**	**22,622**	**19,663**	**20,740**
Harvest as a Percent of Total NFS Lands in the Community Use Area	4.8%	5.2%	5.0%	4.3%	4.6%

Economy

Kake is a traditional native community where commercial fishing, timber harvesting, and subsistence use are important. For subsistence use, west Kupreanof and north Kuiu Islands are some of the important areas. Employment in the commercial fishing sector is not expected to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 52 percent of the total edible pounds of subsistence resources harvested by Kake households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 60 percent of per capita subsistence harvest in Kake in 1996 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 24 percent of the total edible pounds of subsistence resources harvested by Kake households (Kruse and Frazier 1988). Deer accounted for 28 percent of per capita subsistence harvest by Kake residents in 1996 (ADF&G 2014).

Kake residents harvest deer on Admiralty Island and Kupreanof Island, which are included in GMU 4 and GMU 3, respectively. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). The deer populations within GMU 3 have historically fluctuated, with high and low extremes. Between 1994 and 2011, deer harvest in GMU 3 ranged from a low of 333 to a high of 1,119 (Harper 2013). As of 2013, the harvest level was about 100 deer below the previous 10-year mean (Harper 2013).

Five WAAs account for the majority (76 percent) of deer harvest by Kake Residents (Table 3.23-32). The Kake portion ranges from about 11 percent (WAA 1420) to 60 percent (WAA 5132) of the total harvest and from 19 percent to 68 percent of the rural hunter harvest in these WAAs. About 35 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Table 3.23-32
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Kake Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013[2]			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Kake Residents	All Rural Hunters[3]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1420	30	158	276	49%	45%	45%	45%	45%	44%
3940	26	61	75	93%	93%	93%	93%	93%	93%
3939	19	71	105	100%	100%	100%	100%	100%	100%
4041	5	16	19	91%	91%	91%	91%	91%	91%
5132	5	7	8	70%	71%	71%	71%	71%	71%

[1] Calculated based on harvest where location is known.
[2] 2008 data not available for Kake residents.
[3] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Four out of the five WAAs heavily used by Kake residents would not be affected under all alternatives (Table 3.23-32). Deer habitat capability in WAA 1420, which is currently at less than half of 1954 levels, would be further reduced by 4 to 5 percent under all alternatives (Table 3.23-32).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted in the Kake community use area by Kake residents, all rural hunters, and all hunters in the short term, and Kake residents and, under all but one of the alternatives, all rural hunters over the long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Kake's community use area than the alternatives considered in this EIS (approximately 197 to 452 percent higher). Given this and the minimal effect shown in Table 3.23-32, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Kake residents and all rural hunters. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all hunters in the long term. It is possible this would still be the case under all current alternatives.

In summary, use of most subsistence resources by Kake residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer in one of the WAAs hunted by Kake residents may be affected to the point that some restriction in hunting might be necessary over the long term, particularly for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Kake's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity. Such impacts would be relatively low based on the limited accessibility of these areas to non-local hunters.

Kasaan

Affected Environment

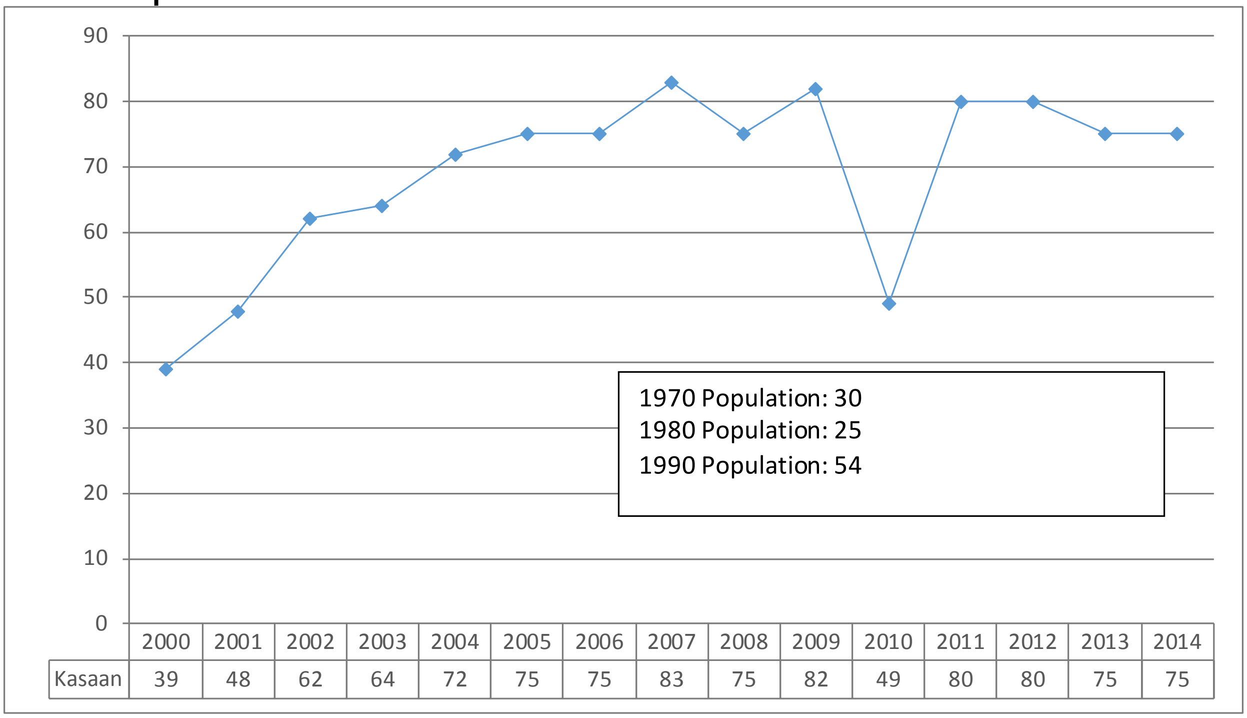
Overview and Demographic Characteristics

Kasaan is a small village located on the eastern side of Prince of Wales Island. Originally Tlingit territory, Kasaan gets its name from the Tlingit word meaning "pretty town." Haidas migrated north from the Queen Charlotte Islands in the early 1700s to the Island and established the village known as "Old Kasaan." In 1898 the Copper Queen mine, camp, sawmill, post office, and store were built on Kasaan Bay, and the Haida people subsequently relocated to this new site in 1904.

A Federally recognized tribe, the Organized Village of Kasaan, is located in the community. Traditionally a Haida village, the population now includes Tlingits, Eskimos, and non-Natives, as well as Haidas. The community had a total estimated population of 75 in 2014, with the population almost doubling between 2000 and 2014 (Figure 3.23-32). Alaska Natives comprise about 35 percent of the local population, with 53 percent of the population identifying as White in the 2010 Census (U.S. Census Bureau 2011).

Kasaan's population grew by 80 percent between 1970 and 1990. The population declined between 1990 and 2000, decreasing by 15 people or 28 percent. The population has nearly doubled since 2000, with an estimated 75 people living in Kasaan in 2014 (Alaska DOL 2015b). A total of 12 students were enrolled in the Barry C. Stewart Kasaan School in 2014 (Table 3.23-9).

Figure 3.23-32
Kasaan Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The majority of local residents are employed in the public sector. Two residents held commercial fishing permits and most villagers participate in subsistence for food sources, harvesting deer, salmon, halibut, shrimp, and crab. One tourism-related business operates in the village, providing meals and lodging for visitors (Dugan et al. 2009). Local residents use parts of the project area for subsistence and recreation activities.

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 19 percent of the labor force in Kasaan was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $43,750, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	1	4
Construction	1	4
Manufacturing	0	0
Trade, Transportation and Utilities	2	8
Information	0	0
Financial Activities	0	0
Professional and Business Services	2	8
Educational and Health Services	0	0
Leisure and Hospitality	2	8
State Government	2	8
Local Government	16	62

Employment by Industry in 2013	Number	Percent of Total
Other	0	0
Unknown	0	0
Total Employment	**26**	**100**
Source: Alaska DOL 2015d		

Kasaan is part of the AP&T system that connects the community with the communities of Coffman Cove, Craig, Hollis, Hydaburg, Klawock, and Thorne Bay. Kasaan is served by hydroelectric generation, with diesel generation used as a back-up. Residential rates for 2011 before and after the application of PCE payments were 24 cents/kWh and 16 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 24 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Kasaan in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-33. This area contains 540,324 acres of NFS land (among other land ownerships). Table 3.23-33 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Kasaan, ranging from about 2.3 percent (Alternative 1) to 4.0 percent (Alternative 2). Harvest activities could have localized effects if they coincide with a particular location favored by Kasaan residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternative 2; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-33).

Figure 3.23-33
Kasaan's Community Use Area

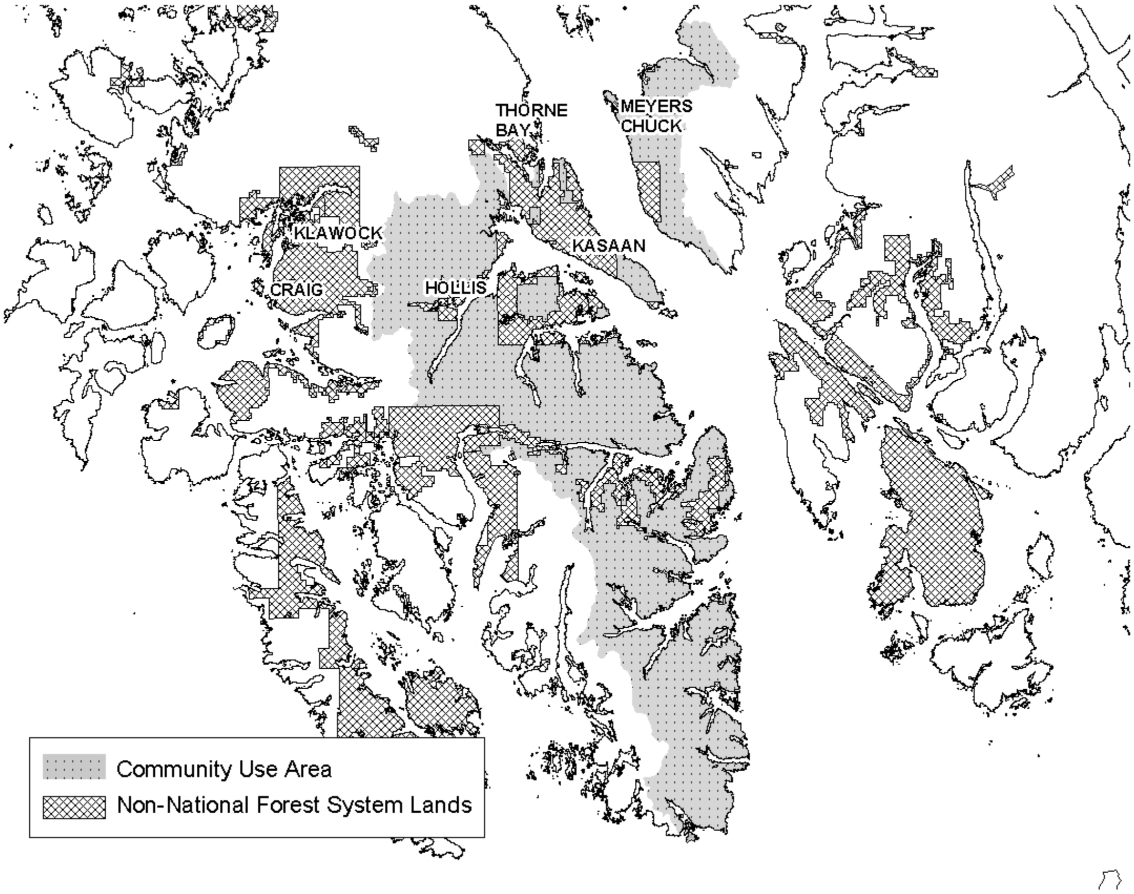


Table 3.23-33
Estimated Maximum Harvest (acres) over 100 Years in Kasaan's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	9,329	19,061	17,845	11,390	12,858
Old Growth	2,630	1,611	1,913	2,008	2,282
Total	**11,959**	**20,672**	**19,758**	**13,397**	**15,140**
Harvest as a Percent of Total NFS Lands in the Community Use Area	2.3%	4.0%	3.8%	2.6%	2.9%

Economy

Subsistence use and commercial fishing are the primary elements of Kasaan's economy. Commercial fisheries employment is not likely to be affected under any of the alternatives. Much of the timber harvest in the vicinity of Kasaan has historically been on private land owned by the Kasaan Native Corporation. This land would not be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 74 percent of the total edible pounds of subsistence resources harvested by Kasaan households (Kruse and Frazier 1988) and 75 percent of per capita harvest in 1998 (ADF&G 2014).

The 1988 TRUCS survey found that deer account for 22 percent of the total edible pounds of subsistence resources harvested by Kasaan households (Kruse and Frazier 1988). Deer accounted for 15 percent of per capita subsistence harvest by Kasaan residents in 1998 (ADF&G 2014).

The majority of deer harvest by Kasaan residents takes place near the community on north Prince of Wales Island, which is included in GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Kasaan residents, total annual deer harvest is generally low, but has increased over the past decade. In 2013 deer harvest was more than four times as high (23 more deer) as it was in 2004 (ADF&G 2015b).

Residents of Kasaan harvest the majority (87 percent) of their deer from two WAAs (Table 3.23-34). The Kasaan portion makes up 2 percent of the total combined harvest and 4 percent of the rural hunter harvest in these WAAs. About 42 percent of the combined harvest in these WAA is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Table 3.23-34
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Kasaan Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Kasaan Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1315	9	201	317	56%	50%	51%	50%	51%	50%
1214	4	120	235	77%	71%	72%	71%	72%	71%

[1] Calculated based on harvest where location is known
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Both WAAs are in areas with substantial past timber harvest and, therefore, deer habitat capabilities are currently estimated to be considerably below 1954 levels (Table 3.23-34). Under each of the alternatives, additional harvest would occur that would further reduce habitat capabilities after 100 years by 5 to 6 percent (Table 3.23-34).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted in the Kasaan community use area by Kasaan residents and all rural hunters in the short term, as well as Kasaan residents in the long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Kasaan's community use area than the alternatives considered in this EIS (approximately 4 to 13 times higher).

Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long term for deer hunted by Kasaan residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to support deer populations sufficient to avoid effects on hunter success for all rural hunters and all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Kasaan residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. Kasaan is currently competing with other communities in their subsistence use areas and this is likely to continue to be the case under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Kasaan's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Ketchikan

Affected Environment

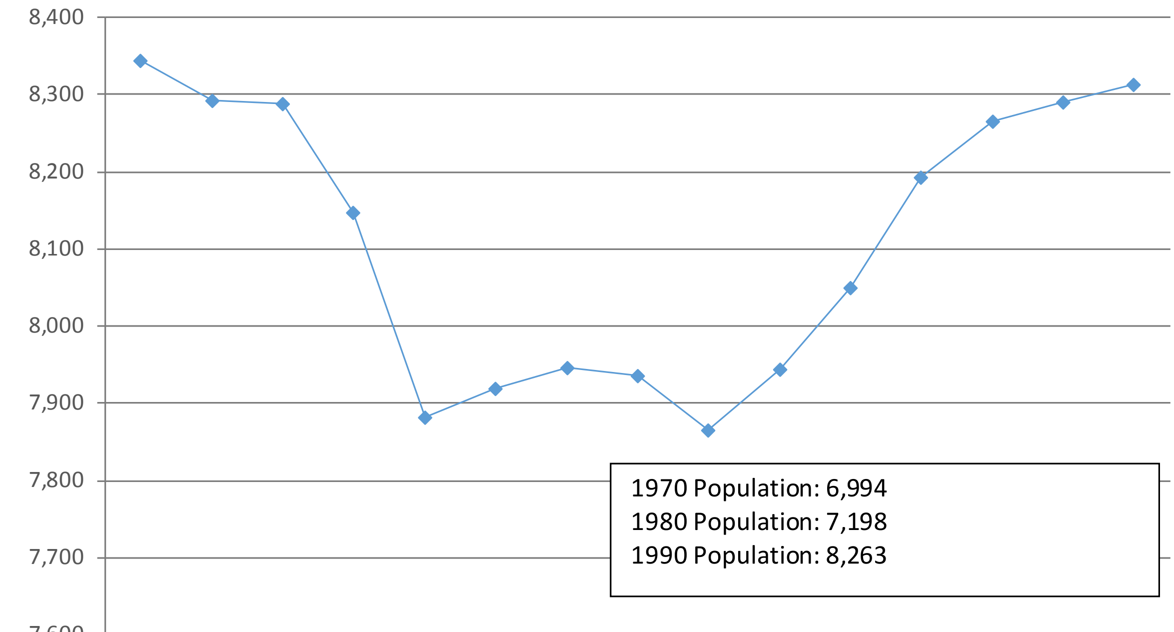
Overview and Demographic Characteristics

Ketchikan is located on Revillagigedo Island near the southernmost boundary of Alaska. Ketchikan lies approximately 679 miles north of Seattle and 235 miles south of Juneau. It is the first Alaska port-of-call for northbound ships. According to the 2010 Census, Ketchikan had a population of 8,050, with Alaska Natives comprising 17 percent of the total (U.S. Census Bureau 2011).

The Ketchikan area was a summer fishing camp for the Tlingit Alaska Natives. Their name for the area, "kitschk-him," meant "thundering wings of an eagle." Its abundant fish and timber resources eventually attracted non-Natives, with the first cannery opening in Ketchikan in 1886 and four more by 1912. Nearby gold and copper discoveries briefly brought activity to Ketchikan during the late 1890s, but timber and fishing became the chief economic forces at the turn of the century and have remained important. The 1954 construction of a pulp mill in Ward Cove continued a tradition begun by the 1903 opening of Ketchikan Spruce Mills, which operated for more than 70 years. Ketchikan has also remained an important hub for fishing, both for fish processing and as home to those with commercial fishing permits (295 area residents in 2013).

The population of Ketchikan increased by 18 percent between 1970 and 1990 and has remained relatively stable since, with the exception of noticeable drops in 2004 and 2008 (Figure 3.23-34). The population has been increasing since 2008, with an estimated population of 8,314 in Ketchikan in 2014 (Alaska DOL 2015b). A total of 2,360 students were enrolled in the Ketchikan Gateway Borough School District in 2014 (Table 3.23-9).

Figure 3.23-34
Ketchikan Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Ketchikan	8,345	8,293	8,289	8,148	7,882	7,920	7,947	7,935	7,865	7,944	8,050	8,194	8,265	8,291	8,314

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Ketchikan is an industrial center and a major port of entry in Southeast Alaska. It has a diverse economy, supported by a large fishing fleet, fish processing facilities, timber and tourism. The estimated gross fishing earnings of local residents neared $23 million in 2013 (ACFEC 2015). Four canneries, three cold storage facilities, and a fish processing plant support the fishing industry in summer months.

While the timber industry remains important to the economy and a home base for several timber companies, the Ketchikan Pulp Corporation's pulp mill closed in March 1997. Closure of the mill, the community's largest employer, resulted in the loss of 500 direct jobs, many of which were high paying and year round. The Pacific Log and Lumber sawmill, which in 2006 employed 20 people, is also now decommissioned (Parrent and Grewe 2014). Employment data compiled by the Alaska DOL indicate that employment in the lumber and wood products sector declined from 11.8 percent of total wage and salary employment in 1996 to 5.7 percent in 1999 (Baker 2001), and now represents only one percent of employment (Alaska DOL 2015d).

Tourism and local retail are growing economic sectors. In 2009, an estimated 937,419 people visited Ketchikan on cruise ships (Himes-Cornell et al. 2013). Ketchikan has a well-developed network and system of shore-excursions, with 47 shore excursions advertised by the various cruise lines that dock there (Dugan et al. 2009). Most nature-based activities that originate in Ketchikan fell into four general categories: flightseeing, marine charters, adventure experiences, and general sightseeing. In all cases, the majority of clients participating in these activities were cruise ship passengers (Dugan et al. 2009).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 11 percent of the labor force in Ketchikan was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014; Alaska DOL 2015d). Median household income was $52,266, compared to the state median of $70,760 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	25	1
Construction	180	5
Manufacturing	262	7
Trade, Transportation and Utilities	914	25
Information	47	1
Financial Activities	194	5
Professional and Business Services	127	4
Educational and Health Services	466	13
Leisure and Hospitality	422	12
State Government	353	10
Local Government	564	16
Other	59	2
Unknown	0	0
Total Employment	**3,613**	**100**

Source: Alaska DOL 2015d

Ketchikan is served by the SEAPA system that connects Ketchikan, Petersburg, and Wrangell. The Swan Lake and Tyee Lake hydroelectric projects provide electricity to this SEAPA network (Table 3.12b-2). Residential rates for 2011 before and after the application of PCE payments were both 10 cents/kWh (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 10 cents/kWh and 8 cents/kWh, respectively.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Ketchikan in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-35. This area contains 1,975,122 acres of NFS land (among other land ownerships). Table 3.23-35 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Ketchikan, ranging from about 1.4 percent (Alternative 1) to 2.0 percent (Alternatives 2 and 3). Harvest activities could have localized effects if they coincide with a particular location favored by Ketchikan residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternative 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-35).

Figure 3.23-35
Ketchikan's Community Use Area

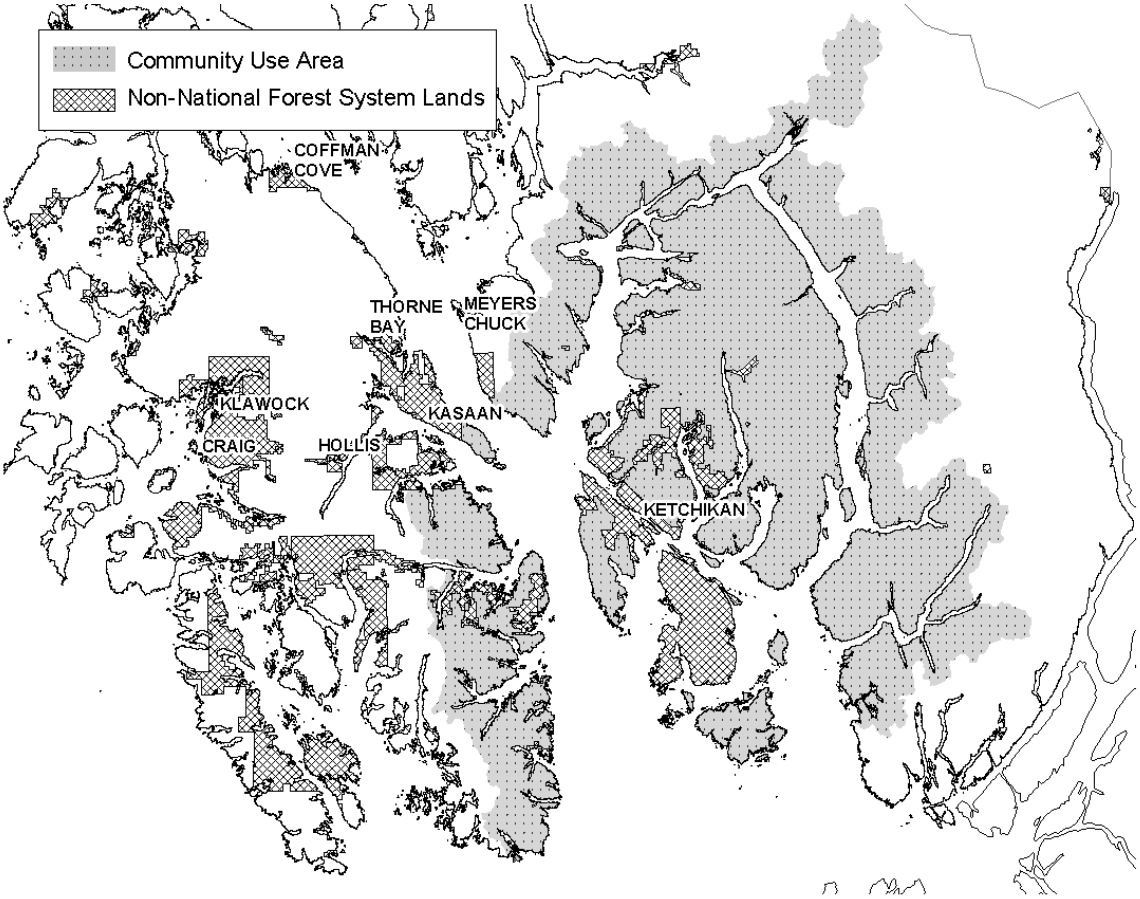


Table 3.23-35
Estimated Maximum Harvest (acres) over 100 Years in Ketchikan's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	21,384	36,253	35,219	28,464	29,626
Old Growth	6,006	3,149	4,502	4,853	5,618
Total	**27,390**	**39,403**	**39,721**	**33,317**	**35,244**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.4%	2.0%	2.0%	1.7%	1.8%

Economy

Ketchikan would be primarily influenced by changes in timber processing, recreation and tourism use, commercial fishing, and recreation opportunities. Potentail impacts on timber processing are discussed in the *Regional and National Economy* section, above. None of the alternatives are expected to affect recreation and tourism-related employment or employment in the commercial fisheries sector.

Subsistence

Ketchikan is not classified as a subsistence community; however, many residents use the surrounding Tongass for hunting and fishing. Given the non-subsistence status of the community and its large size, no attempt is made here to summarize the WAAs that community residents use to hunt deer. The following paragraphs do, however, summarize the findings of the 1997 EIS and provide a general overview of the likely impacts of the current alternatives.

The majority of deer harvest by Ketchikan residents likely takes place within the community's identified use area (Figure 3.23-15), which is mainly located within GMU 1A and GMU 2. As of 2013, deer numbers were at very low levels throughout most of GMU 1A and were no longer meeting local hunter demands or established deer harvest objectives (Harper 2013). Though not closed, starting in 2011 the deer hunting season was shortened to August 1 through November 30 instead of continuing through December. Hunters are known to be shifting efforts to other more productive areas, such as nearby GMU 2, leading to less hunter effort and fewer deer harvested in GMU 1A (Harper 2013). In GMU 2, following a deer population decline from 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by all hunters in the short term. However, projected deer harvest in the long term by Ketchikan residents, all rural hunters, and all hunters exceeded the level that is both sustainable and provides a reasonably high level of hunter success for their effort. If a restriction were necessary, sport hunting by Ketchikan residents would be restricted before subsistence hunting by rural hunters is restricted.

In summary, use of most subsistence resources by Ketchikan residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all current alternatives.

Klawock

Affected Environment

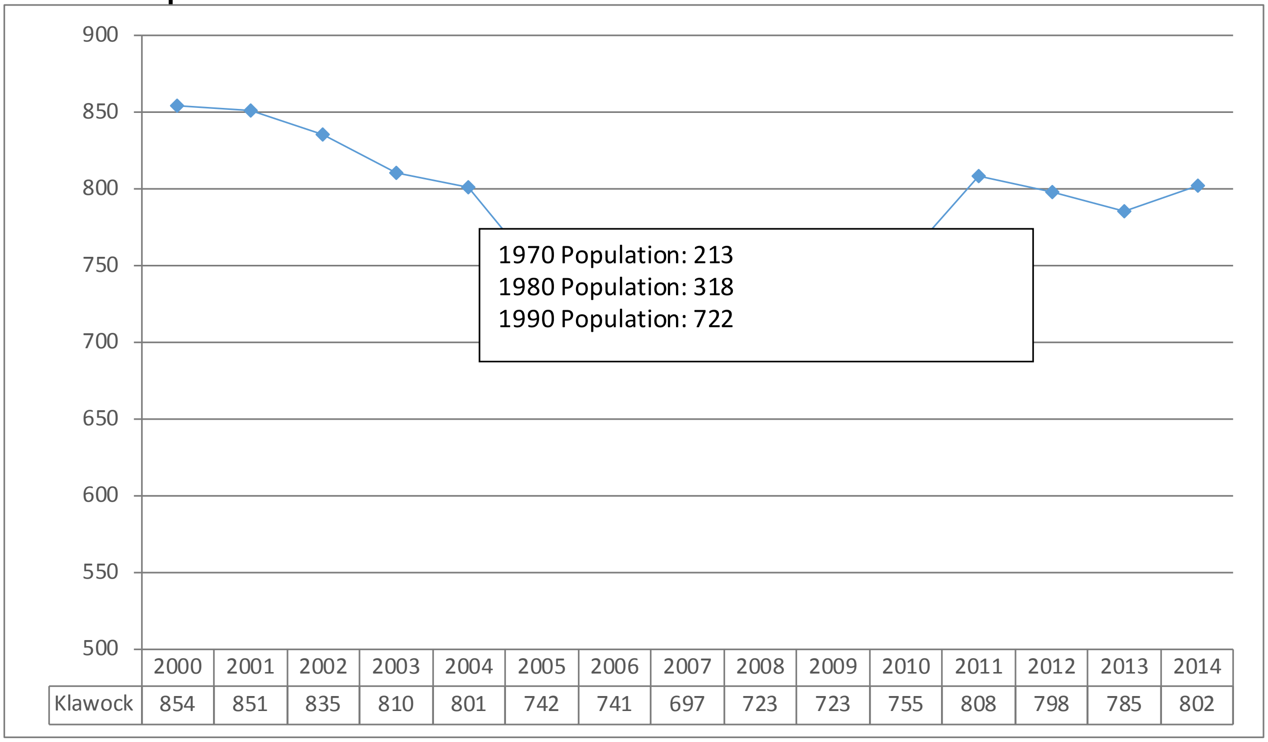
Overview and Demographic Characteristics

Klawock, located on the west coast of Prince of Wales Island, is the second largest community on the island. The mouth of the Klawock River, where the village of Klawock is now located, has been the site of Tlingit occupation for at least 600 years and now serves as the center of the Tlingit population on west Prince of Wales Island. A trading post and salmon saltery were established in the community in 1868, and the first cannery in Alaska was built here by a San Francisco firm in 1878. Klawock was incorporated as a first-class city in 1929.

A federally recognized tribe—the Klawock Cooperative Association—is located in the community. The community had a total population of 802 in 2014, approximately 52 or 6 percent fewer residents than 14 years earlier in 2000 (Figure 3.23-36). Population has fluctuated over this period, dropping to a low of 697 residents in 2007. Alaska Natives comprise about 48 percent of the local population, with 37 percent of the population identifying as White in the 2010 Census (Table 3.23-8).

School enrollment in Klawock has declined since 2000, dropping from 190 students in 2000 to 121 students in 2014 (Table 3.23-9).

Figure 3.23-36
Klawock Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Klawock	854	851	835	810	801	742	741	697	723	723	755	808	798	785	802

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The community has been historically dependent on fishing and cannery operations; however, the timber industry has increased in importance with a relatively large number of residents employed in logging and ship loading in the Klawock and Craig area (ADCCED 2011). Viking Lumber is located between Klawock and Craig. A total of 39 residents held commercial fishing permits in 2013 (ACFEC 2015).

Retail trade and services are also important to the economy of Klawock. Many residents of communities on northern Prince Wales, as well as recreationists and tourists shop at the shopping center located in Klawock. There are also three sport fishing lodges that provide charter and accommodation packages, as well as an independent operator offering day charters. Klawock also has two recreational vehicle (RV) parks that mostly serve long-term visitors (Dugan et al. 2009).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 16 percent of the labor force in Klawock was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $37,083, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	20	5
Construction	33	8
Manufacturing	28	7
Trade, Transportation and Utilities	90	23
Information	1	< 1
Financial Activities	13	3
Professional and Business Services	7	2
Educational and Health Services	59	15
Leisure and Hospitality	36	9
State Government	9	2
Local Government	92	24
Other	4	1
Unknown	0	0
Total Employment	**392**	**100**

Source: Alaska DOL 2015d

Klawock is part of the AP&T system that connects the community with the communities of Coffman Cove, Craig, Hollis, Hydaburg, Kasaan, and Thorne Bay. Klawock is served by hydroelectric generation, with diesel generation used as a back-up. Residential rates for 2011 before and after the application of PCE payments were 24 cents/kWh and 16 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 24 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Klawock in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-37. This area contains 767,934 acres of NFS land (among other land ownerships). Table 3.23-36 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 7.7 percent of the Klawock community use area under Alternative 1 to 10.6 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular location favored by Klawock residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-36).

Figure 3.23-37
Klawock's Community Use Area

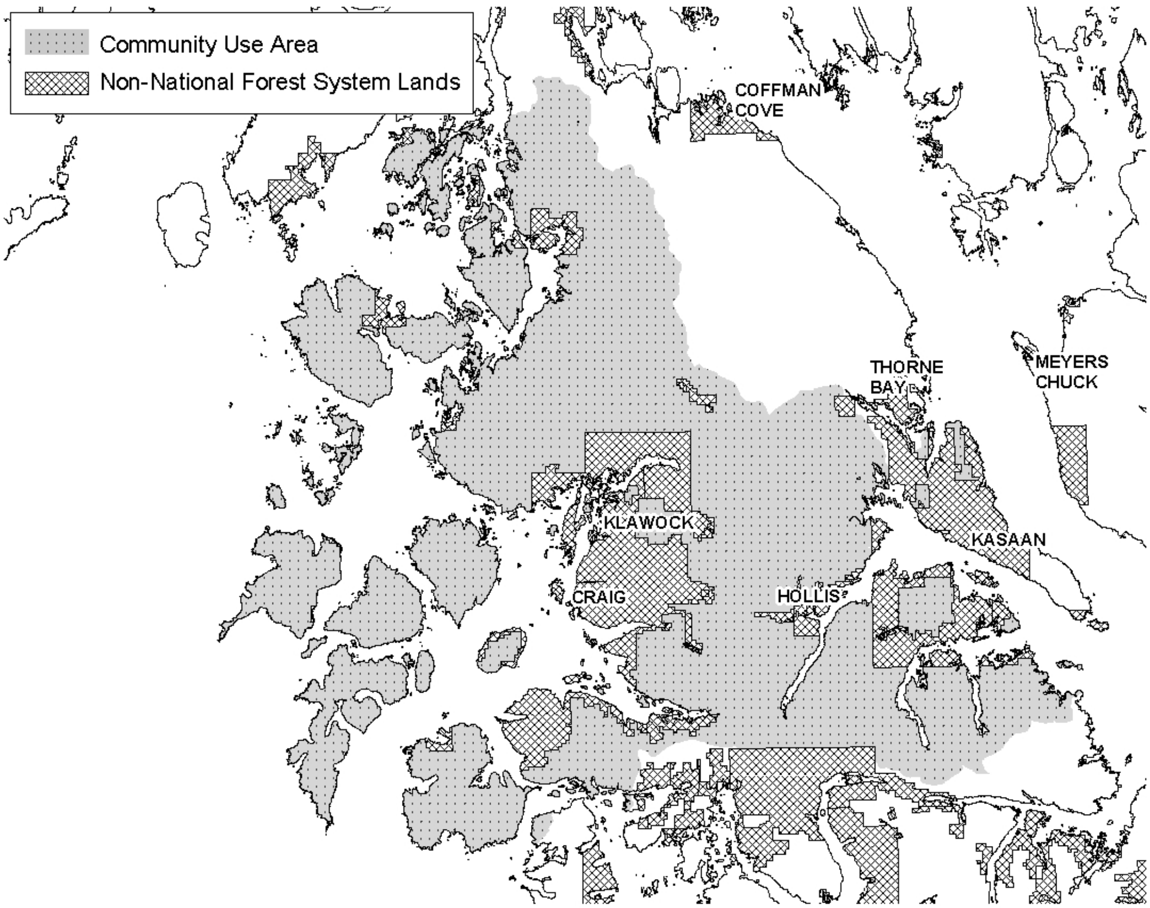


Table 3.23-36
Estimated Maximum Harvest (acres) over 100 Years in Klawock's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	47,273	73,058	68,617	56,495	60,686
Old Growth	9,442	4,955	5,525	7,505	7,738
Total	**56,715**	**78,013**	**74,142**	**64,000**	**68,424**
Harvest as a Percent of Total NFS Lands in the Community Use Area	7.7%	10.6%	10.1%	8.7%	9.3%

Economy

Klawock is a traditional native community. Timber employment, subsistence use, and retail services are most likely to be affected in this community. Viking Lumber, the largest and most modern sawmill in the region, is located between Craig and Klawock. The alternatives would all supply old-growth volume to support operations in Southeast Alaska in the short term, including Viking Lumber, but the amount of old-growth timber available for sale would decrease over time as the Forest Service completes the transition to young growth. The speed of the transition and the relative and absolute volumes of young growth would vary by alternative as discussed in the *Regional and National Economy* section, above.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 75 percent of the total edible pounds of subsistence resources harvested by Klawock households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 71 percent of per capita subsistence harvest in Klawock in 1997 (ADF&G 2014). The 1988 TRUCS study found that deer accounted for 19 percent of the total edible pounds of subsistence resources harvested by Klawock households (Kruse and Frazier 1988). Deer accounted for 15 percent of per capita subsistence harvest by Klawock residents in 1997 (ADF&G 2014).

Klawock residents mainly harvest deer on north Prince of Wales Island, which is included in GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Klawock residents, total annual deer harvest has generally increased over the past decade, and in 2013 was 71 percent higher (183 more deer) than in 2004 (ADF&G 2015b).

Residents of Klawock harvest the majority (74 percent) of their deer from eight WAAs (Table 3.23-37). The Klawock portion represents from about 5 percent (WAA 1420) to 34 percent (WAA 1318) of the total harvest and about 9 percent to 42 percent of the rural hunter harvest in these WAAs. About 34 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a limited harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Most of the WAAs identified in Table 3.23-37 occur in areas with substantial past harvest and, therefore, deer habitat capabilities are currently estimated to be below 1954 levels. Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years in all of the WAAs except for one (WAA 1107) by 1 to 7 percent (Table 3.23-37).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Klawock residents in the short term and long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Klawock's community use area than the alternatives considered in this EIS (approximately 107 to 325 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long term for deer hunted by Klawock residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to support deer populations sufficient to avoid effects on hunter success for all rural hunters and all hunters in both the short and long terms. This may still be the case under all current alternatives.

Table 3.23-37
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Klawock Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

WAA	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
	Klawock Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1318	67	159	198	90%	83%	85%	84%	84%	84%
1422	65	247	383	57%	50%	52%	51%	50%	50%
1319	28	169	226	74%	67%	67%	69%	69%	69%
1214	26	120	235	77%	71%	72%	71%	72%	71%
1107	22	99	130	99%	99%	99%	99%	99%	99%
1315	21	201	317	56%	50%	51%	50%	51%	50%
1317	19	93	133	58%	56%	56%	56%	56%	56%
1420	15	158	276	49%	45%	45%	45%	45%	44%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

In summary, use of most subsistence resources by Klawock residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within the Klawock subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Metlakatla

Affected Environment

Overview and Demographic Characteristics

Metlakatla is located on Annette Island, 15 miles south of Ketchikan. Believed to have been occupied at one time by Tlingit Indians, Metlakatla was settled in 1887 by Church of England minister William Duncan and about 830 Tsimshian followers from northern British Columbia. In 1891, an Act of Congress declared Annette Island an Indian Reservation (the Annette Island Reserve), the only one in Alaska. This action set aside the reservation for the exclusive use and occupancy by "Metlakatla Indians and such other Natives of Alaska who might join them" (ADF&G 1994).

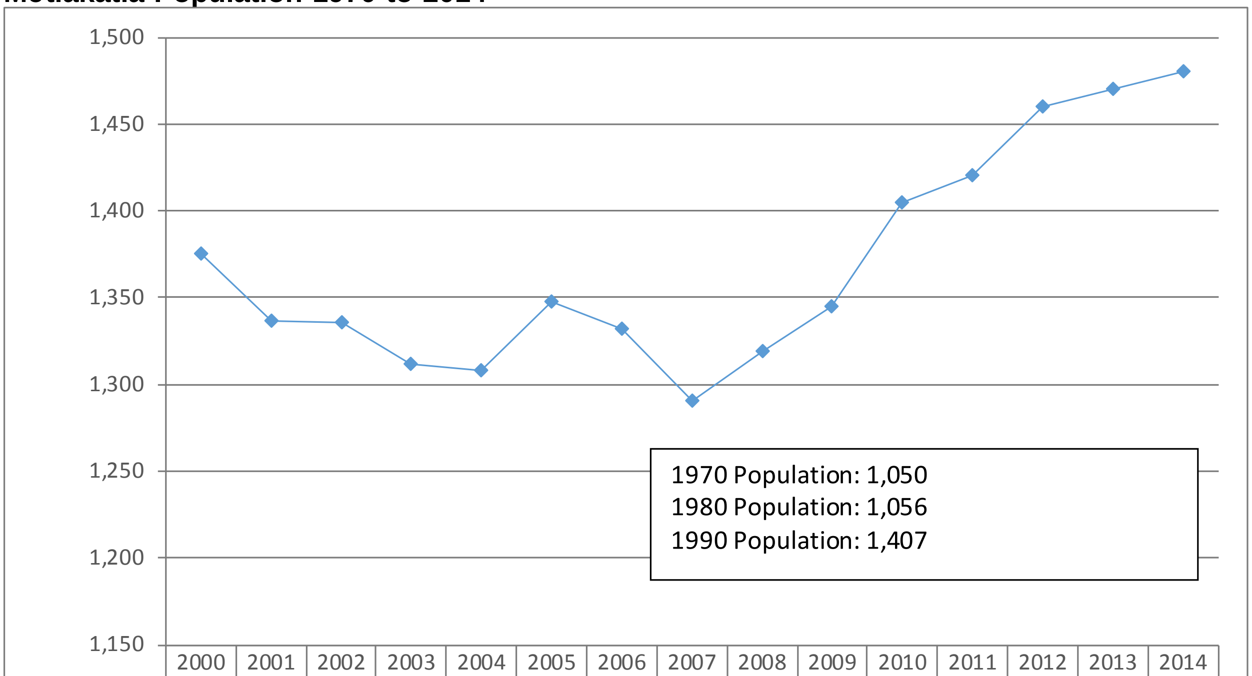
Metlakatla is a traditional Tsimshian community with a subsistence lifestyle. The community was not part of ANCSA. The 86,000-acre Island reservation and surrounding 3,000 feet of coastal waters are not subject to State jurisdiction. The Annette Island Reserve regulates commercial fishing in these waters, and operates its own tribal court system (Alaska DCED 2006).

The population of Metlakatla increased by a third between 1970 and 1990, and has since remained fairly constant. Population has fluctuated over the last 14 years, reaching a low of 1,291 residents in 2007. Population has increased in

Metlakatla since 2007, with an estimated total of 1,407 residents in 2014 (Figure 3.23-38). Alaska Natives comprised 83 percent of the population in 2010 (Table 3.23-8).

A total of 359 students were enrolled in the Annette Island School District in 2014, up from 272 students in 2010 (Table 3.23-9).

Figure 3.23-38
Metlakatla Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Metlakatla	1,375	1,337	1,336	1,312	1,308	1,348	1,332	1,291	1,319	1,345	1,405	1,420	1,460	1,470	1,480

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Metlakatla is a federal Indian reservation with no local taxes. The economy is based primarily on commercial fishing, fish processing, and services (Himes-Cornell et al. 2013). A total of 42 residents held commercial fishing permits in 2013, with estimated gross earnings of $1.6 million (ACFEC 2015). Metlakatla Indian Community, the largest employer, operates a salmon hatchery on Tamgas Creek, the tribal court, and all local services and utilities (Himes-Cornell et al. 2013). Annette Island Packing Co. is a cold storage facility in Metlakatla owned by the community and is the second largest employer (Himes-Cornell et al. 2013). The school district, Metlakatla Housing Authority, the State, Metlakatla Power & Light, and several private companies are also important employers (Himes-Cornell et al. 2013).

Historically the community's economy was also supported by the timber industry; however, the two sawmills located in Metlakatla are no longer in operation (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. Approximately 15 percent of the labor force in Metlakatla was identified as unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census

Bureau 2014b; Alaska DOL 2015d). Median household income was $49,663, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	1	< 1
Construction	18	3
Manufacturing	3	< 1
Trade, Transportation and Utilities	80	12
Information	0	0
Financial Activities	54	8
Professional and Business Services	4	1
Educational and Health Services	12	2
Leisure and Hospitality	11	2
State Government	16	2
Local Government	489	71
Other	1	< 1
Unknown	0	0
Total Employment	**689**	**100**

Source: Alaska DOL 2015d

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Metlakatla in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-39. This area contains 1,975,123 acres of NFS land (among other land ownerships). Table 3.23-38 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Metlakatla, ranging from about 1.4 percent (Alternative 1) to 2.0 percent (Alternatives 2 and 3). Harvest activities could have localized effects if they coincide with a particular location favored by Metlakatla residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-38).

Figure 3.23-39
Metlakatla's Community Use Area

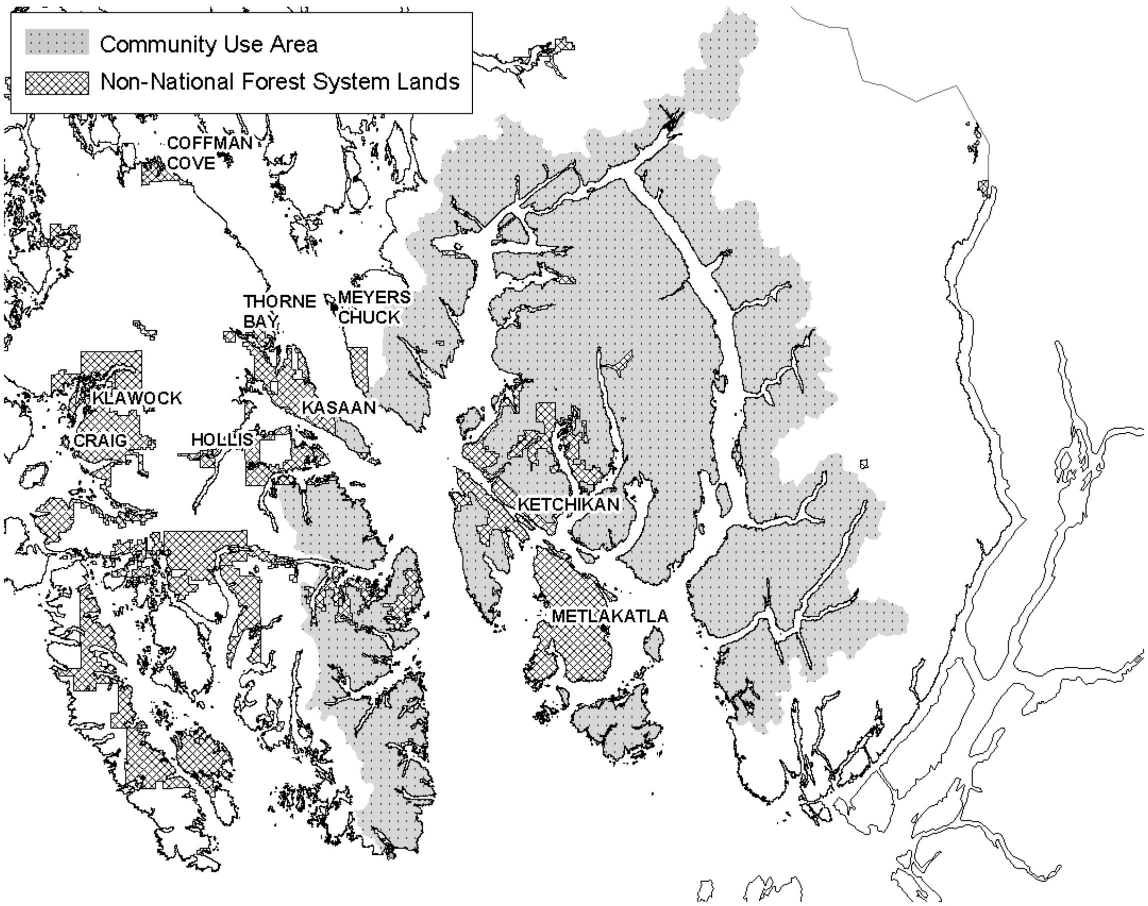


Table 3.23-38
Estimated Maximum Harvest (acres) over 100 Years in Metlakatla's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	21,384	36,253	35,219	28,464	29,626
Old Growth	6,006	3,149	4,502	4,853	5,618
Total	**27,390**	**39,403**	**39,721**	**33,317**	**35,244**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.4%	2.0%	2.0%	1.7%	1.8%

Economy
Metlakatla could be affected primarily by changes in commercial fishing and subsistence opportunities. Commercial fisheries employment is not likely to be affected under any of the alternatives.

Subsistence
No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for

75 percent of the total edible pounds of subsistence resources harvested by Metlakatla households (Kruse and Frazier 1988).

The 1988 TRUCS study found that deer account for 15 percent of the total edible pounds of subsistence resources harvested by Metlakatla households (Kruse and Frazier 1988).

The majority of deer harvest by Metlakatla residents occurs in the vicinity of the community in GMU 1A and on north Prince of Wales Island in GMU 2. As of 2013, deer numbers were at very low levels throughout most of GMU 1A and were no longer meeting local hunter demands or established deer harvest objectives (Harper 2013). Though not closed, starting in 2011 the deer hunting season was shortened to August 1 through November 30 instead of continuing through December. Hunters are known to be shifting efforts to other more productive areas, such as nearby GMU 2, leading to less hunter effort and fewer deer harvested in GMU 1A (Harper 2013). In GMU 2, following a deer population decline from 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Metlakatla residents, total annual deer harvest fluctuated between 2004 and 2013 with a low of 18 deer in 2011 and a high of 97 the next season in 2012 (ADF&G 2015b). As of 2013, harvest remained about 38 percent higher (12 more deer) than in 2004 (ADF&G 2015b).

The majority (72 percent) of deer harvest by Metlakatla residents takes place in ten WAAs (Table 3.23-39). Metlakatla residents account for 1 percent (WAA 1315) to 100 percent (WAAs 0405 and 0406) of the rural harvest in these WAAs, and 1 percent (WAAs 1214 and 1315) to 15 percent (WAA 0405) of all harvest.. About 39 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

The WAAs used by Metlakatla residents occur in areas that have been affected to variable degrees by past timber harvest and, therefore, deer habitat capabilities are currently estimated at 56 to 100 percent of 1954 levels (Table 3.23-39). Two of the 10 WAAs (1107 and 1210) used most by Metlakatla residents would not be affected by any of the alternatives (Table 3.23-39). In the remaining eight WAAs, additional harvest would occur under all alternatives that would reduce habitat capabilities after 100 years by a further 1 to 7 percent (Table 3.23-39).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted in the Metlakatla community use area by Metlakatla residents, all rural hunters, and all hunters in both the short and long terms. Because proposed harvest is substantially less under all current alternatives than in the 1997 analysis, it is likely that all of the current alternatives would also provide sufficient habitat capability for deer hunted by Metlakatla residents, all rural hunters, and all hunters in this area over the course of Forest Plan implementation.

Table 3.23-39
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Metlakatla Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

WAA	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
	Metlakatla Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1107	8	99	130	99%	99%	99%	99%	99%	99%
1318	7	159	198	90%	83%	85%	84%	84%	84%
1422	6	247	383	57%	50%	52%	51%	50%	50%
0405	4	4	25	89%	87%	87%	87%	87%	86%
1214	3	120	235	77%	71%	72%	71%	72%	71%
1421	3	76	102	68%	62%	63%	63%	63%	64%
1315	3	201	317	56%	50%	51%	50%	51%	50%
1210	2	4	31	100%	100%	100%	100%	100%	100%
0406	2	2	55	76%	72%	74%	72%	72%	71%
0509	2	2	19	95%	93%	94%	93%	94%	93%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Meyers Chuck

Affected Environment

Overview and Demographic Characteristics

Meyers Chuck is a small fishing village on the northwest tip of Cleveland Peninsula, 40 miles northwest of Ketchikan. According to the 2000 Census, Meyers Chuck had a 2000 population of 21, none of whom were Alaska Native (U.S. Census Bureau 2001). As noted earlier, effective June 1, 2008, Meyers Chuck was incorporated into the Wrangell City and Borough CA and its population is no longer separately counted or estimated by the federal or state government.

Beginning as a protected anchorage for fishing vessels, Meyers Chuck grew with the building of a cannery in Union Bay in 1916. Postal service began in 1922. Fishing and fish processing, and support services sustained the community until the mid-1900s. Fishing and fish processing are still the basic sources of income in the community.

Meyers Chuck's population was the same in 1990 as it was in 1970, but declined by 16 residents, or 43 percent, between 1990 and 2000. The population declined by a further 6 people or 29 percent between 2000 and 2005. Total estimated population was 11 in Meyers Chuck in 2006 (Alaska DOL 2007).

Year	1970	1980	1990	2000	2005	2006
Population	37	50	37	21	15	11

Source: USDA Forest Service 1997a; U.S. Census Bureau 2001; Alaska DOL 2007

Economic Conditions

The Meyers Chuck economy is primarily based on fishing with ten residents holding commercial fishing licensees in 2013, bringing in over $300,000 in estimated gross earnings (ACFEC 2015). Due to the relatively few cash opportunities, many residents depend on subsistence activities (Alaska DCED 2002).

Employment by industry data for Meyers Chuck were not available. The 2000 U.S. Census identified 3 people as employed in a potential workforce of 13 residents. While no adults in Meyers Chuck were identified as unemployed and seeking work in 2000, 77 percent of the population was identified as unemployed and not seeking work. Meyers Chuck has no central utility system and residents rely upon individual generators.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Meyers Chuck in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-40. This area contains 380,308 acres of NFS land (among other land ownerships). Table 3.23-40 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Meyers Chuck, ranging from about 0.4 percent (Alternatives 1 and 4) to 0.8 percent (Alternative 3). Harvest activities could have localized effects if they coincide with a particular location favored by Meyers Chuck residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-40).

Figure 3.23-40
Meyers Chuck's Community Use Area

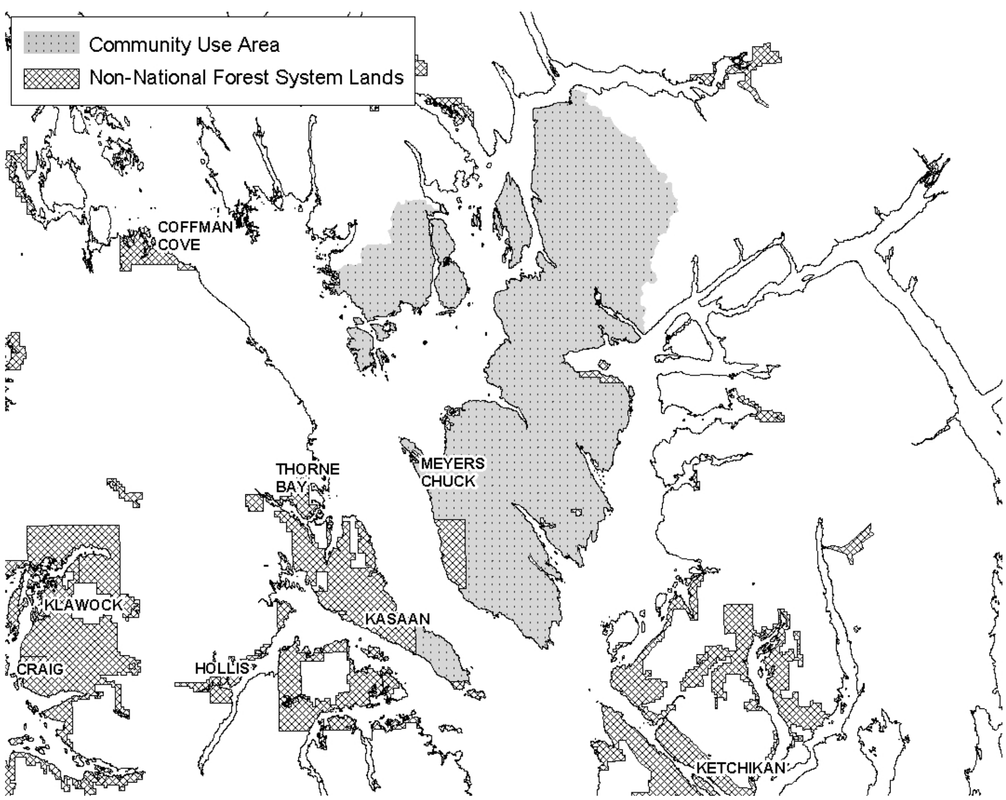


Table 3.23-40
Estimated Maximum Harvest (acres) over 100 Years in Meyers Chuck's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	989	2,326	2,640	1,388	1,554
Old Growth	361	309	386	282	290
Total	**1,350**	**2,635**	**3,025**	**1,670**	**1,844**
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.4%	0.7%	0.8%	0.4%	0.5%

Economy

Meyers Chuck is primarily a fishing community and would be primarily influenced by changes in fishing. Commercial fishing is not likely to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 80 percent of the total edible pounds of subsistence resources harvested by Meyers Chuck households (Kruse and Frazier, 1988).

The 1988 TRUCS study found that deer account for 5 percent of the total edible pounds of subsistence resources harvested by Meyers Chuck households (Kruse and Frazier, 1988).

Data were not provided for Meyers Chuck in the ADF&G deer harvest reports for 2004 to 2013. The majority of deer harvest by Meyers Chuck residents likely takes place in GMU 1A and GMU 2. As of 2013, deer numbers were at very low levels throughout most of GMU 1A and were no longer meeting local hunter demands or established deer harvest objectives (Harper 2013). Though not closed, starting in 2011 the deer hunting season was shortened to August 1 through November 30 instead of continuing through December. Hunters are known to be shifting efforts to other more productive areas, such as nearby GMU 2, leading to less hunter effort and fewer deer harvested in GMU 1A (Harper 2013). Following a deer population decline from 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013).

In summary, use of most subsistence resources (fish and marine invertebrates) by Meyers Chuck residents is not expected to be affected under any of the alternatives. Given the small portion (0.4 to 1.4 percent) of the Meyers Chuck community use area that could be affected by timber harvest, subsistence use of deer is also not likely to be affected under any of the alternatives.

Naukati Bay

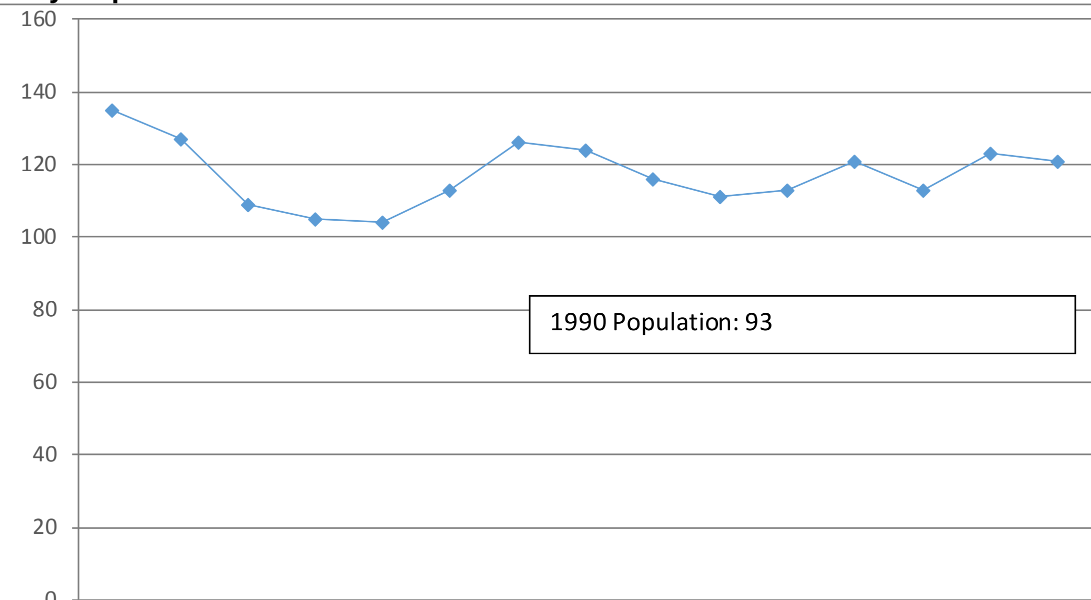
Affected Environment

Overview and Demographic Characteristics

Naukati Bay is located on the northwest coast of Prince of Wales Island. The area was named "Naukatee Nay" in 1904 after the local Native name for the area. The community of Naukati Bay was initially developed as a logging camp, but was later settled as an Alaska Department of Natural Resources land disposal site (Alaska DCED 2006). Naukati Bay is now a Home Owners Association and a 501(c)(4) Corporation; in 2006, the community rejected a proposal to become a second-class city and remains an unincorporated community with a homeowners association (Naukati Bay 2015).

The population of Naukati Bay increased by 42 people or 45 percent between 1990 and 2000. The population has fluctuated since 2000 but overall remained fairly constant, with a total estimated population of 121 in 2014 (Figure 3.23-41). Alaska Natives comprised 6 percent of the population in Naukati Bay in 2010 (Table 3.23-8). A total of 19 students were enrolled in Naukati School in 2014, down from 36 students in 2000 (Table 3.23-9).

Figure 3.23-41
Naukati Bay Population 1990 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Naukati Bay	135	127	109	105	104	113	126	124	116	111	113	121	113	123	121

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Naukati Bay economy is dependent on the timber industry and employment is largely seasonal. The Naukati Logging camp provides log transfer services for several smaller camps on Prince of Wales Island. With help from the State and Forest Service, Naukati Bay built an oyster nursery raising oyster seed and sells the larger oysters to the grow out farms regionally and around Alaska (Naukati Bay 2015). Two residents held commercial fishing permits in 2013 (ACFEC 2015). Local businesses also include a cabin rental business and one sport fish charter operation (Dugan et al. 2009). A new marina and boat ramp was completed in 2014 (Naukati Bay 2015).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. While no one was estimated to be unemployed and seeking work in 2013, an estimated 20 percent of the population was not in the labor force, which includes seasonal workers interviewed during the off season who were not looking for work (U.S. Census Bureau 2014b). Median household income was $45,750, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	6	13
Construction	12	26
Manufacturing	1	2
Trade, Transportation and Utilities	1	2
Information	1	2
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	12	26
Leisure and Hospitality	2	4
State Government	1	2
Local Government	10	21
Other	1	2
Unknown	0	0
Total Employment	**47**	**100**

Source: Alaska DOL 2015d

Naukati Bay has some of the highest electric rates in Alaska due to the use of diesel-generated power. Residential rates for 2011 before and after the application of PCE payments were 55 cents/kWh and 18 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 55 cents/kWh. In June of 2013, residential rates before and after PCE payments had reached 58 cents/kWh and 36 cents/kWh, respectively (AEDG 2015a). The high cost of energy currently impedes economic development for commercial and industrial ventures (Alexander et al. 2010).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Naukati Bay in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-42. This area contains 1,109,349 acres of NFS land (among other land ownerships). Table 3.23-41 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 9.3 percent of the Naukati Bay community use area under Alternative 1 to 12.2 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular location favored by Naukati Bay residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-41).

Economy

Naukati Bay is primarily a logging community and as such would be directly affected by the amount of logging opportunities on north Prince of Wales Island. Potential impacts to the timber industry are discussed in the *Regional and National Economy* section, above.

Figure 3.23-42
Naukati Bay's Community Use Area

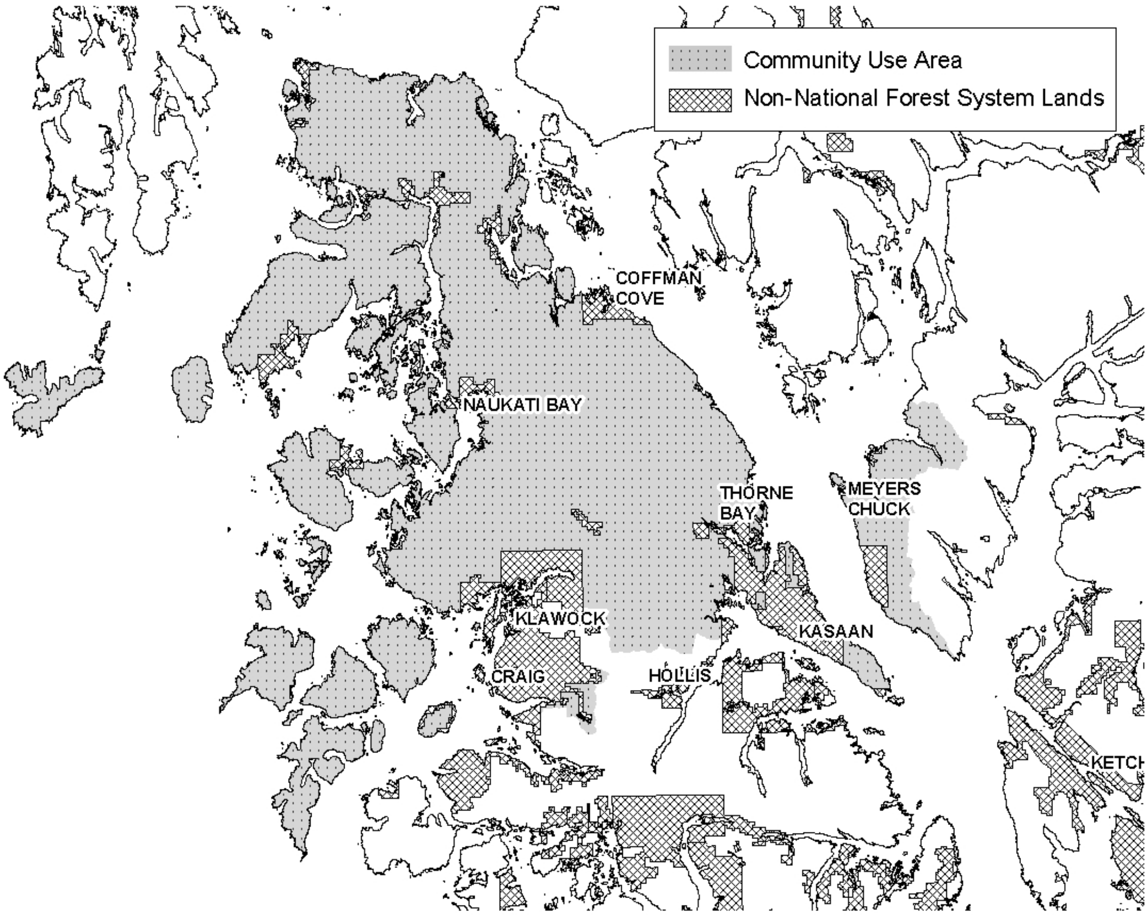


Table 3.23-41
Estimated Maximum Harvest (acres) over 100 Years in Naukati Bay's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	85,483	124,350	118,471	97,431	108,007
Old Growth	14,861	7,317	6,553	10,975	11,537
Total	**100,344**	**131,666**	**125,024**	**108,406**	**119,544**
Harvest as a Percent of Total NFS Lands in the Community Use Area	9.3%	12.2%	11.6%	10.1%	11.1%

Subsistence

Naukati Bay was not surveyed by the Tongass Resource Use Cooperative Survey, and there are no baseline subsistence data for this community. No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. Marine resources (fish and marine invertebrates) accounted for 73 percent of per capita subsistence harvest in Naukati Bay in 1998 (ADF&G 2014). Deer accounted for 19 percent of per capita subsistence harvest by Naukati Bay residents in 1988 (ADF&G 2014).

Naukati Bay residents harvest deer almost entirely on Prince of Wales Island, which is included in GMU 2. Following a deer population decline from 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Naukati Bay residents, total annual deer harvest in 2013 was more than double the 2004 harvest level (34 more deer) (ADF&G 2015b).

Residents of Naukati Bay harvest the majority (73 percent) of their deer from three WAAs on north Prince of Wales Island (1422, 1529, and 1531). As shown in Table 3.23-42, the Naukati Bay portion ranges from 2 percent to 21 percent of the total harvest and from 4 percent to 37 percent of the rural hunter harvest in these WAAs. About 40 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Table 3.23-42
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Naukati Bay Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Naukati Bay Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1422	30	247	383	57%	50%	52%	51%	50%	50%
1531	8	22	39	64%	64%	64%	64%	64%	63%
1529	3	77	154	68%	64%	69%	69%	68%	66%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The three WAAs heavily used by Naukati Bay residents occur in an area with substantial past harvest and, therefore, deer habitat capabilities are currently estimated to be considerably below 1954 levels (Table 3.23-42). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 1 to 7 percent (Table 3.23-42).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted in the Naukati Bay community use area by Naukati residents, all rural hunters, and all hunters in the short term, as well as for Naukati Bay residents in the long term. All of the 1997 alternatives included higher levels of timber harvest in Naukati Bay's community use area than the alternatives considered in this EIS (34 to 247 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long terms for Naukati residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to support deer populations sufficient to avoid effects on hunter success for all rural hunters and all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Naukati Bay residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Naukati Bay's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Pelican

Affected Environment

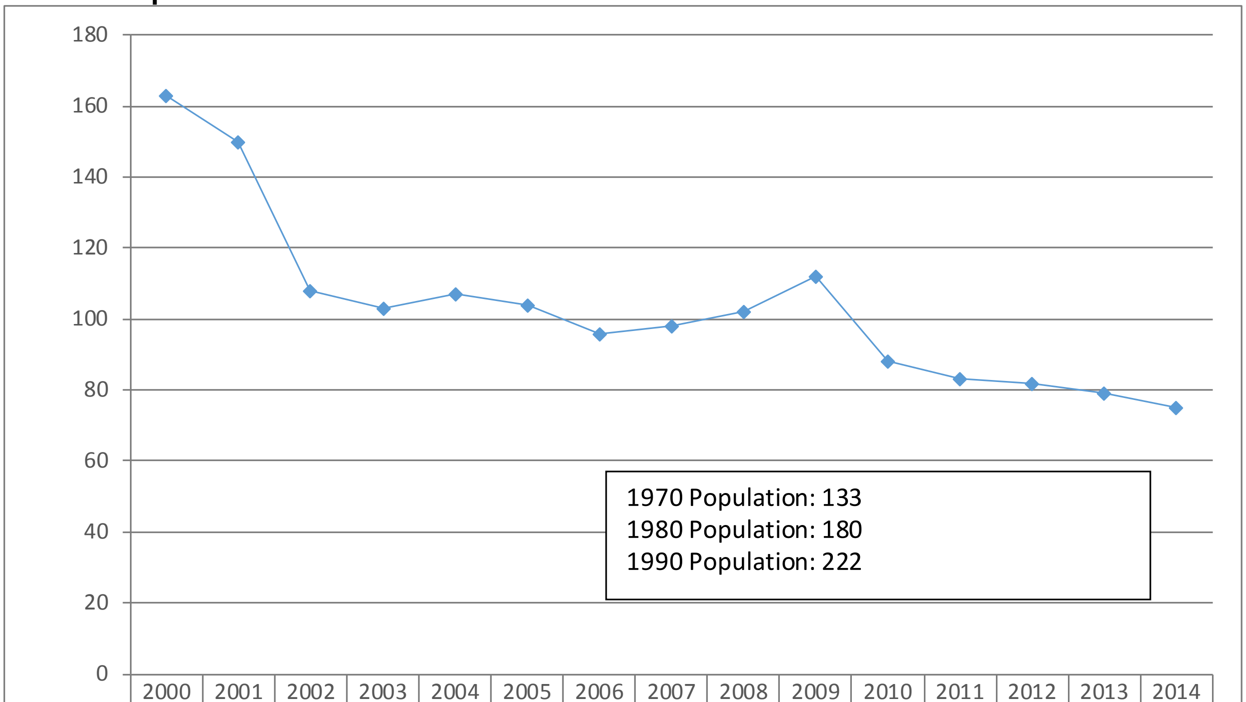
Overview and Demographic Characteristics

Pelican is a fishing village along Lisianski Inlet on the northwest corner of Chichagof Island, located approximately 70 air miles north of Sitka and 70 air miles west of Juneau. Part of the community is built on pilings over tideland. A boardwalk serves as the town's main thoroughfare due to lack of flat land for roads. Prior to its settlement in 1938, the Pelican area was used as a safe harbor by fishermen and as a hunting, fishing, trapping, and gathering site by Hoonah Tlingit groups, who claimed lands on either side of Cross Sound (ADF&G 1994).

Pelican was incorporated in 1943 and is a first-class city with a Strong Mayor form of government. The government includes a seven-person city council including the mayor, a five-person advisory school board, a five-person planning and zoning commission, and a number of municipal employees. The community also has an active local Fish and Game Advisory Committee (ADF&G 2015a). The Native community, largely Tlingit, is represented by a local Tlingit and Haida Community Council. No Native land allotments or withdrawals occur in the immediate vicinity of Pelican. Pelican is accessible via the Alaska Marine Highway System, as well as floatplane from Juneau or Sitka (ADF&G 1994).

The population of Pelican grew by 67 percent between 1970 and 1990, increasing from 133 to 222 residents over this period. The population of Pelican decreased by 59 residents (27 percent) from 1990 to 2000, and has continued to trend downward since 2000, with a total estimated population of 75 residents in 2014 (Figure 3.23-43). Alaska Natives comprised 34 percent of the population in 2010 (Table 3.23-8). School enrollment has also declined since 1990, dropping from 51 students in 1990 to 13 students in 2014 (Table 3.23-9).

Figure 3.23-43
Pelican Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Pelican	163	150	108	103	107	104	96	98	102	112	88	83	82	79	75

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Pelican economy is primarily based on commercial fishing, sport fishing, and tourism. In 2013, 30 residents held commercial fishing permits and brought in estimated gross earnings of just over $1 million (ACFEC 2015). Salmon, halibut, and sablefish are the most important local fisheries. Pelican Seafoods, a fish processing plant that was formerly the largest employer, went through a series of ownership changes and ultimately closed after forecolosure on the last owner in 2010 (Himes-Cornell et al. 2013).

There have been low levels of tourism in Pelican for some time but more recently has begun to play a more important role in the local economy (Dugan et al. 2009). Tourism in Pelican is primarily focused on sport fishing and marine wildlife viewing charters, with 12 marine charters operating out of the town in 2005. The town also serves as a jumping-off point for independent travelers accessing nearby wilderness (Dugan et al. 2009).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 31 percent of the labor force in Pelican was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $89,167, compared to the state median of $70,760; the corresponding median for the Hoonah-Angoon CA was $49,545 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	0	0
Construction	0	0
Manufacturing	1	3
Trade, Transportation and Utilities	2	7
Information	0	0
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	1	3
Leisure and Hospitality	0	0
State Government	4	14
Local Government	21	72
Other	0	0
Unknown	0	0
Total Employment	**29**	**100**

Source: Alaska DOL 2015d

The City of Pelican runs its own 0.7MW run-of-river hydroelectric project that serves the community (Table 3.12b-2). The facility failed during a major flood event in 2009, causing the project to be completely renovated and upgraded over several years. The Pelican Hydroelectric project became operational again in March 2013. The residential rates for 2011 are during the period when the Pelican hydroelectric project power was unavailable and rates increased. At that time, residential rates before and after the application of PCE payments were 69 cents/kWh and 31 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 69 cents/kWh. As of June 2013, residential rates before and after PCE payments were 61 cents/kWh and 47 cents/kWh, respectively (AEDG 2015b).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Pelican in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-44. This area contains 488,851 acres of NFS land (among other land ownerships). As shown in Table 3.23-43, no young-growth or old-growth harvest is projected to take place in the community use area for Pelican over the next 100 years under any alternative; therefore, no timber-harvest-related effects to this area are expected.

Figure 3.23-44
Pelican's Community Use Area

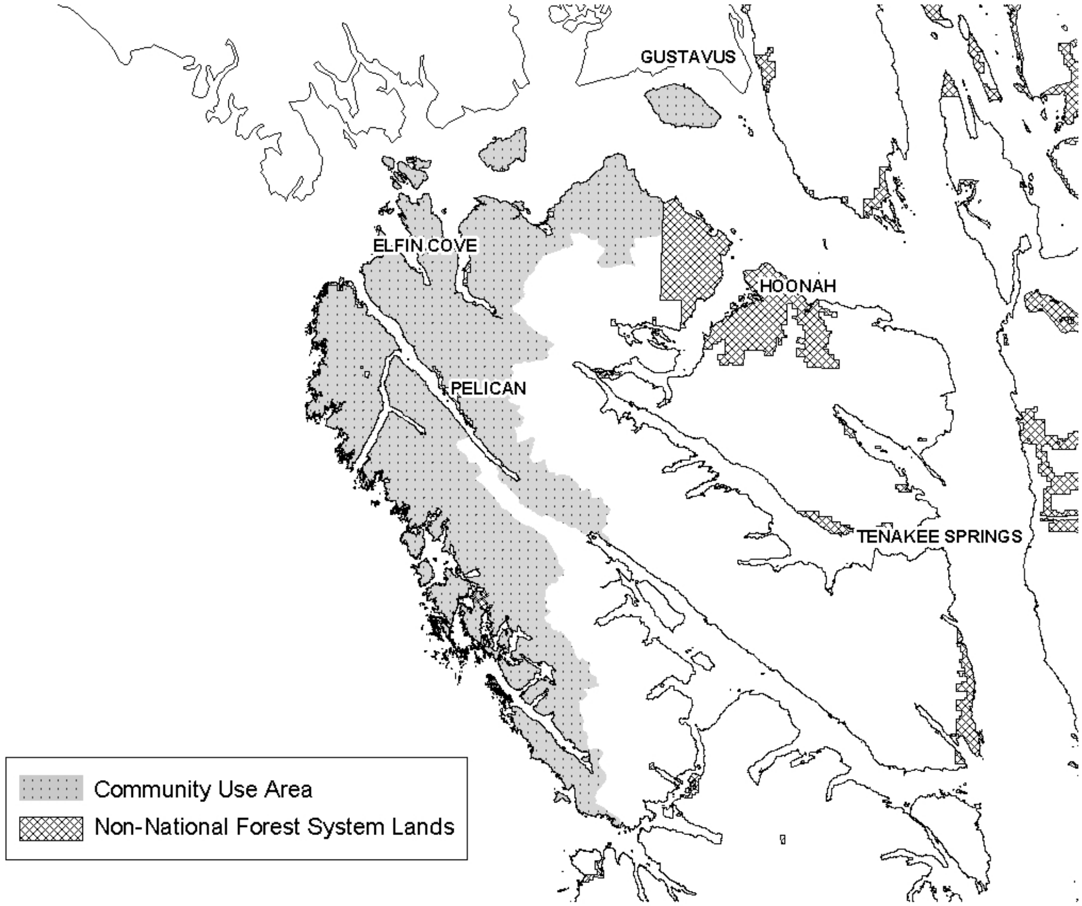


Table 3.23-43
Estimated Maximum Harvest (acres) over 100 Years in Pelican's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	0	0	0	0	0
Old Growth	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.0%	0.0%	0.0%	0.0%	0.0%

Economy
The Pelican economy is primarily based on commercial fishing, sport fishing, and tourism. None of the alternatives are expected to affect these activities.

Subsistence
In terms of subsistence use, Lisianski Inlet, Icy Strait, northwest Chichagof, and Yakobi Island are important areas to Pelican. These areas are presently legislatively withdrawn from timber harvest as either Wilderness or LUD II or

allocated to the Mostly Natural LUDs. Therefore, it is unlikely that subsistence use in Pelican would be directly affected under any of the alternatives.

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 63 percent of the total edible pounds of subsistence resources harvested by Pelican households (Kruse and Frazier, 1988).

The 1988 TRUCS study found that deer account for 30 percent of the total edible pounds of subsistence resources harvested by Pelican households (Kruse and Frazier, 1988).

The WAAs used by Pelican residents for hunting deer lie within GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). However, deer harvest by Pelican residents has generally declined over the past decade, with about 61 percent lower total annual harvest (or 47 fewer deer) in 2013 than in 2004 (ADF&G 2015b).

Pelican residents take the majority (94 percent) of their deer from three WAAs on northwestern Chichagof Island (3417, 3418, and 3419). As shown in Table 3.23-44, these WAAs and, therefore, subsistence deer harvest would not be affected by any of the alternatives.

Table 3.23-44
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Pelican Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Pelican Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3419	20	23	40	100%	100%	100%	100%	100%	100%
3418	13	18	26	100%	100%	100%	100%	100%	100%
3417	6	60	115	100%	100%	100%	100%	100%	100%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Petersburg and Kupreanof

Affected Environment

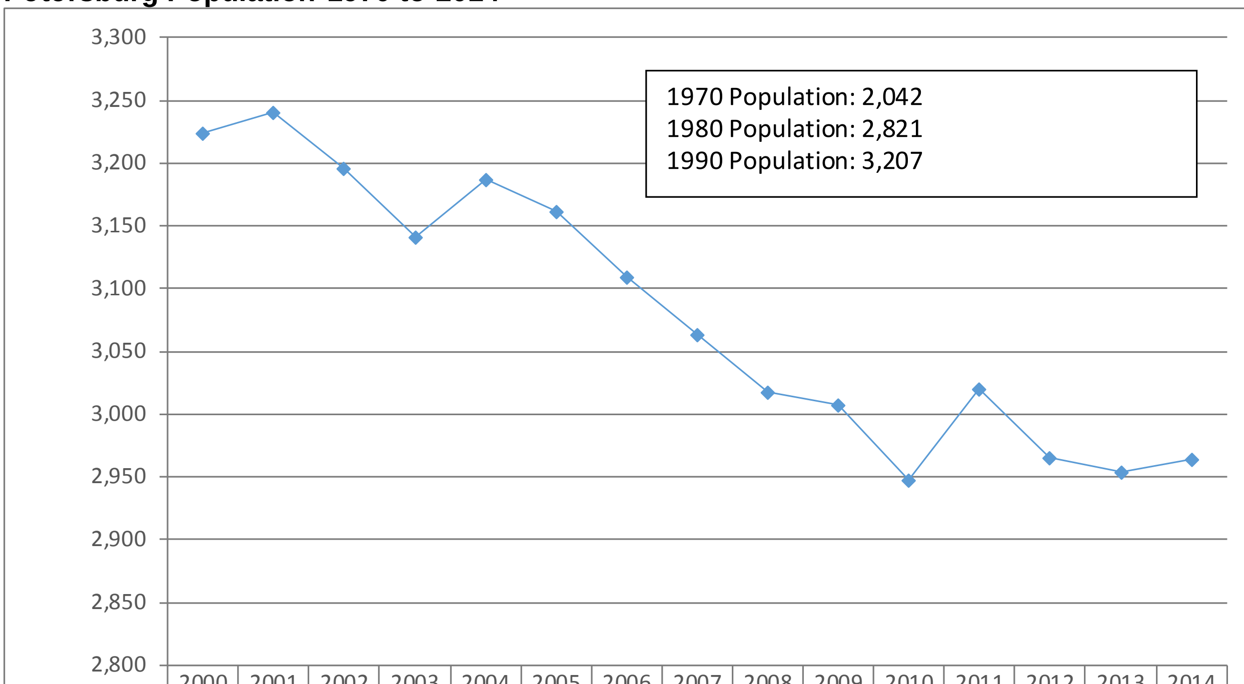
Overview and Demographic Characteristics
Petersburg
Petersburg is located on the northwest end of Mitkof Island, where the Wrangell Narrows meet Frederick Sound. Formerly the City of Petersburg, the community of Petersburg is now part of the larger Petersburg Borough, which includes the former city and the rest of Mitkof Island, part of Kupreanof Island, and the mainland coastline north to Endicott Arm. The City of Petersburg was dissolved in January 2013 and became part of the new home-rule Petersburg Borough at this time.

Tlingit Indians from Kake historically used the north end of Mitkof Island as a summer fish camp, with some reportedly living year-round at the site. Petersburg was named after Norwegian immigrant Peter Buschmann, who arrived in the late 1890s. By 1900, he had built the Icy Strait Packing Company cannery, a sawmill, and a dock. The City incorporated in 1910, and by 1920, 600 people lived in Petersburg year-round. Alaska's first shrimp processor, Alaska Glacier Seafoods, was founded in Petersburg in 1916, and a cold storage plant was built in 1926.

Today, Petersburg is one of Alaska's major fishing communities. Petersburg has one of the largest home-based halibut fleets in Alaska, and is also well-known for shrimp, crab, salmon, herring, and other fish products. Subsistence remains an important part of the local way of life. The community maintains a mixture of Tlingit and Scandinavian history and is known as "Little Norway." Petersburg has a local Fish and Game Advisory Committee, which takes an active interest in resource management issues, meeting three to four times a year (ADF&G 2015a).

The population of Petersburg grew by 57 percent between 1970 and 1990, with the number of residents increasing from 2,042 to 3,207 (Figure 3.23-45). The population remained more or less constant between 1990 and 2000, increasing by less than 1 percent over this period. Petersburg had a total estimated population of 2,964 in 2014, approximately 260 or 8 percent fewer residents than 14 years earlier in 2000. Alaska Natives comprised 7 percent of the population in 2010 (Table 3.23-8). School enrollment has also declined since 2000, decreasing at a faster rate than the population, with a total of 436 students enrolled in 2014 versus 678 students in 2000 (Table 3.23-9).

Figure 3.23-45
Petersburg Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Petersburg	3,224	3,240	3,196	3,141	3,187	3,161	3,109	3,063	3,017	3,008	2,948	3,020	2,965	2,954	2,964

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Kupreanof

The City of Kupreanof is located across the Wrangell Narrows from Petersburg, on the northeast shore of Kupreanof Island. Originally known as West Petersburg, the town was homesteaded around the turn of the century. In 1911, the Knudsen brothers established the first business in town, a small sawmill that produced barrels for salted fish. The Yukon Fur Farm was established in the early 1920s. The farm initially raised foxes, but soon shifted to mink and became the first mink farm in Alaska. During the 1920s, more than 100 people resided in West Petersburg, with residents operating a small store and a gaff hook factory. Businesses in the 1930s and 1940s included a small ship repair facility, an outboard motor shop, commercial logging, and a clam cannery.

Although the Knudsen Mill and Yukon Fur Farm continued to operate until the 1960s, the population fell during the 1950s, dropping from 60 in 1950 to 26 in 1960. The population has since remained stable. The community changed its name to Kupreanof when it incorporated as a second class city in 1975.

Kupreanof is a small, closely knit, non-Native community. All of the homes are built on the waterfront; there are no roads. Residents use skiffs to travel to Petersburg for schooling, goods and services. The majority of Kupreanof's working residents are self-employed although some commute by boat to jobs in Petersburg. Subsistence and recreation uses of resources around Kupreanof supplement household incomes; deer, salmon, halibut, shrimp and crab are favorites. Although located within the boundary for the recently formed Petersburg Borough, the City of Kupreanof continues to exist as a separate municipality. The City has no full-time staff, few services, and no public utilities.

Kupreanof had a total estimated population of 25 in 2014. Population in the community has remained constant for more than two decades with some minor fluctuations. Total estimated population was 23 in 1990 and 2000 (Alaska DOL 1999, 2010a, 2015b).

Economic Conditions

The Petersburg economy is primarily based on the commercial fishing industry (443 residents had commercial fishing permits in 2013). Estimated gross fishing revenues of local residents was approximately $68 million in 2013 (ACFEC 2015). Petersburg is among the top-ranked ports in the United States for quality and value of fish landed. The city includes several processors operating cold storage, canneries, and custom packing services and the state-run Crystal Lake salmon hatchery. Petersburg also has two small active saw mills, and provides supplies and services for many of the area logging camps (Himes-Cornell et al. 2013).

While there is no deep water dock suitable for cruise ships, some small-ship cruise lines stop in Petersburg and local charter boats and fishing lodges draw tourism visitation (Himes-Cornell et al. 2013). In the summer of 2007, about 13,000 people visited Petersburg for nature-based tourism (mainly fishing lodges and charters) generating over $2.7 million in revenue (Dugan et al. 2009).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 4 percent of the labor force in Petersburg was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $66,125, compared to the state median of $70,760; the corresponding median for the Petersburg Borough was $63,934 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	26	2
Construction	69	6
Manufacturing	155	14
Trade, Transportation and Utilities	229	20
Information	18	2
Financial Activities	24	2
Professional and Business Services	34	3
Educational and Health Services	165	14
Leisure and Hospitality	77	7
State Government	67	6
Local Government	253	22
Other	30	3
Unknown	26	2
Total Employment	**1,147**	**100**

Source: Alaska DOL 2015d

Petersburg is served by the SEAPA system that connects Ketchikan, Petersburg, and Wrangell. The Swan Lake and Tyee Lake hydroelectric projects provide electricity to this SEAPA network (Table 3.12b-2). Residential rates for 2011 before and after the application of PCE payments were both 10 cents/kWh (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 12 cents/kWh and 11 cents/kWh, respectively. Three SEAPA hydroelectric projects would help support reliability on the Swan-Tyee Intertie, including Whitman Lake, Swan Lake Expansion, and Mahoney Lake (Table 3.12b-3). Petersburg has been involved in a regional effort to connect hydroelectric systems to sell power and help smaller communities replace their dieslel systems (Alexander et al. 2010).

Kupreanof has no central utility system, and residents rely upon individual generators.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Petersburg in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-46. This area contains 742,197 acres of NFS land (among other land ownerships). Table 3.23-45 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Petersburg, ranging from about 2.9 percent (Alternative 1) to 3.8 percent (Alternative 2). Harvest activities could have localized effects if they coincide with a particular location favored by Petersburg residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-45).

Figure 3.23-46
Petersburg's Community Use Area

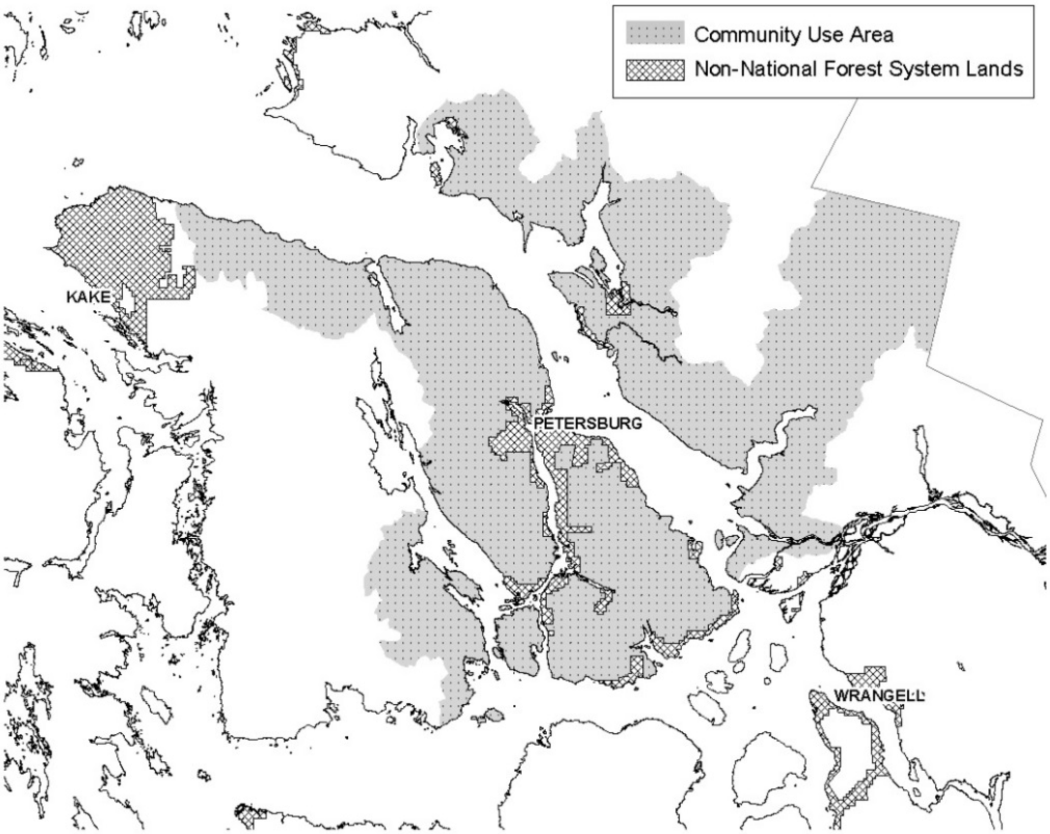


Table 3.23-45
Estimated Maximum Harvest (acres) over 100 Years in Petersburg's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	16,017	24,972	23,692	17,644	20,437
Old Growth	5,760	3,268	3,993	4,390	5,049
Total	**21,777**	**28,240**	**27,685**	**22,034**	**25,486**
Harvest as a Percent of Total NFS Lands in the Community Use Area	2.9%	3.8%	3.7%	3.0%	3.4%

Economy

Commercial fishing is particularly important to Petersburg. Commercial fisheries employment is not likely to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 52 percent of the total edible pounds of subsistence resources harvested by Petersburg households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 86 percent of per capita subsistence harvest in Petersburg in 2000 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 21 percent of the total edible pounds of subsistence resources harvested by Petersburg households (Kruse and Frazier 1988). Deer accounted for 11 percent of per capita subsistence harvest by Petersburg residents in 1987 (ADF&G 2014).

Petersburg residents harvest deer on and around Mitkof and Kupreanof Islands, with the majority of harvest occurring within GMUs 3 and 4. The deer populations within GMU 3 have historically fluctuated with high and low extremes. Between 1994 and 2011, deer harvest ranged from a low of 333 to a high of 1,119 (Harper 2013). As of 2013, the harvest level was about 100 deer below the previous 10-year mean (Harper 2013). GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Petersburg residents, total annual deer harvest appears to have followed a corresponding pattern, dipping after 2006 and then gradually increasing. In 2013, total annual harvest by Petersburg residents was still 32 percent less (209 fewer deer) than in 2004 (ADF&G 2015b).

Seventeen WAAs account for the majority (74 percent) of deer harvest by Petersburg residents. As shown in Table 3.23-46, the Petersburg portion ranges from 2 to 100 percent of all hunters and 4 to 100 percent of all rural hunters in these WAAs, and represents the majority or all of rural hunter deer harvest in 12 of the 17 WAAs. About 30 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a limited harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

In 7 of the 17 WAAs, there would be no effect to deer habitat capability under all alternatives (Table 3.23-46). In the remaining 10 WAAs, all of which currently have deer habitat capability below 1954 levels due to prior timber harvest, deer habitat capability would be further reduced by 1 to 7 percent (Table 3.23-46).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Petersburg residents, all rural hunters, and all hunters in the short term, as well as for Petersburg residents in the long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Petersburg's community use area than the alternatives considered in this EIS (approximately 122 to 516 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long terms for deer hunted by Petersburg residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all rural hunters under the two most timber intensive alternatives and for all hunters under all alternatives in the long term. This may still be the case under all current alternatives.

Table 3.23-46
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Petersburg Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Petersburg Residents	All Rural Hunters[2]	All Hunters	2104	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
5138	56	56	61	80%	73%	76%	75%	73%	72%
2007	43	44	46	75%	72%	73%	72%	73%	71%
3939	42	71	105	100%	100%	100%	100%	100%	100%
3938	30	41	75	100%	100%	100%	100%	100%	100%
3940	30	61	75	93%	93%	93%	93%	93%	93%
1605	24	24	27	77%	76%	76%	76%	77%	74%
1603	18	21	25	94%	94%	94%	94%	94%	94%
1528	18	30	36	78%	76%	78%	78%	78%	78%
1905	16	190	204	73%	68%	71%	71%	67%	67%
1706	14	14	15	100%	100%	100%	100%	100%	100%
1530	12	57	124	61%	58%	60%	59%	58%	57%
1529	10	77	154	68%	64%	68%	68%	68%	66%
5134	9	10	13	89%	89%	89%	89%	89%	89%
5136	9	9	9	84%	74%	81%	81%	76%	77%
1420	7	158	276	49%	45%	45%	45%	45%	44%
5137	7	7	7	100%	100%	100%	100%	100%	100%
5133	6	6	6	**98%**	98%	98%	98%	98%	98%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

In summary, use of most subsistence resources by Petersburg residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer in some of the WAAs hunted by Petersburg residents may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Petersburg's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Point Baker

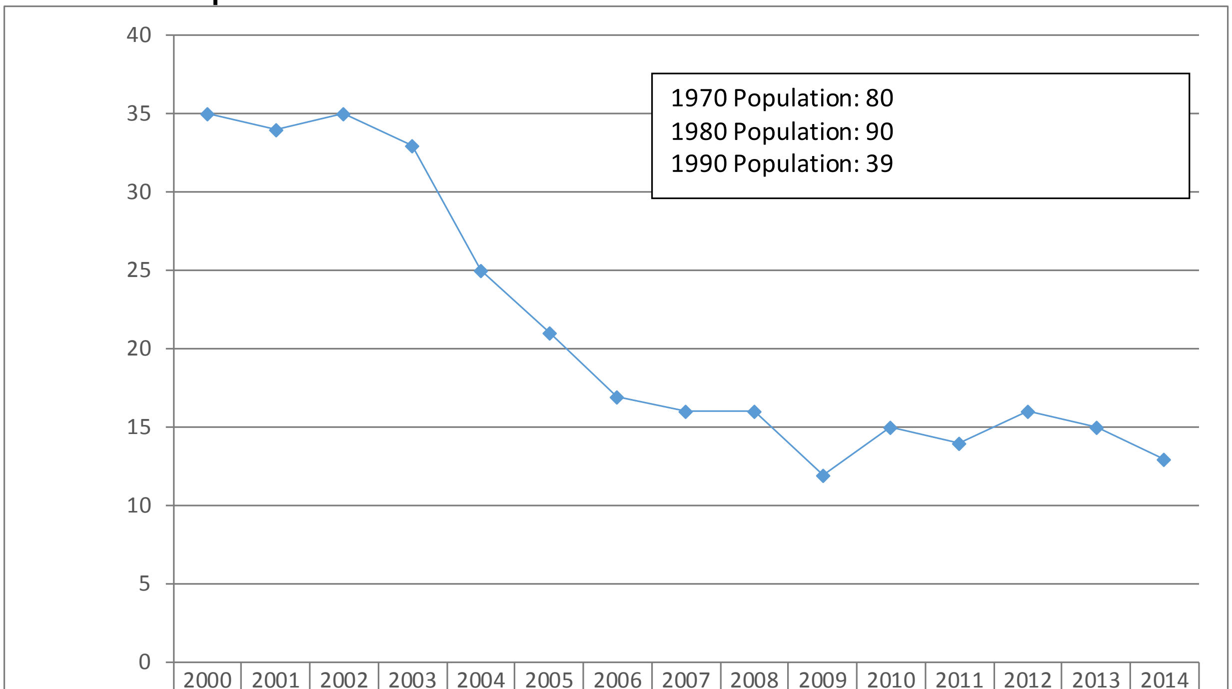
Affected Environment

Overview and Demographic Characteristics
Point Baker is located on the northern tip of Prince of Wales Island, 101 air miles northwest of Ketchikan. Point Baker received its name in 1793 from Captain George Vancouver. Native settlement of the area was already established during Vancouver's time. Tlingits used fish camps at Point Baker to participate in both customary trade and subsistence fishing. Commercial fishing at Point Baker began in the early 1900s, when the area was used as the site of a floating fish packer. Land sales in Point Baker accounted for part of an increase in year-round residents, the majority being non-Native (ADF&G 1994).

Point Baker is accessible by floatplane and skiff. The community of Point Baker is not incorporated or located within any other local government jurisdiction. Point Baker is part of the Prince of Wales-Hyder CA.

The population of Point Baker decreased between 1970 and 1990, dropping by 50 percent from 80 people in 1970 to 39 people in 1990. Population in Point Baker has trended downward since 2000, falling from 35 residents in 2000 to 13 residents in 2014 (Figure 3.23-47). According to the 2010 Census, there were no Alaska Native residents in Point Baker. Point Baker is served by the school in Port Protection.

Figure 3.23-47
Point Baker Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Point Baker	35	34	35	33	25	21	17	16	16	12	15	14	16	15	13

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Point Baker economy is heavily dependent on the fishing industry, with the entire adult population holding commercial fishing permits (ACFEC 2015). In 2013, local residents grossed an estimated $611,000 from salmon and halibut fishing (ACFEC 2015). Residents also participate in subsistence and recreational harvest of deer, salmon, halibut, shrimp, and crab (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. While no adults in Point Baker were identified as unemployed and seeking work in 2013, an estimated 68 percent of the population was not employed and not seeking work (U.S. Census Bureau 2014b). Median household income was $18,906, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Point Baker has no central utility system and residents rely upon individual generators.

Employment by Industry (2012)	Number	Percent of Total
Natural Resources and Mining	0	0
Construction	0	0
Manufacturing	1	17
Trade, Transportation and Utilities	1	17
Information	0	0
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	1	17
Leisure and Hospitality	0	0
State Government	0	0
Local Government	1	17
Other	2	33
Unknown	0	0
Total Employment	**6**	**100**

Source: Alaska DOL 2015d

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Point Baker in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-48. This area contains 842,636 acres of NFS land (among other land ownerships). Table 3.23-47 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 8.0 percent of the Point Baker community use area under Alternative 1 to 10.8 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular location favored by Point Baker residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-47).

Economy

Commercial fisheries and subsistence use are important to Point Baker. Commercial fisheries employment is not expected to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 59 percent of the total edible pounds of subsistence resources harvested by Point Baker households (Kruse and Frazier, 1988). Marine resources (fish and marine invertebrates) accounted for 79 percent of per capita subsistence harvest in Point Baker in 1996 (ADF&G 2014).

The 1988 TRUCS study found that deer account for 27 percent of the total edible pounds of subsistence resources harvested by Point Baker households (Kruse and Frazier 1988). Deer accounted for 16 percent of per capita subsistence harvest by Point Baker residents in 1996 (ADF&G 2014).

Point Baker residents harvest deer on north Prince of Wales Island and Kupreanof Island, which are included in GMUs 2 and 3, respectively. In GMU 2, following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). The deer populations within GMU 3 have historically fluctuated with high and low extremes. Between 1994 and 2011, deer harvest ranged from a low of 333 to a high of 1,119 (Harper 2013). As of 2013, the harvest level was about 100 deer below the previous 10-year mean (Harper 2013). Among Point Baker residents, data was not available for the 2011 to 2013 hunting seasons; however, data from 2004 to 2010 indicates generally low levels of harvest, and in 2010 total annual harvest was about 40 percent higher (4 more deer) than in 2004 (ADF&G 2015b).

Figure 3.23-48
Point Baker's Community Use Area

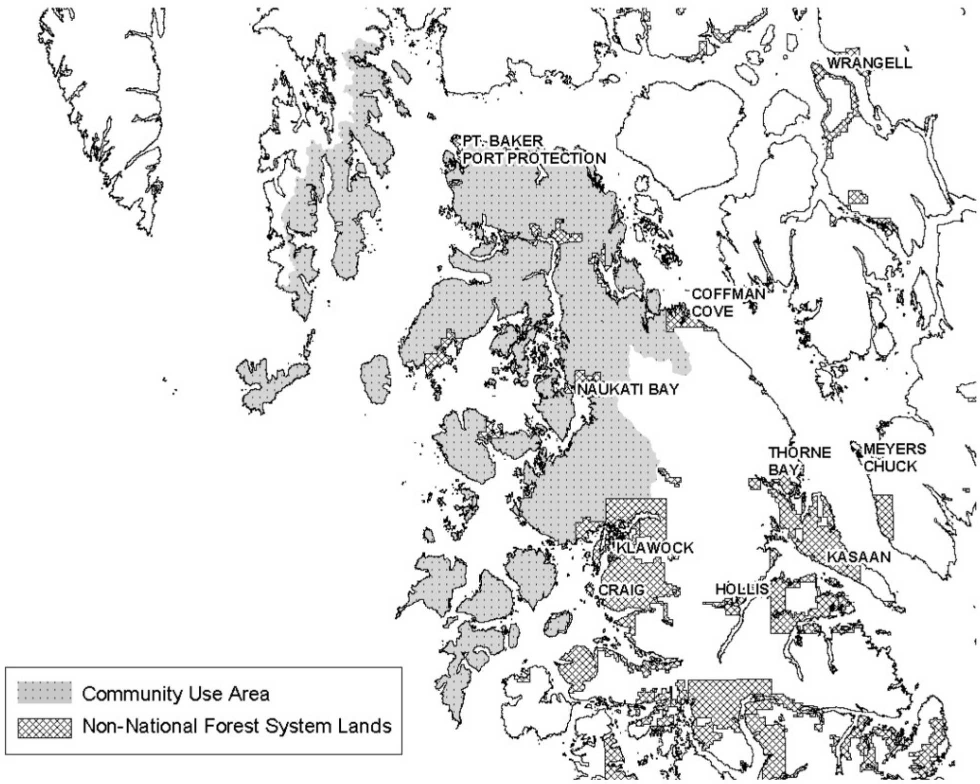


Table 3.23-47
Estimated Maximum Harvest (acres) over 100 Years in Point Baker's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	54,062	81,809	78,311	63,653	69,043
Old Growth	10,174	5,005	4,297	7,090	7,056
Total	**64,236**	**86,814**	**82,608**	**70,743**	**76,100**
Harvest as a Percent of Total NFS Lands in the Community Use Area	8.0%	10.8%	10.2%	8.8%	9.4%

Residents of Point Baker harvest the majority (69 percent) of their deer from two WAAs, 1529 and 1529. As shown in Table 3.23-48, the Point Baker portion is about 6 percent of the total combined harvest and 12 percent of the rural hunter harvest in these WAAs. About 48 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Both WAAs used most by Point Baker residents occur in an area with substantial past timber harvest and, therefore, deer habitat capabilities are currently estimated to be below 1954 levels (Table 3.23-48). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 1 to 4 percent (Table 3.23-48).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Point Baker residents and all rural hunters in the short term and long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Point Baker's community use area than the alternatives considered in this EIS (approximately 41 to 288 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Point Baker residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Point Baker residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer on Prince of Wales Island may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Point Baker's subsistence use areas on Prince of Wales Island could also occur under all alternatives if of hunters from other communities were displaced due to timber harvest activity.

Table 3.23-48
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Point Baker Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013[2]			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Point Baker Residents	All Rural Hunters[3]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1529	10	77	154	68%	64%	69%	69%	68%	66%
1527	1	17	27	72%	69%	71%	71%	70%	70%

[1] Calculated based on harvest where location is known.
[2] Data from 2011-2013 not available for Point Baker residents.
[3] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Port Alexander

Affected Environment

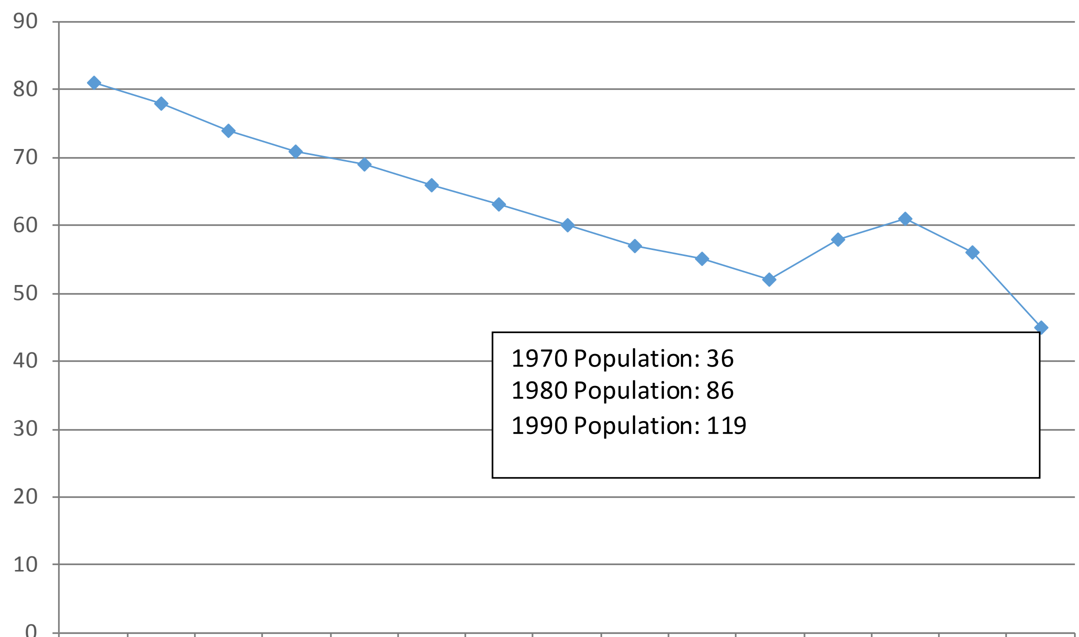
Overview and Demographic Characteristics

Port Alexander is located on the southern tip of Baranof Island about 85 miles south of Sitka. Port Alexander was named in 1849 by the governor of the Russian American colonies. In 1913, salmon trollers discovered the rich fishing grounds in the area, and two floating processors arrived soon after. By 1916, there was a fishing supply store, a shore station, and a bakery at Port Alexander. During the 1920s and 1930s, a prosperous fishing fleet evolved, and houses, stores, restaurants, and a school were constructed. The 1940s and 1950s saw a steep decline in Port Alexander's population.

Today, people choose Port Alexander as a home because of its independent, subsistence lifestyle, and commercial fishing opportunities, as well as its remote setting. There are no roads in Port Alexander; travel within the community is by skiff, boardwalks, and footpaths (ADF&G 1994). The community has a local Fish and Game Advisory Committee; however, the last meeting was held in 2008 and it is currently considered inactive (ADF&G 2015a). .

Port Alexander's population more than tripled between 1970 and 1990, increasing from 36 in 1970 to 119 in 1990 (Figure 3.23-49). Population in Port Alexander has trended downward since 2000, dropping by 44 percent from 81 people in 2000 to 45 people in 2014. Alaska Natives comprised 4 percent of the population in Port Alexander in 2010 (Table 3.23-8). A total of 10 students were enrolled in Port Alexander School in 2014, down from 18 students in 2000 (Table 3.23-9).

Figure 3.23-49
Port Alexander Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Port Alexander	81	78	74	71	69	66	63	60	57	55	52	58	61	56	45

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The economy of Port Alexander is largely based on commercial fishing and subsistence use of marine and forest resources. In 2013, 17 residents, about 30 percent of the population that year, held commercial fishing permits (ACFEC 2015). Subsistence food sources include deer, salmon, halibut, shrimp, and crab (Himes-Cornell et al. 2013). The City, the Armstrong Keta salmon hatchery (several miles to the north), a private construction company, a private lodge, the school, and post office provide employment in the area (Himes-Cornell et al. 2013).

This is a small, remote community of approximately 60 summer residents and 30-40 residents in the offseason. Summer commercial and guided sport fishing drive the local economy in this board walk community.

Employment by industry data for Port Alexander by the Alaska Department of Labor and Workforce Development are summarized in the table below. While no adults in Point Alexander were identified as unemployed and seeking work in 2013, an estimated 25 percent of the population was not employed and not seeking work (U.S. Census Bureau 2014b). Median household income was $56,250, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Port Alexander has no central utility system and residents rely upon individual generators.

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	10	39
Construction	2	8
Manufacturing	0	0
Trade, Transportation and Utilities	0	0
Information	0	0
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	0	0
Leisure and Hospitality	2	8
State Government	1	4
Local Government	11	42
Other	0	0
Unknown	0	0
Total Employment	**26**	**100**

Source: Alaska DOL 2015d

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Port Alexander in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-50. This area contains 86,828 acres of NFS land (among other land ownerships). As shown in Table 3.23-49, no young-growth or old-growth harvest is projected to take place in the community use area for Port Alexander over the next 100 years under any alternative; therefore no timber-harvest-related effects to this area are expected.

Economy

Port Alexander is primarily a commercial fishing town. Commercial fishing and subsistence use are important to the community. Commercial fishing employment is not expected to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 55 percent of the total edible pounds of subsistence resources harvested by Port Alexander households (Kruse and Frazier 1988).

Deer account for 36 percent of the total edible pounds of subsistence resources harvested by Port Alexander households (Kruse and Frazier, 1988).

Port Alexander residents take the majority (71 percent) of their deer from one WAA (3734) on the south end of Baranof Island. This WAA is located within GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Port Alexander residents, deer harvest has fluctuated, and in 2013 was over four times as high than in 2004 (22 more deer) (ADF&G 2015b).

As shown in Table 3.23-50, WAA 3734 would not be affected under any of the alternatives as no timber harvest is proposed in these areas. It is also unlikely that Port Alexander residents would be affected by increased competition because of the limited access to this area.

Figure 3.23-50
Port Alexander's Community Use Area

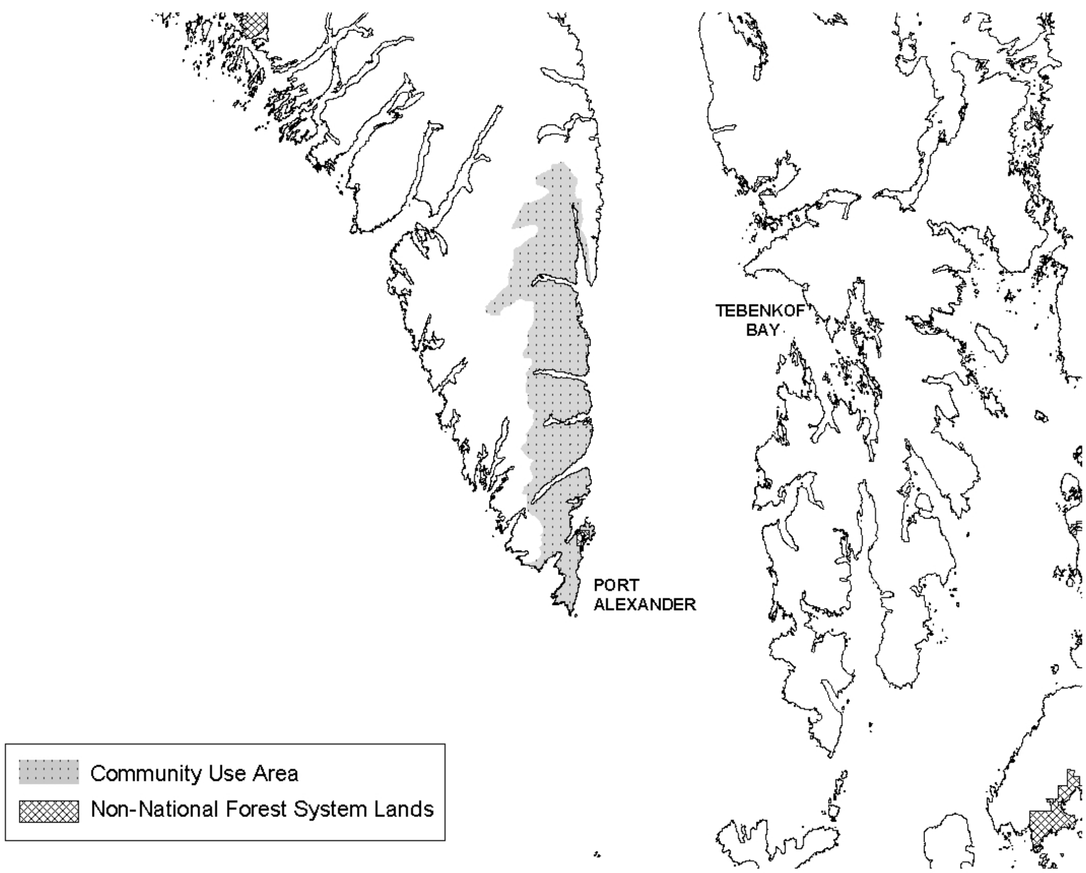


Table 3.23-49
Estimated Maximum Harvest (acres) over 100 Years in Port Alexander's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	0	0	0	0	0
Old Growth	0	0	0	0	0
Total	0	0	0	0	0
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.0%	0.0%	0.0%	0.0%	0.0%

Table 3.23-50
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Port Alexander Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Port Alexander Residents	All Rural Hunters [2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3734	26	59	66	100%	100%	100%	100%	100%	100%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Port Protection

Affected Environment

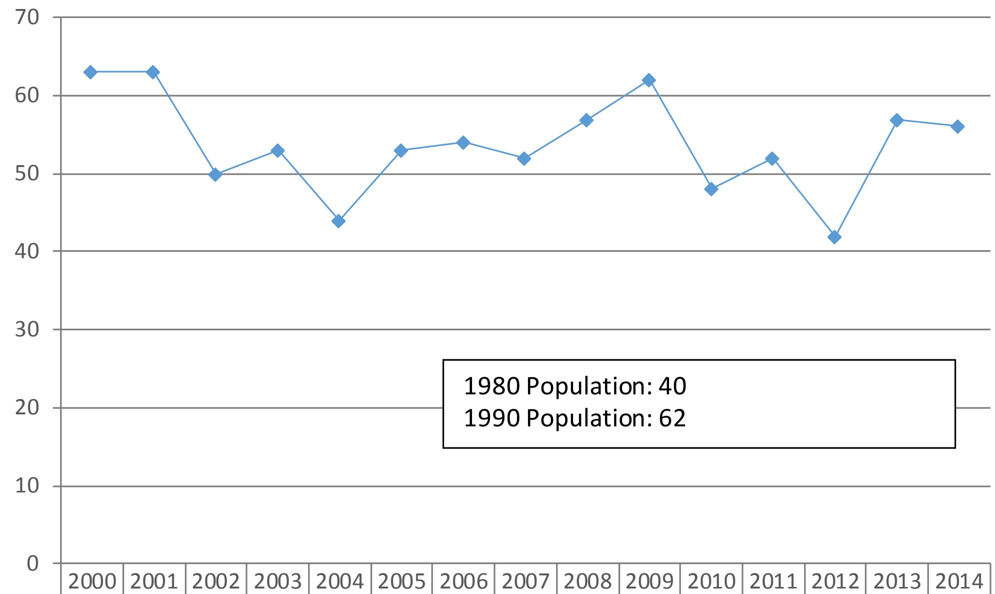
Overview and Demographic Characteristics

Port Protection, located on the northern end of Prince of Wales Island in a bay facing Sumner Strait, is only accessible by air and water. The community's setting along the waterfront of the cove requires skiff travel for most purposes (ADF&G 1994). The community of Port Protection is not incorporated or located within any other local government jurisdiction. Port Protection is part of the Prince of Wales-Hyder CA.

Port Protection was first reported to the western world by the English explorer George Vancouver in 1793. Signs of earlier indigenous occupation of the northern shoreline of Prince of Wales Island include stone and wooden stake fish weirs and traps, as well as shell middens of edible marine invertebrates (ADF&G 1994). A scow served as a fish-buying station until it was replaced in 1946 by a trading post. A long float dock accommodated many fishing boats at the post (ADF&G 1994).

The population of Port Protection, which increased by approximately 50 percent between 1980 and 1990, was approximately the same in 2000 as it was in 1990. The population decreased by an estimated 7 people or 11 percent between 2000 and 2014. Total estimated population was 56 in Port Protection in 2014 (Alaska DOL 2015b).

Figure 3.23-51
Port Protection Population 1980 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Port Protection	63	63	50	53	44	53	54	52	57	62	48	52	42	57	56

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Port Protection economy peaks during the fishing season in summer and fall. In 2013, one resident held a commercial fishing permit (ACFEC 2015) and some residents provide sport fishing charters. The school district, Port Protection Community Association, Woodenwheel Cove Trading Post, and the Rural Alaska Community Action Program provide are main employers (Himes-Cornell et al. 2013). Local residents also depend on subsistence for year-round support (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. While no adults in Port Protection were unemployed and seeking work in 2013, an estimated 27 percent were unemployed and not seeking work (U.S. Census Bureau 2014b). Median household income was $27,875, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Port Protection has no central utility system and residents rely upon individual generators.

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	1	4
Construction	0	0
Manufacturing	0	0
Trade, Transportation and Utilities	5	21
Information	1	4
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	0	0
Leisure and Hospitality	2	8
State Government	0	0

Employment by Industry in 2013	Number	Percent of Total
Local Government	4	17
Other	11	46
Unknown	0	0
Total Employment	**24**	**100**
Source: Alaska DOL 2015d		

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Port Protection in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-52. This area contains 706,627 acres of NFS land (among other land ownerships). Table 3.23-51 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 9.0 percent of the Port Protection community use area under Alternative 1 to 12.3 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular location favored by Port Protection residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-51).

Figure 3.23-52
Port Protection's Community Use Area

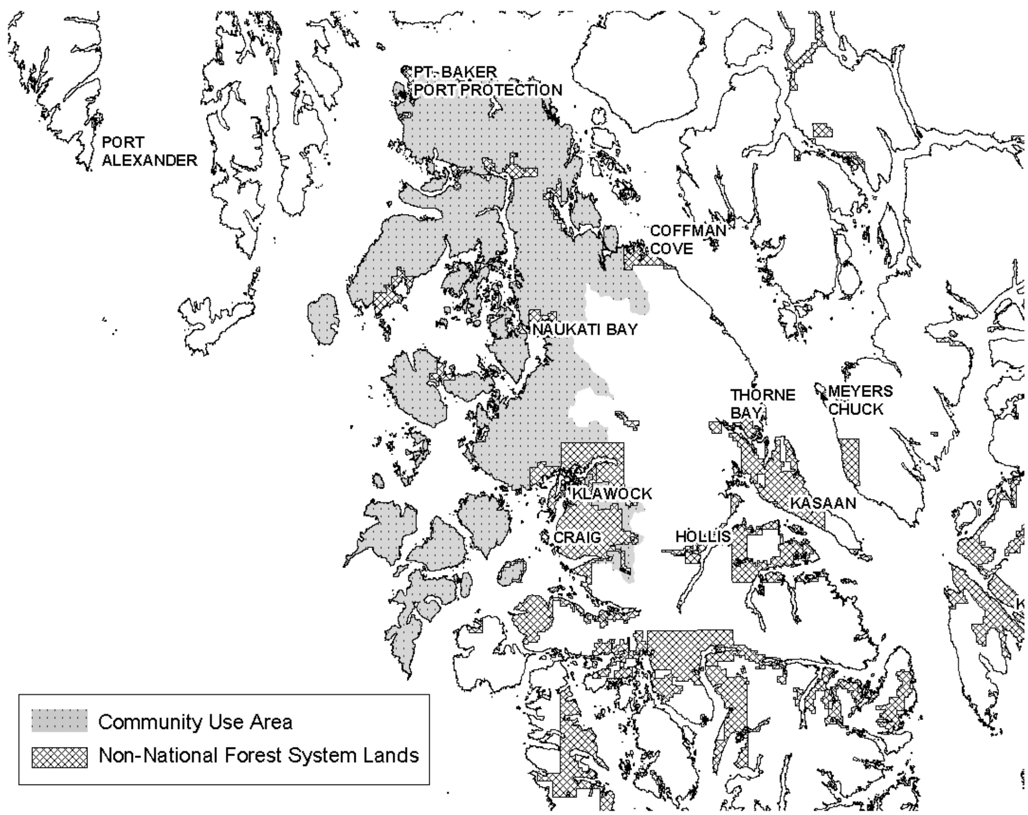


Table 3.23-51
Estimated Maximum Harvest (acres) over 100 Years in Port Protection's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	51,735	78,265	75,194	61,160	65,828
Old Growth	9,117	4,498	4,283	6,869	6,797
Total	**60,852**	**82,763**	**79,476**	**68,029**	**72,625**
Harvest as a Percent of Total NFS Lands in the Community Use Area	9.0%	12.3%	11.8%	10.1%	10.8%

Economy

Port Protection's economy primarily depends upon commercial fishing. Subsistence use is also important in this community. Commercial fisheries employment is not expected to be affected under any of the alternatives.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. Marine resources (fish and marine invertebrates) accounted for 69 percent of per capita subsistence harvest in Port Protection in 1996 (ADF&G 2014).

Deer accounted for 21 percent of per capita subsistence harvest by Port Protection residents in 1996 (ADF&G 2014).

Port Protection residents harvest deer almost entirely on Prince of Wales Island, which is included in GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Port Protection residents, total annual deer harvest is generally low, and in 2013 was 23 percent higher (3 more deer) than in 2004 (ADF&G 2015b).

Port Protection residents take the majority (64 percent) of their deer from two WAAs (Table 3.23-52). As shown in Table 3.23-52, the Port Protection portion of harvest represents about 3 percent of the total combined harvest and about 6 percent of the rural hunter harvest in these WAAs. About 41 percent of the harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Both WAAs occur in an area with substantial past harvest and, therefore, deer habitat capabilities are currently estimated to be considerably below 1954 levels (Table 3.23-52). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 1 to 4 percent (Table 3.23-52).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Port Protection residents and by all hunters in the short-term. All of the 1997 alternatives included substantially higher levels of timber harvest in Port Protection's community use area than the alternatives considered in this EIS (approximately 40 to 263 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Port Protection residents. However, the 1997 analysis found that, in the long term, the affected WAAs may not be able to provide deer for all rural hunters and all hunters. This may still be the case under all current alternatives.

Table 3.23-52
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Port Protection Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013[2]			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Port Protection Residents	All Rural Hunters[3]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1529	9	77	154	68%	64%	68%	68%	68%	66%
1317	1	93	133	58%	56%	56%	56%	56%	56%

[1] Calculated based on harvest where location is known.
[2] 2011 data not available for Port Protection residents.
[3] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

In summary, use of most subsistence resources by Port Protection residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Port Protection's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Saxman

Affected Environment

Overview and Demographic Characteristics

Saxman is located on west Revillagigedo Island on the Tongass Highway, about three miles south of Ketchikan. In 1894, Tlingits from the old Cape Fox and Tongass villages chose Saxman as the site for a new village and the location of a government school and a Presbyterian church. Saxman was incorporated in 1929 and was certified by the federal government as a second class municipal corporation. Three years later, the federal government issued a patent to 365 acres of land to the townsite trustee for Saxman (ADF&G 1994).

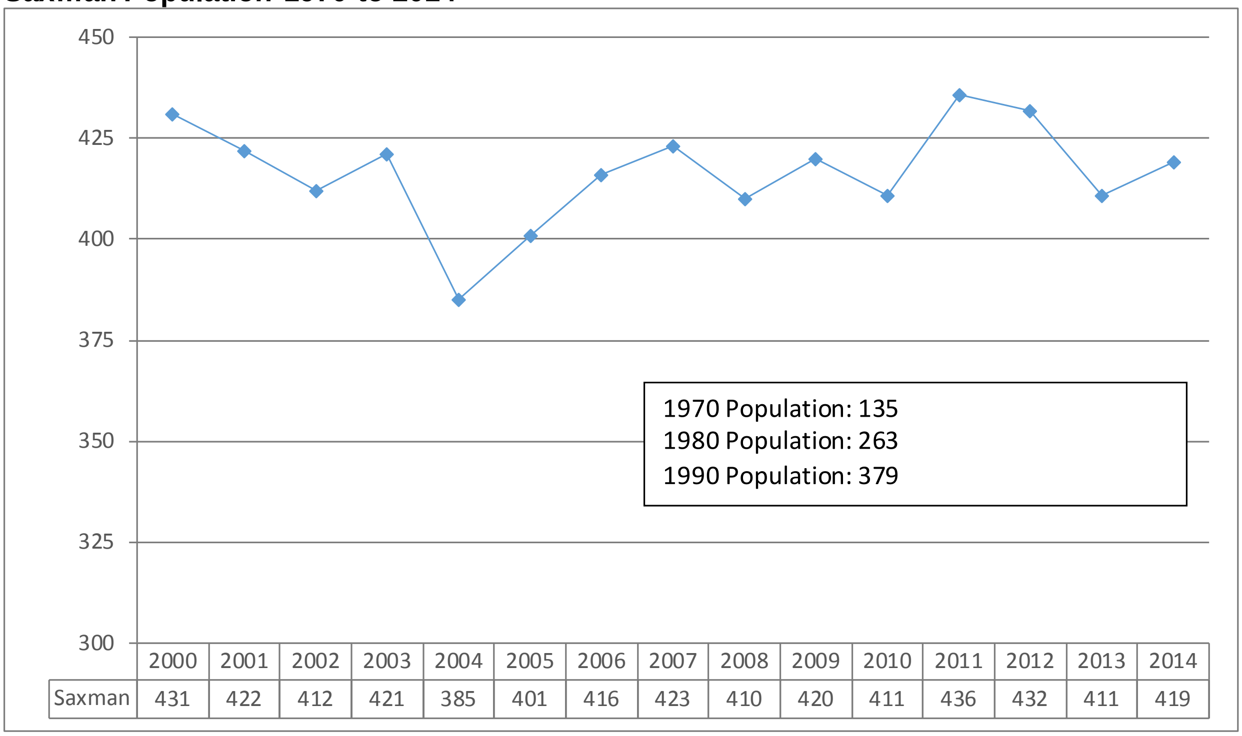
When the Ketchikan Gateway Borough was formed in 1963, Saxman was included within its boundaries. In 1971 and 1973, respectively, Saxman was recognized and then certified as a Native village under ANCSA. An elected mayor and six city council members constitute the governing body of the municipality as organized under state law. The community has a local Fish and Game Advisory Committee that has been considered inactive since mid-2010 (ADF&G 2015a).

When the Tlingits left their old villages to move to Saxman, they left behind houses, totems, carvings, and other cultural and ceremonial artifacts. In 1938, the Civilian Conservation Corps retrieved and brought to Saxman original totems from the abandoned villages and cemeteries of Tongass, Cat, and Pennock

Islands, and Cape Fox. The Totem Park in Saxman has become a major attraction for Ketchikan area visitors (ADF&G 1994).

The population of Saxman almost tripled between 1970 and 1990, increasing from 135 in 1970 to 379 in 1990 (Figure 3.23-53). Population in Saxman has remained fairly constant since 2000, with 419 residents in 2014 down from 431 residents in 2000. Alaska Natives comprised 51 percent of the population in Saxman in 2010 (Table 3.23-8). The community of Saxman is served by the Ketchikan Gateway Borough School District.

Figure 3.23-53
Saxman Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Saxman	431	422	412	421	385	401	416	423	410	420	411	436	432	411	419

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Most employment opportunities for Saxman residents are in the City of Ketchikan. The City of Saxman, the Saxman Seaport, and the Cape Fox Corporation provide employment for a number of local residents. The Saxman Totem Park with a tribal house, a carving center, and a cultural hall for traditional Tlingit dance, has become an attraction for Ketchikan area visitors (Alaska DCED 2002).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 22 percent of the labor force in Saxman was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $46,250, compared to the state median of $70,760; the corresponding median for the Ketchikan Gateway Borough was $62,519 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	1	1
Construction	13	7
Manufacturing	9	5
Trade, Transportation and Utilities	50	27
Information	0	0
Financial Activities	6	3
Professional and Business Services	2	1
Educational and Health Services	18	10
Leisure and Hospitality	29	16
State Government	15	8
Local Government	40	22
Other	3	2
Unknown	0	0
Total Employment	**186**	**100**

Source: Alaska DOL 2015d

Saxman is currently served by Ketchikan Public Utilities, sourced from a mix of hydroelectricity and diesel generation (Southeast Conference 2015). Ketchikan Public Utilities residential rates for 2011 before and after the application of PCE payments were both 10 cents/kWh (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 10 cents/kWh and 8 cents/kWh, respectively. The City of Saxman holds a FERC license issued in 1998 to construct the 9.6 MW Mahoney Lake Hydroelectric Project; as of 2015, this project has not been built (Table 3.12b-3).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Saxman in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-54. This area contains 1,975,123 acres of NFS land (among other land ownerships). Table 3.23-53 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Saxman, ranging from about 1.3 percent (Alternative 1) to 2.0 percent (Alternative 3). Harvest activities could have localized effects if they coincide with a particular location favored by Saxman residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old growth harvest in this area (see Table 3.23-53).

Economy

Saxman, a traditional native community, could be affected primarily by changes in recreation and tourism use, commercial fishing, timber processing, and subsistence opportunities. Commercial fisheries employment is not expected to be affected under any of the alternatives. Recreation and tourism in Saxman is also unlikely to be affected under any of the alternatives.

The proposed Mahoney Lake Hydroelectric Project is located in a Semi-Remote Recreation LUD and Inventoried Roadless Area 524. Semi-Remote Recreation is considered a TUS "window" under the 2008 Forest Plan, an area potentially available for the location of transportation or utility corridors and sites. This classification and the standards and guidelines in the current Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, energy projects would be managed under the Renewable Energy Plan Components identified in Chapter 5 of the proposed amended Forest Plan.

Figure 3.23-54
Saxman's Community Use Area

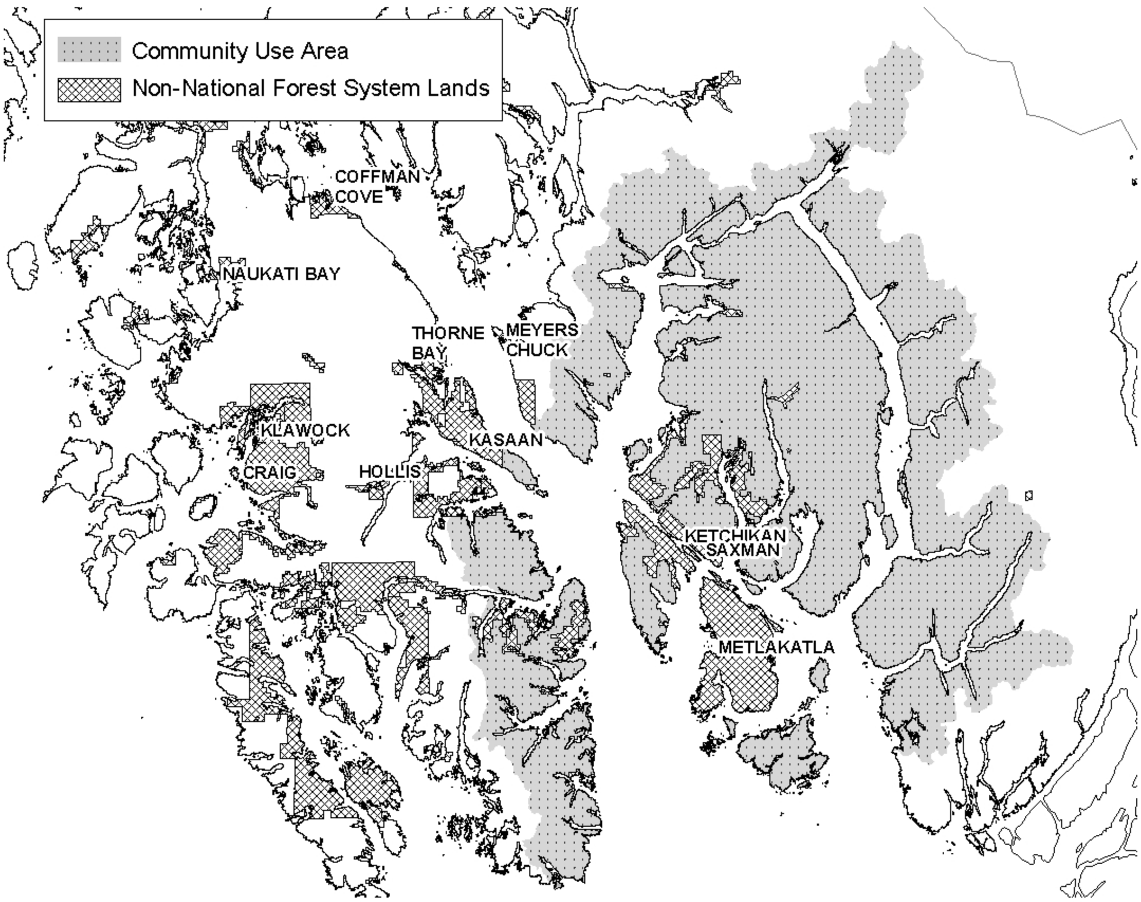


Table 3.23-53
Estimated Maximum Harvest (acres) over 100 Years in Saxman's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	20,284	33,533	33,248	26,392	25,562
Old Growth	5,393	2,639	5,735	4,411	3,669
Total	**25,678**	**36,172**	**38,983**	**30,804**	**29,231**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.3%	1.8%	2.0%	1.6%	1.5%

Subsistence

No significant decline in salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 68 percent of the total edible pounds of subsistence resources harvested by Saxman households (Kruse and Frazier, 1988). Marine resources (fish and marine invertebrates) accounted for 70 percent of per capita subsistence harvest in Saxman in 1999 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 19 percent of the total edible pounds of subsistence resources harvested by Saxman households (Kruse and Frazier 1988). Deer accounted for 13 percent of per capita subsistence harvest by Saxman residents in 1999 (ADF&G 2014).

Data were not provided separately for Saxman in the ADF&G deer harvest reports for 2004 to 2013. The majority of deer harvest by Saxman residents likely takes place in GMU 1A. As of 2013, deer numbers were at very low levels throughout most of GMU 1A and were no longer meeting local hunter demands or established deer harvest objectives (Harper 2013). Though not closed, starting in 2011 the deer hunting season was shortened to August 1 through November 30 instead of continuing through December. Hunters are known to be shifting efforts to other more productive areas, such as nearby GMU 2, leading to less hunter effort and fewer deer harvested in GMU 1A (Harper 2013).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide habitat capability for deer hunted in the Saxman community use area by Saxman residents, all rural hunters, and all hunters in the short term. All alternatives were also estimated to provide sufficient habitat capability for Saxman residents and all rural hunters in the long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Saxman's community use area than the alternatives considered in this EIS (approximately 3 to 11 times as high). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Saxman residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Saxman residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, under all alternatives.

Sitka

Affected Environment

Overview and Demographic Characteristics

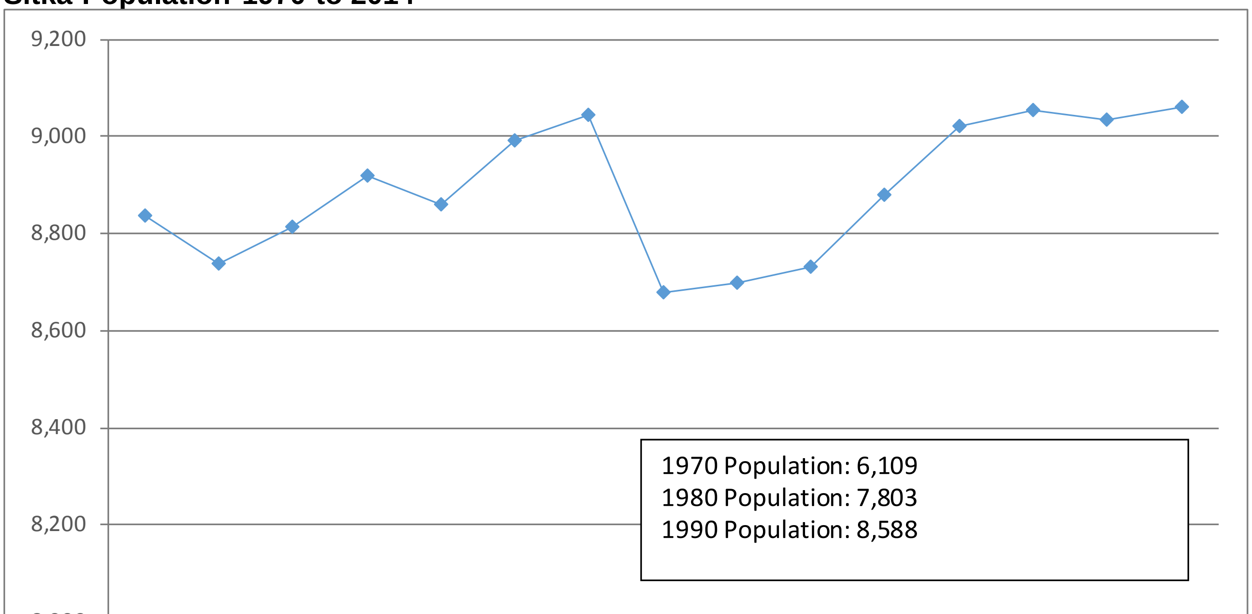
Located on the west side of Baranof Island, Sitka is the only community in Southeast Alaska that fronts the open sea. Sitka was originally inhabited by a major tribe of Tlingits who called the village "Shee Atika." Traditionally, the Tlingits used a wide area surrounding the community for hunting, fishing, and gathering wild resources. The site became "New Archangel" in 1799, the capital of Russian America (ADF&G 1994).

Sitka became the focal point of Russian fur trade in North America beginning in 1741. During the mid-1800s, Sitka was the major port on the north Pacific coast, with ships calling from many nations. After the purchase of Alaska by the United States in 1867, it remained the capital of the Territory until 1906, when the seat of government moved to Juneau. During the early 1900s gold mines contributed to its growth, and during World War II the town was fortified. After the war, the Bureau of Indian Affairs converted some of the buildings to a boarding school for Alaska Natives (ADF&G 1994). The APC pulp mill operated in Sitka from 1959 through 1993, employing almost 400 people at the time of closure.

The population of Sitka grew by 41 percent between 1970 and 1990, increasing from 6,109 residents in 1970 to 8,588 residents in 1990 (Figure 3.23-55). The population in Sitka has remained fairly constant sine 1990, increasing by 3 percent between 1990 and 2000, and another 3 percent or an estimated 226 residents between 2000 and 2014. Total estimated population was 9,061 in Sitka in 2014. Alaska Natives comprised 17 percent of the population in Sitka in 2010 (Table 3.23-8).

While the population in Sitka has remained fairly constant over the past two decades or so, it has been aging at faster than normal rates (Alexander et al. 2010). This is reflected in the school district enrollment, with enrollment dropping from 2,008 students in 1990 to 1,796 students in 2014 (Table 3.23-9).

Figure 3.23-55
Sitka Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sitka	8,835	8,737	8,812	8,918	8,860	8,990	9,043	8,678	8,698	8,730	8,881	9,022	9,055	9,034	9,061

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Sitka has a diversified economy, with tourism, fishing, fish processing, government, health care services, transportation, and retail all contributing to its base (Himes-Cornell et al. 2013). In 2013, 574 residents held commercial fishing permits, with estimated gross earnings of over $48 million (ACFEC 2015). The seafood industry is a major employer, as well as regional health care services, the Forest Service, and the U.S. Coast Guard (Himes-Cornell et al. 2013).

A study conducted by the Alaska DOL in 2003 suggested that Sitka's economy appears to have survived the downturn in its economy caused by the pulp mill closure, in large part because it has a relatively diversified economy (Gilbertson 2003). While the community of Sitka does not appear to have been as negatively affected by the closure of the pulp mill as some predicted, the effects have been felt by the workers who lost their jobs. By 2001, 57 percent of the former pulp mill labor force were no longer employed in Alaska, 43 percent had left the State, and 14 percent were in the State but had left the workforce, most likely retired.

Only 25 percent of the former pulp mill workers were still living and working in Sitka (Gilbertson 2003).

Nature-based tourism in Sitka is less dominated by large cruise ships than in the other coastal communities with independent travelers making up a larger share of total visitors (Dugan et al. 2009). Multi-day fishing packages and kayaking and hunting are popular nature-based tourist activities operating from Sitka. Overall, nature-based tourism generated nearly $74 million in revenue in 2006 (Dugan et al. 2009).

Sitka experienced an estimated high of 289,000 cruise ship passengers in 2008, followed by a steady decline to an estimated low of 90,000 passengers in 2014. (SEDA 2015). In September 2012, a new deepwater dock opened for cruise ships in Sitka, making it possible for non-lightering cruise vessels to visit Sitka, resulting in additional visits beyond projections. In 2014, Sitka had almost 106,000 cruise ship passengers (not counting smaller cruise vessels such as Disney and National Geographic), with 19 percent of passengers disembarking at the new deepwater dock (known as the "Old Sitka Dock") located near Old Sitka (SEDA 2015). The remaining cruise ships anchor offshore and transport passengers to Sitka on smaller lightering vessels. In 2015, the large cruise ship industry anticipates a 28 percent increase in passenger visits, to 130,000 (SEDA 2015).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 5 percent of the labor force in Sitka was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $69,405, compared to the state median of $70,760 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	54	1
Construction	252	7
Manufacturing	262	7
Trade, Transportation and Utilities	657	17
Information	44	1
Financial Activities	113	3
Professional and Business Services	197	5
Educational and Health Services	702	19
Leisure and Hospitality	347	9
State Government	374	10
Local Government	702	19
Other	99	3
Unknown	0	0
Total Employment	**3,803**	**100**

Source: Alaska DOL 2015d

Sitka is currently served by the Blue Lake and Green Lake hydropower projects run by the City and Borough of Sitka (Table 3.12b-2). The system cannot meet Sitka's full energy demand, and is supplemented by diesel generation during peak load hours on a daily basis (Alexander et al. 2010). The Blue Lake Expansion project was completed in 2015 and increased electricity output for Sitka by about 27 percent (Blue Lake Expansion Project 2015).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Sitka in their local day-to-day work, recreational, and subsistence activities is shown on

Figure 3.23-56. This area contains 425,121 acres of NFS land (among other land ownerships). Table 3.23-54 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Sitka, ranging from about 1.0 percent (Alternative 4) to 3.1 percent (Alternative 2). Harvest activities could have localized effects if they coincide with a particular location favored by Sitka residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternative 3; however, it may be noted that Alternative 1 (which would have less potential total suitable harvest compared to Alternative 3) would have the largest potential old-growth harvest in this area (see Table 3.23-54).

Economy

Commercial fishing, recreation and tourism, and subsistence are important to Sitka residents. Commercial fishing is not expected to be significantly affected under any of the alternatives. None of the alternatives are expected to affect recreation and tourism-related employment in Sitka.

Figure 3.23-56
Sitka's Community Use Area

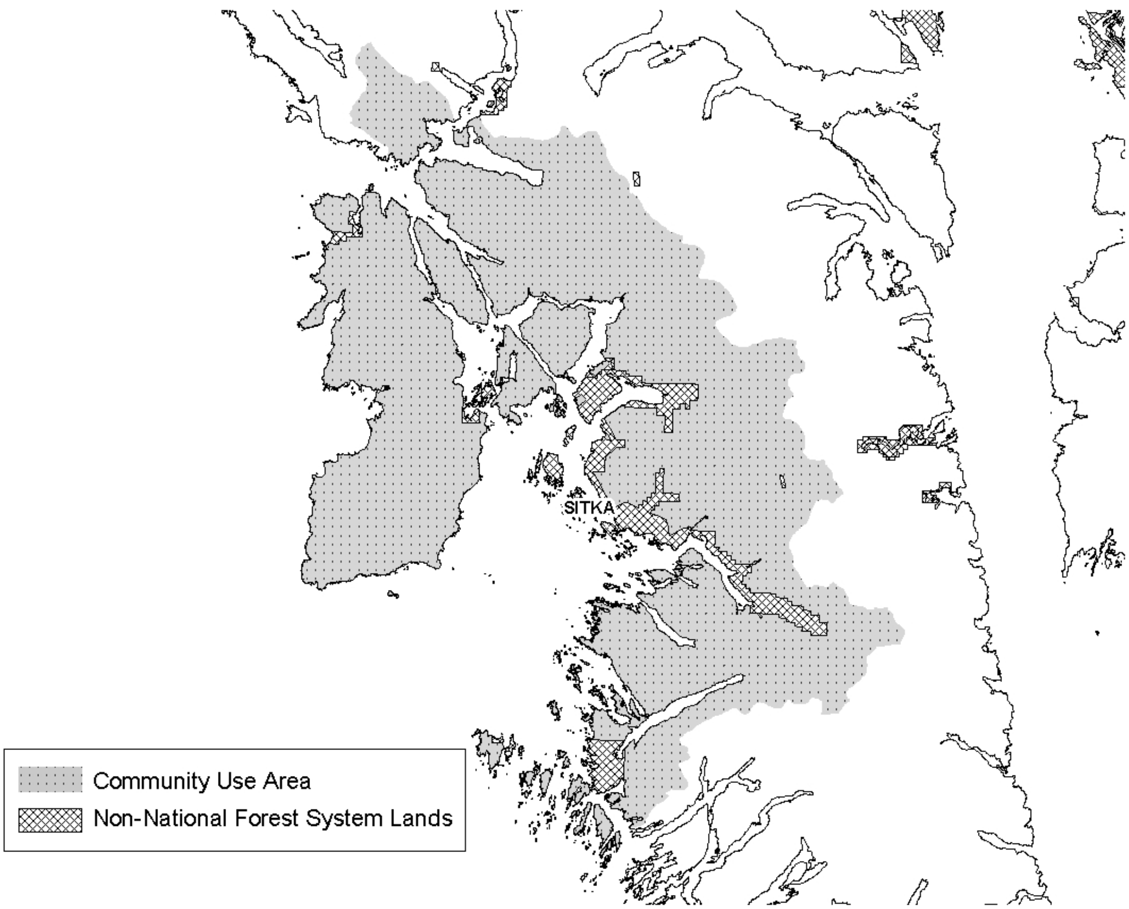


Table 3.23-54
Estimated Maximum Harvest (acres) over 100 Years in Sitka's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	5,529	12,808	10,217	3,777	9,560
Old Growth	922	448	565	440	430
Total	**6,451**	**13,256**	**10,782**	**4,217**	**9,990**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.5%	3.1%	2.6%	1.0%	2.4%

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 69 percent of the total edible pounds of subsistence resources harvested by Sitka households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 68 percent of per capita subsistence harvest in Sitka in 1996 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 27 percent of the total edible pounds of subsistence resources harvested by Sitka households (Kruse and Frazier, 1988). Deer accounted for 22 percent of per capita subsistence harvest by Sitka residents in 1996 (ADF&G 2014).

Sitka residents mainly harvest deer on Baranof Island, which is included in GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Sitka residents, total annual deer harvest has fluctuated in recent years, and in 2013 was 20 percent lower (525 fewer deer) than in 2004 (ADF&G 2015b).

Sixteen WAAs account for the majority (75 percent) of deer harvest by Sitka residents. As shown in Table 3.23-55, the Sitka portion represents about 97 percent of the rural hunter harvest and 87 percent of the total harvest in these WAAs. About 11 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is little harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Of the 16 WAAs used most heavily by Sitka residents, under all alternatives only one would have a reduction in deer habitat capability (Table 3.23-55). In WAA 3308, Alternatives 1, 4, and 5 would further reduce deer habitat capability after 100 years of Forest Plan implementation by 1 percent (Table 3.23-55).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that at that time, Sitka residents were harvesting deer at a rate above what was considered both sustainable and able to provide a reasonably high level of hunter success. In addition, all 1997 alternatives would not be able to provide sufficient habitat capability for deer hunted in the Sitka community use area by Sitka residents, all rural hunters, and all hunters in the short term or long term. The Final EIS analysis concluded that at some point a restriction in hunting might be necessary. The 1997 alternatives all included more timber harvest than the alternatives considered in this EIS, ranging from about 47 percent to over 1,800 percent higher (or 19 times as high). Due to the lower level of timber harvest, and minimal change in deer habitat capability, it is unlikely any of the current alternatives would have a noticeable effect on the availiabity of deer for Sitka hunters. However, as in the 1997 analysis, in the long term a restriction in hunting may be necessary under all alternatives due to existing circumstances.

In summary, use of most subsistence resources by Sitka residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may reach a point that some restriction in hunting might be necessary over the long term, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Sitka's subsistence, use areas could also occur under all alternatives if hunters from other communities were displaced due to timber production activity.

Table 3.23-55
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Sitka Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

WAA	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
	Sitka Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3001	334	338	361	82%	82%	82%	82%	82%	82%
3002	268	272	299	69%	69%	69%	69%	69%	69%
3003	144	144	152	86%	86%	86%	86%	86%	86%
3314	122	123	136	90%	90%	90%	90%	90%	90%
3311	112	113	127	97%	97%	97%	97%	97%	97%
3313	106	107	125	97%	97%	97%	97%	97%	97%
3310	88	92	100	92%	92%	92%	92%	92%	92%
3207	86	88	94	100%	100%	100%	100%	100%	100%
3104	73	75	84	74%	74%	74%	74%	74%	74%
3416	71	78	88	100%	100%	100%	100%	100%	100%
3309	70	72	81	100%	100%	100%	100%	100%	100%
3733	69	77	81	100%	100%	100%	100%	100%	100%
3312	68	69	76	95%	95%	95%	95%	95%	95%
3206	61	63	68	100%	100%	100%	100%	100%	100%
3105	56	58	68	99%	99%	100%	100%	99%	99%
3308	52	61	107	66%	65%	66%	66%	65%	65%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Skagway

Affected Environment

Overview and Demographic Characteristics

Skagway is located in northern Southeast Alaska at the head of Taiya Inlet, 95 air miles north of Juneau. It is the end-of-the line for the Alaska Marine Highway System and the entrance to the Klondike Highway. The area was initially settled by Chilkoot Tlingit who called it "Skagua," or "the place where the north wind blows." The Chilkoots controlled access into the interior along what has become known as the Chilkoot Trail, which follows along the Taiya River and over the

Chilkoot Pass. The Chilkoot Trail was a major trade route for the Chilkoot Tlingit, interior Tlingit, and Athabaskans (ADF&G 1994).

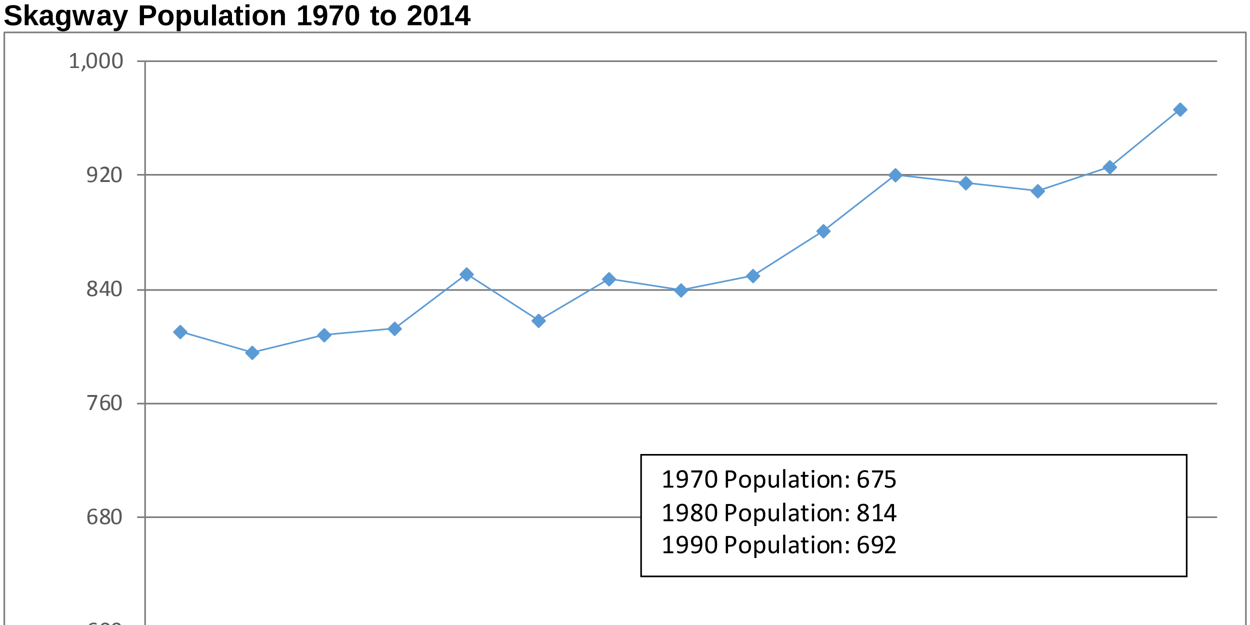
The current settlement began in Skagway in 1887 when a seafarer named William Moore decided to develop a trading and mining route into the Yukon Territory using the Chilkoot Trail. As the Klondike gold rush hit the area in 1896, the Chilkoot and White Pass trails became the major routes into the Interior. Within a few years, the trails were superseded by the adjacent White Pass and Yukon Railway. The railway continued to function as a supply and shipping route between Skagway and Whitehorse until 1982 (ADF&G 1994). The railway currently operates as a tourist attraction.

Skagway became the first incorporated first-class city in Alaska in 1900. During 2007, the city government dissolved and the Municipality of Skagway Borough formed. The community participates in the Upper Lynn Canal Fish and Game Advisory Committee (ADF&G 2015a).

The population of Skagway, which declined between 1980 and 1990, increased by 170 people or 25 percent between 1990 and 2000 (Figure 3.23-57). The population continued to increase by an estimated 156 residents or 19 percent between 2000 and 2014. Total estimated population was 957 in Skagway in 2014 (Alaska DOL 2015b). Alaska Natives comprised 4 percent of the population in Skagway in 2010 (Table 3.23-8).

Despite the steady increase in population in Skagway over the past two decades or so, school enrollment has dropped, falling by more than a third between 2000 and 2014, with 132 and 86 students enrolled in 2000 and 2014, respectively (Table 3.23-9). Local leaders reportedly attribute this decline to the closure of the year-round railroad operation of the White Pass-Yukon Railroad (Alexander et al. 2010).

Figure 3.23-57
Skagway Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Skagway	811	796	808	813	851	818	847	840	850	881	920	915	909	926	967

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Skagway has a strong base in the tourism industry. It is a port of call for cruise ships and a transfer site for interior rail and bus tours. The Alaska Marine Highway System also connects travelers to the rest of Southeast Alaska. More than 600,000 cruise ship passengers and numerous state ferry travelers visit Skagway each year. Skagway is also the site of trans-shipment of lead/zinc ore, fuel, and freight via the Port and Klondike Highway to and from Canada (Alaska DCED 2002; 2006).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 8 percent of the labor force in Skagway was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $71,435, compared to the state median of $70,760 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	0	0
Construction	18	5
Manufacturing	10	3
Trade, Transportation and Utilities	155	39
Information	0	0
Financial Activities	9	2
Professional and Business Services	13	3
Educational and Health Services	9	2
Leisure and Hospitality	77	19
State Government	16	4
Local Government	84	21
Other	9	2
Unknown	0	0
Total Employment	**400**	**100**

Source: Alaska DOL 2015d

Skagway is part of an AP&T system that connects Haines and Skagway in the Upper Lynn Canal Region, and is connected via an intertie to the existing Inside Passage Electric Cooperative system that serves Klukwan and Chilkat Valley. The existing AP&T Goat Lake and Dewey Lakes hydropower projects support this system (Table 3.12b-2). Residential rates for 2011 before and after the application of PCE payments were 22 cents/kWh and 15 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 22 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Skagway in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-58. This area contains 199,938 acres of NFS land (among other land ownerships). As shown in Table 3.23-56, no young-growth or old-growth harvest is projected to take place in the community use area for Skagway over the next 100 years under any alternative; therefore no timber-harvest-related effects to this area are expected.

There are no acres within the Skagway Community Use Area allocated to Wilderness/National Monument LUDs under any of the alternatives.

Figure 3.23-58
Skagway's Community Use Area

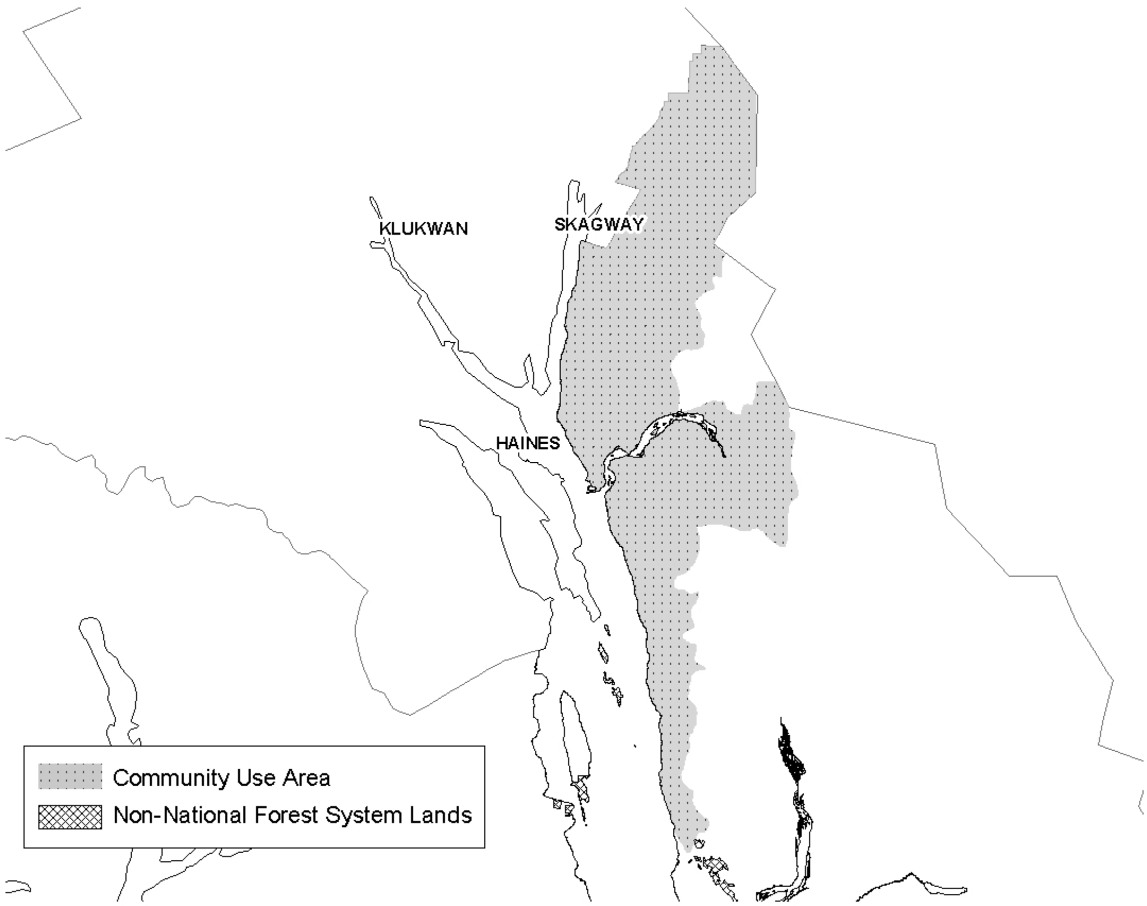


Table 3.23-56
Estimated Maximum Harvest (acres) over 100 Years in Skagway's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	0	0	0	0	0
Old Growth	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**
Harvest as a Percent of Total NFS Lands in the Community Use Area	0.0%	0.0%	0.0%	0.0%	0.0%

Economy

Recreation, tourism, and subsistence use are important to the community of Skagway. None of the alternatives are expected to affect recreation and tourism-related employment in Skagway.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for

88 percent of the total edible pounds of subsistence resources harvested by Skagway households (Kruse and Frazier 1988).

The 1988 TRUCS study found that deer account for only a small fraction of the total edible pounds of subsistence resources harvested by Skagway households (Kruse and Frazier, 1988).

Skagway residents primarily harvest deer in four WAAs (Table 3.23-57); three of these WAAs are located in GMU 4; the other is located in GMU 1C. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Deer populations in GMU 1C have historically fluctuated with periodic severe winter weather, most recently during the winter of 2006-2007. The snow pack led to a substantial deer die off, and opportunities to harvest deer will likely improve in the coming years if winter weather isn't too severe (Harper 2013). Skagway residents harvested very few deer from 2004 to 2013 (Table 3.23-57). Residents harvested an annual average of two to four deer over this period.

As shown in Table 3.23-57, the four WAAs used by Skagway residents would not be affected by any of the alternatives as no timber harvest is proposed in these areas. Indirect effects could occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Table 3.23-57
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Skagway Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013[2]			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Skagway Residents	All Rural Hunters[3]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3836	4	16	210	100%	100%	100%	100%	100%	100%
2515	2	1	12	100%	100%	100%	100%	100%	100%
2722	2	6	302	100%	100%	100%	100%	100%	100%
4044	2	6	57	98%	98%	98%	98%	98%	98%

[1] Calculated based on harvest where location is known.
[2] Data from 2007 and 2008 not available for Skagway residents.
[3] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

Tenakee Springs

Affected Environment

Overview and Demographic Characteristics

Tenakee Springs is located 50 miles northeast of Sitka on the north shore of Tenakee Inlet (east Chichagof Island). Tenakee Springs, accessible only by floatplane or boat, is a stop on the Alaska Marine Highway System.

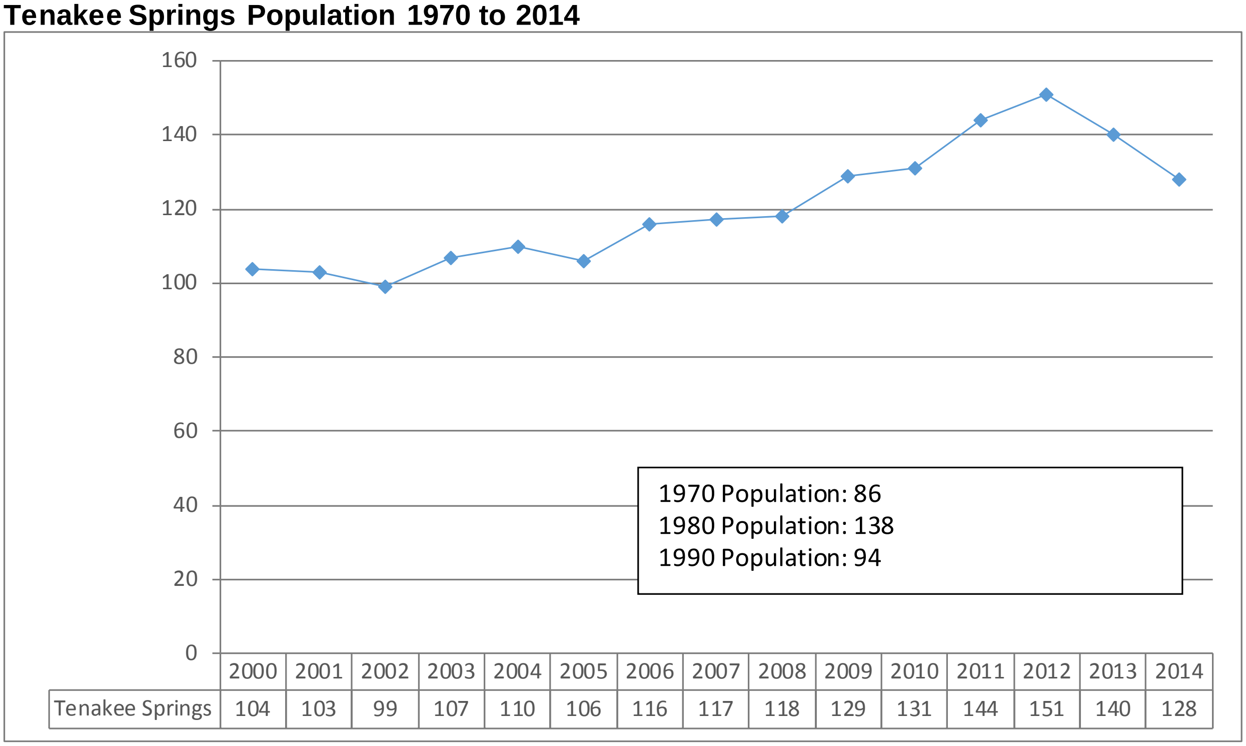
A Tlingit winter village site was historically located in the vicinity of the present-day harbor and a summer village was located across the Inlet at Kadashan Bay (ADF&G 1994). Early prospectors and fishermen came to the site to wait out the winters and enjoy the natural hot springs in Tenakee. Around 1895, a large tub and building were constructed to provide a warm bathing place. The 108-degree sulfur springs is the social focus of the community, with bathing times scheduled for men and women.

In 1904, E. Snyder bought a tract of land from a Tlingit resident, including a house located near the public bathhouse. The post office, established in 1903, used the name Tenakee. In 1928, the community's name was changed to Tenakee Springs. The community has a local Fish and Game Advisory Committee (though currently inactive), and many residents practice a subsistence lifestyle, actively exchanging resources with neighbors (ADF&G 1994, 2015c).

Residents use four wheelers on the single dirt road in the community, but no vehicles, other than the city-owned fuel truck, are allowed access. The harbor is poorly protected, especially during the winter storms and unloading barged supplies can be challenging (Alexander et al. 2010).

Tenakee Springs' population fluctuated between 1980 and 2000. The population has generally trended upward since 2000, increasing from 104 in 2000 to 128 in 2014, with a peak estimated population 151 in 2012 (Figure 3.23-59). Alaska Natives comprised 1 percent of the population in Tenakee Springs in 2010 (Table 3.23-8). School enrollment has hovered around 10 students since 1990, with total enrollment of 12 students in 2014 (Table 3.23-9).

Figure 3.23-59
Tenakee Springs Population 1970 to 2014



Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Tenakee Springs is often considered a retirement and vacation community, though fishing and tourism are important sources of income (Himes-Cornell et al.

2013). The City, State of Alaska, local store, school, bakery, and post office are main employers (Himes-Cornell et al. 2013).

An estimated 25 percent of the homes in Tenakee Springs are second homes. Tourism activities are limited to two family-run marine charters and Tenakee Springs residents have been vocal in their opposition to tourism development (Dugan et al. 2009). The Chichagof Conservation Council noted in 2007 that small-scale, locally-owned businesses catering to independent travelers are a large part of the Tenakee Springs economy. Local residents opposed cruise ship development, not all tourism development.

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 5 percent of the labor force in Tenakee Springs was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $62,813, compared to the state median of $70,760; the corresponding median for the Hoonah-Angoon CA was $49,545 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	1	2
Construction	8	18
Manufacturing	0	0
Trade, Transportation and Utilities	7	16
Information	0	0
Financial Activities	0	0
Professional and Business Services	1	2
Educational and Health Services	1	2
Leisure and Hospitality	1	2
State Government	5	11
Local Government	21	47
Other	0	0
Unknown	0	0
Total Employment	**45**	**100**

Source: Alaska DOL 2015d

Tenakee Springs has the second highest electricity rates in the region due to the use of diesel generated power (tied with the community of Pelican). Residential rates for 2011 before and after the application of PCE payments were 69 cents/kWh and 31 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 69 cents/kWh. The City of Tenakee Springs is constructing an 180 kW run-of-river hydroelectric project on Indian River (Table 3.12b-3). The project would supply approximately 90 percent of the city's electricity use, reducing diesel use and lowering rates substantially.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Tenakee Springs in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-60. This area contains 196,031 acres of National Forest the System land (among other land ownerships). Table 3.23-58 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Tenakee Springs, ranging from about 2.5 percent (Alternative 4) to 3.6 percent (Alternatives 2 and 5). Harvest activities could have localized effects if they coincide with a particular location favored by Tenakee Springs residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 5; however, it may be noted that Alternative 1 (which would have less potential total suitable harvest compared to Alternative 2) would have the largest potential old-growth harvest in this area (see Table 3.23-58).

Figure 3.23-60
Tenakee Springs' Community Use Area

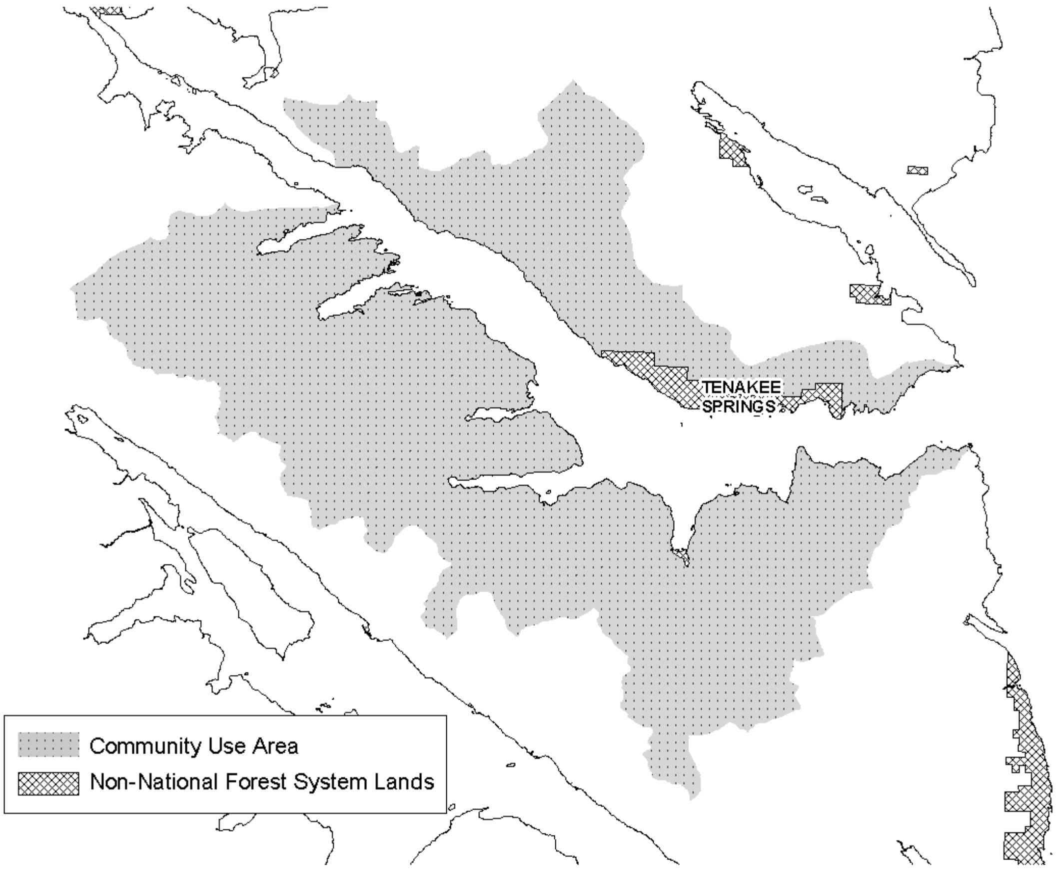


Table 3.23-58
Estimated Maximum Harvest (acres) over 100 Years in Tenakee Spring's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	3,161	6,075	4,951	3,530	5,409
Old Growth	2,196	1,066	1,289	1,339	1,569
Total	**5,357**	**7,141**	**6,240**	**4,869**	**6,978**
Harvest as a Percent of Total NFS Lands in the Community Use Area	2.7%	3.6%	3.2%	2.5%	3.6%

Economy

Tenakee Springs is primarily a commercial fishing, subsistence, and retirement community. Commercial fishing is not expected to be affected by any of the alternatives.

The Tenakee Springs/Indian River project is located on non-NFS lands and would not be directly affected by the Renewable Energy Plan Components identified in Chapter 5 of the proposed amended Forest Plan.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 55 percent of the total edible pounds of subsistence resources harvested by Tenakee Springs households (Kruse and Frazier 1988).

The 1988 TRUCS study found that deer accounted for 39 percent of the total edible pounds of subsistence resources harvested by Tenakee Springs households (Kruse and Frazier, 1988).

The WAAs used by Tenakee Springs residents for hunting deer lie within GMU 4. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). Among Tenakee Springs residents, total annual deer harvest has fluctuated up and down over the past decade, and in 2013 was about 12 percent less (9 fewer deer) than in 2004 (ADF&G 2015b).

Tenakee Springs residents take the majority (71 percent) of their deer from six WAAs (Table 3.23-59). As shown in Table 3.23-59, the Tenakee Springs portion ranges from about 4 to 31 percent of total harvest and 8 to 90 percent of all rural deer harvest in these WAAs. About 58 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

Table 3.23-59
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Tenakee Springs Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Tenakee Springs Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
3627	20	25	63	76%	72%	74%	75%	72%	72%
3526	15	28	63	80%	77%	79%	79%	77%	78%
3629	14	23	66	91%	91%	91%	91%	91%	91%
3525	5	56	118	75%	69%	71%	71%	70%	72%
3630	4	6	18	99%	99%	99%	99%	99%	99%
3628	2	2	8	98%	98%	98%	98%	98%	98%

[1] Calculated based on harvest where location is known.

[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

All of the WAAs identified in Table 3.23-59 are in areas with at least some past timber harvest and, therefore, deer habitat capabilities are currently estimated to be below 1954 levels (Table 3.23-59). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities in three of the six WAAs by a further 1 to 6 percent (Table 3.23-59).

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined all 1997 alternatives should be able to provide sufficient habitat capability over the short term and long term for deer hunted by Tenakee Springs residents and all rural hunters, and over the short term for all hunters. All of the 1997 alternatives included substantially higher levels of timber harvest in Tenakee Spring's community use area than the alternatives considered in this EIS (approximately 4 to 11 times as high). Therefore, it is likely all of the current alternatives would provide sufficient habitat in the short and long terms for deer hunted by Tenakee Spring's residents and all rural hunters. However, the 1997 analysis concluded that all alternatives may have future inadequate habitat capability for the total deer hunt and at some point a restriction in hunting may be necessary. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Tenakee Springs residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area.

Thorne Bay

Affected Environment

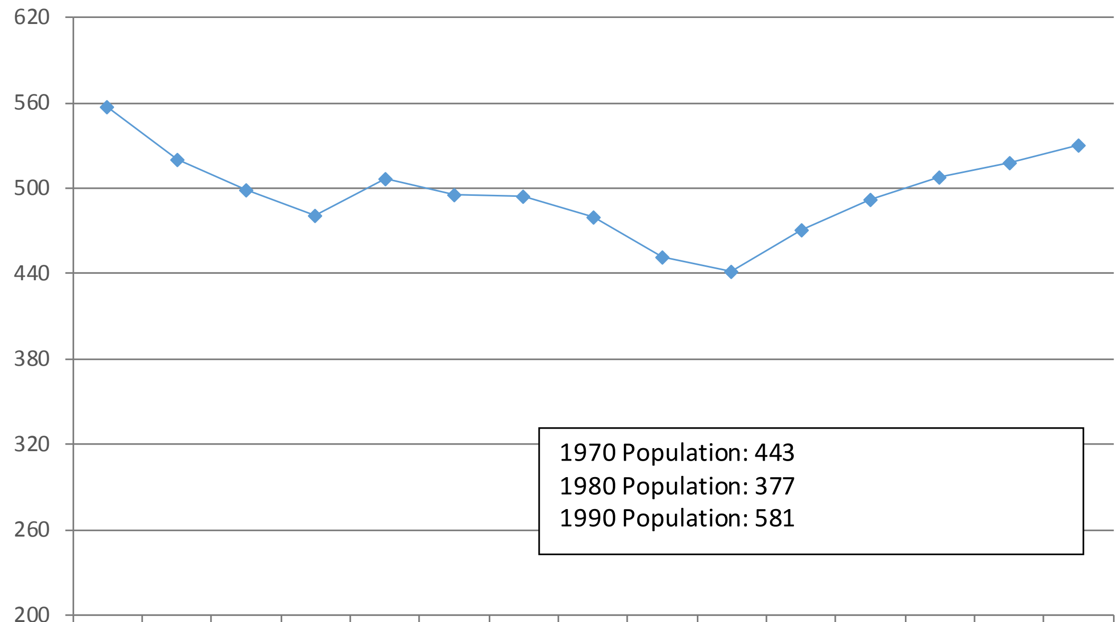
Overview and Demographic Characteristics

Thorne Bay is located at the head of Thorne Bay on eastern Prince of Wales Island, approximately 40 air miles northwest of Ketchikan. Petroglyphs and other archaeological remains indicate occupation and use of the area by Alaska Natives dating back at least 3,000 years. Post-contact development began in the early 1900s with construction of a saltery on the south shore of Thorne Bay.

Thorne Bay developed as a result of the long-term timber sale contract between the Forest Service and the Ketchikan Pulp Company. In 1960, a floating logging camp was built in Thorne Bay, and, in 1962, a shop, barge terminal, log sort yard, and camp were built to replace facilities at Hollis. During this era, Thorne Bay was considered the largest logging camp in North America. Thorne Bay was incorporated as a second-class city in 1982, making it one of Alaska's newest cities.

Thorne Bay's population decreased by 4 percent between 1990 and 2000, dropping by a further 21 percent between 2000 and 2009, but has since rebounded nearly to 2000 levels. Total estimated population was 530 in Thorne Bay in 2014 (Figure 3.23-61). Alaska Natives comprised 2 percent of the population in Thorne Bay in 2010 (Table 3.23-8). A total of 76 students were enrolled in Thorne Bay in 2014, down from 136 students in 2000 and 168 students in 1990 (Table 3.23-9).

Figure 3.23-61
Thorne Bay Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Thorne Bay	557	520	499	481	507	496	495	480	452	442	471	492	508	518	530

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Thorne Bay economy is primarily based on the timber industry and the USDA Forest Service management of the National Forest. Logging operations in the area are generally seasonal (March to November) and include a major log transfer site for Prince of Wales Island. The 2013 mill survey conducted for the USDA Forest Service identified four active timber processors in Thorne Bay: Porter Lumber Company, Thuja Plicata Lumber Company, Good Faith Lumber Company, and Western Gold Cedar Products. These mills had a combined installed production capacity of 22 MMBF and together processed approximately 2 MMBF in 2013 and employed about 12 people (Parrent and Grewe 2014). Northern Star Cedar Products and Thorne Bay Enterprises, also located in Thorne Bay, are currently idle (Parrent and Grewe 2014).

Commercial fishing, tourism, and government also provide employment (Himes-Cornell et al. 2013). In 2013, 17 residents held commercial fishing permits and grossed an estimated $523,000 (ACFEC 2015).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 8 percent of the labor force in Thorne Bay was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $49,323, compared to the state median of $70,760; the corresponding median for the Prince of Wales-Hyder CA was $46,071 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	12	7
Construction	21	12
Manufacturing	5	3

Employment by Industry in 2013	Number	Percent of Total
Trade, Transportation and Utilities	37	21
Information	0	0
Financial Activities	5	3
Professional and Business Services	6	3
Educational and Health Services	13	7
Leisure and Hospitality	11	6
State Government	7	4
Local Government	62	34
Other	1	1
Unknown	0	0
Total Employment	**180**	**100**

Source: Alaska DOL 2015d

Thorne Bay is part of the AP&T system that connects the community with the communities of Coffman Cove, Craig, Hollis, Hydaburg, Kasaan, and Klawock. Thorne Bay is served by hydroelectric generation, with diesel generation used as a back-up. Residential rates for 2011 before and after the application of PCE payments were 24 cents/kWh and 16 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 24 cents/kWh.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Thorne Bay in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-62. This area contains 1,000,251 acres of NFS land (among other land ownerships). Table 3.23-60 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 10.4 percent of the Thorne Bay community use area under Alternative 1 to 13.6 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular location favored by Thorne Bay residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-60).

Economy

Thorne Bay is primarily a logging community and as such would be directly affected by the amount of logging opportunities on north Prince of Wales Island, as well as elsewhere on the Tongass. Several small timber operators produce value-added products in and near Thorne Bay. These value added products include music wood, cabinets, and other products. These operators process relatively low volumes of timber, but require specific species and grades to meet their needs. All alternatives would supply old-growth volume (5 MMBF) to support the small operators in Southeast Alaska, including those located in and around Thorne Bay.

The lodges located near the community would not be affected under any of the alternatives.

Figure 3.23-62
Thorne Bay's Community Use Area

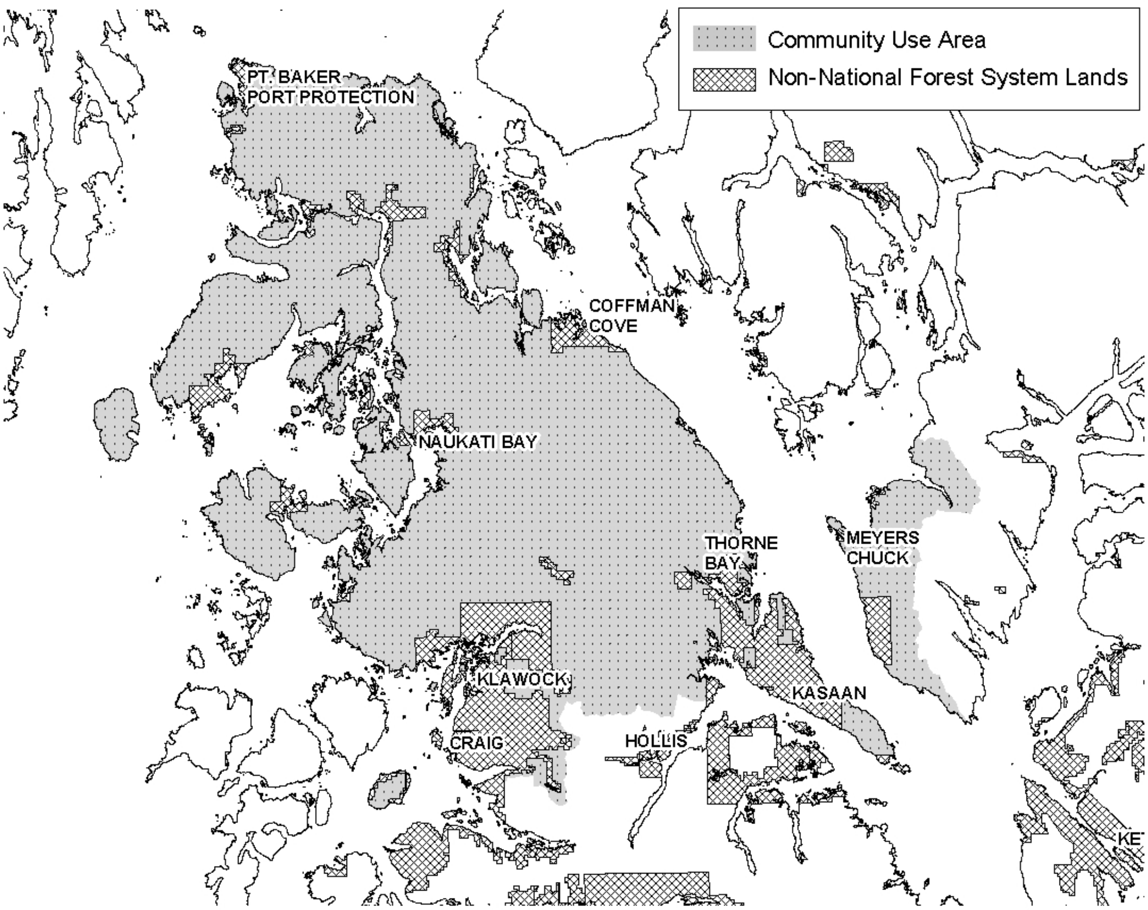


Table 3.23-60
Estimated Maximum Harvest (acres) over 100 Years in Thorne Bay's Community Use Area by Alternative

	Alternative				
	1	**2**	**3**	**4**	**5**
Young Growth	85,483	124,351	118,472	97,432	108,007
Old Growth	14,881	7,326	6,634	10,990	11,555
Total	**100,365**	**131,677**	**125,105**	**108,422**	**119,562**
Harvest as a Percent of Total NFS Lands in the Community Use Area	10.4%	13.6%	12.9%	11.2%	12.4%

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 75 percent of the total edible pounds of subsistence resources harvested by Thorne Bay households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 54 percent of per capita subsistence harvest in Thorne Bay in 1998 (ADF&G 2014).

The 1988 TRUCS study found that deer accounted for 20 percent of the total edible pounds of subsistence resources harvested by Thorne Bay (Kruse and Frazier 1988). Deer accounted for 27 percent of per capita subsistence harvest by Throne Bay residents in 1998 (ADF&G 2014).

Thorne Bay residents harvest deer almost entirely on Prince of Wales Island, which is included in GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Thorne B ay residents, total annual deer harvest has generally increased over the past decade, and in 2013 was about 40 percent higher (89 more deer) than in 2004 (ADF&G 2015b).

Residents of Thorne Bay harvest the majority (70 percent) of their deer from two WAAs in north-central Prince of Wales Island (1319 and 1315). As shown in Table 3.23-61, the Thorne Bay portion represents about 38 percent and 40 percent of the total harvest and about 59 percent and 53 percent of the rural hunter harvest in these WAAs, respectively. About 32 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a limited harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

WAAs 1319 and 1315 occur in an area with substantial past harvest and, therefore, deer habitat capabilities are currently estimated to be below 1954 levels (Table 3.23-61). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 5 to 7 percent in WAA 1319 and 5 to 6 percent in WAA 1315 (Table 3.23-61).

Table 3.23-61
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Thorne Bay Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Thorne Bay Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1319	119	201	317	74%	67%	67%	69%	69%	69%
1315	90	169	226	56%	50%	51%	50%	51%	50%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all1997 alternatives except for the most timber intensive (Alternatives 2, 7, and 9) should be able to provide sufficient habitat capability over the short and long term for deer hunted by Thorne Bay residents. All of the 1997 alternatives included substantially higher levels of timber harvest in Thorne Bay's community use area than the alternatives considered in this EIS (approximately 36 to 252 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Thorne Bay residents. However, projected deer harvest in the Thorne

Bay community use area by all rural hunters and all hunters was estimated to exceed the level that the analysis is assumed would provide a reasonably high level of hunter success for their effort, in the short and long term. This may still be the case under all alternatives.

In summary, use of most subsistence resources by Thorne Bay residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rual hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within Thorne Bay's subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Whale Pass

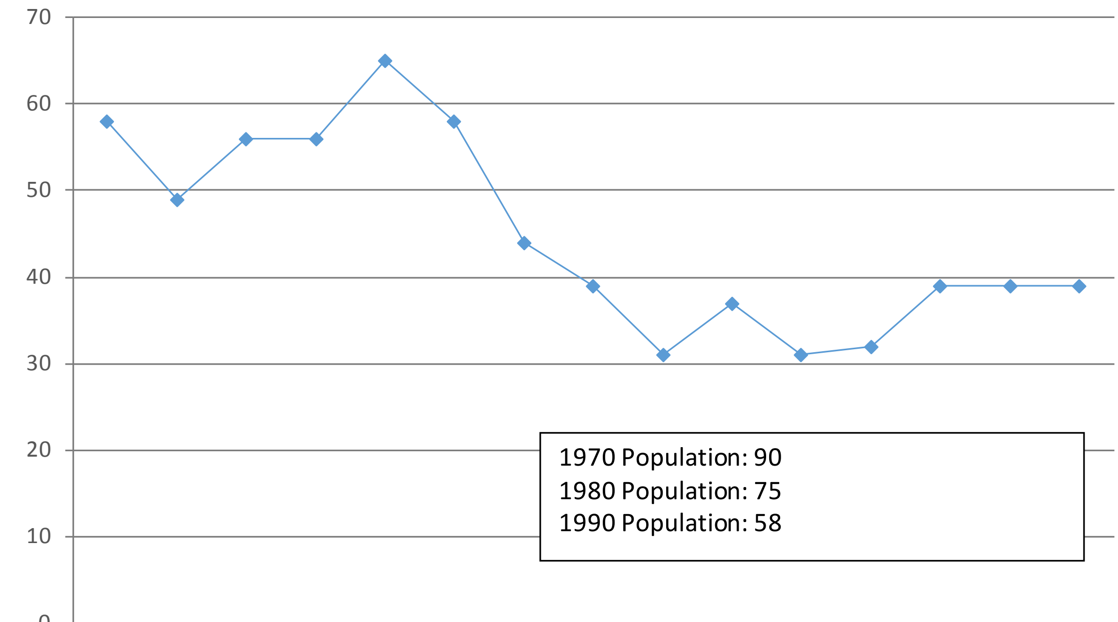
Affected Environment

Overview and Demographic Characteristics

Whale Pass is an unincorporated community located on the northeast coast of Prince of Wales Island. Whale Pass was originally established as a logging camp by Ketchikan Pulp Company in the early 1960s. According to local residents, a float camp housed loggers and their families in this location for almost 30 years. In 1982, the float camp was removed and many of the logging families left. Others moved to trailer pads on land at the head of the cove. That same year, Whale Pass became the site of a State land sale, which brought renewed population growth and the founding of a homeowners association. The community has been connected to the road system on Prince of Wales Island since 1981. A log transfer station remains on the southwest side of the bay (ADF&G 1994).

The population of Whale Pass dropped from 90 in 1970 to 58 in 2000, and has continued to generally trend downward since 2000, with a total estimated population of 39 in 2014 (Figure 3.23-63). According to the 2010 Census, there were no Alaska Native residents in Whale Pass (Table 3.23-8). Whale Pass school was closed in 2000 and 2010; 11 students were enrolled in the school in 2014 (Table 3.23-9).

Figure 3.23-63
Whale Pass Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Whale Pass	58	49	56	56	65	58	44	39	31	37	31	32	39	39	39

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

Whale Pass is primarily dependent on the timber industry, tourism, sport fishing and hunting, with logging operations and related services as the only steady employment opportunities (Himes-Cornell et al. 2013). Subsistence activities and public assistance payments supplement income (Himes-Cornell et al. 2013).

Most visitors arrive by car coming in through Craig or Ketchikan, with visitors to the one high-end ecolodge arriving by float plane included in the guest package (Dugan et al. 2009). Five visitor operations were in business in the summer of 2007, grossing an estimated $120,000 from about 275 guests (Dugan et al. 2009).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. According to the ACS, in 2013, the entire active labor force in Whale Pass (an estimated 16 residents) was unemployed and looking for work, and the remaining adult residents were unemployed and not looking for work (U.S. Census Bureau 2014b). These estimates conflict with the State data presented below (that are direct counts), which identify 25 people in Whale Pass as employed. The sampling limitations of the ACS for small communities can lead to a large margin of error; in this case, the estimate of 100 percent unemployment had a margin of error of 58 percent (U.S. Census Bureau 2014b). Median household income is not available for this community. State data indicate that 84 percent of resident workers' annual wages were $50,000 or less (Alaska DOL 2015d).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	4	16
Construction	4	16
Manufacturing	0	0
Trade, Transportation and Utilities	3	12
Information	0	0
Financial Activities	0	0
Professional and Business Services	0	0
Educational and Health Services	2	8
Leisure and Hospitality	5	20
State Government	3	12
Local Government	4	16
Other	0	0
Unknown	0	0
Total Employment	**25**	**100**

Source: Alaska DOL 2015d

Whale Pass has some of the highest electric rates in Alaska due to the use of diesel generated power. Residential rates for 2011 before and after the application of PCE payments were 60 cents/kWh and 26 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 60 cents/kWh. The high cost of energy is believed to currently impede economic development for commercial and industrial ventures (Alexander et al. 2010).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Whale Pass in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-64. This area contains 1,000,251 acres of NFS land (among other land ownerships). Table 3.23-62 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. Total areas available for harvest range from about 10.4 percent of the Whale Pass community use area under Alternative 1 to 13.6 percent under Alternative 2. Harvest activities could have localized effects if they coincide with a particular location favored by Whale Pass residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old-growth harvest in this area (see Table 3.23-62).

Figure 3.23-64
Whale Pass' Community Use Area

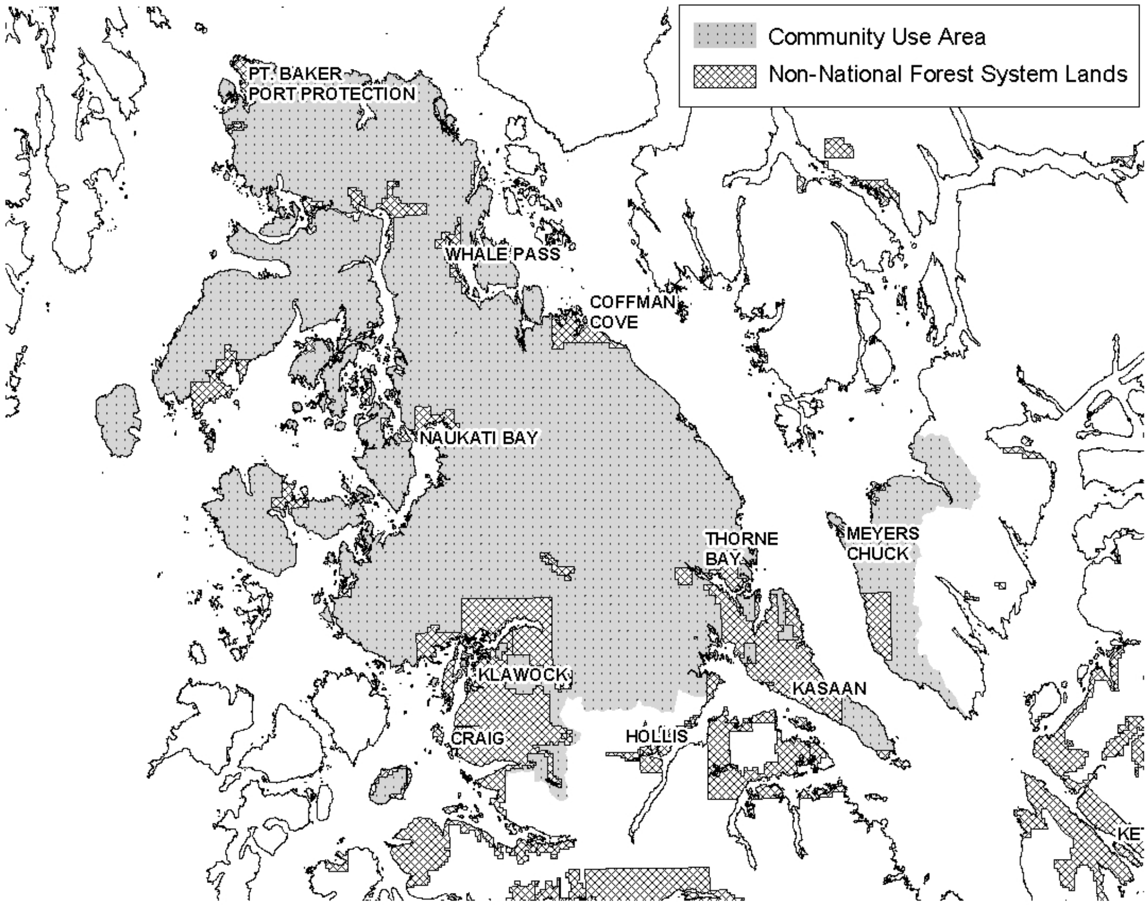


Table 3.23-62
Estimated Maximum Harvest (acres) over 100 Years in Whale Pass' Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	85,483	124,351	118,472	97,432	108,007
Old Growth	14,881	7,326	6,634	10,990	11,555
Total	**100,365**	**131,677**	**125,105**	**108,422**	**119,562**
Harvest as a Percent of Total NFS Lands in the Community Use Area	10.4%	13.6%	12.9%	11.2%	12.4%

Economy

Residents of Whale Pass could be potentially affected by changes in timber harvest, karst protection, recreation and tourism, and subsistence opportunities. Members of several speliological societies derive a portion of their income from cave and karst analysis and exploration in the vicinity. The Whale Pass Resort and a retail store are located in Whale Pass.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 60 percent of the total edible pounds of subsistence resources harvested by Whale Pass households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 61 percent of per capita subsistence harvest in Whale Pass in 2012 (ADF&G 2014).

The 1988 TRUCS study found that deer account for 27 percent of the total edible pounds of subsistence resources harvested by Whale Pass households (Kruse and Frazier, 1988). Deer accounted for 29 percent of per capita subsistence harvest by Whale Pass residents in 2012 (ADF&G 2014).

The majority of deer harvest by Whale Pass residents occurs on Prince of Wales Island, which is included in GMU 2. Following a deer population decline 2006 to 2009 due to severe winters, the population is now considered stable to increasing, with above-average deer harvest in this GMU (Harper 2013). Among Whale Pass residents, total annual deer harvest is generally low and in 2013 was about 10 percent higher (3 more deer) than in 2004 (ADF&G 2015b).

Residents of Whale Pass harvest the majority (72 percent) of their deer from two WAAs in north Prince of Wales Island (1530 and 1527). As shown in Table 3.23-63, the Whale Pass portion represents about 15 percent and 11 percent of the total harvest and about 32 percent and 18 percent of the rural hunter harvest in these WAAs, respectively. About 51 percent of the combined harvest in these WAAs is by non-rural hunters, suggesting that there is a harvest buffer that could be restricted, if necessary, before restrictions are placed on rural harvests.

WAAs 1530 and 1527 occur in an area with substantial past timber harvest and, therefore, deer habitat capabilities are currently estimated to be below 1954 levels (Table 3.23-63). Under each of the alternatives, additional harvest would occur that would reduce habitat capabilities after 100 years by a further 2 to 4 percent WAA 1530 and 1 to 3 percent in WAA 1527.

Table 3.23-63
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Whale Pass Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Whale Pass Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1530	18	57	124	61%	58%	60%	59%	58%	57%
1527	3	17	27	72%	69%	71%	71%	70%	70%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined all 1997 alternatives should be able to provide sufficient habitat capability over the short and long term for deer hunted by Whale Pass residents. All of the 1997 alternatives included substantially higher levels of timber harvest in Whale Pass' community use area than the alternatives considered in this EIS (approximately 36 to 252 percent higher). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long term for deer hunted by Whale Pass residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all rural hunters and all hunters in both the short and long terms. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Whale Pass residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area. Indirect effects associated with increased competition for deer within the Whale Pass subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity.

Wrangell

Affected Environment

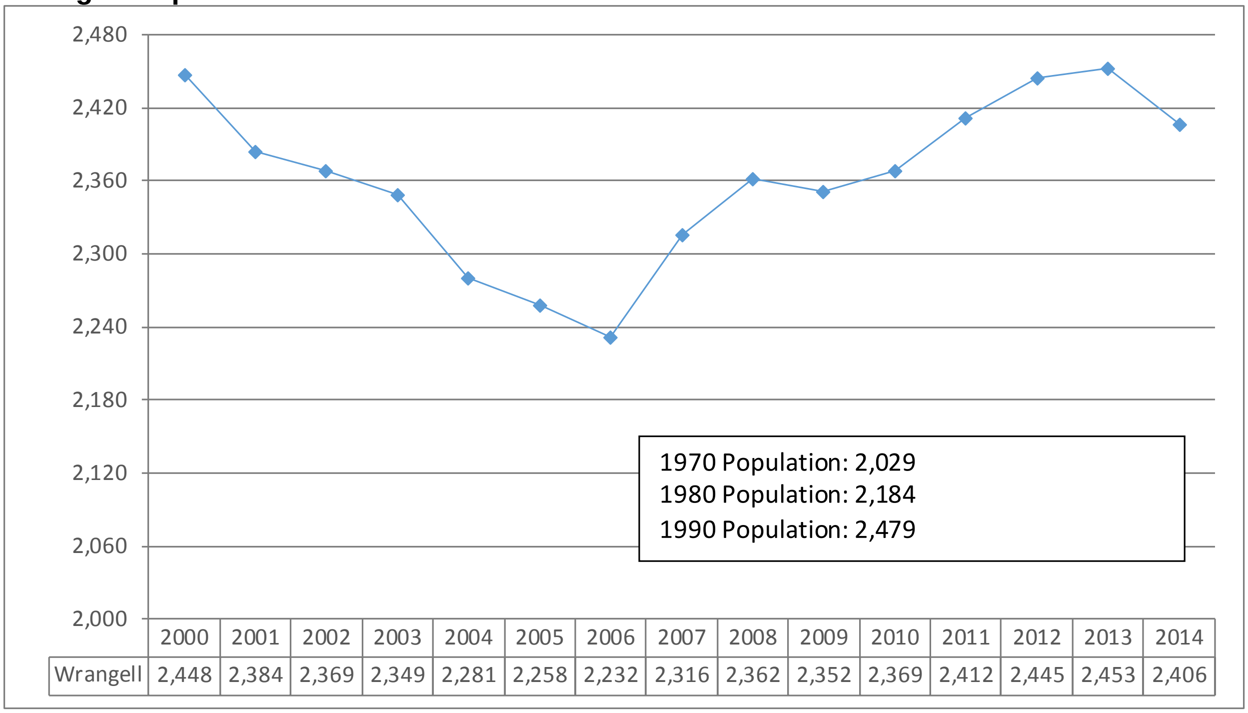
Overview and Demographic Characteristics

Wrangell is located on the north end of Wrangell Island, near the mouth of the Stikine River, an historic trade route to the Canadian interior. Wrangell began as an important Tlingit site primarily because of its proximity to the Stikine River. Wrangell clans held a monopoly of trading rights along the Stikine. In 1811, the Russians began fur trading with area Tlingits and built a stockade named Redoubt Saint Dionysius in 1834. In 1867, a military post named Fort Wrangell was established as part of the Alaska Territory. The community continued to grow because of its strategic location as a military fur trading center, and as an outfitter for gold prospectors between 1861 and the 1930s (ADF&G 1994; Alaska DCED 2006).

In 2008, residents decided by local election that the City of Wrangell should dissolve and incorporate as the City and Borough of Wrangell. This added the communities of Meyers Chuck, Union Bay, Thoms Place, Olive Cove, and Farm Island to the new unified city and borough. The community has an active local Fish and Game Advisory Committee focused on commercial, sport, and personal use fishing, hunting, and subsistence (ADF&G 2015a).

Wrangell's population increased between 1970 and 2000, with a total of 2,448 residents identified in 2000 (Figure 3.23-65). Population has fluctuated since 2000, reaching its lowest level in 2006, with an estimated 2,232 residents. Total estimated population was 2,406 in Wrangell in 2014 (Figure 3.23-65). Alaska Natives comprised 16 percent of the population in Wrangell in 2010 (Table 3.23-8). School enrollment in Wrangell has decreased at a much higher rate than population, with enrollment decreasing from 491 students in 2000 to 275 students in 2014, a drop of 44 percent (Table 3.23-8).

Figure 3.23-65
Wrangell Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Wrangell	2,448	2,384	2,369	2,349	2,281	2,258	2,232	2,316	2,362	2,352	2,369	2,412	2,445	2,453	2,406

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Wrangell economy is primarily based on commercial fishing, fish processing, the timber industry, and tourism (Himes-Cornell et al. 2013). In 2013, 205 residents held commercial fishing permits and estimated gross fishing earnings of local residents exceeded $14 million (ACFEC 2015). A dive fishery, including for urchins, sea cucumbers, and geoducks, is developing. Tourism provides a significant source of income and employment; in 2009, Wrangell attracted 23,000 independent travelers, 4,400 small cruise ship passengers, and 470 pleasure vessel calls (Himes-Cornell et al. 2013).

The Alaska Pulp Corporation mill and subsequent Silver Bay Logging mill are both closed. In 2010, very little timber related employment existed (Himes-Cornell et al. 2013). No timber-related employment was identified in Wrangell in 2012 (see the Subregional Overview discussion of employment, above).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 8 percent of the labor force in Wrangell was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $45,841, compared to the state median of $70,760 (Tables 3.23-4 and 3.23-8).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	29	3
Construction	67	8
Manufacturing	50	6
Trade, Transportation and Utilities	145	17
Information	7	1
Financial Activities	23	3

Employment by Industry in 2013	Number	Percent of Total
Professional and Business Services	18	2
Educational and Health Services	106	12
Leisure and Hospitality	61	7
State Government	54	6
Local Government	273	32
Other	24	3
Unknown	0	0
Total Employment	**857**	**100**

Source: Alaska DOL 2015d

Wrangell is served by the SEAPA system that connects Ketchikan, Petersburg, and Wrangell. The Swan Lake and Tyee Lake hydroelectric projects provide electricity to this SEAPA network (Table 3.12b-2). Residential rates for 2011 before and after the application of PCE payments were both 11 cents/kWh (see Table 3 in the Energy Resource Report [Tetra Tech 2015]).

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Wrangell in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-66. This area contains 819,240 acres of NFS land (among other land ownerships). Table 3.23-64 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Wrangell, ranging from about 2.6 percent (Alternative 1) to 3.5 percent (Alternatives 2 and 3). Harvest activities could have localized effects if they coincide with a particular location favored by Wrangell residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternatives 2 and 3; however, it may be noted that Alternative 1 (which would have the least amount of potential suitable harvest) would have the largest potential old growth harvest in this area (see Table 3.23-64).

Economy

Commercial fishing, recreation and tourism, and subsistence opportunities are particularly important to Wrangell. Wrangell is one of the stop-over points for visitors traveling to the Stikine River and the Stikine-LeConte Wilderness. Commercial fisheries employment and recreation and tourism activities are not likely to be affected under any of the alternatives.

Figure 3.23-66
Wrangell's Community Use Area

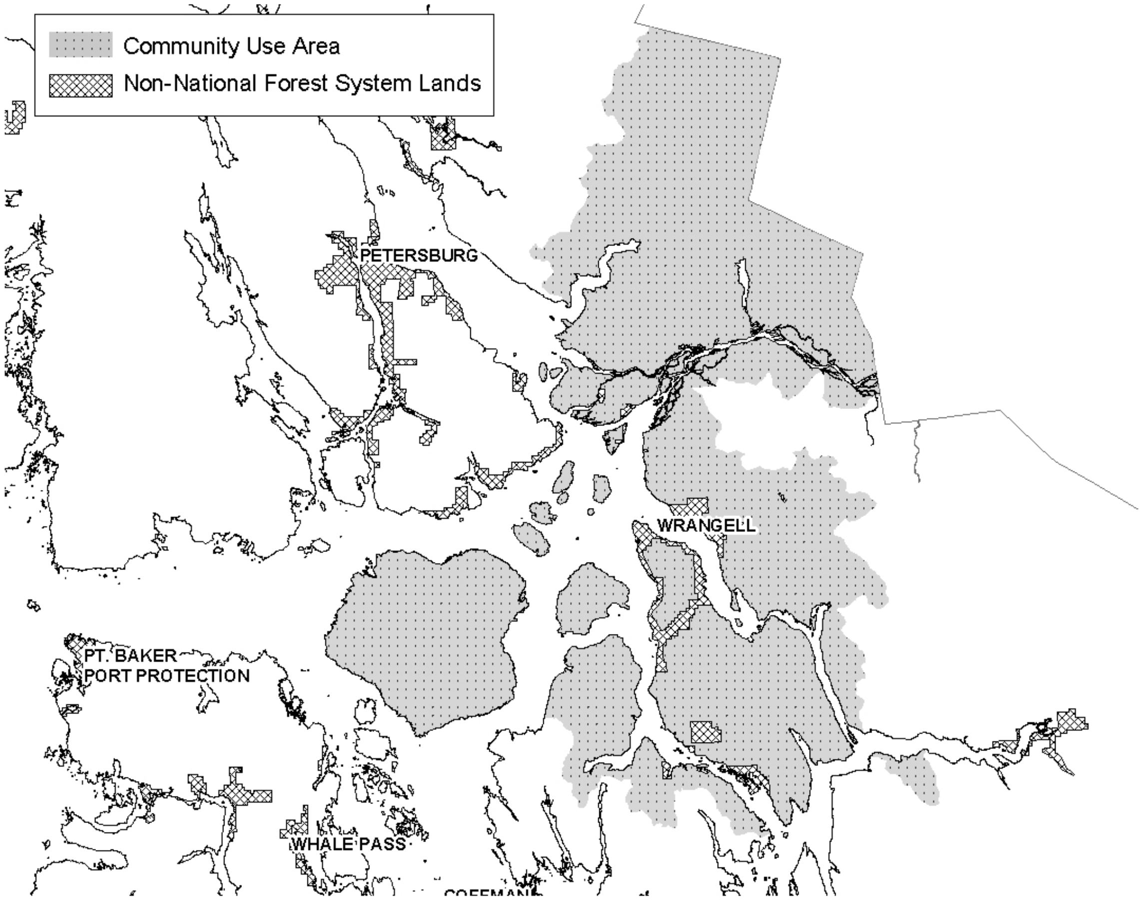


Table 3.23-64
Estimated Maximum Harvest (acres) over 100 Years in Wrangell's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	16,183	25,434	25,030	19,978	21,780
Old Growth	5,428	3,072	3,968	4,349	4,869
Total	**21,611**	**28,506**	**28,998**	**24,327**	**26,648**
Harvest as a Percent of Total NFS Lands in the Community Use Area	2.6%	3.5%	3.5%	2.9%	3.2%

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 52 percent of the total edible pounds of subsistence resources harvested by Wrangell households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 71 percent of per capita subsistence harvest in Wrangell in 2000 (ADF&G 2014).

The 1988 study found that deer account for 21 percent of the total edible pounds of subsistence resources harvested by Wrangell households (Kruse and Frazier 1988). Deer accounted for 17 percent of per capita subsistence harvest by Wrangell residents in 2000 (ADF&G 2014).

Wrangell residents mainly harvest deer on Wrangell, Zarembo Island, and other surrounding islands, with the majority of harvest occurring in GMU 3. Deer harvest in GMU 3 has historically fluctuated. Between 1994 and 2011, deer harvest ranged from a low of 333 to a high of 1,119 (Harper 2013). The harvest level in 2013 was about 100 deer below the previous 10 year mean (Harper 2013). From 2004 to 2013, deer harvest by Wrangell residents fluctuated, ranging from 370 to 506 deer, with similar numbers harvested in 2004 and 2013 (ADF&G 2015b).

Deer harvest by Wrangell residents is spread over many WAAs, but the majority (76 percent) of their deer are from six WAAs located on Wrangell and surrounding islands. Zarembo Island (WAA 1905) alone accounted for 39 percent of the annual average deer harvest by Wrangell residents from 2004 to 2013. The Wrangell portion of the harvest in these six WAAs represents about 76 percent of the total harvest and about 85 percent of the rural hunter harvest (Table 3.23-65).

The majority of the WAAs used heavily by Wrangell residents are in areas with substantial past harvest and deer habitat capabilities are currently estimated to be considerably below 1954 levels (Table 3.23-65). Under each of the alternatives, additional harvest would further reduce habitat capabilities after 100 years by 1 to 6 percent (Table 3.23-65).

Table 3.23-65
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Wrangell Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Wrangell Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
1905	170	190	204	73%	68%	71%	71%	67%	67%
1903	67	69	72	84%	80%	82%	81%	82%	82%
1901	53	56	62	90%	89%	89%	88%	89%	89%
1003	15	28	44	59%	55%	58%	58%	54%	55%
1528	12	30	36	78%	76%	78%	78%	78%	78%
1904	12	12	14	66%	67%	66%	66%	66%	66%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives except for Alternative 7 and 9 should be able to provide sufficient habitat capability over the long term for deer hunted by Wrangell residents. All of the 1997 alternatives included substantially higher levels of timber harvest in Wrangell's community use area than the alternatives considered in this EIS (approximately 2 to 6 times as high). Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the long term for deer hunted by Wrangell residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to produce deer populations sufficient to avoid effects on hunter success for all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Wrangell residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction on hunting might be necessary over the long term, especially for all hunters, under all alternatives. The risk of hunting restrictions would be reduced somewhat through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area.

Yakutat

Affected Environment

Overview and Demographic Characteristics

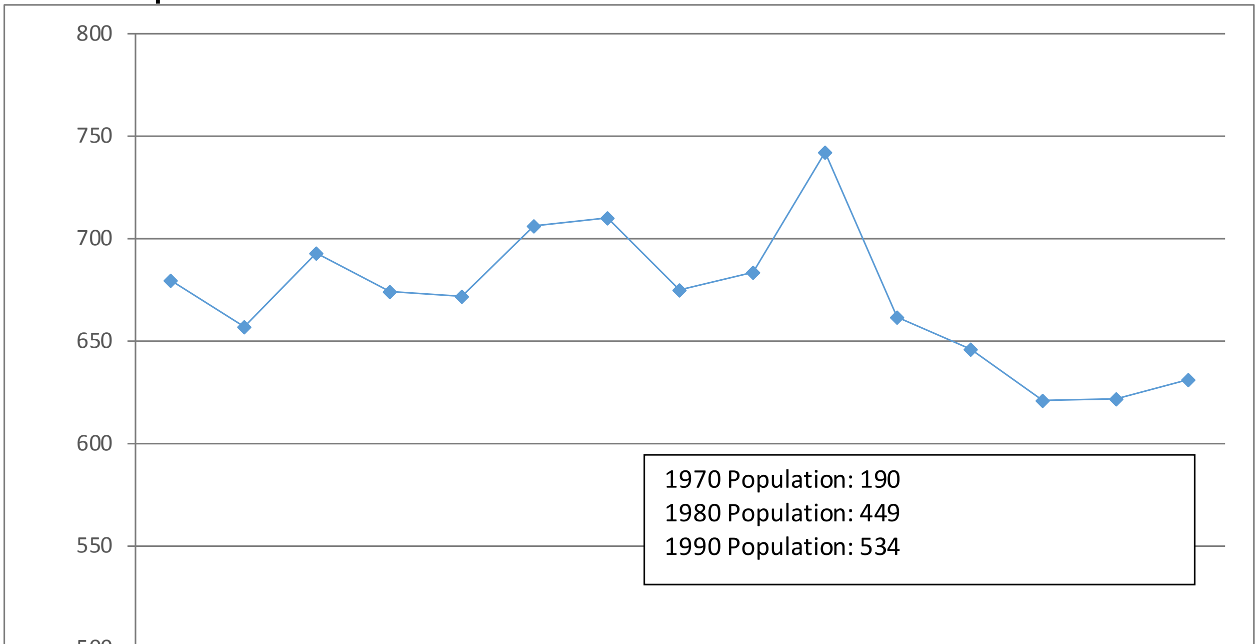
Yakutat is located in the lowlands along the northern Gulf of Alaska, 212 miles northwest of Juneau at the mouth of Yakutat Bay. Yakutat, which means "the place where the canoes rest," has a diverse cultural history. The original settlers, believed to have been Eyak people from the Copper River area, were later conquered by the Tlingits. Intensive contact with European explorers came in the late 1700s when a Russian fur trading company moved into the Yakutat area. By the mid-1800s, foreign traders were well established along the coast. The contemporary town grew up around "the old village," which was established in 1889 by missionaries (ADF&G 1994).

Incorporated as a first-class city in 1948, Yakutat is governed by a mayor and a city council. Yakutat Borough, incorporated in 1992, expanded the original city boundaries to include a large section of the Gulf Coast north of Cape Fairweather. Yakutat has an active local Fish and Game Advisory Committee (ADF&G 2015a). Yakutat is accessible by jet service from Juneau and Anchorage. Wrangell-Saint Elias National Park, Russell Fiords Wilderness, and Glacier Bay National Park are located northwest, northeast, and southeast of Yakutat, respectively.

The population of Yakutat increased almost threefold between 1970 and 1990, and increased by an additional 27 percent between 1990 and 2000 (Figure 3.23-67). Population in Yakutat has fluctuated since 2000, with 49 fewer residents in 2014 than in 2000. Total estimated population was 631 in Yakutat in 2014 (Alaska DOL 2015b). Alaska Natives comprised 36 percent of the population in Yakutat in 2010 (Table 3.23-8).

Enrollment in Yakutat schools has also declined since 2000, dropping from 167 in 2000 to 109 in 2014, a 35 percent decrease, compared to an overall declinein population of 7 percent (Table 3.23-9; Figure 3.23-67).

Figure 3.23-67
Yakutat Population 1970 to 2014



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Yakutat	680	657	693	674	672	706	710	675	684	742	662	646	621	622	631

Sources: Alaska DOL 2015b; USDA Forest Service 1997a

Economic Conditions

The Yakutat economy is primarily dependent on fishing, fish processing, and government (Himes-Cornell et al. 2013). In 2013, a total of 158 residents held commercial fishing permits, with estimated gross earnings of approximately $5.4 million (ACFEC 2015). Fishing opportunities in the area, both freshwater in the Situk River and saltwater, are considered world class. Most residents depend on subsistence hunting and fishing (Himes-Cornell et al. 2013). Employment remains largely seasonal; in 2008 the number of jobs almost doubled in the summer (Himes-Cornell et al. 2013).

In addition to fish-related industries and government, tourism is important to Yakutat. As of 2010, there were 41 businesses within the area providing lodging of some type, including 27 located directly in Yakutat. Tourists come for rafting trips, sport fishing, surfing, and cruise trips (Himes-Cornell et al. 2013).

Employment by industry data compiled by the Alaska Department of Labor and Workforce Development are summarized in the table below. An estimated 7 percent of the labor force in Yakutat was unemployed and seeking work in 2013, compared to 6 percent for Southeast Alaska as a whole (U.S. Census Bureau 2014b; Alaska DOL 2015d). Median household income was $72,500, compared to the state median of $70,760 (Tables 3.23-4 and 3.23-8).(U.S. Census Bureau 2014b).

Employment by Industry in 2013	Number	Percent of Total
Natural Resources and Mining	2	1
Construction	12	4
Manufacturing	14	5
Trade, Transportation and Utilities	48	16
Information	2	1
Financial Activities	9	3
Professional and Business Services	13	4
Educational and Health Services	8	3
Leisure and Hospitality	33	11
State Government	21	7
Local Government	141	46
Other	1	< 1
Unknown	0	0
Total Employment	**304**	**100**

Source: Alaska DOL 2015d

Yakutat has some of the highest electric rates in Alaska due to the use of diesel generated power. Residential rates for 2011 before and after the application of PCE payments were 50 cents/kWh and 17 cents/kWh, respectively (see Table 3 in the Energy Resource Report [Tetra Tech 2015]). Commercial and other rates were 50 cents/kWh. Resolute Marine Energy has proposed a wave energy project that could make Yakutat one of the first municipalities in North America to generate electrical grid power from wave energy (Table 3.12b-3). The Yakutat Wave project would have a capacity of 500 to 750 kW.

Potential Effects

Community Use Area

The general area commonly used or related to by many of the residents of Yakutat in their local day-to-day work, recreational, and subsistence activities is shown on Figure 3.23-68. This area contains 250,271 acres of NFS land (among other land ownerships). Table 3.23-66 shows the estimated maximum acres of young-growth and old-growth harvest by alternative. In general, potential harvest levels represent a small portion of the community use area for Yakutat, ranging from about less than 0.1 percent (Alternative 4) to 1.3 percent (Alternatives 1 and 2). Harvest activities could have localized effects if they coincide with a particular location favored by Yakutat residents, and project-level impacts would be subject to future analysis under NEPA. In general, the potential for impacts would be higher under those alternatives with more lands identified as suitable for timber production within the community use area, as would be the case with Alternative 1.

Economy

Commercial fishing and subsistence are important to Yakutat. The Yakutat Forelands are some of the community's important subsistence use areas. Commercial fishing is not expected to be affected under any of the alternatives.

The proposed Yakutat Wave Project is located in a Scenic Viewshed LUD. Scenic Viewshed is considered a TUS "window" under the 2008 Forest Plan, an area potentially available for the location of transportation or utility corridors and sites. This classification and the standards and guidelines in the 2008 Forest Plan would continue to apply under Alternative 1. Under Alternatives 2 through 5, energy projects would be managed under the Renewable Energy Plan Components identified in Chapter 5 of the proposed Forest Plan amendment.

Subsistence

No significant effect on salmon, other finfish, or invertebrate habitat capability is expected from implementation of any alternative. These resources account for 82 percent of the total edible pounds of subsistence resources harvested by Yakutat households (Kruse and Frazier 1988). Marine resources (fish and marine invertebrates) accounted for 74 percent of per capita subsistence harvest in Yakutat in 2000 (ADF&G 2014).

Moose are more important than deer as a subsistence meat source for Yakutat residents. Moose availability would not be significantly affected under any of the alternatives.

The 1988 TRUCS study found that deer account for only a small fraction of the total edible pounds of subsistence resources harvested by Yakutat households (Kruse and Frazier, 1988). Deer accounted for 1 percent of per capita subsistence harvest by Yakutat residents in 2000 (ADF&G 2014).

Figure 3.23-68
Yakutat's Community Use Area

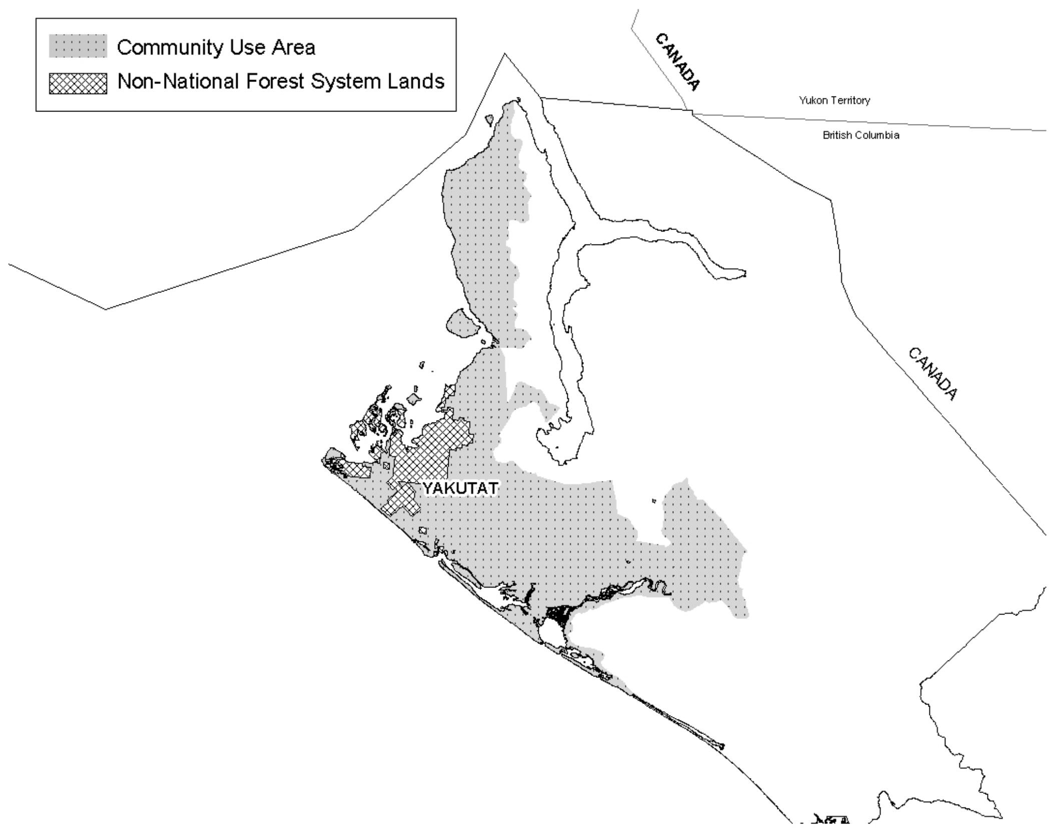


Table 3.23-66
Estimated Maximum Harvest (acres) over 100 Years in Yakutat's Community Use Area by Alternative

	Alternative				
	1	2	3	4	5
Young Growth	2,309	2,907	2,849	12	2,495
Old Growth	1,126	550	0	0	0
Total	**3,435**	**3,457**	**2,849**	**12**	**2,495**
Harvest as a Percent of Total NFS Lands in the Community Use Area	1.3%	1.3%	1.1%	0.0%	1.0%

Yakutat residents harvested an annual average of 36 deer from 2004 to 2013, with four WAAs accounting for 76 percent of this annual average (Table 3.23-67). These WAAs are located in GMU 4 and GMU 5A. GMU 4 is considered to provide a substantial portion of the deer hunting opportunity in Southeast Alaska (Harper 2013). Severe winter weather in 2006 and moderately severe winters the following two winters led to a dramatic decline in the deer populations throughout Southeast Alaska (Harper 2013). The deer population has rebounded in recent years, leading to an increase in successful hunters in this GMU (Harper 2013). In 1991, the Board of Game instituted a limited hunt in Unit 5A, with a one month bucks only season. Deer populations remain low in the Yakutat area, but are believed to be much more abundant than ever before and to have expanded their range inland (Harper 2013). Annual average deer harvest by Yakutat residents fluctuated from 2004 to 2013, but was substantially higher in 2013 than 10 years earlier (61 deer versus 33 deer) (ADF&G 2015b).

Table 3.23-67
Deer Harvest (2004 to 2013) and Deer Habitat Capability on NFS Lands in 2014 and After 100 Years of Full Implementation under Each Alternative, Expressed as a Percent of 1954 Habitat Capability, for the WAAs where Yakutat Residents Obtain Approximately 75% of their Average Annual Deer Harvest[1]

	Average Deer Harvest from 2004 to 2013			Deer Habitat Capability in 2014 and after 100 Years of Full Implementation Under Each Alternative, Expressed as a Percent of the 1954 Habitat Capability					
WAA	Yakutat Residents	All Rural Hunters[2]	All Hunters	2014	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
4504	15	15	17	100%	100%	100%	100%	100%	100%
4508	7	7	7	94%	94%	94%	94%	94%	94%
3315	3	38	46	84%	84%	84%	84%	84%	84%
3835	3	5	141	100%	100%	100%	100%	100%	100%

[1] Calculated based on harvest where location is known.
[2] The category "All Rural Hunters" includes residents of Southeast Alaska communities, excluding the cities of Juneau and Ketchikan.

The Deer Availability and Anticipated Demand analysis completed for the 1997 Forest Plan EIS determined that all 1997 alternatives should be able to provide sufficient habitat capability for deer hunted by Yakutat residents in the short term and long term. All of the 1997 alternatives included substantially higher levels of timber harvest in Yakutat's community use area than the alternatives considered in this EIS. Therefore, it is likely all of the current alternatives would provide sufficient habitat capability over the short and long term for deer hunted by Yakutat residents. However, the 1997 analysis concluded that demand would exceed the capability of the habitat to support deer populations sufficient to avoid effects on hunter success for all hunters in the long term. This may still be the case under all current alternatives.

In summary, use of most subsistence resources by Yakutat residents (fish and marine invertebrates) is not expected to be affected by any of the alternatives. However, subsistence use of deer may be affected to the point that some restriction in hunting might be necessary over the long term, especially for non-rural hunters, under all alternatives. The highest use areas for Yakutat households are within Wilderness and LUD II designations that will not change by alternative. The risk of hunting restrictions would be reduced somewhat, through more intensive management (e.g., thinning) of the existing and future closed-canopy, young-growth forests in this area.

Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires each federal agency to make the achievement of environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The Order further stipulates that the agencies conduct their programs and activities in a manner that does not have the effect of excluding persons from participating in, denying persons the benefits of, or subjecting persons to discrimination under such programs, policies, and activities because of their race, color, or national origin.

Race and ethnicity are shown by borough in Table 3.23-68. These data show that 65 percent of the population of Southeast Alaska identified as White in the 2010 census. American Indian and Alaska Native was the largest minority group, accounting for 16 percent of the total Southeast Alaska population. Table 3.23-68 indicates that there are relatively large proportions of Alaska Natives in Hoonah-Angoon, Yakutat, and Prince of Wales-Hyder. The populations of Haines, Juneau, and Skagway in contrast, have relatively low proportions of Alaska Natives, below the Southeast Alaska average of 16 percent.

Alaska Native populations are identified as a percentage of total population by community in Table 3.23-8. This information is presented graphically in Figure 3.17-1 (in the *Subsistence* section). These data indicate that 14 of Southeast Alaska's 32 communities have Alaska Native populations that comprise a larger share of total population than the regional average (16 percent). Alaska natives comprised a particularly large share of total population in Angoon (76 percent), Hoonah (53 percent), Hydaburg (85 percent), Kake (67 percent), Klawock (51 percent), Metlakatla (77 percent), and Saxman (51 percent), all considered traditional Native communities.

Table 3.23-68
Race/Ethnicity by Borough/Census Area, 2010

Geographic Area	Total Population	Percent of Total Population: White[1]	American Indian and Alaska Native[1]	Hispanic or Latino	Other Race[1,2]	Two or More Races[1]
Northern Boroughs						
Haines Borough	2,508	82	9	2	1	5
Hoonah-Angoon CA	2,150	46	40	4	1	10
City and Borough of Juneau	31,275	67	11	5	8	9
City and Borough of Sitka	8,881	64	16	5	7	9
Municipality of Skagway Borough	968	90	4	2	1	4
City and Borough of Yakutat	662	40	35	3	6	15
Southern Boroughs						
Ketchikan Gateway Borough	13,477	66	14	4	8	8
Petersburg CA	3,815	69	16	3	3	8
Prince of Wales-Hyder CA	5,559	50	39	2	1	8
City and Borough of Wrangell	2,369	72	16	2	2	9
Southeast Alaska	**71,664**	**65**	**16**	**4**	**6**	**8**
Alaska	710,231	64	14	6	10	6

CA – Census Area
[1] Non-Hispanic only. The Federal Government considers race and Hispanic/Latino origin (ethnicity) to be two separate and distinct concepts. People identifying as Hispanic or Latino origin may be of any race. In this table people identifying as Hispanic or Latino are included in the Other Race category only.
[2] The "Other Race" category presented here includes census respondents identified as Black or African American, Asian, Native Hawaiian and Other Pacific Islander, or Some Other Race.
Source: Alaska DOL 2015g

Median household income and the percent of households below the poverty line is presented by borough in Table 3.23-6. The percent of people below the poverty line in Alaska as a whole was 10.1 percent in 2013. Median household income was approximately $70,760. Juneau is the only borough in the region with median household income above the state median. Median household income as a share of the state median in the other boroughs ranged from 60.3 percent in Hoonah-Angoon to 94.3 percent in Sitka (Table 3.23-6). The share of the population below the poverty level in the northern boroughs in 2013 ranged from 4.2 percent in Skagway to 19.2 percent in Hoonah-Angoon compared to the statewide average of 10.1 percent (Table 3.23-6).

The percent of households below the poverty line and the median household income in 2013 are identified by community in Table 3.23-8. The U.S. Census identified 20 communities in Southeast Alaska with 10 percent or more of their population below the poverty line. All but four of the communities identified in Table 3.23-8 had median household incomes below the state average.

The potential effects of the alternatives on the economic and social environment of Southeast Alaska are discussed in the *Regional and National Economy* section of this document. The principal regional effects would be those associated with changes in the timber industry and recreation and tourism. There could also be potential effects upon subsistence use and heritage resources that have particular significance for Alaska Native populations.

The effects of the alternatives on communities are discussed by community in the preceding part of this section. These community assessments include a discussion of the potential effects to the subsistence resources and the land base used by each community. Overall effects on heritage resources are expected to be low under all the alternatives because of the protection offered by Forest-wide standards and guidelines. Further, the potential effects of the alternatives upon heritage resources are expected to be the lower than under the 2008 Forest Plan because of the lower allowable amount of potential timber harvest.

CHAPTER 4
LIST OF PREPARERS

List of Preparers

Provided below are brief bio-sketches of the primary preparers and contributors from the Forest Service and Tetra Tech. Additional Forest Service, Tetra Tech, and other agency staff, who contributed to various sections through an extensive internal review process, or in other ways, are also listed.

Susan Howle, Project Manager and Plan Amendment Team Leader – Forest Service

Education

M.S., Geography, University of Massachusetts, 1998

B.S., Geography, Middle Tennessee State University, 1988

Experience

Twelve years of Forest Service experience in land and resource management planning, NEPA compliance, interdisciplinary team leadership, and project management in Regions 1, 3, 4, 5, 9 and 10, and the Washington Office

Five years of Bureau of Land Management experience in land use planning, NEPA compliance, wildland fire, partnerships, special initiatives coordination, and fuels program management in Nevada

Rick Abt, Operations and Planning Staff Officer – Forest Service

Education

B.S., Forest Management, University of Montana, 1979

Experience

Over twenty years of Forest Service experience as a project manager or interdisciplinary team leader for NEPA projects on the Tongass National Forest, including four years as the Forest Planner and two years developing land and resource management plans.

Four years of experience as Social Forester as Peace Corps volunteer in Philippines in community development.

Sheila Spores, Forest Silviculturist – Forest Service

Education

M.E.M. and B.S., Forest Resource Management and Ecosystem Management, University of Montana, 1996

B.A., Geography, University of Mary Washington, 1990

Experience

Twenty-three years of Forest Service experience in silviculture and forest management in Region 10, Tongass National Forest.

Melissa Dinsmore, Special Uses Program Manager and Energy Coordinator – Forest Service

Education

B.S.F., Forestry, Purdue University, 1990

Experience

Twenty-two years of experience with the Forest Service in lands and special uses management, energy project coordination, business, and pre-sale forestry in Region 10, Tongass National Forest

Cathy Tighe, Inventory and Monitoring Program Manager – Forest Service

Education

B.S., Biology, University of Oregon, 1994

A.A., Umpqua Community College, 1992

Experience

Twenty-two years of Forest Service experience including recreation and wilderness program management, interdisciplinary team contributor for wildlife, recreation and wilderness, and timber/silviculture, and support services in Region 10, Tongass National Forest

Randal Fairbanks, Interdisciplinary Team Leader, Project Manager, Timber Lead – Tetra Tech

Education

M.S., Forest Science/Biostatistics, University of Washington, 1979

B.S., Wildlife Science, University of Washington, 1972

Experience

Over forty years of experience in design, conduct, and management of ecological and forest inventory and research, impact assessments, and mitigation plans.

Project manager or interdisciplinary team leader for 14 major forest management-related EIS/EA efforts.

Major contributor to dozens of other EISs, EAs, and Environmental Reports.

David Cox, Deputy Project Manager; Forest Plan and NEPA Specialist – Tetra Tech

Education

B.S., Environmental and Engineering Geology, Western Washington University, 2000

Experience

Fifteen years of experience in conducting and leading hydrologic, soil, geomorphic and aquatic resource surveys.

Thirteen years of experience in preparing and managing NEPA projects on federal lands, including six EISs on the Tongass.

Matt Dadswell, Senior Social Scientist/Economist – Tetra Tech

Education

Ph.D., Candidate, Geography, University of Washington

M.A., Geography, University of Cincinnati, 1990

B.A., Economics and Geography, Portsmouth Polytechnic, 1988

Experience

Fifteen years of experience conducting economic, social, and environmental regulatory analysis on a variety of natural resource projects, including Forest Service and NEPA projects.

Ten years of experience working on Forest Service projects, including projects on the Tongass National Forest.

John Knutzen, Senior Fisheries Biologist/Aquatic Ecologist – Tetra Tech

Education

M.S., Fisheries, University of Washington, 1977

B.A., Biology, Western Washington State College, 1972

Experience

Thirty-eight years of experience evaluating developmental activity impacts to lakes, rivers, and stream water quality and aquatic resources in the Pacific Northwest, with emphasis on salmonids.

Experience working on more than 80 projects in the Pacific Northwest, including assessing effects of federal actions on endangered fish species.

Provided scientific evaluation on more than 30 NEPA documents, including Forest Service EISs for the Tongass National Forest.

Steve Negri, Wildlife Biologist – Tetra Tech

Education

M.S., Wildlife Ecology, Michigan State University, 1995

B.S., Business Finance, University of Missouri, 1985

Experience

Eighteen years of experience as a wildlife biologist, including work on three EISs for the Tongass National Forest and more than a dozen Forest Service-related projects.

Experience working on approximately 20 EISs and other NEPA documents in the Pacific Northwest and Alaska.

Previous experience includes working 5 years as threatened and endangered species biologist for the Washington Department of Fish and Wildlife.

Brita Woeck, Wildlife Biologist – Tetra Tech

Education

M.S., Wildlife Ecology and Management, University of Missouri, Columbia, 2003

B.S., Wildlife Science, University of Washington, 1999

Experience

Fourteen years of experience in environmental planning and permitting, biological resource analysis, and terrestrial and aquatic ecosystems monitoring.

Expertise in Endangered Species Act (ESA) implementation, including Biological Assessment and Habitat Conservation Plans development; National Environmental Policy Act (NEPA) and state equivalents, including management and/or facilitation of all aspects of the NEPA process; Environmental Impact Statements (EIS) and Environmental Assessments (EA) preparation for natural resource, renewable energy, mining, land management, transmission line, and gas pipeline projects; and wildlife surveys and habitat assessments.

Mary Jo Watson, GIS Analyst – Tetra Tech

Education

B.S., Computer Information Systems, Menlo College

Experience

Twenty-three years of experience as a GIS analyst specializing in creating complex riparian models, surface models, habitat models, perspective scene analysis, aerial photo interpretation of logging units, preparation of field maps, and final production of maps for numerous timber sale EISs.

Experience includes serving as lead GIS analyst on more than a dozen Forest Service projects, including four EIS projects specific to Southeast Alaska and the Tongass National Forest.

Karen Brimacombe, Wetland Scientist /Botanist – Tetra Tech

Education

B.A., Botany, University of Washington, 2000

M.B.A., University of Chicago, 1993

Experience

Over fourteen years of experience in plant ecology, wetland biology, vegetation mapping, rare plant, noxious weed, and general botanical surveys, including work on the Tongass National Forest.

Seven years of experience working on EIS and NEPA documents.

Chris James, Hydrology – Tetra Tech

Education

M.S., Forest Hydrology, University of Washington, 2007

Certified, Watershed Management, Portland State University, 2005

B.A., Environmental Resources (Chemistry minor), Lewis and Clark College, 1999

Experience

Fifteen years of experience performing surface water data collection, analysis, and reporting to evaluated impacts associated with water and fisheries resources.

Ten years of experience working on NEPA documents, including projects on the Tongass.

John Crookston, Biologist and Planner– Tetra Tech

Education

B.S., Biology, University of California San Diego, 2002

M.S., Ecology, San Diego State University, 2007

Experience

Twelve years of experience as a biologist and environmental planner, including NEPA and ESA related studies and impact analyses, and computer based population modeling.

Bob Evans, Landscape Architect – Tetra Tech

Education

M.S., Landscape Architecture, 2006

M.S., Community Planning, 2006

B.S., Environmental Design, 2003

Experience

More than nine years of experience in interdisciplinary environmental planning with an extensive focus on visual resource inventory and analysis.

Jeff Phillips, Geomorphologist– Tetra Tech

Education

M.S., Fluvial Geomorphology, University of British Columbia, 2007

B.S., Physical Geography, University of Utah, 2005

Experience

Nine years of experience designing and conducting ecological research and assessments including the impacts of forest practices on soil and aquatic resources.

Josh Rodriguez, Forest Health – Tetra Tech

Education

M.S., Forestry, University of Montana, 2005

B.S., Forest Resources Management, University of Montana, 2001

Experience

Ten years of experience in designing, managing and completing ecological studies including extensive work in forest, range and wetland ecosystems.

T. Weber Greiser, Heritage Resource Specialist/Archaeologist

Education

M.A., Anthropology, University of New Mexico, 1972

B.A., Anthropology, University of New Mexico, 1969

Experience

Thirty-four years of experience as Project Manager and/or Principal Investigator on heritage resource projects in Alaska and throughout the Western U.S. Experience includes prehistoric and historic archaeological predictive modeling; heritage resource surveys, testing projects, and excavations; laboratory analysis of artifacts and faunal remains; and ethnographic investigations and oral interviews of native inhabitants regarding land use, water use, and sacred lands.

Heritage resource Principal Investigator for background research, cultural resource survey, preparation of specialist report, and/or preparation of EA or EIS cultural resource sections for nine projects since 1993 on the Tongass.

Other Contributors

Forest Service

Craig Anderson – Timber Sale Preparation
Jason Anderson – Tongass Advisory Committee
Jim Baichtal – Geology/Karst
Bonnie Bennetsen – Wildlife and Subsistence
Ben Case – Young-growth
Carla Casulucan – Tribal Coordination
Forrest Cole – Forest Supervisor, Retired
Kent Cummins – Public Affairs
Vel Diemert – GIS
Karen Dillman – Air Quality, Climate Change
Marla Dillman – Wildlife
Lisa Fluharty –Wilderness, Wild and Scenic Rivers, Recreation Special Uses
Milt Fusselman – Recreation Trails and Facilities
Mary Friberg – Wildlife
Michael Goldstein – Regional Planner
Nicole Grewe – Economics
Barth Hamberg – Scenery
Greg Hayward – Regional Wildlife Ecologist
Karen Iwamoto – Administrative Record/PALS Database

4 List of Preparers

Sheila Jacobson – Fisheries
Sue Jennings – Roadless
Patti Krosse – Botany, Ecology, Invasive Plants
Dennis Landwehr – Soils
Brian Logan – Wildlife
Tim Marshall – Heritage, Sacred Sites
Stan McCoy – Timber
Matt Reece – Minerals
Carol Seitz-Warmuth – Transportation
Cynthia Sever – Timber
Dani Snyder – Scenery
Earl Stewart – Forest Supervisor
Regis Terney – Planning Specialist
Theresa Thibault – Heritage, Sacred Sites
Julianne Thompson – Hydrology
Cathy Tighe – Wildlife Biologist
Janette Turk – Public Affairs
Hillary Woods – Lands

U.S. Fish and Wildlife Service
Steve Brockmann – Wildlife Biologist, Southeast Alaska Coordinator

Tetra Tech
Wayne Watson – Geospatial Analyst
David Gravender – Technical Editor
Dawn Nelson – Desktop Publishing
Steve Flegel – Desktop Publishing

Mason Bruce and Girard
Mark Rasmussen – Forest Planner and Economist
Kendrick Greer – Forest Planning Analyst
Andrew Burrow – Forest Planning Analyst
Jessica Burton Desrocher – Geospatial Analyst

CHAPTER 5
LIST OF DOCUMENT RECIPIENTS

List of Document Recipients and Those Notified

Federal Agencies

Federal Energy Regulatory Commission, Environmental Compliance Branch
Federal Highway Administration, Division Administrator
Library of Congress
National Oceanic and Atmospheric Administration (NOAA), NWS Office of Strategic Planning and Policy
National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service, Habitat Conservation Division, Alaska Region
National Environmental Coordinator, NRCS
US Government Accountability Office
US Government Publishing Office, Federal Digital System
US Advisory Council on Historic Preservation, Planning and Review
US Army Corps of Engineers, Pacific Ocean Division
US Coast Guard, Environmental Management CG-443
US Coast Guard, Coast Guard Commandant CG47th
US Department of Agriculture, APHIS PPD/EAD
US Department of Agriculture, Forest Service, Alaska Region
US Department of Agriculture, Forest Service, Chugach National Forest
US Department of Agriculture, Forest Service, Ecosystem Management Coordination Staff
US Department of Agriculture, Forest Service, Forestry Services Library
US Department of Agriculture, Forest Service, Legislative Affairs
US Department of Agriculture, Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory
US Department of Agriculture, Forest Service, Office of the Chief
US Department of Agriculture, Forest Service, Office of General Counsel
US Department of Agriculture, Forest Service, Region 10, Regional Office Planning
US Department of Agriculture, Forest Service, Southeast Regional Subsistence Advisory Council
US Department of Agriculture, Forest Service, Tongass National Forest, Admiralty National Monument
US Department of Agriculture, Forest Service, Tongass National Forest, Deputy Forest Supervisor, Alaska Region
US Department of Agriculture, Forest Service, Tongass National Forest, Craig Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Hoonah Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Juneau Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Ketchikan-Misty Fiords Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Ketchikan Supervisor's Office
US Department of Agriculture, Forest Service, Tongass National Forest, Petersburg Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Petersburg Supervisor's Office

5 List of Document Recipients and Those Notified

US Department of Agriculture, Forest Service, Tongass National Forest, Sitka Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Thorne Bay Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Wrangell Ranger District
US Department of Agriculture, Forest Service, Tongass National Forest, Yakutat Ranger District
US Department of Agriculture, National Agricultural Library
US Department of Agriculture, Natural Resources Conservation Service
US Department of Agriculture, Rural Development, Rural Utilities Service
US Department of Energy, Office of NEPA Policy and Compliance
US Department of the Interior, Bureau of Land Management, Alaska State Office
US Department of the Interior, Bureau of Land Management, Anchorage District
US Department of the Interior, Bureau of Land Management, Fairbanks District
US Department of the Interior, Federal Subsistence Management Program
US Department of the Interior, Office of Environmental Policy and Compliance
US Department of the Interior, US Geological Survey Alaska Science Center
US Department of Transportation, Federal Aviation Administration, Office of the Regional Director
US Department of Transportation, Federal Highway Administration, Alaska Division Administrator
US Environmental Protection Agency, Environmental Review and Sediment Management Unit
US Environmental Protection Agency, Region 10
US Fish and Wildlife Service, Anchorage Field Office
US Fish and Wildlife Service, Juneau Field Office
US Navy, Energy and Environmental Readiness Division
US Navy, Office of the Chief of Navy Operations
USGS Alaska Science Center

Federal Advisory Committee

Tongass Advisory Committee

Jason Anderson
Jaeleen Araujo
Wayne Benner
Leslie Cronk
Jason Custer
Kirk Hardcastle
Philip Hyatt
Lynn Jungwirth
John C. Maisch
Brian McNitt
Robert Mills
Eric Nichols
Richard Peterson
Christopher Rose
Keith Rush
Carol Rushmore
Erin Steinkruger
Andrew Thoms
Kate Troll

Lawerence Widmark
Jeffery Wade Zammit

State and Federal Congressional Representatives

Lisa Murkowski, U.S. Senator
Dan Sullivan, U.S. Senator
Don Young, U.S. Representative
Dennis Egan, Senator (Alaska Legislature, Dist. Q)
Sam Kito, Representative (Alaska Legislature, Dist. 35)
Jonathan Kreiss-Tomkins, Representative (Alaska Legislature, Dist. 35)
Cathy Muñoz, Representative (Alaska Legislature, Dist. 34)
Dan Ortiz, Representative (Alaska Legislature, Dist. 36)
Bert Stedman, Senator (Alaska Legislature, Dist. R)

Alaska Native Tribes and Corporations

Alaska Native Brotherhood Grand Camp
Alaska Native News
Alaska Tribal Leader Committee
Angoon Community Association
Alaska Native Sisterhood Grand Camp
Cape Fox Corporation
Central Council Tlingit & Haida Indian Tribes of Alaska
Chilkat Indian Village
Chilkoot Indian Association
Craig Tribal Association
Douglas Indian Association
Goldbelt, Incorporated
Haida Corporation
Hoonah Indian Association
Huna Totem Corporation
Hydaburg Cooperative Association
Kake Tribal Corporation
Kavilco Inc.
Ketchikan Indian Community
Klawock Cooperative Association
Klawock Heenya Corporation
Klukwan Inc.
Kootznoowoo Inc.
Metlakatla Indian Community
Organized Village of Kake
Organized Village of Kasaan
Organized Village of Saxman
Petersburg Indian Association
Sealaska Corporation

5 List of Document Recipients and Those Notified

Shaan-Seet Inc.
Shee Atika Incorporated
Sitka Tribe of Alaska
Skagway Traditional Council
Wrangell Cooperative Association
Yak-Tat Kwaan, Inc.
Yakutat Tlingit Tribe

State Agencies

Alaska Congressional Delegation
Alaska Department of Commerce, Community and Economic Development
Alaska Department of Commerce, Community and Economic Development, Alaska Energy Authority
Alaska Department of Environmental Conservation
Alaska Department of Environmental Conservation, Division of Air Quality
Alaska Department of Environmental Conservation, Division of Environmental Health
Alaska Department of Environmental Conservation, Division of Water
Alaska Department of Fish and Game, Administrative Services
Alaska Department of Fish and Game, Boards Support Section
Alaska Department of Fish and Game, Division of Commercial Fisheries
Alaska Department of Fish and Game, Division of Habitat
Alaska Department of Fish and Game, Division of Subsistence
Alaska Department of Fish and Game, Division of Wildlife Conservation
Alaska Department of Fish and Game, Division of Sport Fish
Alaska Department of Fish and Game, Division of Wildlife Conservation
Alaska Department of Labor and Workforce and Development
Alaska Department of Natural Resources, Alaska Mental Health Trust Land Office
Alaska Department of Natural Resources, Citizens' Advisory Commission on Federal Areas
Alaska Department of Natural Resources, Office of Project Management and Permitting
Alaska Department of Natural Resources, Office of Project Management and Permitting, ANILCA
Alaska Department of Natural Resources, State Historic Preservation Office
Alaska Department of Natural Resources, Division of Forestry
Alaska Department of Natural Resources, Division of Mining, Land and Water
Alaska Department of Natural Resources, Office of Project Management and Permitting
Alaska Department of Natural Resources, State Division of Parks and Outdoor Recreation
Alaska Department of Transportation and Public Facilities
Alaska Department of Transportation and Public Facilities, Southcoast Region
Alaska Office of the Governor
Alaska Office of the Lieutenant Governor
Alaska State Legislature
University of Alaska

City and Borough Agencies, Libraries, and Schools

Alaska Court System, Juneau Law Library
Alaska Court System, Ketchikan Law Library
Alaska Legislative Affairs Agency, Legislative Reference Library

Alaska Resources Library and Information Services (ARLIS)
Angoon Public School Library
Bruce Hill School
City and Borough of Juneau
City and Borough of Sitka
City and Borough of Wrangell
City and Borough of Yakutat
City of Angoon
City of Coffman Cove
City of Craig
City of Edna Bay
City of Hoonah
City of Hydaburg
City of Kake
City of Kasaan
City of Ketchikan
City of Klawock
City of Kupreanof
City of Pelican
City of Point Baker
City of Port Alexander
City of Saxman
City of Tenakee Springs
City of Thorne Bay
Community of Naukati West
Community of Whale Pass
Craig Public Library
Douglas Public Library
Edna Bay School Library
Elfin Cove Public Library
Haines Borough
Esther Greenwald Library
Greater Ketchikan Chamber of Commerce
Haines Public Library
Hollis Public Library
Hoonah Public Library
Howard Valentine School
Hydaburg School Library
Hyder Public Library
Hyder School
Juneau Chamber of Commerce
Juneau City Clerk
Juneau Public Library
Kake Community Library
Kasaan Community Library
Ketchikan Chamber of Commerce

5 List of Document Recipients and Those Notified

Ketchikan Gateway Borough
Ketchikan High School Library
Ketchikan Public Library
Ketchikan Visitors Bureau
Kettleson Memorial Library
Klawock Public Library
Legislative Reference Library
Mendenhall Valley Public Library
Metlakatla Centennial Library
Municipality of Skagway
Pelican Public Library
Petersburg Borough
Petersburg Borough Police Department
Petersburg Borough Chamber of Commerce
Petersburg Public Library
Port Protection School
Prince of Wales Island Chamber of Commerce
Reville High School
Skagway Public Library
Skagway Traditional Council
Southeast Island School District
Sunnyside School Library
Tenakee Springs Public Library
Thorne Bay Community Library
Transylvania Cooperative Extension Service
University of Alaska - Southeast, Ketchikan College Library
University of Alaska - Southeast, William A. Egan Library
University of Alaska at Fairbanks
University of Alaska at Fairbanks Elmer E. Rasmussen Library
University of Alaska at Fairbanks, School of Natural Resources and Agricultural Sciences, Palmer Research Center
University of Alaska at Sitka
University of Alaska Facilities and Land Management
USDA National Agriculture Library
Whale Pass Community Library
Whale Pass School
Wrangell Chamber of Commerce
Wrangell Public Library
Yakutat School District Library

Other Organizations

Alaska Independent Power Producers Association
Alaska Audubon
Alaska Dispatch News
Alaska Forest Association

Alaska Mental Health Trust
Alaska Miners Association
Alaska Power & Telephone Co. (AP&T)
Alaska Power and Telephone Skagway
Alaska Public Radio Network
Alaska Resource Development Council (RDC)
Alaska Wilderness League
Alaska Wildlife Alliance
Alaska Wood Utilization Research and Development Center
All Aboard Yacht Charters & Southeast Alaska Wilderness Tours Association
Allen Marine Inc.
Anchorage LIO
Audubon Alaska
Baranof Wilderness Lodge/Beyond Boundaries Expeditions
Capital City Weekly
Cascadia Wildlands
Center for Biological Diversity
Chatham School District
Daily Sitka Sentinel
Defenders of Wildlife
Earthjustice
EDC Alaska, Inc.
First Things First Alaska Foundation
Geos Institute
Greenpeace USA
Hook on Juneau
Inter-Island Ferry Authority
Juneau Audubon Society
Juneau Economic Development Council Southeast Cluster Initiative
Ketchikan Daily News
Ketchikan High School Youth Advisory Council
KCAW-FM, Raven Radio
KFSK Petersburg Community Radio
KHNS – FM
KINY – AM, KSUP – FM (Juneau)
KJNO – AM, KTKU – FM (Juneau)
Konnintie15
KRBD Community Radio for Southern Southeast Alaska
KSTK-FM Stikine Silver Radio Wrangell
KTKN/KGTW Ketchikan Radio Center
KTOO Juneau Public Radio and Television
Maybeso Creek Enterprises
Narrows Conservation Coalition
National Audubon Society
Natural Resources Defense Council
Northern Ecologic LLC

Petersburg Pilot
Pioneer Alaskan Fisheries Inc
Prince Rupert Port Authority
Prince Rupert Visitor’s Centre
Public Land News /Resources Publishing Company
Renewable Energy Alaska Project (REAP)
Resource Development Council
Sealaska Corporation
Sierra Club
Sierra Club Alaska (Tongass Group)
Sitka Conservation Society
Sound Sailing
Southeast Alaska Conservation Council
Southeast Alaska Power Agency
Southeast Alaska Watershed Coalition
Southeast Conference
Stewart-Hyder International Chamber of Commerce
T&H Ketchikan
Tenakee Logging Company
Tenakee Springs Business Association
The Boat Company
The Nature Conservancy
The Nature Conservancy in Alaska
Thorne Bay Wood Products Enterprise
Three Rivers Timber
Trout Unlimited
Trout Unlimited Alaska
Van Ness Feldman
Venture Travel
Viking Lumber
Wesley Rickard Inc.
Whale Pass Home Owners' Association
Woodbury Enterprise
W.R. Jones & Son Lumber Co.
Wrangell Sentinel

Individuals

Notifications of the availability of the Final Environmental Impact Statement were also sent to over 42,000 individuals.

CHAPTER 6
REFERENCES

References

Abrahamson, M. 2013. Alaska's Mining Industry. Strong growth in jobs, wages, and production value. Alaska Economic Trends. May. Volume 33, Number 5, pp. 4-11.

ACFEC (Alaska Commercial Fisheries Entry Commission). 2015. 2013 Permit and Fishing Activity by Alaskan Community. Available online at http://www.cfec.state.ak.us/gpbycen/2013/MenuComm.htm

Adams, T.K., and K. Sullivan. 1989. The physics of forest stream heating: a simple model. Timber/Fish/Wildlife Report Number TFW-WQ3-90-007. Weyerhaeuser, Federal Way, Washington.

ADCCED (Alaska Department of Commerce, Community & Economic Development). 2011. Community Profiles Online. Available online at: http://www.commerce.state.ak.us/dca/commdb/CF_COMDB.htm

ADEC (Alaska Department of Environmental Conservation). 2014a. Juneau – Particulate Matter

ADEC. 2014b. 18 Alaska Administrative Code 50 Air Quality Control.

ADEC. 2013. Alaska's Final 2012 Integrated Water Quality Monitoring and Assessment Report. December 23.

ADEC. 2008. Alaska's Final 2008 Integrated Water Quality Monitoring and Assessment Report. April 1.

ADEC. 2006. Water Quality Standards. As Amended through September 1, 2006. 18 AAC 70.

ADEC and USDA Forest Service. 1992. Memorandum of Agreement between the Alaska Department of Environmental Conservation and the USDA Forest Service, Alaska Region. 2534.1 - Exhibit 01.

ADED (Alaska Division of Economic Development). 2013. Small Ships, Big Benefits for Alaska Visitors and Businesses. Small Cruise Ship Market Update. October 8. Available online at: https://www.commerce.alaska.gov/web/ded/DEV/TourismDevelopment/TourismResearch.aspx

ADF&G (Alaska Department of Fish and Game). 2016. Alaska Sport Fishing Survey – Southeast Alaska Region. Web site Access May 2016. http://www.adfg.alaska.gov/sf/sportfishingsurvey/index.cfm?ADFG=region.home

ADF&G . 2015a. Invasive Species web site http://www.adfg.alaska.gov/index.cfm?adfg=invasive.main Accessed Feb 2015)

ADF&G. 2015b. Sitka black-tailed deer harvest dataset and summary statistics by Wildlife Analysis Area (WAA) for harvests in Southeast, Alaska during the period 2004-2013. Division of Wildlife Conservation, Southeast Region. Juneau.

ADF&G. 2015c. Advisory Committees by Region. Southeast Region. Available online at: http://www.adfg.alaska.gov/index.cfm?adfg=process.acregion

6 References

ADF&G. 2015d. 2015-2016 Alaska Hunting Regulations. http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulations.hunting

ADF&G. 2014. Community Subsistence Information System. Available online at: https://www.adfg.alaska.gov/sb/CSIS/

ADF&G. 2013. Deer management report of survey-inventory activities 1 July 2010-30 June 2012. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2013-1, Juneau.

ADF&G. 2012. Status of wolves in southeast Alaska. Division of Wildlife Conservation, Alaska Department of Fish and Game.

ADF&G. 2006. Subsistence Community Profile Database. Available online at: http://www.state.ak.us/local/akpages/FISH.GAME/subsist

ADF&G. 2004. Comprehensive Salmon Enhancement Plan for Southeast Alaska: Phase III. Developed by Joint Northern/Southern Southeast Regional Planning Team. Juneau, Alaska. June 2004.

ADF&G. 2000. Southeast Alaska Unit 4 Brown Bear Management Strategy. Available online at: http://www.alaskabears.alaska.gov/management/planning/planning_pdfs/u4rep.pdf

ADF&G. 1999. Draft Southeast Alaska Elk Management Plan. Division of Wildlife Conservation.

ADF&G. 1998. Tongass Fish and Wildlife Resource Assessment.

ADF&G. 1994. Subsistence Resource Use Patterns in Southeast Alaska: Summaries of 30 Communities.

ADNR (Alaska Department of Natural Resources). 2013. Alaska Forest Resources & Practices Regulations, 2013. Division of Forestry. Anchorage, Alaska.

ADNR. 1997-2005. Alaska's Mineral Industry. Special Reports 51-59 (annual reports for 1996 through 2004). Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys.

ADOT&PF (Alaska Department of Transportation and Public Facilities). 2014. Draft Southeast Alaska Transportation Plan. Available online at: http://dot.alaska.gov/sereg/projects/satp/assets/SATP_2014_Draft_Final_Web.pdf

ADOT&PF. 2004. Southeast Alaska Transportation Plan. August 2004.

AEA (Alaska Energy Authority). 2014. Pelican. Available online at: http://www.akenergyauthority.org/Pelican

AEA and REAP (Renewable Energy Alaska Project). 2013. Renewable Energy Atlas.

AEDG (Alaska Energy Data Gateway). 2015a. Community Data Summary – Naukati Bay. Institute of Social and Economic Research, University of Alaska Anchorage. Accessed online at: https://akenergygateway.alaska.edu/

AEDG. 2015b. Community Data Summary – Pelican. Institute of Social and Economic Research, University of Alaska Anchorage. Accessed online at: https://akenergygateway.alaska.edu/

AEL&P (Alaska Electric Light & Power). 2013. Application for Preliminary Permit before the Federal Energy Regulatory Commission. Sheep Creek Hydroelectric Project.

AEL&P (Alaska Electric Light and Power Company). 2014. Electrical Generation Facilities. Available online at: http://www.aelp.com/history/electric.htm

AKEPIC (Alaska Exotic Plants Information Clearinghouse). 2016. Non-Native Plant Species List. Alaska Center for Conservation Science, University of Alaska, Anchorage. Available online at: http://accs.uaa.alaska.edu/invasive-species/non-native-plant-species-list. Accessed: May 3, 2016.

AKEPIC. 2015. Alaska Exotic Plant Information Clearinghouse data portal. Alaska Natural Heritage Program, University of Alaska, Anchorage. Available online at: http://aknhp.uaa.alaska.edu/botany/akepic/. Accessed: February 12, 2015.

AKEPIC. 2006. AKEPIC Inventory. Alaska Natural Heritage Program, UAA, USDA Forest Service, State and Private Forestry. Available online at: http://akweeds.uaa.alaska.edu/

Alaska DCED (Department of Community and Economic Development). 2006. Community Profiles Online. Available online at: http://www.dced.state.ak.us/

Alaska DCED. 2002. Community Profiles Online. Available online at: http://www.dced.state.ak.us/

Alaska Department of Education & Early Development. 2015. Child Nutrition Program, National School Lunch Programs, Free and Reduced Price Meals Report. Program Years 2001 to 2015. Available online at: https://www.eed.state.ak.us/tls/cnp/nslp.html

Alaska DNR (Department of Natural Resources). 2015. Kensington Gold Mine. http://dnr.alaska.gov/mlw/mining/largemine/kensington/

Alaska DOL. 2015a. Alaska Population Estimates by Borough, Census Area, City, and Census Designated Place (CDP), 2010 to 2014. January 15. Available online at: http://laborstats.alaska.gov/pop/popest.htm

Alaska DOL. 2015b. Alaska Labor Force -- All Areas. Not Seasonally Adjusted. Research and Analysis Section. June 18. Available online at: http://live.laborstats.alaska.gov/labforce/

Alaska DOL. 2015c. Worker Residency by Industry. Alaska - Southeast Region. 2013. Alaska Department of Labor and Workforce Development, Research and Analysis Section. February 17.

Alaska DOL. 2015d. Alaska Local and Regional Information. Southeast Economic Region 2013 Annual Average Unemployment Rate. Available online at http://live.laborstats.alaska.gov/alari/.

Alaska DOL. 2015e. Alaska Local and Regional Information. 2013 Workers by Industry. Available online at http://live.laborstats.alaska.gov/alari/.

Alaska DOL. 2015f. Alaska Local and Regional Information. Accessed online at http://live.laborstats.alaska.gov/alari/.

Alaska DOL. 2015g. 2010 Census PL 94-171 Redistricting Data for Boroughs and Census Areas. Available online at: http://live.laborstats.alaska.gov/cen/redistr.cfm Downloaded February 6.

6 References

Alaska DOL. 2014a. Alaska Population Estimates by Borough, Census Area, City, and Census Designated Place (CDP), 2010-2013. Available online at: http://laborstats.alaska.gov/pop/popest.htm

Alaska DOL. 2014b. Race and Ethnicity by Borough and Census Area, 2010. PL 94-171 Redistricting Data. Available online at: http://live.laborstats.alaska.gov/cen/redistr.cfm

Alaska DOL. 2014c. Race and Ethnicity by Place, 2010. PL 94-171 Redistricting Data. Available online at: http://live.laborstats.alaska.gov/cen/redistr.cfm

Alaska DOL. 2014d. Population of Alaska by Economic Region, Borough, and Census Area, 2010-2014. Research and Analysis Section. Available online at: http://laborstats.alaska.gov/pop/popest.htm

Alaska DOL. 2014e. Alaska Labor Force -- All Areas. Not Seasonally Adjusted. Research and Analysis Section. 10/20/2014. Available online at: http://live.laborstats.alaska.gov/labforce/

Alaska DOL. 2014f. Seafood Processing Workforce by Borough or Census Area, 2012. Southeast Region. Research and Analysis Section. Available online at: http://laborstats.alaska.gov/seafood/Southeast/SESFPBorca.pdf

Alaska DOL. 2010a. Population of Alaska by Economic Region, Borough, and Census Area, 2000-2010. Research and Analysis Section. Available online at: http://laborstats.alaska.gov/pop/popest.htm

Alaska DOL. 2010b. Alaska Population by Age, Sex and Borough/Census Area, 2000 to 2010. Research and Analysis Section. http://laborstats.alaska.gov/pop/popest.htm#

Alaska DOL. 2007. Table 4.3 Alaska Places by Borough and Census Area 2000-2006. Available online at: http://www.labor.state.ak.us/research/pop/estimates/06t4-3x.xls

Alaska DOL. 1999. Alaska Population Estimates by Borough, Census Area, City and Census Designated Place (CDP), 1990-1999. Research and Analysis Section.

Alaska DOT (Department of Transportation). 2006. Email correspondence/Personal communication between Patrick Nobilio of the Alaska Department of Transportation and Shaun Brooks, Tetra Tech EC. August 17.

Alaska Energy Authority. 2015. Gartina Falls. Accessed online at: http://www.akenergyauthority.org/GartinaFalls

Alaska Forest Association. Undated. Alaska Forest Facts. http://www.akforest.org/index.htm

Alaska Interagency Coordination Center. 2015. Yearly Fire Statistics. Available online at: http://fire.ak.blm.gov/predsvcs/intel.php

Alaska Invasive Species Workshop. 2010. Workshop Summary and Recommendations. Final Workshop Proceedings. Alaska SeaLife Center – Seward, Alaska. March 2-4, 2010. Prepared April 20, 2010. http://www.alaskasealife.org/New/research/mis_documents/MIS%20Workshop%20Proceedings.pdf Accessed Feb 2015.

Alaska Marine Highway System. 2014. 2013 Annual Traffic Volume Report. Available online at: http://dot.alaska.gov/amhs/reports.shtml

Alaska Native Heritage Center. 2014. Eyak, Tlingit, Haida & Tsimshian. Cultures of Alaska. Available online at: http://www.alaskanative.net/en/main-nav/education-and-programs/cultures-of-alaska/eyak-tlingit-haida-and-tsimshian/ Accessed on 12/29/2014

Alaska Shorebird Group. 2008. Alaska Shorebird Conservation Plan. Version II. Alaska Shorebird Group, Anchorage, Alaska. Available online at: http://www.fws.gov/alaska/mbsp/mbm/shorebirds/pdf/ascp_nov2008.pdf

Alaska State Parks. 2009. Alaska's Outdoor Legacy. Statewide Comprehensive Outdoor Recreation Plan (SCORP) 2009-2014. September. Available online at: http://dnr.alaska.gov/parks/plans/scorp/scorp0914.pdf

Alaska Travel Industry. 2006. Email correspondence/Personal communication between Mark Miller of the Alaska Travel Industry and Shaun Brooks, Tetra Tech EC. July 27.

Albert, D. and J. Schoen. 2007. A Conservation Assessment for the Coastal Forests and Mountains Ecoregion of Southeastern Alaska and the Tongass National Forest. From the Southeast Alaska Conservation Assessment, Chapter 2 of The Coastal Forests and Mountains Ecoregion of Southeastern Alaska and the Tongass National Forest; a conservation assessment and resource synthesis. Editors: Schoen, J. and Dovichin, E. March 2007.

Alexander, S.J. 2012. Employment Coefficients and Indirect Effects, for NEPA planning: 2012 update memo. Regional Economist, USFS Alaska Region. August 9.

Alexander, E. 1990. Compaction by Shovel Yarder. North Irish Timber Sale, Unit 1. unpublished monitoring report. May 18, 1990.

Alexander, E.B. 1987. Mass failure hazard rating, Tongass National Forest. Unpublished report. May 1987.

Alexander, S. J., E.B. Henderson, and R. Coleman. 2010. Economic Analysis of Southeast Alaska: Envisioning a Sustainable Economy with Thriving Communities. Forest Service, Alaska Region Publication R10-MB-725, Juneau, AK, 93 p.

Aley, T.C. 1997. Karst Vulnerability Assessment Review, Heceta Island. Report prepared for the Thorne Bay District Ranger, Steve Kimball. USFS internal document. 7 pp.

Aley, T., C. Aley, W.R Elliott, and P. Huntoon. 1993. Karst and Cave Resource Significance Assessment Ketchikan Area, Tongass National Forest, Alaska. Final Report. Prepared for Ketchikan Area of the Tongass National Forest. 79 pp. and Appendix.

Allen, B.M., and R.P. Angliss. 2014. Sperm Whale (*Physeter macrocephalus*): North Pacific Stock. Pp. 172–176 in Alaska Marine Mammal Stock Assessments, 2014. NOAA-TM-AFSC-301. Revised 10/09/2014.

Andrén, H. 1994. Effects of habitat fragmentation on birds and mammals in landscapes with different proportions of suitable habitat: a review. Oikos 71: 355–366.

Andres, B.A., and G.A. Falxa. 1995. Black oystercatcher (Haematopus bachmani). The Birds of North America Online. Cornell Lab of Ornithology, Ithaca, NY. Available online at: http://bna.birds.cornell.edu/bna/species/155/articles/introduction.

6 References

ANHP (Alaska Natural Heritage Program). 2015. Rare Plant Species Information. Available online at: http://aknhp.uaa.alaska.edu/botany/rare-plant-species-information/

AP&T (Alaska Power and Telephone Company). 2014. Alaska Power Company. Upper Lynn Canal Power Supply System. Available online at: http://www.aptalaska.com/index.php?action=switchTabs&tabID=14

Arhangelsky, K. 2005. Non-native Plant Species of Prince of Wales Island, Alaska Summary of Survey Findings. Final Report of USDA Forest Service, State and Private Forestry. Turnstone Environmental Consultants, Inc. Portland, OR.

Arians, Alison. 2003. Summary of monitoring studies of the effectiveness of practices under the Alaska Forest Resources and Practices Act 1990-2002. DNR Division of Forestry. April.

As, S. 1999. Invasion of matrix species in small habitat patches. Conservation Ecology [online] 3(1): 1. Available from the Internet. URL: http://www.consecol.org/vol3/iss1/art1/

Athey, J.E., L.K. Freeman, L.A. Harbo, and P.S. Lasley. 2014. Alaska's Mineral Industry 2013: Alaska Division of Geological & Geophysical Surveys Special Report 69.

Audubon Alaska and The Nature Conservancy. 2007. Coastal Forests and Mountains Ecoregions of Southeastern Alaska and the Tongass National Forest: A Conservation Assessment and Resource Synthesis. Available online at: https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/alaska/seak/era/cfm/Pages/CA-AKCFM.aspx

Aust, W.M. , M.B. Carroll, M.C. Bolding, and C.A. Dolloff. 2011. Operational Forest Stream Crossings Effects on Water Quality in the Virginia Piedmont. South. J. Appl. For. 35(3): 123-130.

Bachelet D., J. Lenihan, R. Neilson, R. Drapek, and T. Kittel. 2005. Simulating the response of natural ecosystems and their fire regimes to climate variability in Alaska. *Canadian Journal of Forest Research* 35: 2244–2257.

Bachman, R., W. Bergmann, J. Breese, W. Davidson, P. Doherty, S. Forbes, D. Gordon, D. Harris, S. Heinl, K. Jensen, M. Kallenberger, S. Kelley, B. Lynch, B. Meredith, K. Monagle, P. Skannes, L. Shaul, T, Thynes, A. Tingley, and G. Woods. 2005. 2005 Commercial, Personal Use, and Subsistence Salmon Fisheries: Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game. Division of Sport Fish and Commercial Fisheries. Fishery Management Report No. 05-68. December 2005.

Baichtal, J. 2006. Geologic Resources, Paleontology, Geologic Special Areas, and Listing of Significant Caves. Forest Plan Adjustment Proposal Report. Rationale and process used in making the recommended changes to the Plan. USDA Forest Service, Tongass National Forest. File Code 2880 Geology and Karst Resources. Letter to Lee Kramer, Forest Plan Adjustment Coordinator. March 24.

Baichtal, J. 1997. Application of a Karst Management Strategy: Two Case Studies from the Tongass National Forest, Southeastern Alaska; The Challenges of Implementation. In *Proceedings of the 1997 Karst and Cave Management Symposium 13th National Cave Management Symposium.* Bellingham, Washington and Chilliwack and Vancouver Island, BC, Canada, October 7-10, 1997. R. Stitt, proceedings editor. Pp. 4-11.

Baichtal, J.F., and D.J. Landwehr. 1997. Heceta Sawfly Salvage Sale, Soils, Karst, and Cave Resource Evaluation, Heceta Island, Southeastern Alaska. Unpublished, USFS internal document.

Baichtal, J.F., and D.N. Swanston. 1996. Karst Landscapes and Associated Resources: A Resource Assessment. General Technical Report, PNW-GTR-383. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 13 pp.

Baird, E.J., W. Floyd, I. van Meerveld, and A. E. Anderson. 2012. Road Surface Erosion, Part 1: Summary of Effects, Processes, and Assessment Procedures. *Streamline Watershed Management Bulletin* 15(1) Summer 2012.

Baker, R. 2001. The Ketchikan Gateway Borough. A Profile of the Island Community in Southeast Alaska, in Alaska Economic Trends, January, pp 11-16.

Barbour, R. J., R. R. Zaborske, M. H. McClellan, L. Christian, and D. Golnick. 2005. Young-stand Management Options and Their Implications for Wood Quality and Other Values. Landscape and Urban Planning 72:79-94.

Barrett, T.M. 2014. Storage and Flux of Carbon in Live Trees, Snags, and Logs in the Chugach and Tongass National Forests. USDA-FS. General Technical Report PNW-GTR-889. 44 pp.

Barrett, T.M., G. Latta, P.E. Hennon, B.I.N. Eskelson, and H. Temesgen. 2012. Host-Parasite Distributions Under Changing Climate: *Tsuga heterophylla* and *Arceuthobium tsugense* in Alaska. *Canadian Journal of Forest Research* 42: 642–656.

Bartos, L. 1989. A New Look at Low Flows after Logging. Page 96-97 in: Proceedings: Watershed ’89, A Conference on the Stewardship of Soil, Air, and Water Resources. Juneau, Alaska: USDA Forest Service.

Bartos, L.R. 1990. Low Flows after Timber Harvest Related to Geologic Zones in Southeast Alaska. November 27-29, 1990.

Bauder, P., and J. Heys. 2004. Exotic Plant Management at Wrangell-St. Elias National Park and Preserve; Summer 2004 Field Season Report. National Park Service. Wrangell-St. Elias National Park and Preserve.

BC Hydro. 2012. Electric Load Forecast Fiscal 2013 to Fiscal 2033. Energy Planning and Economic Development, BC Hydro.

Beamish, R.J., B.E. Riddell, K.L. Lange, E. Farley Jr., S. Kang, T. Nagasawa, V. Radchenko, O. Temnykh, and S. Urawa. 2009. The Effects of Climate on Pacifc Salmon - A Summary of Published Literature. North Pacific Anadromous Fish Commission (www.npafc.org). http://www.npafc.org/new/publications/Special%20Publications/LRMP_Synthesis.pdf. Accessed Dec 2014.

6 References

The Beck Group. 2009. Transitioning to Young Growth: Prince of Wales Island, Southeast Alaska. Project Report prepared for The Nature Conservancy, Juneau, Alaska. February.

Beechie, T.J., and T.H. Sibley. 1997. Relationships between channel characteristics, woody debris, and fish habitat in northwestern Washington streams. Transactions of the American Fisheries Society 126:217-229.

Bell, C. 2015. Tourism in Southeast. Visitor-related Jobs a Key Part of the Region's Economy. Alaska Economic Trends. Vol. 35, 8. pp. 4-8.

Belt, G.H., J. O'Laughlin, and T. Merrill. 1992. Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature. Idaho Forest, Wildlife and Range Policy Analysis Group Report No. 8. June 1992.

Ben-David, M., R.T. Bowyer and J.B. Faro. 1996. Niche Separation by Mink and River Otters: Coexistence in a Marine Environment. Oikos 75(1):41-48.

Ben-David, M,. R.W. Flynn, and D.M. Schell. 1997. Annual and seasonal changes in diets of martens: evidence from stable isotope analysis. Oecologia 111:280-291.

Benda, L., D. Miller, J. Sias, D. Martin, R. Bilby, C. Veldhuisen, and T. Dunne. 2003. Wood recruitment processes and wood budgeting. American Fisheries Society Symposium 37:49-73.

Bentz, B.J., J. Regniere, C.J. Fettig, E.M. Hansen, J.L. Hayes, J.A. Hicke, R.G. Kelsey, J.F. Negron, and S.J. Seybold. 2010. Climate Change and Bark Beetles of the Western United States and Canada: Direct and Indirect Effects. *BioScience* 60: 602-613.

Berg, E.C., C.B. Gale, T.A. Morgan, A.M. Brackley, C.E. Keegan, S.J. Alexander, G.A. Christensen, C.P. McIver, and M.G. Scudder. 2014. Alaska's Timber Harvest and Forest Products Industry, 2011. USDA Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-903. November.

Berman, M., G.P. Juday, and R. Burnside. 1998. Climate change and Alaska's forests: People problems and policies. In: G.Weller and P. A. Anderson, compilers. *Assessing the consequences of climate change for Alaska and the Bering Sea region.* Proceedings from a workshop held 29-30 October 1998, University of Alaska, Fairbanks.

Beschta, R.L., Bilby, R.E., Brown, G.B., Holtby, L.B., Hofstra, T.D. 1987. Streamside Management, Forestry and Fisheries Interactions. Chapter 6: Stream Temperature and Aquatic Habitat: Fisheries and Forestry Interactions. Salo, E.O. and T.W. Cundy (Editors). Institute of Forest Resources, University of Washington, Seattle, WA, 191-232.

Bilby, R.E. 1979. The function and distribution of organic debris dams in forest stream ecosystems. Ithaca, NY: Cornell University. 143 p. Ph.D. dissertation.

Bilby, R.E. and P.A. Bisson. 1998. Function and distribution of large woody debris. Pages 324-346 in R.J. Naiman and R.E. Bilby, editors. River ecology and management: lessons from the Pacific coastal ecoregion. Springer-Verlag, New York, New York.

Billings, R.F. 1970. Logging Practices on the Yakutat Forelands. Unpublished letter to Regional Timber Program Lead Overdorff. November 18, 1970.

Binkley, C.S., M.J. Apps, R.J. Dixon, P.F. Kauppi, and L.O. Nilsson. 1997. Sequestering Carbon in Natural Forests. Critical Reviews in Environmental Science and Technology, 27 (Special) S23-S45.

Birdsey, R.A., A.J. Plantinga, and L.S. Heath. 1993. Past and prospective carbon storage in United States forests. Forest Ecology and Management. 58 (1993) pages 33-40.

Bishop, D.M., and M.E. Stevens. 1964. Landslides on Logged Areas in Southeast Alaska. USDA FS Res .Pap NOR-1 1964. Northern For Exp. Sta. Juneau, Alaska.

Bisson, P.A., R.E. Bilby, M.D. Bryant, C.A. Dolloff, G.B. Grette, R.A. House, M.L. Murphy, K.V. Koski, and J.R. Sedell. 1987. Large woody debris in forested streams in the Pacific Northwest: past, present, and future. Pages 143-190 in E.O. Salo and T.W. Cundy, editors. Streamside management: forestry and fishery interactions. College of Forest Resources, University of Washington, Seattle, Washington. Contribution No. 57.

Bissonette, J.A., D.J. Harrison, C.D. Hargis, and T.G. Chapin. 1997. The influence of spatial scale and scale-sensitive properties on habitat selection by American marten. Pages 368-385 in J.A. Bissonett, editor. Wildlife and Landscape Ecology. Springer-Verlag, NY.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams, pp. 83-128. In: W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. American Fisheries Society, Bethesda, Maryland

Black, H.C. 1979. Black’s Law Dictionary. Fifth Edition. West Publishing Company, St. Paul, Minn. 1,451 pp., appendix.

Black & Veatch. 2012. Southeast Alaska Integrated Resource Plan. Prepared for the Alaska Energy Authority. Available online at: http://www.akenergyauthority.org/southeastIRP.html

BLM (Bureau of Land Management). 2006. Ring of Fire Proposed Resource Management Plan and Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Land Management, Anchorage Field Office. Anchorage, Alaska. July 2006.

BLM and USDA Forest Service. 2008. Programmatic Environmental Impact Statement for Geothermal Leasing in the Western United States. FES 08-44. Available online at http://www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide/Documents/Final_PEIS.html

Blue Lake Expansion Project. 2015. The Blue Lake Expansion Project is Complete! Available online at: http://www.bluelakeexpansion.com/

Boag, D. A., and M. A. Schroeder. 1992. Spruce Grouse. In: A. Poole, P. Stettenheim, and F. Gill, editors. The Birds of North America. Philadelphia: The Academy of Natural Sciences. Washington, DC. The American Ornithologists’ Union.

6 References

Boland, J.L., W.P. Smith, and J.P. Hayes. 2009. Survey of Bats in Southeast Alaska with emphasis on Keen's Myotis (*Myotis keenii*). *Northwest Science* 83(3):169-179.

Bollens, S., R. Hooff, M. Butler, J. Cordell, and B. Frost. 2010. Feeding ecology of juvenile Pacific salmon (*Oncorhynchus* spp.) in a northeast Pacific fjord: diet, availability of zooplankton, selectivity for prey, and potential competition for prey resources. Fish. Bull. 108:393–407.

Bonsal, B.R., and T.D. Prowse. 2006. Regional Assessment of CCM-Simulated Current Climate Over Northern Canada. Artic Vol. 59, No, 02, pages 33-40

Booth, D. B., and C.J. Jackson. 1997. Urbanization of aquatic systems—degradation thresholds, stormwater detention, and the limits of mitigation. Water Resources Bulletin, v. 33, p. 1077-1090.

Booth, D.B., D. Hartley, and R. Jackson. 2002. Forest Cover, Impervious-Surface Area, and the Mitigation of Stormwater Impacts. Journal of the American Water Resources Association 38[3]:835–845.

Bosakowski, T., B. McCullough, F.J. Lapsansky, and M. E. Vaughn. 1999. Northern Goshawks nesting on a private industrial forest in western Washington. Journal of Raptor Research 33:240-244.

Bosch, J. M., and Hewlett, J. D. 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. Journal of Hydrology, 55: 3¬23

Bowker, J.M. 2001. Outdoor recreation by Alaskans: projections for 2000 through 2020. General Technical Report PNW-GTR-527. Portland, Oregon. USDA Forest Service, Pacific Northwest Research Station. 22p. Available online at: http://www.fs.fed.us/pnw/pubs/gtr527.pdf

Bowyer, R.T., G.M. Blundell, M. Ben-David, S.C. Jewett, T.A. Dean, and L.K. Duffy. 2003. Effects of the Exxon Valdez oil spill on river otters: injury and recovery of a sentinel species. Wildlife Monographs No. 153:1-53.

Boyce, D. A., Jr., R. T. Reynolds, and R. T. Graham. 2006. Goshawk status and management: what do we know, what have we done, where are we going? Pp 312-3325 in M. L. Morrison, editor. The northern goshawk: a technical assessment of its status, ecology, and management. Studies in Avian Biology No. 31, Cooper Ornithological Society.

BPIF (Boreal Partners in Flight Working Group). 1999. Landbird Conservation Plan for Alaska Biogeographic Regions, Version 1.0. Unpublished report, U.S. Fish and Wildlife Service, Anchorage, AK. 45 pp.

Brackley, A.M., T.D. Rojas, and R.W. Haynes. 2006a. Timber Products Output and Timber Harvests in Alaska: Projections for 2005-25. Gen. Tech. Rep. PNW-GTR-677. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 33 p.

Brackley, A.M., D.J. Parrent, and T.D. Rojas. 2006b. Estimating Sawmill Processing Capacity for Tongass Timber: 2003 and 2004 Update. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, Oregon. Res. Note. PNW-RN-553. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 15 p.

Bradner, T. 2014. Parnell signs bill to boost Bokan, Niblack mine projects. Alaska Journal of Commerce. June 19. Available online at: http://www.alaskajournal.com/business-and-finance/2014-06-19/parnell-signs-bill-boost-bokan-niblack-mine-projects

Brennan, J.S., H. Culverwell, R. Gregg, and P. Granger. 2009. Protection of Marine Riparian Functions in Puget Sound, Washington. Prepared for Washington Department of Fish and Wildlife. Prepared by Washington Sea Grant, Seattle, Wa.

Brennan, J.S., K.F. Higgins, J.R. Cordell, and V.A. Stamatiou. 2004. Juvenile salmon composition, timing distribution, and diet in marine nearshore waters of central Puget Sound in 2001-2002. King County Department of Natural Resources and Parks, Seattle, WA. 164 p.

Brennan, J. and H. Culverwell. 2004. Marine Riparian: An Assessment of Riparian Functions in Maine Ecosystems. Published by Washington Sea Grant Program, Seattle, WA. 34 p.

Brickell, J.E. 1989. Review of Forest Inventory Methodology and Results, Tongass National Forest. USDA Forest Service, Alaska Region, unpublished report. 28 pp.

Brinkman, T.J. 2009. Resilience of a deer hunting system in southeast Alaska: integrating social, ecological, and genetic dimensions. Dissertation. University of Alaska Fairbanks, Fairbanks, AK.

Brinkman, T.J. 2006. The Prince of Wales Island Deer Hunter Project. Preliminary Summary of Hunter Responses to Interview Questions. Community Report. Unpublished report. February.

Brooks, D.J., and R.W. Haynes. 1997. Timber Products Outputs and Timber Harvests in Alaska: Projections for 1997-2010. Gen. Tech. Rep. PNW-GTR-409. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 17pp.

Brooks, D.J., and R.W. Haynes. 1994. Timber Products Outputs and Timber Harvests in Alaska: Projections for 1992-2010. Gen. Tech. Rep. PNW-GTR-261. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Brooks, D.J., and R.W. Haynes. 1990. Timber Products Outputs and Timber Harvests in Alaska: Projections for 1989-2010. Gen. Tech. Rep. PNW-GTR-334. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Brown, G.W. 1983. Chapter III, Water Temperature. Forestry and Water Quality. Oregon State University Bookstore. Pp. 47-57.

Brown, M. 1997. Letter from Alaska Department of Environmental Conservation Office of the Commissioner to Phil Janik, Regional Forester, USDA Forest Service, Alaska Region, Juneau, Alaska. January 22, 1997.

Bryant, M.D. 1980. Evolution of large, organic debris after timber harvest: Maybeso Creek, 1949 to 1978. General Technical Report pnw-101. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Bryant, M.D. 1985. Changes 30 years after logging in large woody debris, and its use by salmonids, pp. 329-334. In: R.R. Johnson, C.D. Ziebell, D.R. Patton, P.R. Folliot, and R.H. Hamre (editors). *Riparian ecosystems and* *their management: Reconciling conflicting uses.* First North American Riparian Conference, Tuscon, Arizona. General Technical Report RM-120. USDA Forest Service, Rocky Mountain Forest and Range Experiement Station, Fort Collins, CO.

Bryant, M. 2009. Global Climate Change and Potential Effects on Pacific Salmonids in Freshwater Ecosystems of Southeast Alaska. *Climate Change*. DOI 10.1007/s10584-008-9530-x

Bryant, M.D., and Everest. 1998. Management and Condition of Watersheds in Southeast Alaska: The Persistence of Anadromous Salmon. Northwest Science, Vol. 72, No. 4, 1998.

Bryant, M.D., and B.E. Wright. [unpublished manuscript]. An analysis of juvenile salmonid densities from a diverse long-term data set.

Bryant, M.D., J. Caouette, and B. Wright. 2004. Evaluating stream habitat survey data and statistical power using an example from Southeast Alaska. *North American Journal of Fisheries Management* 24:1353–1362.

Bunnell, F.L., L.L. Kremsater, and E. Wind. 1999. Managing to sustain vertebrate richness in forests of the Pacific Northwest: relationships within stands. Environmental Review. 7: 97-146.

Burgner, R. L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito. 1991. Distribution and Origins of Steelhead Trout (*Oncorhynchus mykiss*) in Offshore Waters of the North Pacific Ocean. Bulletin Number 51. International North Pacific Fisheries Commission.

Burkey, T.V. 1995. Extinction rates in archipelagoes: implications for populations in fragmented habitats. *Conservation Biology* 9:527–541.

Buskirk, S.W. and W. J. Zielinski. 1997. American marten (*Martes americana*) ecology and conservation. Pages 17-22 in J.E. Harris, and C.V. Ogan, (eds.), *Mesocarnivores of northern California: biology, management, and survey techniques, workshop manual.* August 12-15, 1997, Humboldt State University, Arcata, CA. The Wildlife Society, California North Coast Chapter, Arcata, CA. 127 pp.

Caouette, J.P., and E.J. DeGayner. 2005. Predictive Mapping for Tree Sizes and Densities in Southeast Alaska. *J. Land. Urban Plan*. 72(1-3):49-63.

Caouette, J.P., M.G. Kramer, and Nowacki, G.J. 2001. Deconstructing the Timber Volume Paradigm in the Management of the Tongass National Forest. General Technical Report PNW-GTR-482. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. 20 pp.

Carey, A.B. 2000. Ecology of northern flying squirrels: implications for ecosystem management in the Pacific Northwest, USA. Pages 45–66 in R.L. Goldingay and J.S. Scheibe (eds). *Biology of gliding mammals*. Filander Verlag, Forth, Germany.

Carey, A.B. 2003. Biocomplexity and Restoration of Biodiversity in Temperate Coniferous Forest: Inducing Spatial Heterogeneity with Variable-density Thinning. Forestry Volume 76, No. 2.

Carlson, M., and M. Shephard. 2007. Is the spread of non-native plants in Alaska accelerating? In: *Meeting the Challenge: Invasive Plants in Pacific Northwest Ecosystems.* U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. General Technical Report GTR-694. Portland, OR.

Carlson, M.L., I.V. Lapina, M. Shephard, J.S. Conn, R. Densmore, P. Spencer, J. Heys, J. Riley, J. Nielsen. 2008. USDA Forest Service, Alaska Region. Technical Report R10-TP-143.

Carstensen, R., J. Schoen, and D. Albert. 2007. Biogeographic provinces of southeastern Alaska. In: J. Schoen and E. Dovichin, eds. The coastal forests and mountains ecoregion of southeastern Alaska and the Tongass National Forest: A conservation assessment and resource synthesis. Audubon Alaska and The Nature Conservancy. Anchorage, Alaska.

Cederholm, C.J., L.M. Reid, E.O. Salo. 1981. Cumulative effects of logging road sediment on salmonid populations in the Clearwater River, Jefferson County, Washington, pages 38-47 in, Proceedings, conference on salmon spawning gravel: a renewable resource in the Pacific Northwest? Report 39: Washington State University, Water Research Center, Pullman, Washington

Center for Biological Diversity and Greenpeace. 2011. Petition to list the Alexander Archipelago Wolf (*Canis lupus ligoni*) as threatened or endangered under the United States Endangered Species Act. Submitted to the U.S. Fish and Wildlife Service August 10, 2011.

Cerveny, L.K. 2005. Tourism and its effects on southeast Alaska communities and resources: case studies from Haines, Craig, and Hoonah, Alaska. Research Paper PNW-RP-566. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 147 p. Available online: http://www.treesearch.fs.fed.us/pubs/20434

Chamberlin, T.W., R.D. Harr, and F.H. Everest. 1991. Timber Harvesting, Silviculture, and Watershed Processes. In: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, W.R. Meehan (ed.), American Fisheries Society Special Publication 19:181-205. 1991.

Chapin, T.G., D.J. Harrison, and D.D. Katnik. 1998. Influence of landscape pattern on habitat use by American marten in an industrial forest. Conservation biology 12: 96-227.

Chapin, F.S., III, S.F. Trainor, P. Cochran, H. Huntington, C. Markon, M. McCammon, A. D. McGuire, and M. Serreze. 2014. Ch. 22: Alaska. *Climate Change Impacts in the United States: The Third National Climate Assessment,* J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 514-536. doi:10.7930/J00Z7150.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. *Transactions of the American Fisheries Society* 117:1-21.

Chapman, D.W. and K.P. McLeod. 1987. Development of criteria for fine sediment in the Northern Rockies ecoregion. EPA 910/9-87-162. U.S. Environmental Protection Agency, Seattle, Washington.

6 References

Christensen, G.A., K.R. Julin, R.J. Ross, and S. Willits. 2002. Volume Recovery, Grade Yield and Properties of Lumber from Young-growth Sitka Spruce and Weatern hemlock in Southeast Alaska. Forest Products Journal Volume 52, no. 5, May 2002.

CLAA (Cruise Line Agencies of Alaska). 2014a. Cruise Ship Calendar for 2014.

CLAA. 2014b. Cruise Ship Calendar for 2015.

Coe, D. 2004. The Hydrologic Impacts of Roads at Varying Spatial and Temporal Scales: A Review of Published Literature as of April 2004. Prepared for Upland Processes Science Advisory Group of the Committee for Cooperative Monitoring, Evaluation, and Research.

Coho, C. and S.J. Burges. 1991. Analysis of initiation mechanisms of dam-break floods in managed forests. Report Number TFW-SH9-91-001. Washington Department of Natural Resources, Forest Practices Division, Olympia, Washington. 23pp

Collins, B., D. Montgomery, K. Fetherston, and T. Abbe. 2011. The Floodplain Large-wood Cycle Hypothesis: A Mechanism for the Physical and Biotic Structuring of Temperate Forested Alluvial Valleys in the North Pacific Coastal Ecoregion. *Geomorphology.* Pages 460-470.

Colt, S. 2001. The Economic Importance of Healthy Alaska Ecosystems. Prepared for Alaska Conservation Foundation. January. Available online at: http://www.iser.uaa.alaska.edu/resourcestudies/healthy-ecosystems.pdf

Colway, C., and D.E. Stevenson. 2007. Confirmed Records of Two Green Sturgeon from the Bering Sea and Gulf of Alaska. Northwestern Naturalist 88:188–192.

Conrad, S., and D. Gray. 2014a. Overview of the 2013 Southeast Alaska and Yakutat Commercial, Personal Use, and Subsistence Salmon Fisheries. Fishery Management Report No. 14-28, Anchorage, AK.

Conrad, S., and D. Gray. 2014b. Overview of the 2014 Southeast Alaska and Yakutat Commercial, Personal Use, and Subsistence Salmon Fisheries. Alaska Department of Fish and Game, Fishery Management Report No. 14-61, Anchorage, AK.

Cook, J.A., and S.O. MacDonald. 2001. Should endemism be the focus of conservation efforts along the North Pacific Coast of North America? Biological Conservation 97: 207-213.

Cook, J.A., N.G. Dawson, and S.O. MacDonald. 2006. Conservation of Highly Fragmented Systems: The North Temperate Alexander Archipelago. Biol. Conserv. 133: 1-15.

Coulson, J., J. Butterfiled, and E. Henderson. 1990. The Effect of Open Drainage Ditches on the Plant and Invertebrate Communities of Moorland and on the Decomposition of Peat. *The Journal of Applied Ecology* 27(2): 549-561.

Cowardin, L., Carter, V., Golet, F., and LaRoe, E. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, FWS/OBS-79/31. Washington DC.

Cox, D., T. Opolka, and J. Hawkins. 2013. Soil and Wetland Resource Report, Big Thorne Project. Tetra Tech EC, Inc. Prepared for Thorne Bay Ranger District, Tongass National Forest.

Croke, J.C., and P.B. Hairsine. 2006. Sediment Delivery in Managed Forests: A Review. Environmental Review 14: 59–87. Available online at: http://er.nrc.ca/ (Accessed April – May 2011).

Cruise Line Agencies of Alaska. 2006. Personal communication between Fred Reeder of Cruise Line Agencies of Alaska and Shaun Brooks, Tetra Tech EC. August 31.

Cruse, C., and D. Powers. 2006. Estimating School District Poverty with Free and Reduced-Price Lunch Data. U.S. Census Bureau, Small Area Estimates Branch. Available online at: http://www.census.gov/did/www/saipe/publications/files/CrusePowers2006asa.pdf

Cummins, K.W., 1974. Structure and function of stream ecosystems. *Bioscience* 24: 631–641.

Dahlheim, M.E., J.M. Waite, and P.A. White. 2009. Cetaceans of Southeast Alaska: distribution and seasonal occurrence. Publications, Agencies, and Staff of the U.S. Department of Commerce. Paper 157. Available online at: http://digitalcommons.unl.edu/usdeptcommercepub/157.

D'Aleo, J., and D. Easterbrook. 2011. Relationship of Multidecadal Global Temperatures to Multidecadal Oceanic Oscillations. Chapter 5 in: Evidence-Based Climate Science. DOI: 10.1016/B978-0-12-385956-3.10005-1.

D'Amore, D. 2016. Personal communication between Patricia Krosse and David D'Amore (USDA Forest Service Research Scientist) on 4/11/2016.

D'Amore, D. V., and W. C. Lynn. 2002. Classification of forested Histosols in southeast Alaska. Soil Science Society of America Journal 66:554-62

D'Amore, D., and R. Edwards. No Date. Climate and Carbon in Southeast Alaska: Beyond the Threashold of Change in a Dynamic Landscape. Juneau Forestry Science Laboratory, PNW Research Station, Juneau, Alaska.

D'Amore, D., P. Herendeen, and E. Hood. 2015. Dissolved Organic Carbon Fluxes from Hydropendologic Units in Alaska Coastal Temperate Rainforest Watersheds.

D'eon, R.G., S.M. Glenn, I. Parfitt, and M. Fortin. 2002. Landscape connectivity as a function of scale and organism vagility in a real forested landscape. Conservation Ecology 6:10. Available online: http://www.consecol.org/vol6/iss2/art10

Daniel, T. W., J. A. Helms, and F. S. Baker. 1979. *Principles of Silviculture*. Second Edition, McGraw-Hill, New York.

Daniels, J. 2015. Alaska Timber Demand Baseline Methods for Review. Unpublished Draft Methodology. USDA Forest Service. Pacific Northwest Research Station.

Daniels, Jean M.; Paruszkiewicz, Michael D.; Alexander, Susan J. 2016. Tongass National Forest timber demand: projections for 2015 to 2030. Gen. Tech. Rep. PNW-GTR-934. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 53 p.

Darimont, C.T., and T.E. Reimchen. 2002. Intra-hair stable isotope analysis implies seasonal shift to salmon in gray wolf diet. *Canadian Journal of Zoology* 80: 1638-1632.

6 References

Davidson, E., and I. Janssens. 2006. Temperature Sensitivity of Soil Carbon Decomposition and feedbacks to Climate Change. *Nature Reviews.*

Davis, H., A.N. Hamilton, A.S. Harestad, and R.D. Weir. 2012. Longevity and reuse of black bear dens in managed forests of coastal British Columbia. *The Journal of Wildlife Management* 76: 523–527.

Dawson, N.G., and J.A. Cook. 2012. Behind the genes: diversification of North American martens (*Martes americana* and *M. caurina*). Pages 23-38 in K. B. Aubry, W. J. Zielinski, M. G. Raphael, and S. W. Buskirk, editors. *Biology and conservation of martens, sables, and fishers: a new synthesis*. Cornell University Press, Ithaca, New York.

Dawson, N.G., S.O. MacDonald, J.A. Cook. 2007. Endemic mammals of the Alexander Archipelago. Chapter 6.7 *In* J.W. Schoen and E. Dovichin, editors. The Coastal Forests and Mountains Ecoregion of Southeastern Alaska and the Tongass National Forest: A conservation assessment and resource synthesis.. The Nature Conservancy and Audubon Alaska.

Day, R.H., Nigro , D.A. & Prichard, A.K. 2000. At-sea habitat use by the Kittlitz's Murrelet (Brachyramphus brevirostris) in nearshore waters of Prince William Sound, Alaska. *Marine Ornithology* 28: 105-114.

Deal, R.L. 2001. The effects of partial cutting on forest plant communities of western hemlock--Sitka spruce stands in southeast Alaska. *Canadian Journal of Forest Research* 31: 2067-2079.

Deal, R.L., and J.C. Tappeiner. 2002. The effects of partial cutting on stand structure and growth in western hemlock-Sitka spruce stands in Southeast Alaska. *Forest Ecology and Management* 159: 173-186.

Deal, R.L., J. C. Tappeiner, and P.E. Hennon 2002. Developing Silvicultural Systems Based on Partial Cutting in Western Hemlock-Sitka Spruce Stands of Southeast Alaska. Forestry Volume 75, number 4.

Deal, R.L., J. H. Barbour, M. H. McClellan, and D. L. Parry. 2003. Development of epicormic sprouts in Sitka spruce following thinning and pruning in south-east Alaska. *Forestry* 76(4).

Deal, R.L., J.C. Tappeiner and P.E. Hennon, 2002. Developing silvicultural systems based on partial cutting of western hemlock-Sitka spruce stands of southeast Alaska. *Forestry* 75: 425-431.

Deering, B. 2014. Local biomass pellets provide heat and jobs. USDA Forest Service. March 11. Available online at: http://www.fs.usda.gov/detail/tongass/news-events/?cid=STELPRD3792905

DeGayner, G. 1997. Summary of the 1997 American marten risk assessment panel. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

DellaSala, D. 2016. The Tongass Rainforest as Alaska's First Line of Climate Change Defense and Importance to the Paris Climate Change Agreements.

DellaSala, D. 2014. Why Forests Are Pivotal in Planning for Climate Change. PowerPoint presentation.

DellaSala, D., and M. Koopman. 2015. Thinning Combined with Biomass Energy Production may increase rather than reduce greenhouse gas emissions. Geological Institute. Ashland, OR.

DellaSala, D.A., K.A.Engel, D.P. Voisen, and R.L. Fairbanks. 1994. Effectiveness of Silvicultural Modifications of Young-Growth Forest for Enhancing Wildlife Habitat on the Tongass National Forest. Prepared under contract for USDA Forest Service Region 10.

Demboski, J.R., B. K. Jacobsen, and J. A. Cook. 1998. Implications of cytochrome b sequence variation for biogeography and conservation of the northern flying squirrel (*Glaucomys sabrinus*) of the Alexander Archipelago, Alaska. *Canadian Journal of Zoology* 76:1771–1776.

DeMeo, T., J. Martin, and R. West. 1992. Forest Plant Association Guide Ketchikan Area, Tongass National Forest. USDA Forest Service. Alaska Region R10-MB-210. December 1992.

DeVelice, R. L., and J. R. Martin. 2001. Assessing the Extent to Which Roadless Areas Complement the Conservation of Biological Diversity. *Ecological Applications* 11(4): 1008-1018.

DeWalle, D.R. 2010. Modeling stream shade: Riparian buffer height and density as important as buffer width. *Journal of the American Water Resources Association* 45(2): 323–333.

Dickerman, R.W., and J. Gustafson. 1996. The Prince of Wales spruce grouse: a new subspecies from southeastern Alaska. *Western Birds* 27:41–47.

Dillman, K. 2004. Epiphytic Lichens of the Forest-Marine Ecotone of Southeastern Alaska. M.S. Thesis, Arizona State University, Tempe.

Dillman, K.L. 2008. Conservation Assessment for the Large Round-leaved Orchid (*Platanthera orbiculata* (Pursh.) Lindl. on the Tongass National Forest, Alaska Region. US. USDA Forest Service, Tongass National Forest.

Dillman, K.L. 2011a. Conservation Assessment of *Piperia unalascensis* (Spreng.) Rydb. Region 10 Sensitive Species. USDA Forest Service, Tongass National Forest.

Dillman, K.L. 2011b. Conservation Assessment of *Lobaria amplissima* (Scop.) Forss. Region 10 Sensitive Species. USDA Forest Service, Tongass National Forest.

Dillman, K.L., L.H. Geiser, and G. Brener. 2007. Air Quality Bio-monitoring with Lichens-Tongass National Forest; USDA Forest Service. Petersburg, Alaska.

Douglas, G., G. Straley, D. Meidinger, and J. Pojar (eds.). 1999. Illustrated Flora of British Columbia, Vol. 3: Dicotyledons (Diapensiaceae through Onagraceae). Victoria, British Columbia: British Columbia Ministry of Environment, Lands and Parks and Ministry of Forests.

Doyle, F. I. and J. N. M. Smith. 1994. Population responses of northern goshawks to the10-year cycle in numbers of snowshoe hares. *Studies in Avian Biology* 16:122-129.

Duffy, E. 2003. Early Marine Distribution and Trophic Interactions of Juvenile Salmon in Puget Sound. Masters Thesis, University of Washington, Seattle, WA

Dugan, D., H. Griego, G. Fay, and S. Colt. 2006. Nature-Based Tourism in Southeast Alaska: Results from 2005. Institute of Social and Economic Research. University of Alaska Anchorage. Report prepared for the Alaska Conservation Foundation. September.

6 References

Dugan, D., G. Fay, H. Griego, and S. Colt. 2009. Nature-Based Tourism in Southeast Alaska. ISER Working Paper 2009.1. March. Institute of Social and Economic Research, University of Alaska Anchorage. Available online at: www.iser.uaa.alaska.edu

Duncan, S. 2002. Soggy soils and sustainability: forested wetlands in southeast Alaska. Science Findings (41): 1-5. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, Oregon.

Dunlap, R. 1996. Fish/Riparian Assessment Panel Summary, Tongass National Forest, Juneau, Alaska. February 13, 1996.

Dunlap, R. 1997. Summary of the 1997 Fish Habitat Risk Assessment Panel, Tongass National Forest, Juneau, Alaska. May 7, 1997.

EcoAdapt. 2014. A Climate Change Vulnerability Assessment for Aquatic Resources in the Tongass National Forest.

ECONorthwest. 2014. The Economic Importance of Alaska's Wildlife in 2011. Final Report prepared for Alaska Department of Fish & Game. May.

EEI (Edison Electric Institute), Avian Powerline Interaction Committee, and the California Energy Commission. 2006. Suggested practices for avian protection on power lines: the state of the art in 2006. Pier final project report CEC-500-2006-022. Washington D.C. and Sacramento CA. Available online at: http://www.aplic.org/uploads/files/2643/SuggestedPractices2006(LR-2).pdf

EIA (U.S. Energy Information Administration). 2013. How much of U.S. carbon dioxide emissions are associated with electricity generation? Available online at http://www.eia.gov/tools/faqs/faq.cfm?id=77&t=11

Environmental Laboratory, 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1, U.S. Army Waterways Experiment Station, Vicksburg, Mississippi. Available on line at: http://www.fws.gov/habitatconservation/delineation%2087.pdf

EPA (U.S. Environmental Protection Agency). 2014a. EPA's Climate Impacts in Alaska website. Available online at: http://www3.epa.gov/climatechange/impacts/alaska.html

EPA. 2014b. Sources of Greenhouse Gas Emissions. Available online at http://www.epa.gov/climatechange/ghgemissions/sources/electricity.html

EPA. 2014c. Maintenance areas for PM10 http://www.epa.gov/airquality/greenbook/pmcs.html#ALASKA site accessed December 31, 2014

EPA. 1994. Mendenhall Valley attainment plan (59 FR 13884).

Euskirchen, E.S., Q. Li. and K.A. Harper. 2006. The influence of edges on plant communities: research frontiers for forested landscapes. Pages 71–88 in *Ecology of Hierarchical Landscapes: From Theory to Application.* Edited by J. Chen, S. Saunders, K. Broskofske and T.R. Crow. Nova Science Publishers, Hauppauge, NY.

Everest, F.H., R.L. Beschta, J.C. Schrivener, K.V. Koski, J.R. Sedell, and C.J. Cederholm. 1987. Chapter 4. Fine sediment and salmonid production: A paradox. In: Salo, E.O., T.W. Cundy, editors. *Streamside Management. Forestry and Fishery Interactions.* University of Washington, Institute of Forest Resources. Contribution No. 57. P. 98-142.

Everest, F.H., and G. H. Reeves. 2007. Riparian and Aquatic Habitats of the Pacific Northwest and Southeast Alaska: Ecology, Management History, and Potential Management Strategies (FNW-GTR-692). USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Fahrig, L. 2003. Effects of habitat fragmentation on biodiversity. *Annual Review of Ecology, Evolution, and Systematics* 34:487–515.

Fahrig, L. 1999. Forest loss and fragmentation: which has the greater effect on persistence of forest-dwelling animals? Pages 87–95 in J.A. Rochelle, L.A. Lehmann, and J. Wisniewski (eds). *Forest Fragmentation: Wildlife and Management Implications.* Brill, NY.

Fahrig, L. 1997. Relative effects of habitat loss and fragmentation on population extinction. *Journal of Wildlife Management* 61:603–610.

Fall, J.A. 2014. Subsistence in Alaska: A Year 2012 Update. Division of Subsistence, ADF&G, February.

Faris, T.L., and K.D. Vaughan. 1985. Log transfer and storage facilities in Southeast Alaska: A review. USDA Forest Service GTR PNW-174. Portland, Oregon. 24 pp., plus map. Ref. 7667.

Farmer, C.J., and M.D. Kirchhoff. 2007. Ecological classification of deer habitat in the Tongass National Forest, Alaska. *Northwestern Naturalist* 88:73–84.

Farr, W.A. 1984. Site Index and Height Growth Curves for Unmanaged Even-aged Stands of Western Hemlock and Sitka Spruce in Southeast Alaska. Res. Pap. PNW-326. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 26 pp.

Farr, W.A. and A. S. Harris. 1971. Partial cutting of western hemlock and sitka spruce in Southeast Alaska. USDA Forest Service, PNW-124. 107 pp. Ref. 8420.

Farr, W.A. and M.H. McClellan. 1994. Size and Age Structure of Trees in the Old-Growth Forests of Southeast Alaska. USDA Forest Service, Pacific Northwest Research Station. Unpublished, non-peer-reviewed manuscript on file at Juneau Forestry Sciences Laboratory, Juneau, AK. Ref. R-721.

Fay, V. 2002. Alaska Aquatic Nuisance Species Management Plan. Juneau, Alaska. October. Available online at: http://www.adfg.state.ak.us/special/invasive/ak_ansmp.pdf

Fay, G., A. V. Meléndez, and C. West. 2013. Alaska Energy Statistics 1960-2011 Final Report. Prepared by the Institute of Social and Economic Research, University of Alaska Anchorage for the Alaska Energy Authority. December.

FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment. U.S. Government Printing Office: 1993-793-071. USDA Forest Service, Washington DC.

FGDC (Federal Geographic Data Committee). 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington D.C.

Flaherty, E.A., W.P. Smith, S. Pyare, and M. Ben-David. 2008. Experimental trials of the northern flying squirrel (*Glaucomys sabrinus*) traversing managed rainforest landscapes: perceptual range and fine-scale movements. *Canadian Journal of Zoology* 86:1050–1058.

Flather, C. H; Bevers, M; and J. Hof. 2002. Prescribing habitat layouts: analysis of optimal placement for landscape planning. Pages 428-453 in Gutzwiller, K.J., editor. *Applying Landscape Ecology in Biological Conservation.* New York: Springer-Verlag.

Flynn, R., S.B. Lewis, L.R. Beier, G.W. Pendleton. 2007. Brown bear use of riparian and beach zones of northeast Chichagof Island: implications for streamside management in coastal Alaska. Wildlife Research Final Report. Alaska Department of Fish and Game, Douglas, Alaska.

Flynn, R., T.V. Schumacher, and M. Ben-David. 2004. Abundance, prey availability, and diets of American martens: implications for the design of old-growth reserves in Southeast Alaska. Wildlife Research Final Report. Alaska Department of Fish and Game.

Flynn, R.W., and T. Schumacher. 2001. Ecology of martens in southeast Alaska, 1 July 2000-30 June 2001. Alaska Department of Fish and Game. Federal aid in wildlife restoration final research performance report, grants W-23-4 to W-27-4. Study 7.16. Juneau, AK.

FNA (Flora of North America). 2014. eFloras: *Papaver alboroseum*. Available online at: http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500840. Accessed on December 15, 2014.

Forest Sciences Lab Juneau. 2014 unpublished: Forest Sciences Lab Juneau. 2014. Prince of Wales commercial thin study. Unpublished data.

Foss, J.V. 2015. Soil Quality monitoring Results from LWD collection site Unit 19, Soda-Nick Timber sale and photo point locations. Unpublished letter to Dennis Landwehr dated October 7, 2010 but updated with 2015 monitoring information.

Franklin, J.F. 1993. Preserving Biodiversity: Species, Ecosystems, or Landscapes? *Ecological Applications* 3:202-205.

Franklin, J.F., D.R. Berg, D.A. Thornburgh, and J.C. Tappeiner. 1997. Alternative silvicultural approaches to timber harvesting: variable retention harvest systems. Pages 111–140 in K.A. Kohm, J.F. Franklin (eds). *Creating a Forestry for the 21st Century.* Island Press, Washington, D.C.

Franklin, J.F., T.A. Spies, R. Van Pelt, A.B. Carey, D.A. Thornburgh, D.R. Berg, D.B. Lindenmayer, M.E. Harmon, W.S. Keeton, D.C. Shaw, K. Bible, and J. Chen. 2002. Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example. *Forest Ecology and Management* 155:399-423.

Fresh, K. 2006. Juvenile Pacific Salmon in Puget Sound. Technical Report 2006-06. Prepared in support of the Puget Sound Nearshore Partnership. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, WA

Furniss, M. J., S. Flanagan, and B. McFadin. 2000. Hydrologically-Connected Roads: An Indicator of the Influence of Roads on Chronic Sedimentation, Surface Water Hydrology and Exposure to Toxic Chemicals. Stream Notes, July 2011.

Furniss, M.J., T.D. Roelofs, and C.S. Yee. 1991. Road Construction and Maintenance. In: *Influences of Forest Rangeland Management on Salmonid Fishes and Their Habitat,* W.R. Meehan (ed.), American Fisheries Society Special Publication 19:297-323, 1991.

Galginaitus, M. 2004. Subsistence Resource Report for the Couverden Forest Service Project. Applied Sociocultural Research. Anchorage, Alaska.

Geiser, L.H., C.C. Derr, and K.L. Dillman. 1994. Air Quality Monitoring on the Tongass National Forest, Methods and Baselines Using Lichens. Report R10-TB-46, USDA Forest Service, Petersburg, Alaska.

Gibson, J.R., Haedrich, R.L., and Wenerheim. 2005. Loss of Habitat as a Consequence of Inappropriately Constructed Stream. *Fisheries*, 30(1), 10-16.

Gilbertson, N. 2004. Southeast Alaska. A Tale of Two Economies. Alaska Economic Trends. March. Available online at: http://www.labor.state.ak.us/trends/

Gilbertson, N. 2003. Sitka: An Economic Profile. Alaska Economic Trends. February. pp. 3-9.

Glaser, P.H. 1999. The Impact of Forestry Roads on Peatlands within the Tongass National Forest, Southeast Alaska.

Godin, J. 1981. Daily Patterns of Feeding Behavior, Daily Rations, and Diets of Juvenile Pink Salmon (*Oncorhynchus gorbuscha*) in two Marine Bays of British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 38: 10-15.

Goldstein, M.I., A.J. Poe, E. Cooper, D. Youkey, B.A. Brown, and T.L. McDonald. 2005. Mountain goat response to helicopter overflights in Alaska. *Wildlife Society Bulletin* 33(2): 688-699.

Goldstein, M.I., D. Martin, and M.C. Stensvold. 2009. Forest Service Alaska Region Sensitive Species List. Assessment and Proposed Revisions to the 2002 List. Juneau. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_037658.pdf. Accessed: December 15, 2014.

Gomi, T. R. Sidle, M. Brant, and R. Woodsmith. 2001. The Characteristics of Woody Debris and Sediment Distribution in Headwater Streams, Southeastern Alaska. *Canadian Journal of Forest Research* 31: 1386-1399.

Gomi, T., R.C. Sidle, and D.N. Swanston. 2004. Hydrogeomorphic linkages of sediment transport in headwater streams, Maybeso Experimental Forest, southeast Alaska. *Hydrological Processes* 18: 667-683.

Gomi, T., R.D. Moore, and A.S. Dhakal. 2006. Headwater Stream Temperature Response to Clear-cut Harvesting with Different Riparian Treatments, Coastal British Columbia, Canada. Water Resources Research 42, W08437, doi: 10.1029/2005WR004162

Gomi, T., R.D. Moore, and M.A. Hassan. 2005. Suspended Sediment Dynamics in Small Forest Streams of the Pacific Northwest. *Journal of the American Water Resources Association* 41, 4; *ProQuest Science Journals*, pp. 877. August 2005.

6 References

Germano, J., and D. Browning. 2005. Marine Log Transfer Facility and Wood Waste: When Dredging is not Your Final Answer. Germano and Associates, Inc. Bellevue, WA.

Grant, G.E., S.L. Lewis, F.J. Swanson, J.H. Cissel, and J.J. McDonnell. 2008. Effect of Forest Practices on Peak Flows and Consequent Channel Response: A State-of-Science Report for Western Oregon and Washington. General Technical Report. PNW-GTR-760. Portland, Oregon: USDA Forest Service, Pacific Northwest Research Station. 76p

Grantham, T.E., D.A. Newburn, M.A. McCarthy, and A.M. Merenlender. 2012. The Role of Streamflow and Land Use in Limiting Oversummer Survival of Juvenile Steelhead in California Streams. *Transactions of American Fisheries Society* 141: 585–598.

Gravelle, J. G. Ice, T. Link, and D. Cook. 2009. Nutrient Concentration Dynamics in an Inland Pacific Northwest Watershed Before and After Timber Harvest. *Forest Ecology and Management* 257(8): 1663-1675.

Gregory, S.V. and P.A. Bisson. 1997. Degradation and loss of anadromous salmonid habitat in the Pacific Northwest. Pages 277-314 in D.J. Stouder, P.A. Bisson, and R.J. Naiman, editors. *Pacific Salmon and Their Ecosystems: Status and Future Options.* Chapman and Hall, New York, New York.

Gregory, S.V., F.J. Swanson, W.A. Mckee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones: focus on links between land and water. *BioScience* 41:540-551.

Griffiths, P.A., T. Aley, K. Prussian, J. Baichtal, S. Hohensee, S.R.H. Worthington, C. Mayn, W.K. Jones. 2002. Karst Management Standards and Implementation Review: Final Report of the Karst Review Panel. USDA Forest Service, Tongass National Forest.

Groom, J.D., L. Dent, L.J. Madsen, and J. Fleuret. 2011. Response of Western Oregon (USA) Stream Temperatures to Contemporary Forest Management. *Forest Ecology and Management* 262:1618-1629.

Groot, C., and L. Margolis (eds.). 1991. *Pacific Salmon Life History.* University of British Columbia, Vancouver BC.

Gucinski, H., Furniss, M. J., Ziemer, R. R., Brookes, M. H. 2001. Forest roads: a synthesis of scientific information. General Technical Report. PNW-GTR-509. Portland, OR, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 103p.

Guthrie, R.H. 2002. The effects of logging on frequency and distribution of landslides in three watersheds on Vancouver Island, British Columbia. *Geomorphology* 43: 273.

Hagar, J.C., W.C. McComb, and W.H. Emmingham. 1996. Bird communities in commercially thinned and unthinned Douglas-fir stands of western Oregon. *Wildlife Society Bulletin* 24: 353-366.

Hagar, J., S. Howlin, and L. Ganio. 2004. Short-term response of songbirds to experimental thinning of young Douglas-fir forests in the Oregon Cascades. *Forest Ecology and Management* 199: 333-347.

Hagar, J. and C. Friesen. 2009. Young stand thinning and diversity study: response of songbird community one decade post-treatment. U.S. Geological Survey Open-File Report 2009-1253. 20pp. Available online at: http://pubs.usgs.gov/of/2009/1253/pdf/ofr20091253.pdf

Haggerty, M. 2009. Lake Ozette Sockeye Limiting Factors Analysis. Prepared for: The Makah Indian Tribe and NOAA Fisheries in cooperation with the Lake Ozette Sockeye Steering Committee.

Haines Convention and Visitors Bureau. 2015. Email correspondence between T. Piper of HCVB and M. Dadswell of Tetra Tech. January 7.

Haines Convention and Visitors Bureau. 2014. Visitation Totals 2007 through 2013. December 19.

Hanley, T.A., W.P. Smith, and S. M. Gende. 2005. Maintaining Wildlife Habitat in Southeastern Alaska: Implications of New Knowledge for Forest Management and Research. *Landscape and Urban Planning* 72: 113-133.

Hanley, T.A., D.E. Spalinger, K.J. Mock, O.L. Weaver, and G.M. Harris. 2012. Forage resource evaluation system for habitat – deer: an interactive deer habitat model. USDA Forest Service General Technical Report PNW-GTR-858, January 2012.

Harding, K.A., and D.C. Ford. 1993. Impacts of Primary Deforestation upon Limestone Slopes in Northern Vancouver Island, British Columbia. *Environmental Geology* 21:137-143.

Hargis C.D., J.A. Bissonette, and D.L. Turner. 1999. The influence of forest fragmentation and landscape pattern on American martens. *Journal of Applied Ecology* 36:157-172.

Harmon, M.E., W.K. Ferrell, and J.F. Franklin. 1990. Effects on Carbon Storage of Old-Growth Forests to Young Forests. *Science* Volume 247, February 1990.

Harper, P., editor. 2013. Deer management report of survey-inventory activities 1 July 2010-30 June 2012. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-201301, Juneau.

Harper, K.A., S.E. MacDonald, P.J. Burton, J. Chen, K.D. Brosofske, S.C. Saunders, E.S. Euskirchen, D. Roberts, M.S. Jaiteh, and P. Esseen. 2005. Edge influence on forest structure and composition in fragmented landscapes. *Conservation Biology* 19:768–782.

Harris, C.C. 1996. Rural Communities in the Inland Northwest—An Assessment of Small Communities in the Interior and Upper Columbia River Basins. Interior Columbia River Basin Ecosystem Management Project, Walla Walla, WA.

Harr, R.D. 1986. Effects of clearcutting on rain-on-snow runoff in Western Oregon: a new look at old studies. *Water Resources Research* 22(7): 1095-1100.

Harris, A.S. 1989. Wind in the forests of southeast Alaska and guides for reducing damage. Gen. Tech. Rep. PNW-GTR-244. Portland OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 63 p.

Harris, A.S. and D.L. Johnson 1983. Western Hemlock-Sitka Spruce. In: USDA Forest Service Agriculture Handbook No. 445, pp. 1 to 8.

Harris, A.S. and W.A. Farr. 1974. The Forest Ecosystem of Southeast Alaska: Forest Ecology and Timber Management. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station. General Technical Report PNW-25. Ref. R-717.

Harris, A.S., Billings, R.F., Smith, R.C., Knight, C.A., and D.L. Packer. 1976. Report on Regeneration conditions—Yakutat. Unpublished monitoring report. September 1, 1976.

Hassan, M.A., M. Church, T.T. Lisle, F. Brardinoni, L. Benda, and G.E. Grant. 2005. Sediment Transport and Channel Morphology of Small, Forested Streams. *Journal of the American Water Resources Association* 41, 4; *ProQuest Science Journals*, pp. 853. August 2005.

Harvey, B., R. Nakamoto, and J. White. 2006. Reduced Streamflow Lowers Dry Season Growth of Rainbow Trout in a Small Streams. *Transactions of the American Fisheries Society* 135: 998-1005.

Haufler, J.B. 2006. Review of Conservation Science Produced Since 1997 and Its Relationship to the Tongass National Forest Land and Resource Management Plan. Final Draft. Prepared for Tongass National Forest. Ecosystem Management Research Institute (EMRI). August 2006. 35 pp.

Haufler, J., C. Mehl, and S. Yeats. 2010. Climate Change: Anticipated Effects on Ecosystem Services and Potential Actions by the Alaska Region, U.S. Forest Service. Ecosystem Management Research Institute, Seeley Lake, Montana.

Hayward, G.D., and S. Jacobson. 2011. Evaluating Current Management Indicator Species for the Tongass National Forest: Interagency Review. Draft report. September 2011. USDA Forest Service, Tongass National Forest.

Hayward, G.D., N.M. Warren, B. Parrish, M. Williams, C. Liggett, and V. Starostka, 2004. *Region 2 management indicator species selection process and criteria*. Technical Report. Lakewood, Colorado: USDA Forest Service.

Headwater Economics. 2012. Profiles of Timber and Wood Products and Industries that Include Travel & Tourism. Economic Profile System-Human Dimensions Toolkit EPS-HDT.

Heard, W.R. 1991. Life History of Pink Salmon (*Oncorhynchus gorbuscha*), pp. 119-230. In: Pacific Salmon Life Histories., C. Groot and L. Margolis (eds.). University of British Columbia in co-operation with the Government of Canada, Department of Fisheries and Oceans. British Columbia, Canada.

Heifetz, J., M.L. Murphy, and K.V. Koski. 1986. Effects of logging on winter habitat of juvenile salmonids in Alaska streams. *North American Journal of Fisheries Management* 6:52-58.

Heimann, D.C. 1988. Recruitment trends and physical characteristics of coarse woody debris in Oregon Coast Range streams. M.S. thesis, Oregon State University, Corvallis, OR.

Hejl, S.J., K.R. Newlon, M.E. McFadzen, J.S. Young, and C.K. Ghalambor. 2002. Brown creeper (*Certhia americana*). *The birds of North America*. Number 669.

Hendee, J.C., and C.P. Dawson. 2002. *Wilderness Management, Stewardship and Protection of Resources and Values.* Third edition. Fulcrum Publishing. Golden, Colorado. 640 pp.

Hennon, P.E., and M. H. McClellan. 2003. Tree mortality and forest structure in the temperate rain forests of southeast Alaska. *Canadian Journal of Forestry Resources* 33: 1621-1634.

Hennon, P.E., and C.G. Shaw. 1997. The Enigma of Yellow-Cedar Decline. *Journal of Forestry* 95(12): 4-10.

Hennon, P.E., D.V. D'Amore, P.G. Schaberg, D.T. Wittwer, and C.S. Shanley. 2012. Shifting climate, altered niche, and a dynamic conservation strategy for Yellow-cedar in the North Pacific coastal rainforest. *Bioscience* 62:147–158.

Hennon, P.E.; C.M. McKenzie, D.V. D'Amore, D.T. Wittwer, R.L. Mulvey, M.S. Lamb, F.E. Biles, and R.C. Cronn. 2016. A Climate Adaptation Strategy for Conservation and Management of Yellow-Cedar in Alaska. Gen. Tech. Rep. PNW-GTR-917. Portland, OR: U.S. Department of Agriculture Forest Service.

Hernandez, O., R. W. Merritt, and M.S. Wipfli. 2005. Benthic Invertebrate Community Structure is Influenced by Forest Succession and Clearcut Logging in Southeast Alaska. *Hydrobiologia* 533: 45-59.

Hicks, B.J., et al. 1991. Long-term Changes in Streamflow Following Logging in Western Oregon and Associated Fisheries Implication. Water Resources Bulletin 27(2): 217-226.

Hetrick N.J., Brusven M.A., Meehan, W.R., and Bjornn, T.C. 1998. Changes in solar input, water temperature, periphyton accumulation, and allochthonous input and storage after canopy removal along two small salmon streams in southeast Alaska. *Transactions of the American Fisheries Society* 127: 859-875.

Heuttee T. 2015. Personal communication between Tom Heuttee (FHP Aerial Survey Coordinator) and Patti Krosse (Soil Scientist/Ecologist Ecology, Botany and Invasive spp. Program Manager for the Tongass National Forest) on August 2015.

Hieronymus, Mark. 2016. Personal communication with Sheila Jacobson. Explanation of change in Tongass 77 watersheds (VCUs) to 73 watersheds. Email of June 3, 2016.

Hilderbrand, G. V., C.C. Schwartz, C. Robbins, M. E. Jacoby, T. A. Hanley, S. M. Arthur, and C. Servheen. 1999. Importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. *Canadian Journal of Zoology* 77:132-138.

Hillgruber, N., C. E. Zimmerman, S. E. Burril, and L. J. Haldorson. 2007. Early marine ecology of chum salmon (*Oncorhynchus keta*) in Kuskokwim Bay. North Pacific Research Board Final Report 327.

Himes-Cornell, A., K. Hoelting, C. Maguire, L. Munger-Little, J. Lee, J. Fisk, R. Felthoven, C. Geller, and P. Little. 2013. Community profiles for North Pacific fisheries – Alaska. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-259, Volume 11, 816 p. Available online at: http://www.afsc.noaa.gov/REFM/Socioeconomics/Projects/CPU.php

Hines, A.H., G.H. Ruiz, N.G. Hitchcock, and K. deRiveria. 2004. Projecting range expansion of invasive European green crabs (*Carcinus maenas*) to Alaska: temperature and salinity tolerance of larvae. Research Report. Prince William Sound Regional Citizens' Advisory Council.

Hodges, J.I. 2011. Bald eagle population surveys of the North Pacific Ocean, 1967-2010. *Northwestern Naturalist* 92:7-12.

Holsten, E., E. Hennon, L. Trummer, and M. Schultz. 2001. Insects and Diseases of Alaskan Forests. USDA Forest Service R10-TP-87, April 2001.

Holtsmark, B. 2012. The Outcome is in the Assumptions: Analyzing the Effects on Atmospheric CO_2 Levels of Increased Use of Bioenergy from Forest Biomass. *GCB Bioenergy* 5: 467–473. doi:10.1111/gcbb.12015

Hoover, J.P., M.C. Brittingham, and L.J. Goodrich. 1995. Effects of forest patch size on nesting success of wood thrush. *Auk* 112:146-155.

Hoover, C and S. Stout. 2007. The Carbon Consequences of Thinning Techniques: Stand Structure Makes the Difference. *Journal of Forestry* 105(5), July/August 2007.

House, R.A. and P.L. Boehne. 1987. The effect of stream cleaning on salmonid habitat and populations in a coastal Oregon drainage. *Western Journal of Applied Forestry* 2:84-87.

Howe, A.L., G. Fidler, and M.J. Mills. 1995. Harvest, Catch, and Participation in Alaska Sport Fisheries During 1994. Alaska Department of Fish and Game, Division of Sport Fish, Fishery Data Series No. 95-24. October.

Howell, D. 2014. Alaska Population Projections 2012 to 2042. Alaska Economic Trends. June. Pages 4-16. Available online at: http://labor.state.ak.us/trends/

Hubbart, J.A., T.E. Link, J.A. Gravelle, and W.J. Elliot. 2007. Timber harvest impacts on water yield in the continental/maritime hydroclimatic region of the United States. *Forest Science* 53(2): 169–180.

Hudson, R. 2001. Roberts Creek Study Forest: preliminary effects of partial harvesting on peak streamflow in two S6 Creeks. Forest Research Extension Note EN-007, Hydrology, March 2001. Vancouver Forest Region, Nanaimo, BC, Canada.

Huff, D.D., S.T. Lindley, B.K. Wells, and F. Chai. 2012. Green Sturgeon distribution in the Pacific Ocean Estimated from Modeled Oceanographic Features and Migration Behavior. *PLOS ONE* 7(9): 1–12 (e45852).

Hupp, J.W., J.I. Hodges, Jr., B.P. Conant, B.W. Meixell, and D.J. Groves. 2010. Winter distribution, movements, and annual survival of radiomarked Vancouver Canada geese in southeast Alaska. *Journal of Wildlife Management* 74:274–284.

Ice, George G., George W. Brown, John A. Gravelle, C. Rhett Jackson, Jeffrey T. Light, Timothy E. Link, Douglas J. Martin, Dale J. McGreer, and Arne E. Skaugset, 2010. Discussion – ‘‘Stream Temperature Relationships to Forest Harvest in Western Washington’’ by Michael M. Pollock, Timothy J. Beechie, Martin Liermann, and Richard E. Bigley. *Journal of the American Water Resources Association* 1-5. DOI: 10.1111/j.1752-1688.2010.00441.x

IFA (Inter-Island Ferry Authority). 2014. Information. Available online at: http://www.interislandferry.com/information.html (Accessed on December 18, 2014).

IMPROVE (Interagency Monitoring of Protected Visual Environment). 2015. Data Resources. Available online at: http://vista.cira.colostate.edu/improve/Data/data.htm

Independent Multidisciplinary Science Team. 1999. Recovery of wild salmonids in western Oregon forests: Oregon forest practices rules and the measures in the Oregon plan for salmon and watersheds. Governor's Natural Resources Office, Salem, Oregon.

IOC (Intergovernmental Oceanographic Commission). 2007. Ocean Carbon Sequestration: A Watching Brief of the Intergovernmental Oceanographic Commission of UNESCO and the Scientific Committee of Ocean Research. Version 2. January 2007

IPCC (Intergovernmental Panel on Climate Change). 2014. Climate Change 2013: The Physical Science Basis. Intergovernmental Panel on Climate Change. Working Group I, Fifth Assessment Report. WMO and UNEP. Fed 2014.

IPCC. 2007. Mitigation of climate change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Isaacs, F.B., R.G., Anthony, R.W. Krahmer, B.D. Callahan, J.P. Peck. 2005. Effects of forest management on bald eagles nesting on state and private land in Oregon. Oregon Department of Fish and Wildlife. Bald Eagle Monitoring Report TR19. March 2005.

ISLES. 2013. ISLES program website http://www.msb.unm.edu/mammals/ISLES_website_final_20091028/ isles_home.html. Accessed March 2013.

Iverson, C. 1996a. Northern goshawk viability assessment panel summary. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Iverson, C. 1996b. Alexander archipelago wolf viability assessment panel summary. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Iverson, C. 1996c. American marten viability assessment panel summary. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997d)

Iverson, C. 1996d. Brown bear viability assessment panel summary. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Iverson, C. 1997a. Summary of the 1997 northern goshawk risk assessment panel. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Iverson, C. 1997b. Summary of the 1997 Alexander archipelago wolf risk assessment panel. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Iverson, C. 1997c. Summary of the 1997 other terrestrial mammals risk assessment panel. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

6 References

Iverson, C.G., G.D. Hayward, K. Titus, E. DeGayner, R.E. Lowell, D.C. Crocker-Bedford, P.F. Schempf, and J. Lindell. 1996. Conservation Assessment for the Northern Goshawk in Southeast Alaska. Gen. Tech. Rep. PNW-GTR-387, November 1996, Pacific Northwest Research Station, Portland, Oregon. USDA, Forest Service. 101 pp.

Iwamoto, R.N., E.O. Salo, M.A. Madej, and R.L. McComas. 1978. Sediment and water quality: a review of the literature including a suggested approach for water quality criteria. EPA/910/9-78-048. US Environmental Protection Agency, Region Ten, Seattle, Washington

Jacobson, Sheila. 2014. Personal Communication. Transmittal of Power Point File containing commercial fish values from the Tongass. US Forest Service Fish Biologist, Tongass National Forest. December 17, 2014

Jacobson, Sheila. 2015. Personal Communication. Email containing fish passage survey data. US Forest Service Fish Biologist, Tongass National Forest. April 15, 2015.

Jacobson, Sheila. 2016. Personal Communication. Transmittal of Excel File containing stream crossing data. USDA Forest Service Fish Biologist, Tongass National Forest. April.

Jakob, M. 2000. The impacts of logging on landslide activity at Clayoquot Sound, British Columbia. *Catena* 38: 279–300.

James, R.D. 1984. Habitat management guidelines for cavity-nesting birds in Ontario. Royal Ontario Museum. MNR #51604.

Janetski, D. D. Chaloner, S. Tiegs, and G. Lamberti. 2009. Pacific Salmon Effects on Stream Ecosystems: a Quantitative Synthesis. 2009. *Oecologia* 159: 583-595.

Janisch, J.E., S.M. Wondzell and W.J. Ehinger. 2012. Headwater Stream Temperature: Interpreting Response after Logging, with and without Riparian Buffers, Washington, USA. Forest Ecology Management.

Janisch, J.E. and M.E. Harmon. 2002. Successional changes in live and dead wood carbon stores: implications for net ecosystem productivity. *Tree Physiology* 22: 77-89.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2011a. Estimates of participation, catch, and harvest in Alska sport fisheries during 2009. Alaska Department of Fish and Game, Fisheris Data Series No. 11-45, Anchorage, Alaska.

Jennings, G. B., K. Sundet, and A. E. Bingham. 2011b. Estimates of participation, catch, and harvest in Alska sport fisheries during 2010. Alaska Department of Fish and Game, Fisheris Data Series No. 11-60, Anchorage, Alaska.

Jochimsen, D.M., C.R. Peterson, K.M. Andrews, and J.W. Gibbons. 2004. A literature review of the effects of roads on amphibians and reptiles and the measures used to minimize those effects. Final Draft. Idaho Fish and Game Department. USDA Forest Service. 11 November 2004.

Johnson, J., and V. Litchfield. 2015. Catalog of waters important for spawning, rearing, or migration of anadromous fishes – Southeastern Region, Effective June 1, 2015, Alaska Department of Fish and Game, Special Publication No. 15-08, Anchorage.

Johnson, A.C., D.N. Swanston, and K.E. McGee. 2000. Landslide initiation, runout, and deposition within clearcuts and old-growth forests of Alaska. *Journal of the American Water Resources Association* 36: 17-30.

Johnson, A.C., R.T. Edwards, and R. Erhardt. 2007. Ground-water response to forest harvest: Implications for hillslope stability. Journal of the American Water Resources Association. Vol. 43, No. 1, February. p. 134-147.

Johnson, S.W., J. Heifetz, and K.V. Koski. 1986. Effects of logging on the abundance and seasonal distribution of juvenile steelhead in some southeastern Alaska streams. *North American Journal of Fisheries Management* 6:532-537.

Joint Southeast Alaska Planning Team. 1981. Comprehensive Salmon Plan for Southeast Alaska Phase I.

Jones, J.A. 2000. Hydrologic processes and peak discharge response to forest removal, regrowth, and roads in 10 small experimental basins, western Cascades, Oregon. Water Resources Research 36 (9): 2621-2642.

Jones, J.A. and Grant, G.E. 1996. Peak Flow Responses to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon. Water Resources Research, Vol. 32, No. 4: 959-974.

Jonsson, R., W. Mbongo, A. Felton, and M. Boman. 2012. Leakage implications for European timber markets from reducing deforestation in developing countries. *Forests* 3:736-744.

Juday, G. P., R. A, Ott, D. W. Valentine, and V. A. Barber. 1998. Forests, Climate Stress, Insects, and Fire. In: *Implications of Gobal Change in Alaska and the Bering Sea Region* – Proceedings of a Workshop. Center for Global Change and Arctic System Research.

Julin, K.R. (Compiler). 1997. Assessments of Wildlife Viability, Old-growth Timber Volume Estimates, Forested Wetlands, Slope Stability. General Technical Report PNW-GTR-392. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

Julin, K.R. 1995. Other terrestrial mammals panel assessment summary. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997d)

Julin, K. R., C.G. Shaw III, W.A. Farr, and T.M. Hinckley. 1993. The fluted western hemlock of Alaska. II Stand observations and synthesis. *Forest Ecology and management* 60: 133-141.

Julin, K.R. and D.V. D'Amore. 2003. Tree Growth on Forested Wetlands of Southeastern Alaska Following Clearcutting. *Western Journal of Applied Forestry* 18(1).

Julin, K.R. and J.P. Caouette. 1997. Options for Defining Old-growth Timber Volume Strata: A Resource Assessment. In: K. R. Julin (Compiler), Assessments of Wildlife Viability, Old-growth Timber Volume Estimates, Forested Wetlands, Slope Stability. General Technical Report PNW-GTR-392. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. pp. 24-37.

Juneau Economic Development Council. 2014a. 2014 Juneau and Southeast Alaska Economic Indicators and Outlook. September. Available online at: http://www.jedc.org/economic-indicators

Juneau Economic Development Council. 2014b. Cruise Passengers 2006 and 2007; Enplanements 2006 to 2008. Email correspondence between E. Bornstein and B. Hoch of JEDC and M. Dadswell of Tetra Tech. December 19 and 23.

Kahklen, K. and J. Moll. 1999. Measuring Effects of Roads on Groundwater: Five Case Studies. USDA Forest Service Technology and Development Program. January 1999.

Kahklen, K. and W. Hartsog. 1999. Results of Road Erosion Studies on the Tongass National Forest. Unpublished report. 47 pp. On file with: USDA Forest Service, Pacific Northwest Research Station, Forestry Sciences Laboratory, 2770 Sherwood Lane, Suite 200, Juneau, AK 99801.

Karwan, D.L., Gravelle, J.A., and Hubbart, J.A. 2007. Effects of Timber Harvest on Suspended Sediment Loads in Mica Creek, Idaho. In Press. In Special Issue on Headwater Forest Streams. *Forest Science* 53(2): 181-188.

Keller, E.A. and F.J. Swanson. 1979. Effects of large organic material on channel form and fluvial processes. Earth Surface Processes and Landforms 4:361-380

Kelly, B.P., T. Ainsworth, D.A. Boyce Jr., E. Hood, P. Murphy, and J. Powell. 2007. Climate Change, Predicted Impacts on Juneau, Scientific Panel on Climate Change City and Borough of Juneau, Report to Mayor Bruce Botelho and the City and Borough of Juneau Assembly. April 2007.

Kendall, N. W. , J.R. McMillan, M.R. Sloat, T. W. Buehrens, T. P. Quinn, R. R. Pess, K. V. Kuzishchin, M. M. McClure, and R. W. Zabel. 2015. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns. *Canadian Journal of Fisheries and Aquatic Science* 72: 319–342.

Keppeler, E. and J. Lewis. 2007. Understanding the Hydrologic Consequences of Timber-harvest and Roading: Four Decades of Streamflow and Sediment Results from the Caspar Creek Experimental Watersheds. in M. Furniss and M. McCammon, editors. *Advancing the Fundamental Sciences-A Conference for Forest Service Physical Scientists.* USDA Forest Service.

Keppeler, E.T., and R.R. Ziemer. 1990. Logging effects on streamflow: water yield and summer low flows at Caspar Creek in Northwestern California. *Water Resources Research* 26(7): 1669–1679.

Kirchhoff, M. D., and D. L Larsen. 1998. Dietary overlap between native Sitka black-tailed deer and introduced elk in Southeast Alaska. *Journal of Wildlife Management* 62:236-242.

Kissling, M.L. 2003. Effects of Forested Buffer Width on Breeding Bird Communities in Coastal Forests of Southeast Alaska with a Comparison of Avian Sampling Techniques. M.S. Thesis, University of Idaho, Moscow, Idaho.

Kissling, M.L., P.M. Lukacs, S.B. Lewis, S.M. Gende, K.J. Kuletz, N.R. Hatch, S.K. Schoen, and S. Oehlers. 2011. Distribution and Abundance of the Kittlitz's Murrelet *Brachyramphus brevirostris* in Selected Areas of Southeastern Alaska. *Marine Ornithology* 39: 3–11.

Kline, J. D. 2006. Defining and Economics Research Program to Describe and Evaluate Ecosystem Services. USDA Forest Service, Pacific Northwest Research Station. General Technical Report PNW-GTR-700. December.

Knutson, K.L., and V.L. Naef. 1997. Management Recommendations for Washington's Priority Habitats: Riparian. Washington Department of Fish and Wildlife, Olympia, WA. 181 pp.

Konopacky Environmental. 1996. Water Turbidity in Streams, Related to the Installation of Road Culverts of Various Diameters for Timber Harvest Activities, on the Tongass National Forest, Southeast Alaska, During 1994 and 1995. In: Exhibit A, Presentation Sypnosis, Konopacky Project No. 002-0. February 7, 1996.

Koski, K.V. 1972. Effect of sediment on fish resources, a paper presented at Washington State Department of Natural Resources Management Seminar, Lake Limerick, Washington

Kramer, M.G. 2001. Maritime Windstorm Influence on Soil Process in a Temperate Rainforest. PhD Dissertation. Submitted to Oregon State University, May 04, 2001. 114 pp.

Kramer, M.G., A.J. Hansen, M.L. Taper, and E.J. Kissinger. 2001. Abiotic Controls on Long-Term Windthrow Disturbance and Temperate Rain Forest Dynamics in Southeast Alaska. *Ecology* 82(10): 2749-2768.

Kramer, M.G., P Sollins, and R.S. Sletten. 2004. Soil Carbon Dynamics across a Windthrow Disturbance Sequence in Southeast Alaska. *Ecology* 85(8): 2230-2244.

Kreiger, R., K. Wiebold, S. Whitney, and S. Dapcevich. 2015. Nonresidents Working in Alaska: 2013. Alaska Department of Labor and Workforce Development. Research and Analysis Section. February. Available online at: http://laborstats.alaska.gov/reshire/reshire.htm

Kreiger, R., K. Wiebold, S. Whitney, and S. Dapcevich. 2014. Residency of Alaska Workers: 2012. Alaska Department of Labor and Workforce Development. Research and Analysis Section. February. Available online at: http://laborstats.alaska.gov/reshire/historical/NONRES12.pdf

Krosse, P.C. 2016. Biological Evaluation for Plants. Tongass National Forest. Ketchikan, AK.

Kruse, J., and R. Frazier. 1988. Reports to the Communities of Southeast Alaska (one per community). Tongass Resource Use Cooperative Survey. Institute of Social and Economic Research. University of Alaska Anchorage.

Kruse, J., and R. Muth. 1990. Subsistence Use of Renewable Resources by Rural Residents of Southeast Alaska. August. 160 pp.

Lamberti, G.A., S.V. Gregory, L.R. Ashkenas, R.C. Wildman, and K.M.S. Moore. 1991. Stream ecosystem recovery following a catastrophic debris flow. Canadian Journal of Fisheries and Aquatic Sciences 48:196-208.

Landingham, J., M. Sturdevant, and R. Brodeur. 1998. Feeding Habits of Juvenile Pacific Salmon in Marine Waters of Southeastern Alaska and Northern British Columbia. Fishery Bulletin 96: 285-302

Landres, P., S. Boutcher, L, Merigliano, C. Barns, D. Davis, T. Hall, S. Henry, B. Hunter, P. Janiga, M. Laker, A. McPherson, D. Powell, M. Rowan, and S. Sater. 2005. Monitoring Selected Conditions Related to Wilderness Character: A National Framework. USDA Forest Service. Rocky Mountain Research Station. General Technical Report. RMRS-GTR-151. April.

6 References

Landwehr, D.J. 2014. Soil Quality on the Tongass National Forest. Use of ground-based Equipment on Slopes over 30 Percent Gradient. November, 2014. Unpublished monitoring report.

Landwehr, D.J. 2011. Implementation and Effectiveness Monitoring of Wetland Best Management Practices on the Tongass National Forest. Unpublished report. October 2011. USDA Forest Service, Tongass National Forest.

Landwehr, D.J. 2009. Guidelines for root wad tree harvest. Unpublished report September 16, 2009.

Landwehr, D.J. 2008a. Soil Quality Monitoring on the Tongass National Forest: The Tongass' Interpretation of the Region 10 Soil Quality Standards. Unpublished report September, 2008.

Landwehr, D.J. 2008b. Implementation and Effectiveness Monitoring of Wetland Best Management Practices on the Tongass National Forest. Unpublished report. November 2008. USDA Forest Service, Tongass National Forest.

Landwehr, D.J. 2007. Implementation and Effectiveness Monitoring of Wetland Best Management Practices on the Tongass National Forest. Appendix C in the 2007 Tongass National Forest Monitoring Report. USDA Forest Service, Tongass National Forest.

Landwehr, D.J. 2006. Reasonable Assurance of Windfirmness Guidelines, Tongass National Forest, June 13, 2006.

Landwehr, D.J. 1998. The Effectiveness of Standards and Guidelines in Preventing Additional Mass Movement. An 89-94 KPC FEIS Monitoring Report.

Landwehr, D.J. 1994. Inventory and Analysis of Landslides Caused by the October 25, 26, 1993 Storm Event on the Thorne Bay Ranger District. Unpublished report January 10, 1994.

Landwehr, D.J. 1993. Soil disturbance monitoring transects: Thorne Bat Ranger District, Tongass National Forest. In: Proceedings of Watershed '91: Soil, Air, and Water Stewardship Conference, 16-17 April 1991, Juneau, Alaska. T. Brock, Editor. USDA Forest Service, Alaska Region, R10-MB-217. Page 58.

Landwehr, D.J., J.V. Foss, and D.R. Silkworth. 2012. Soil Quality Monitoring on the Tongass National Forest: The Tongass' Interpretation of the Region 10 Soil Quality Standards. Part 2: Summarizing 4 years of data collection. Unpublished report January, 2012.

Landwehr, D.J., and J.V. Foss. 2014. Soil Quality on the Tongass National Forest. Results of compaction studies conducted on the Kuiu Stream restoration access trails. November 2014. Unpublished monitoring report. .

Landwehr, D.J., and J.V. Foss. 2006. Soil Quality on the Yakutat Ranger District, Monitoring report summarizing soil quality data following 2004-2005 salvage logging operations. Unpublished report July, 2006.

Landwehr, D.J., and G. Nowacki. 1999. Statistical Review of Soil Disturbance Transect Data Collected on the Ketchikan Area, Tongass National Forest. Unpublished report February, 1999.

Landwehr, D.J., and D.R. Silkworth. 2011. Soil Quality on the Tongass National Forest. Results of compaction studies conducted on the Experimental Thinnings at Naukati and Maybeso. August, 2011. Unpublished monitoring report.

Larsen, P., O. Goldsmith, O. Smith, M. Wilson, K. Strzepek, P. Chinowsky, and B. Saylor. 2007. Estimating the Future Cost of Alaska Public infrastructure at Risk to Climate Change. Institute of Social and Economic Research.

Larsen, C.F., R.J. Motyka, J.T. Freymueller, K.A. Echelmeyer, and E.R. Ivins. 2005. Rapid viscoelastic uplift in southeast Alaska caused by post-Little Ice Age glacial retreat.

Latterell, J.J., and R.J. Naiman. 2007. Sources and Dynamics of Large Logs in a Temperate Floodplain River. *Ecological Applications* 17:1127–1141. http://dx.doi.org/10.1890/06-0963

Laurent, T.H. 1974. The Forest Ecosystem of Southeast Alaska. Chapter 6. Forest Diseases. GTR PNW-23. Portland, OR.

Law, B. 2014. Role of Forest Ecosystems in Climate Change Mitigation. PowePoint presentation by Beverly Law, Professor, Global Change Biology and Terrestrial Systems Science, Oregon State University. February.

Leavitt, R.H., G.D. Martin, and C.V. Hildenbrand. 2008. Small Hydro Construction in Alaska. HydroWorld.com. Available online at: http://www.hydroworld.com/articles/hr/print/volume-27/issue-7/feature-articles/small-hydro-construction-in-alaska.html

Lee-Yaw, J.A., J.T. Irwin, and D.M. Green. 2008. Postglacial range expansion from northern refugia by the wood frog, *Rana sylvatica*. *Molecular Ecology* 17:867-884.

Leighty, W.W., S.P. Hamburg, and J. Caouette. 2006. Sequestration in Forest Biomass in Southeast Alaska. *Ecosystems* 9: 1051-1065.

Lemieux, J., J. Brennan, M. Farrell, C. Levings, and D. Myers (eds). 2004. Proceedings of the DFO/PSAT Sponsored Maine Riparian Experts Workshop, Tsawwassen, BC. February 17-18,2004. Chilliwack, British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2680: ix + 84 p.

Lerum, L. and P.C. Krosse. 2005. Tongass National Forest Invasive Plant Management Plan. Tongass National Forest. Ketchikan, AK.

Lewis, S. B. 2001. Breeding season diet of northern goshawks in southeast Alaska with a comparison of techniques used to examine raptor diet. Thesis, Boise State University, Idaho, USA.

Lewis, S. B., K. Titus, and M. R. Fuller. 2006. Northern Goshawk Diet during the Breeding Season on Southeast Alaska. *Journal of Wildlife Management* 70(4): 1151-1160.

Li, Q., J. Chen, B. Song, J.J. LaCroix, M.K. Bresee, and J.A. Radmacher. 2007. Areas influenced by multiple edges and their implications in fragmented landscapes. *Forest Ecology and Management* 242:99–107.

Lindley, S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, E.L. Rechisky, J.T. Kelly, J. Heublein, and A.P. Klimley. 2008. Marine Migration of North American Green Sturgeon. *Transactions of the American Fisheries Society* 137:182–194.

Lisle, T.E. 1986. Effects of woody debris on anadromous salmonid habitat, Prince of Wales Island, southeast Alaska. *North American Journal of Fisheries Management* 7:18-33.

6 References

Lloyd, D.S. 1987. Turbidity as Water Quality Standard for Salmonid Habitats in Alaska. *North American Journal of Fisheries Management* 7:34-45.

Lloyd, D.S., J.P. Koenings, and J.D. LaPerriere. 1987. Effects of Turbidity in Freshwaters of Alaska. *North American Journal of Fisheries Management* 7:18-33.

Loeb, S.C., E.A. Winters, M.E. Glaser, M.L. Snively, K.S. Laves, J.K. Isle. 2014. Observations of little brown myotis (*Myotis lucifugus*) habitat associations and activity in the Chugach National Forest, Alaska. *Northwestern Naturalist* 95:264-276.

Lowell, Eini C.; Parrent, Daniel J.; Deering, Robert C.; Bihn, Dan; Becker, Dennis R. 2015. Community biomass handbook. Volume 2: Alaska, where woody biomass can work. Gen. Tech. Rep. PNW-GTR-920. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. September 2015. 104 p.

Luce, C.H., and T.A. Black 1999. Sediment production from forest roads in western Oregon. *Water Resources Research* 35(8): 2561–2570.

Luce, C.H., and T.A. Black 2001, Effects of Traffic and Ditch Maintenance on Forest Road Sediment Production. In Proceedings of the Seventh Federal Interagency Sedimentation Conference, March 25-29, 2001, Reno, Nevada. pp. V67–V74.

Luce, C.H.,and Wemple, B. 2001. Introduction to the Special Issue on Hydrologic and Geomorphic Effects of Forest Roads. *Earth Surface Processes and Landforms* 26(2): 111-113.

MacDonald, L.H., R.W. Sampson, and D.M Anderson. 2001. Runoff and Road Erosion at the Plot and Road Segment Scales, St. John, US Virgin Islands. *Earth Surface Processes and Landforms* 26: 251-272.

MacDonald, S.O. 2003. The Amphibians and Reptiles of Alaska: a Field Handbook. Available online at: http://www.alaskaherps.info. Accessed September 2006.

MacDonald, S.O., and J.A. Cook. 2007. Mammals and Amphibians of Southeast Alaska. Museum of Southwestern Biology, Special Publication No. 8. 191 pp.

Malick, M.J., M.D. Adkison, and A.C. Wertheimer. 2009. Variable Effects of Biological and Environmental Processes on Coho Salmon Marine Survival in Southeast Alaska. *Transactions of the American Fisheries Society* 138: 846–860.

Mantua, N., S. Hare, Y. Zhang, J. Wallace, and R. Francis. 1997. A Pacific Interdecadal Climate Oscillation with Impacts on Salmon Production. Bulletin of the American Meteorological Society.

Martin, D. 2006. Personal Communication. Transmittal of Excel file containing salmon value estimates for the Tongass 1984 - 1993. USDA Forest Service Fish Aquatic Ecologist, Tongass National Forest. July 14.

Martin, D.J. 1996. Monitoring the effects of timber harvest activities on fish habitat in streams of coastal Alaska. Project status report.

Martin, D.J. 1997. A summary of stream water quality monitoring data: South Fork Michael Creek, Admiralty Island, Alaska. Martin Environmental.

Martin, D.J. and L.E. Benda. 2001. Patterns of Instream Wood Recruitment and Transport at the Watershed Scale. *Transactions of the American Fisheries Society* 130(5): 940–958.

Martin, D.J., and J.A. Kirtland. 1995. An assessment of fish habitat and channel conditions in streams affected by debris flows at Hobart Bay. Project 16-004 report written by Pentec Environmental, Inc., Edmonds, Washington. Written for Goldbelt, Inc., Juneau, Alaska. 40pp. plus Appendix.

Martin, D.J., and R.A. Grotefendt. 2007. Stand mortality in buffer strips and the supply of woody debris to streams in Southeast Alaska. Can. J. For. Res. 37: 36-49 (2007)

Martin, D.J., M.E. Robinson, R.A. Grotefendt. 1998. The Effectiveness of Riparian Buffer Zones for Protection of Salmonid Habitat in Alaska Coastal Streams. Prepared for Sealaska Corporation and Alaska Forest Association, May 1, 1998.

Martin, J., S. Trull, W. Brady, R. West, and J. Downs. 1995. Forest Plant Associations Management Guide, Chatham Area, Tongass National Forest. USDA Forest Service. Alaska Region. R10-TP-57. March 1995.

Martin, J.R., R.L. DeVelice, and S. Brown. 2000. Landscape Analysis and Biodiversity Specialist Report. USDA Forest Service. Roadless Area Conservation Final EIS. Available online at: http://roadless.fs.fed.us/documents/feis/ specrep/xlandscape_spec_rpt.pdf

Matlack, G.R. 1994. Vegetation dynamics of the forest edge- trends in space and successional time. *Journal of Ecology* 82:113–123.

May, C. L. , B. Pryor, T. E. Lisle, and M. Lang. 2009. Coupling Hydrodynamic Modeling and Empirical Measures of Bed Mobility to Predict the Risk of Scour and Fish of Salmon Redds in a Large Regulated River. *Water Resources Research* 45: W05402, doi:10.1029/2007WR006498.

McClaren, E. 2004. Queen Charlotte goshawk. Accounts and Measures for Managing Identified Wildlife. Accounts V.

McClellan, M.H. 2005. Recent Research on the Management of Hemlock-spruce Forests in Southeast Alaska. *Landscape and Urban Planning* 72: 65–78.

McClellan, M.H., D.N. Swanston, P.E. Hennon, R.L. Deal, T.L. De Santo, and M.S. Wipfli. 2000. Alternatives to clearcutting in the old-growth forests of Southeast Alaska: study plan and establishment report. USDA Forest Service Pacific Northwest Research Station. General Technical Report PNW-GTR-494.

McCune, S. M. 2010. Improving Forest Road Management: An Analysis of Factors Influencing Road-to-Stream Connectivity in the Wall Creek Watershed, Umatilla National Forest, Oregon. Thesis. Whitman College, Walla Walla, Washington

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. Van Sickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. *Canadian Journal of Forest Research* 20: 326–330.

McDowell Group. 2015. Economic Impact of Alaska's Visitor Industry 2013-2014 Update. Prepared for the: Alaska Department of Commerce, Community, and Economic Development, Division of Economic Development. February.

McDowell Group. 2014. Interim Visitor Volume Report Summer 2014. Prepared for: State of Alaska Department of Commerce, Community, and Economic Development, Division of Economic Development. December. Available online at: https://www.commerce.alaska.gov/web/ded/DEV/TourismDevelopment/TourismResearch.aspx

McDowell Group. 2013a. The Economic Benefits of Alaska's Mining Industry. Prepared for the Alaska Miners Association. January. 4 pp.

McDowell Group. 2013b. Bokan Mountain Rare Earth Element Mine Economic Impact Study. Prepared for Ucore Rare Metals, Inc. January. Available online at: http://ucore.com/McDowell.pdf

McDowell Group. 2012a. Alaska Visitor Statistics Program VI. Summer 2011. Prepared for the State of Alaska Department of Commerce, Community and Economic Development, Division of Economic Development. March.

McDowell Group. 2012b. The Economic Impacts of Alaska's Mining Industry. Prepared for the Alaska Miners Association. January. 59 pp.

McDowell Group. 2005. Juneau Cruise Visitor Profile 2005. Alaska Travelers Survey. Prepared for the City and Borough of Juneau. December. Available online at: http://www.traveljuneau.com/downloads/ATSJuneauCruiseFinal.pdf

McDowell Group, DataPath Systems, and Davis, Hibbitts & Midghall, Inc. 2007. Alaska Visitor Statistics Program. Alaska Visitor Volume and Profile. Summer 2006. Prepared for the State of Alaska Department of Commerce, Community and Economic Development. April.

McGee, K.E. 2000. Effects of Forest Roads on Surface and Subsurface Flow in Southeast Alaska. Master of Science Thesis. Oregon State University, Corvallis, Oregon.

McKee, C. 2006. Exotic Plants in Alaska's Parks. National Forest Service / University of Alaska. Available at: www.uaf.edu/snras/afes/pubs.

McKinley, D., M. Ryan, R. Birdsey, C. Giardina, M. Harmon, L. Heath, R. Houghton, R. Jackson, J. Morrison, R. Murray, D. Pataki, and K. Skog. 2011. A synthesis of current knowledge on forests and carbon storage in the United States. *Ecological Applications* 21(6): 1902–1924.

McNeil, W.J. 1964. Effect of spawning bed environment on reproduction of pink and chum salmon. *Fishery Bulletin* 65:495-523.

McNeil, W.J. and D.C. Himsworth (eds.). 1980. Salmonid Ecosystems of the North Pacific. Oregon State University Press, Corvallis, Oregon.

McPherson, E.G. and R.J. Simpson 1999. Carbon Dioxide Reduction Through Urban Forestry. GSW 171 January 1999

Meade, C. 1997. Brown bear risk assessment panel summary. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Mecklenburg, C.W., Mecklenburg, T. A., and Thorsteinson, L.K. 2002. Fishes of Alaska. American Fisheries Society, Bethesda, Maryland, 192-193

Meehan, W.R. (ed). 1991. Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. USDA Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

Mercer, E. 2010. Population Projections, 2010 to 2034. Alaska by Age, Sex, and Race. Alaska Economic Trends. December. Pages 4-11. Available online at: http://labor.state.ak.us/trends/

Millar. C., R. Neilson, D. Bachelet, R. Drapek, and J. Lenihan. 2006. Climate Change at Multiple Scales, Chapter 3 in: Forest, Carbon and Climate Change: A Synthesis of Science Findings. Oregon Forest Resources Institute. Oregon State University College of Forestry.

Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Synthesis. Island Press. Washington DC. http://www.maweb.org//en/Products.Synthesis.aspx

Mills, M.J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage, Alaska.

Montgomery, David R. 1994. Road surface drainage, channel initiation, and slope instability. *Water Resources Research* 30(6): 1925–1932.

Montgomery, D.R., Collins, B.D., Buffington, J.M., and Abbe, T.B. 2003. Geomorphic effects of wood in rivers. In: *The ecology and management of wood in world rivers.* Pp. 21-47. Edited by S.V. Gregory, K.L. Boyer, and A.M. Gurnell. Symposium 37. American Fisheries Society, Bethesda, Maryland.

Moore, R., and S.M. Wondzell. 2005. Physical hydrology and the effects of forest harvesting in the Pacific Northwest: A review. *Journal of the American Water Resources Association* 41(4): 763–784.

Moore, R.D, D.L. Spittlehouse, and A. Story. 2005. Riparian Microclimate and Stream Temperature Response to Forest Harvesting: A Review. *Journal of the American Water Resources Association* 41: 813–834.

Moore, R. D., S. W. Fleming, B. Menounos, R. Wheate, A. Fountain, K. Stahl, K. Holm and M. Jakob. 2009. Glacier Change in Western North America: Influences on Hydrology, Geomorphic Hazards and Water Quality. *Hydrologic Processes* 23: 42–61.

Moulton, L. 1997. Early marine Residence, Growth, and Feeding by Juvenile Salmon in Northern Cook Inlet. *Alaska Fishery Research Bulletin* 4(2) :154-177.

Muir, J.A. 2006. FIA Monitoring Project: Monitoring hemlock dwarf mistletoe in coastal forests of British Columbia. Unpublished Report prepared for International Forest Products, Campbell River, BC.

Murcia, C. 1995. Edge effects in fragmented forests: implications for conservation. Trends in Ecology and Evolution 10:58–62.

Murphy, M.L., and A.M. Milner. 1997. Alaska Timber Harvest and Fish Habitat. In: A.M. Milner and M.W. Oswood (Eds.), *Freshwaters of Alaska, Ecological Syntheses*. Springer.

Murphy, M.L. 1985. Die-offs of pre-spawn adult pink salmon and chum salmon in southeastern Alaska. *North American Journal of Fisheries Management* 5:302-308.

Murphy, M.L. 1995. Forestry impacts on freshwater habitat of anadromous salmonids in the Pacific Northwest and Alaska-requirements for protection and restoration. Decision Analysis Series Number 7. NOAA Coastal Ocean Program, Silver Spring, Maryland.

Murphy, M.L., and K.V. Koski. 1989. Input and depletion of woody debris in Alaska streams and implication for streamside management. *North American Journal of Fisheries Management* 9:427-436.

Murphy, M.L., J. Heifetz, S.W. Johnson, K.V. Koski, and J.F. Thedinga. 1986. Effects of clearcut logging with and without buffer strips on juvenile salmonids in Alaskan streams. *Canadian Journal of Fisheries and Aquatic Sciences* 43: 1521–1533.

Naiman, R.J., T.J. Beechie, L.E. Benda, D.R. Berg, P.A. Bisson, L.H. MacDonald, M.D. O'Connor, P.L. Olson, and E.A. Steel. 1992. Fundamental elements of ecologically healthy watersheds in the Pacific Northwest coastal ecoregion. Pages 127-188 in R.J. Naiman, editor. *Watershed management: balancing sustainability and environmental change.* Springer-Verlag, New York, New York.

Napper, C. 2008. Soil and Water Road-Condition Index – Field Guide. USDA Forest Service National Technology and Development Program. December.

Naukati Bay Alaska. 2015. Community website accessed March 2015: http://www.naukatibay.com/index.htm

Nawrocki, T., H. Klein, M. Carlson, L. Flagstad, J. Conn, R. DeVelice, A. Grant, G. Graziano, B. Million, and W. Rapp. 2011. Invasiveness Ranking of 50 Non-Native Plant Species for Alaska. Report prepared for the Alaska Association of Conservation Districts. Alaska Natural Heritage Program, University of Alaska Anchorage, Anchorage, AK. 253 pp.

Neal, E.G., M. Walter, and C. Coffeen. 2002. Linking the Pacific decadal oscillation to seasonal stream discharge patterns in Southeast Alaska. *Journal of Hydrology* 263:188–197.

Neilson, P. 2007. Climate Change and Uncertainty and Forecasts of Global to Landscape Ecosystem Dynamics. Forest Ecology Lecture Series. Accessed on the Web at www.fs.fed.us/pnw/pep/climatechange/neilson/index.html. August 2007.

Niblack Project LLC. 2015. Economic Benefits. Available online at: http://www.niblackproject.com/s/Project_Benefits.asp?ReportID=579363

Nilon, C.H., C.N. Long, and W.C. Zipperer. 1995. Effects of wildland development on forest bird communities. *Landscape and Urban Planning* 32:81-92.

NMFS (National Marine Fisheries Service). 2015a. ESA Species in Alaska. Endangered, Threatened and Candidate Species in Alaska. Update April 2014. Web access August 2015. https://alaskafisheries.noaa.gov/protectedresources/esa/ak_nmfs_species.pdf

NMFS. 2015b. Southern Distinct Population Segment of the North American Green Sturgeon (*Acipenser medirostris*). 5-Year Review: Summary and Evaluation. National Marine Fisheries Service, West Coast Region, Long Beach, CA.

NMFS (National Marine Fisheries Service). 2013a. Endangered, threatened, and candidate species under NMFS authority in Alaska. Updated March 2013.

NMFS (National Marine Fisheries Service). 2013b. Endangered and threatened species under NMFS jurisdiction. Updated February 28, 2013. Available online at: http://www.nmfs.noaa.gov/pr/pdfs/species/esa_table.pdf

NMFS. 2011. Impacts to Essential Fish Habitat from Non-fishing activities in Alaska. National Marine Fisheries Service, Alaska Region. November 2011.

NMFS (National Marine Fisheries Service). 2009a. Marine mammal fact pages. Available online at: http://www.nmfs.noaa.gov/pr/species/mammals/

NMFS. 2009b. Green, Leatherback and Loggerhead sea turtle fact pages. Available online at: http://www.nmfs.noaa.gov/pr/species/turtles

NMFS. 2005. Final Environmental Impact Statement for Essential Fish Habitat and Conservation in Alaska. April.

NMFS. 1991. Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland.

Noss, R.F., and A.Y. Cooperrider. 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity.* Island Press. Washington DC.

Nowacki, G. S. and M. G. Kramer. 1998. The Effects of Wind Disturbance on Temperate Rain Forest Structure and Dynamics of Southeast Alaska. USDA Forest Service. PNW GTR-421, April 1998.

Nowacki, G., M. Shephard, P. Krosse, W. Pawuk, G. Fisher, J. Baichta,; D. Brew, E. Kissinger, T. Block. 2001. Ecological subsections of Southeast Alaska and neighboring areas of Canada. USDA Forest Service, Alaska Region. Technical Publication No. R10-TP-75. October.

NPS (National Park Service). 2013. Southeastern Park Units. Retrieved June, 2015, from http://www.nps.gov/akso/nature/documents/SEAK_Drivers.pdf

Office of Subsistence Management. 2016. Federal Subsistence Harvest Data. Microcomputer database, updated May 2016.

Olliff, T., K. Legg, and B. Kaeding, editors. 1999. Effects of winter recreation on wildlife of the greater Yellowstone area: a literature review and assessment. Report to the Greater Yellowstone Coordinating Committee. Yellowstone National Park, Mammoth, Wyoming, USA.

Olsen, D.H., J.B. Leirness, P.G. Cunningham, and E.A. Steel. 2014. Riparian buffers and forest thinning: effects on headwater vertebrates 10 years after thinning. *Forest Ecology and Management* 321: 81-93.

Oswood, N.W., A.M. Milner, and J.G. Irons III. 1992. Climate Change and Alaskan Rivers and Streams. In: *Global Climate Change and Freshwater Ecosystems*. Springer-Verlag. New York.

Parker, D. I., J. A. Cook, and S. W. Lewis. 1996. Effects of timber harvest on bat activity in southeastern Alaska's temperate rainforest. Pp. 277-292, In: R.M.R. Barclay and R.M. Brigham (eds.). Bats and Forests Symposium, October 19-21, 1995, Victoria.

Parrent, D., and N. Grewe. 2014. Tongass National Forest: 2013 Sawmill Capacity and Production Report. Report to Forest Management. USDA Forest service. Alaska Region. September.

6 References

Parson, E.A., L. Carter, P. Anderson, B. Wang, and G. Weller. 2001. Potential Consequences of Climate Variability and Change for Alaska, Chapter 10 in Climate Change Impacts on the United States, National Assessment Synthesis Team, 618 pp. 2001.

Patriquin, K.J., and R.M.R. Barclay. 2003. Foraging by bats in cleared, thinned and unharvested boreal forest. *Journal of Applied Ecology* 40:646-657.

Paustian, S.J. 2004. Development and Implementation of a Riparian Conservation Strategy for the Tongass National Forest. Paper Presented at: American Water Resources Association Conference: Riparian Ecosystems and Buffers: Multi-Scale Structure, Function and Management, June 28-30, 2004, Olympic Valley, CA. Available in Logjam planning file.

Paustian, S.J. 1987. Monitoring nonpoint source discharge of sediment from timber harvesting activities in two southeast Alaska watersheds. In: Water Quality in the Great Land—Alaska's Challenge. Proceedings: Alaska Section, American Water Resources Association. R.G. Huntsinger, Technical Chairman. Water Research Center, Institute of Northern Engineering, University of Alaska, Fairbanks. Pages: 153-168.

Paustian, S., C. Gundy, D. Landwehr, C. SeitzWarmuth, J. McDonell, and J. Thompson. 2006. Evaluation of Concern 04-25, Class Stream Management. March 10, 2006.

Paustian, S.J. (ed.), K. Anderson, D. Blanchet, S. Brady, M. Cropley, J. Edgington, J. Fryxell, G. Johnejack, D. Kelliher, M. Kuehn, S. Maki, R. Olson, J. Seesz, and M. Wolanek. 1992, amended 2010. A Channel Type Users Guide Revision, October 2010, for the Tongass National Forest, Southeast Alaska, USDA Forest Service, Alaska Region. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5413799.pdf

Pawuk, W.H. and E.J. Kissinger. 1989. Preliminary Forest Plant Associations of the Stikine Area, Tongass National Forest. USDA-Forest Service, Alaska Region, R1O-TP-72.

Peacock, E., M.M. Peacock, and K. Titus. 2007. Black bears in southeast Alaska: the fate of two ancient lineages in the face of contemporary movement. Journal of Zoology 271:445–45.

Pearce, D. E., S. A. Hayes, M.H. Bond, C. V. Hanson, E. C. Anderson, R. B. Macfarlane, and J. C. Garza. 2009. Over the Fall? Rapid Evolution of Ecotypic Differentiation in Steelhead/Rainbow Trout (*Oncorhynchus mykiss*). *Journal of Heredity* 100(5): 515–525.

Pentec Environmental, Inc. 1991. Methods for testing effectiveness of Washington Forest Practices Rules and Regulations with regard to sediment production and transport to streams. TFW-WQ8-91-008, prepared for TFW CMER Water Quality Steering Committee and Washington Department of Natural Resources. Olympia, Washington.

Pentec Environmental, Inc. 1996. Fish habitat and channel conditions for streams on forested lands of coastal Alaska: an assessment of cumulative effects, 1995 assessment. Prepared for the Sealaska Corporation, Juneau, AK and Alaska Forest Association, Ketchikan, AK.

Perez-Garcia, J., B. Lippke, J. Comnick, and C. Manriquez. 2005. An Assessment of Carbon Pools, Storage, and Wood Products Market Substitution Using Life-Cycle Analysis Results. College of Forest Resources, University of Washington. Seattle

Person, D. 2010. Estimating wolf populations in southeast Alaska using noninvasive DNA sampling. Federal aid annual progress report, State wildlife grant number W-33-8. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, AK.

Person, D.K., and B.D. Logan. 2012. A spatial analysis of wolf harvest and harvest risk on Prince of Wales and associated islands, southeast Alaska. Final Wildlife Research Report, ADF&G/DWC/WRR-2011-1. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, AK.

Person, D. 2001. Alexander Archipelago wolves: ecology and population viability in a disturbed, insula landscape. Doctoral dissertation, University of Alaska Fairbanks, AK.

Person, D.K., and B.D. Logan. 2012. A spatial analysis of wolf harvest and harvest risk on Prince of Wales and associated islands, southeast Alaska. Final Wildlife Research Report, ADF&G/DWC/WRR-2011-1. Alaska Department of Fish and Game, Division of Wildlife Conservation, Juneau, AK.

Person, D.K., and A.L. Russell. 2009. Reproduction and den site selection by wolves in a disturbed landscape. *Northwest Science* 83:211–224.

Person, D.K., and A.L. Russell. 2008. Correlates of mortality in an exploited wolf population. *Journal of Wildlife Management* 72:1540–1549.

Piccolo, J.J., and M.S. Wipfli. 2002. Does red alder (*Alnus rubra*) in upland riparian forests elevate macroinvertebrate and detritus export from headwater streams to downstream habitats in southeastern Alaska? *Canadian Journal of Fisheries and Aquatic Sciences* 59: 503-513.

Pimm, S.L., H.L. Jones, and J.M. Diamond. 1988. On the risk of extinction. Am. Nat. 132:757-85.

Poiani, K.A., B.D. Richter, M.G. Anderson, and H.E. Richter. 2000. Biodiversity Conservation at Multiple Scales: Functional Sites, Landscapes, and Networks. *Bioscience* 50(2): 133-146.

Pollock, M.M, T.J. Beechie, M. Lierman and R. E. Bigley. 2009. Stream Temperature Relationships to Forest Harvest in Western Washington. Journal of the American Water Resources Association (JAWRA). 45(1): 141-156.

Poole, G., J. Risley, and M. Hicks. 2001. Issue Paper 3 – Spatial and Temporal patterns of Stream Temperature (Revised). Prepared as part of EPA Region 10 temperature water quality criteria guidance development project. EPA-910-D-01-003, Oct 2001. USEPA Region 10, Seattle, Washington.

Porter, B. 2010. Unit 1A mountain goat management report. Pages 1-5 in P. Harper, editor. Mountain goat report of survey and inventory activities 1 July 2007 – 30 June 2009. Alaska Department of Fish and Game. Project 12.0. Juneau, AK.

Potts, D.F., and B.K.M. Anderson. 1990. Organic debris and the management of small stream channels. *Western Journal of Applied Forestry* 5:25-28.

6 References

Powers, R.F., Alban, D.H., Miller, R.E., Tiarks, A.E., Wells, C.G., Avers, P.E., Cline, R.G., Fitzgerald, R.O., Loftus Jr., N.S., 1990. Sustaining site productivity in North American forests: problems and prospects. In: Gessel, S.P., Lacate, D.S., Weetman, G.F.,Powers, R.F. (Eds.), *Proceedings of the Seventh North American Forest Soils Conference on Sustained Productivity of Forest Soils. Faculty of Forestry*, University of British Columbia, Vancouver, BC, pp. 49–79.

Pritchard, D., J. Anderson, C. Correll, J. Fogg, K, Geghardt, R. Krapf, S. Leonard, B. Mitchell, and J. Staats. 1998. Riparian area management: a user guide to assessing proper functioning condition and the supporting science for lotic areas. Technical Reference 1737-15. USDI, Bureau of Land Management, National Applied Resource Sciences Center, Denver, Colorado

Prussian, K. 2010. Throughfall Monitoring – Prince of Wales Island, Alaska. Tongass National Forest. Unpublished Paper. Accessed at: http://www.fs.fed.us/r10/tongass/projects/tlmp/2010_monitoring_report/1021PrussianThroughfall.pdf

Pyare, S. and W.P. Smith. 2005. Functional Connectivity of Tongass Old-Growth Reserves: An Assessment Based on Flying-Squirrel Movement Capability. Progress report for Tongass monitoring grants, April 30, 2005.

Pyare, S., W.P. Smith, and C.S. Shanley. 2010. Den use and selection by northern flying squirrels in fragmented landscapes. *Journal of Mammalogy* 91:886–896.

Quinn, T.P., and N.P. Peterson. 1996. The influence of habitat complexity and fish size on over-winter survival and growth of individually marked juvenile coho salmon (*Oncorynchus kisutch*) in Big Beef Creek, Washington. *Canadian Journal of Fisheries and Aquatic Sciences* 53: 1555–1564

Quinn, J.M., and A.E. Wright-Stow. 2008. Stream size influences stream temperature impacts and recovery rates after clearfell logging. *Forest Ecology and Management* 256, 2101–2109. doi:10.1016/J.FORECO.2008.07.0418

Rabe, D. 2009. Population status of Prince of Wales spruce grouse in Southeast Alaska. Final performance report. Alaska Department of Fish and Game, Juneau. September. 8 pp.

Ralph, S.C., G.C. Poole, L.L. Conquest, and R.J. Naiman. 1994. Stream channel morphology and woody debris in logged and unlogged basins of western Washington. *Canadian Journal of Fisheries and Aquatic Sciences* 51:37-51.

Raphael, M. G., K. V. Rosenberg, and B. G. Marcot. 1988. Large-scale changes in bird populations of Douglas-fir forests, northwestern California. *Bird Conservation* 3:63-83.

Rashin, E. B., C. J. Clishe, A. T. Loch, and J. M. Bell. 2006. Effectiveness of Timber Harvest Practices for Controlling Sediment Related Water Quality Impacts. *Journal of American Water Resources Association* 42(5): 1307-1327.

Rashin, E. B., C. J. Clishe, A. T. Loch, and J. M. Bell. 1999. Effectiveness of Timber Harvest Practices for Controlling Sediment Related Water Quality Impacts. Timber Fish and Wildlife. Report TFW-WQ6-99-001. Publication No. 99-317. Washington State Department of Ecology, Olympia WA. 166 Pages.

Reeves, J. 2016. Subsistence Fisheries Biologist. Personal communication: in-person. USDA Forest Service, Craig Ranger District. Craig, AK.

Reeves, G.H., L.E. Benda, K.M. Burnett, P.A. Bisson, and J.R. Sedell. 1995. A Disturbance-based Ecosystem Approach to Maintaining and Restoring Freshwater Habitats of Evolutionarily Significant Units of Anadromous salmonids in the Pacific Northwest. *American Fisheries Society Symposium* 17:334-349.

Reeves, G.H., K.M. Burnett, and E.V. McGarry. 2003. Sources of large wood in the main stem of a fourth-order watershed in coastal Oregon. *Canadian Journal of Forest Research* 33:1363-1370.

Reeves, M.K., P. Jensen, C.L. Dolph, M. Hoyloak, K.A. Trust. 2010. Multiple stressors and the cause of amphibian abnormalities. *Ecological Monographs* 80(3): 423-440.

Reeves, G., B. Pickard, and K. Johnson. 2016. An Initial Evaluation of Potential Options for Managing Riparian Reserves of the Aquatic Conservation Strategy of the Northwest Forest Plan. General Technical Report PNW-GTR-937. Pacific Northwest Research Station, USDA Forest Service. Corvallis, Oregon.

Reid, L.M. and T. Dunne. 1984. Sediment Production from Forest Road Surfaces. Water Resources Research, WRERAC 20(11) 1753-1761. November 1984.

Reid, W.V., and K.R. Miller. 1989. Keeping Options Alive: The Scientific Basis for Conserving Biodiversity. World Resources Institute, Washington, D.C.

Rennert, K.J., G. Roe, J. Putkonen, and C.M. Bitz. 2009. Soil Thermal and Ecological Impacts of Rain on Snow Events in the Circumpolar Arctic. *Journal of Climate* 22(9): 2302-2315.

Reynolds, R. T., R. T. Graham, and D. A. Boyce Jr. 2006. An Ecosystem-based Conservation Strategy for the Northern Goshawk. Pp 299-311 in M. L. Morrison, editor. The Northern Goshawk: a Technical Assessment of its Status, Ecology, and Management. Studies in Avian Biology No. 31, Cooper Ornithological Society.

Reynolds, R. T., R. T. Graham, M. H. Reiser, R. L. Bassett, P. L. Kennedy, D. A. Boyce, G. Goodwin, R. Smith, and E. L. Fisher. 1992. Management recommendations for the Northern Goshawk in the Southwestern United States. General Technical Report RM-217. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.

Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Iñigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T. C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY. Partners in Flight website. http://www.partnersinflight.org/cont_plan/ (VERSION: March 2005).

Richardson, J.S. 1992. Coarse particulate detritus dynamics in small, montane streams of southwestern British Columbia. *Canadian Journal of Fisheries and Aquatic Sciences* 49:337-346.

Ricketts, T.H., E. Dinerstein, D.M Olson, C.J. Loucks, and W. Eichbaum. 1999. Terrestial Ecoregions of North America: A Conservation Assessment. Island Press. Washington DC.

6 References

Rice, C. 2006. Effects of Shoreline Modifications on a Northern Puget Sound Beach: Microclimate and Embryo Mortality in Surf Smelt (*Hypomesus pretiosus*). Estuaries and Coasts 29(1): 63-71

Rissien, A. 2011. Policy Primer: Watershed Condition Framework Synposis and Review. The Road-RIPorter, Summer Solstice 2011.

Robinson, G. E., K.A. Mills, J. Paul, L. Dent, and A. Skaugset. 1999. Storm impacts and landslides of 1996: final report. Oregon Department of Forestry, Salem, OR, p. 145.

Robinson, S.K. 1992. Population dynamics of breeding Neotropical migrants in a fragmented Illinois landscape. pp 408-418 in J.M. Hagan and D.W. Johnson, editors, Ecology and Conservation of Neotropical Migrant Landbirds. Smithsonian Institution Press, Washington D.C. 609 pp.

Robinson, S.K., F.R. Thompson III, T.M. Donovan, D.R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. *Science* 267:1987–1990.

Romanuk, T.N., and C.D. Levings. 2005. Stable isotope analysis of trophic position and terrestrial vs. marine carbon sources for juvenile Pacific salmonids in nearshore marine habitats. *Fisheries Management and Ecology* 12[2]:113–121.

Root, H., McCune, B., and S. Jovan. 2014. Lichen communities and species indicate climate thresholds in southeast and south-central Alaska, USA. *The Bryologist* 117(3): 241-252. 2014. doi: http://dx.doi.org/10.1639/0007-2745-117.3.241

Ross, J. 2013. Influences of timber management and natural landscape factors on anadromous streams in southeastern Alaska: Relating local and catchment factors to aquatic habitat. MS Thesis. Michigan State University, Ann Arbor MI. 155 pages.

Rossell, L. and P. Dinnel. 2007. Temperature and Shading Effects on Surf Smelt, *Hypomesus pretiosus*, Egg Survival. Proceedings of the 2007 Georgia Basin Puget Sound Resource Conference. March 26-29, 2007. http://depts.washington.edu/uwconf/2007psgb/2007proceedings/papers/p6_rosse.pdf)

Rüegg, J., S. D. Tiegs, D. T. Chaloner, P. S. Levi, J. L. Tank, and G. A. Lamberti. 2011. Salmon subsidies alleviate nutrient limitation of benthic biofilms in southeast Alaska streams. *Canadian Journal of Fisheries and Aquatic Sciences* 68:277–287, doi:doi:10.1139/F10-145.

Rudzitis, G. and R. Johnson. 2000. The impact of wilderness and other wildlands on local economies and regional development trends. In: S.F.McCool, D.N. Cole, W.T. Borrie, J. O'Loughlin, comps. 2000. Wilderness science in a time of change conference—Volume 2: Wilderness within the context of larger systems; 1999 May 23–27; Missoula, MT. Proceedings RMRS-P-15-VOL-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 14-26

Ruth, R. H. and A. S. Harris. 1979. Management of Western Hemlock-Sitka Spruce for USDA Forest Service, Forest Production. GTR PNW-88.

Salafsky, S.R., R.T. Reynolds, B.R. Noon, and J.A. Wiens. 2007. Reproductive responses of northern goshawks to variable prey populations. *Journal of Wildlife Management* 71: 2274-2283.

Salafsky, S.R., R.T. Reynolds, and B.R. Noon. 2005. Patterns of temporal variation in goshawk reproduction and prey resources. *Journal of Raptor Research* 39: 237-246.

Salo, E.O. 1991. Life History of Chum Salmon. (*Oncorhynchus keta*). pp. 231-310. In: Pacific Salmon Life Histories. C. Groot and L. Margolis (eds.). University of British Columbia in co-operation with the Government of Canada, Department of Fisheries and Oceans. British Columbia, Canada.

Sauer, J.R., J.E. Hines, J.E. Fallon, K.L. Pardieck, D.J. Ziolkowski, Jr., and W.A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2013. Version 01.30.2015 USGS Patuxent Wildlife Research Center, Laurel, MD

Schaberg, P.G., D.V. D'Amore, P.E. Hennon, J.M. Halman, and G.J. Hawley. 2011. Do Limited Cold Tolerance and Shallow Depth of Roots Contribute to Yellow-Cedar Decline? *Forest Ecology and Management* 262: 2142-2150.

Scheibe, J.S., W.P. Smith, J. Bassham, and D. Magness. 2006. Locomotor performance and cost of transport in the northern flying squirrel *Glaucomys sabrinus*. *Acta Theriologica* 51: 169–178.

Schirokauer, D., L. Geiser, A. Bytnerowicz, M. Fenn, and K. Dillman. 2014. Monitoring Air Quality in Southeast Alaska's National Parks and Forests Linking Atmospheric Pollutants with Ecological Effects Natural Resource Technical Report NPS/SEAN/NRTR—2014/839

Schmidt, K.M., J.J Roering, J.D.Stock, W.E. Dietrich, D.R. Montgomery, and T. Schaub. 2001. The variability of root cohesion as an influence on shallow landslide susceptibility in the Oregon Coast Range. *Canadian Geotechnical Journal* 38: 995-1024.

Schmiege, D.C., A.E. Helmers, and D.M. Bishop. 1974. The forest ecosystem of Southeast Alaska. 8. Water. PNW-28. 26 pp. Ref. 22300.

Schoen, J., and L. Beier. 1990. Brown bear habitat preferences and brown bear logging and mining relationships in southeast Alaska. Brown bear habitat preferences and brown bear logging and mining relationships in Southeast Alaska. Federal Aid in Wildlife Restoration. Final report. Grant W-22. Alaska Department of Fish and Game, Juneau, AK.

Schrader, B. and P. Hennon. 2005. Assessment of Invasive Species in Alaska and its National Forests. Complied by Schrader and Hennon with contributing authors from USDA Forest Service Alaska Regional Offices. August 30, 2005. 26 pp.

Schroeder, P. 1991. Can Intensive Management Increase Carbon Storage in Forests. *Environmental Management* 15(4): 475 – 481.

Schroeder, R. and R. Mazza. 2005. A Synthesis of Recent Subsistence Research in Southeast Alaska. Available on request.

Schroeder, R., L. Cerveny, and G. Robertson. 2005. Tourism Growth in Southeast Alaska: Trends, Projections, and Issues. In R. Mazza and L.E. Kruger (eds) Social Conditions and Trends in Southeast Alaska. USDA Forest Service, Pacific Northwest Research Station, General Technical Report. PNW-GTR-653. August.

SEAPA (Southeast Alaska Power Agency). 2011. Application for Preliminary Permit for the Sunrise Lake Hydroelectric Project before the Federal Energy

Regulatory Commission. Southeast Alaska Power Agency. Wrangell, Alaska.

SEAPA (Southeast Alaska Power Agency). 2014. Tyee Lake Hydro Facility. Available online at: http://www.seapahydro.org/Tyee-Hydro-Facility.php

SEDA (Sitka Economic Development Association). 2015. Cruise Ship Passenger Information. Personal communication with M. Fusselman, USDA Forest Service. August.

Sedell, J. R., F. N. Leone, and W. S. Duval. 1991. Water Transportation and Storage of Logs, pp. 325-368. In: W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society Special Publication 19. American Fisheries Society, Bethesda, Maryland.

Semlitsch, R.D., B.D. Todd, S.M. Blomquist, A.J.K. Calhoun, J.W. Gibbons, J.P. Gibbs, G.J. Graeter, E.B. Harper, D.J. Hocking. M.L. Hunter Jr., D.A. Patrick, T.A.G. Rittenhouse, and B.B. Rothermel. 2009. Effects of timber harvest on amphibian populations: Understanding mechanisms from forest experiments. *BioScience* 59(10) 853-862.

Shanley, C.S, S. Pyare, M. Goldstien, P. Alaback, D. Albert, C. Beier, T. Brinkman, R. Edwards, E. Hood, A. MacKinnon, M. McPhee, T. Patterson, L. Suring, D. Tallmon, and M. Wipfli. 2015. Climate Change Implications in the Northern Coastal Temperate Rainforest of North America. *Climate Change* 1355-9.

Shanley, C.S., and D.M. Albert. 2014. Climate Change Sensitivity Index for Pacific Salmon Habitat in Southeast Alaska. The Nature Conservancy. August 2014 Volume 9 Issue 8.

Shaul, L. K. Crabtree, E. Jones, S. McCurdy and B. Elliott. 2011. Coho Salmon Stock Status and Escapement Goals in Southeast Alaska. Alaska Department of Fish and Game. Special Publication No. 11-23. Anchorage, Alaska.

Shaul, L. K. E. Jones, Crabtree, T. Tydingco, S. McCurdy and B. Elliott. 2008. Coho Salmon Stock Status and Escapement Goals in Southeast Alaska. Alaska Department of Fish and Game. Special Publication No. 08-20. Anchorage, Alaska.

Shaw, D.C., M. Huso, and H. Bruner. 2008. Basal Area Growth Impacts of Dwarf Mistletoe on Western Hemlock in an Old-Growth Forest. *Canadian Journal of Forest Research* 38: 576-583.

Shaw, C.G. III; and P.E. Hennon. 1991. Spread, intensification, and upward advance of dwarf mistletoe in thinned, young stands of western hemlock in southeast Alaska. *Plant Disease* 75: 363-367

Sheinberg Associates. 2014. The Inter-Island Ferry Authority by the Numbers. Available online at: http://www.interislandferry.com/IFA_by_the_Numbers_2014_final.pdf

Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale. 2005. Wetlands in Washington State - Volume 1. March.

Shephard, M. 1995. Plant Community Ecology and Classification of the Yakutat Foreland, Alaska. USDA Forest Service, R10-TP-56. 215 pp.

Shrader, B. and P. Hennon. 2005. Assessment of Invasive Species in Alaska and its National Forests, 2005. Unpublished report, USDA Forest Service, R10.

Sidle, R.C. 1991. A Conceptual-Model of Changes in Root Cohesion in Response to Vegetation Management. *Journal of Environmental Quality* 20(1): 43-52.

Sidle, R.C. 1992. A theoretical model of the effects of timber harvesting on slope stability. *Water Resources Research* 28(7): 1897-1910.

Skagway Convention and Visitors Bureau. 2014. Skagway Incoming Visitors by Category 1983-2014. Data provided via email correspondence between W. Anderson of SCVB and M. Dadswell of Tetra Tech. December 19.

Slaughter, C., and T. Gasborro (eds). 1988. Proceedings of the Alaska Forest Soil Productivity Workshop. USDA Forest Service, Pacific Northwest Research Station and School of Agriculture and Land Resources Management, University of Alaska Fairbanks. Anchorage, Alaska, April 28-30, 1987. General Technical Report PNW-GTR-219.

Sloat, M., and G. Reeves. 2014. Individual Conditions, Standard Metabolic Rate, and Rearing Temperature Influence Steelhead and Rainbow trout (*Oncorhynchus mykiss*) Life History. *Canadian Journal of Fisheries and Aquatic Science* 71: 1–11.

Sloat, M., G. Reeves, and K. Christiansen. In Press. Predicting the response of salmon spawning habitat to changing hydrologic regimes in the salmon forests of southeast Alaska.

Smith, W. 1996. Marbled murrelet panel – panel assessment summary notes. Tongass Land Management Planning Team. Available in the planning record for the 1997 Tongass National Forest plan revision (USDA Forest Service 1997a).

Story, A., R.D. Moore, and J.S. Macdonald. 2003. Stream Temperature in Two Shaded Reaches Below Cutblocks and Logging Roads: Downstream Cooling Linked to Subsurface Hydrology. *Canadian Journal of Forest Research* 33: 1383–1396.

Smith, W. 2013. Spatially explicit analysis of contributions of a regional conservation strategy toward sustaining northern goshawk habitat. *Wildlife Society Bulletin* 37: 1–10.

Smith, J.E., L.S. Heath, and P.B. Woodbury. 2004a. How to Estimate Forest Carbon for Large areas from Inventory Data. *Journal of Forestry*, July/August 2004.

Smith, W.P., S, Gende, and J.V. Nichols. 2004. Ecological correlates of flying squirrel microhabitat use and density in temperate rainforests of southeastern Alaska. *Journal of Mammalogy* 85: 540–551.

Smith, N, R. Deal, J. Kline, D. Blahna, T. Patterson, T.A. Spies, and K. Bennett. 2011. Ecosystem Services as a Framework for Forest Stewardship: Deschutes National Forest Overview. Pacific Northwest Research Station General Technical Report PNW-GTR-852. August.

SNAP (Scenarios Network for Alaska & Artic Planning). 2013. Community Charts: Juneau, Alaska.

Sobocinski, K., J. Cordell, and C. Simenstad. 2010. Effects of Shoreline Modifications on Supratidal Macroinvertebrate Fauna on Puget Sound, Washington Beaches. *Estuaries and Coasts* 33: 699–711.

Southeast Conference. 2014. Southeast Alaska by the Numbers 2014. Available online at: http://www.seconference.org/southeast-alaska-numbers

Southeast Conference. 2015. Information accessed online at: http://www.seconference.org/saxman

Soule, M.E. 1983. What do we really know about extinction? As Cited in Dawson, N.G., S.O. MacDonald, and J.A. Cook. 2007. Endemic mammals of the Alexander Archipelago. Chapter 6.7, Pages 1–11 in J. Schoen and E. Dovichin (eds). *The Coastal Forests and Mountains Ecoregion of Southeastern Alaska and the Tongass National Forest: a conservation assessment and resource synthesis.* Audubon and Nature Conservancy, Special Publication.

Soule M.E. and M.A. Sanjayan. 1998. Conservation targets: Do they help? *Science* 279: 2060–2061.

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitizki. 1996. An ecosystem approach to salmonid conservation. Report prepared by Management Technology. Sponsored by the National Marine Fisheries Service, U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service, Washington, D.C.

Sperry, D.M. 2006. Avian Nest Survival in Post-logging Coastal Buffer Strips on Prince of Wales Island, Alaska. M.S. Thesis, Humboldt State University, Arcata, California.

Spies, T.A. 2004. Ecological concepts and diversity of old-growth forests. *Journal of Forestry* April/May:14–20.

Spies, T.A. and J.F. Franklin. 1991. The Structure of Natural Young, Mature, and Old-growth Douglas-fir Forest in Oregon and Washington; in Wildlife and Vegetation of Unmanaged Douglas-fir Forests, General Technical Report PNW-285.

Stathers, R. J.; T.P. Rollerson and S.J. Mitchell. 1994. Windthrow Handbook for British Columbia forests. B.C. Min. For., Victoria, B.C. Working Paper 9401.

Steedman, R.J. 1988. Modification and Assessment of an Index of Biotic Integrity to Quantify Stream Quality in Southern Ontario. *Canadian Journal of Fisheries and Aquatic Sciences* 45:492–501.

Steel, E. A., A. Fullerton, Y. Caras, M. Sheer, P. Olson, D. Jensen, J. Burke, M. Maher, D. Miller, P. McElhany. 2007. Lewis River Case Final Report. A Decision-Support Tool for Assessing Watershed-Scale Habitat Recovery Strategies for ESA-Listed Salmonids. Appendix E: Surface Sediment, Erosion, and Runoff. Available online at: http://www.nwfsc.noaa.gov/research/divisions/fed/wpg/documents/lrcs/LewisRiverCaseStudyFinalReport.pdf

Stenhouse, I., and S. Senner. 2005. Alaska WatchList—2005. Audubon Alaska. Anchorage, Alaska.

Stephens, F. R., C. R. Gass, and R. F. Billings. 1969. Seedbed history affects tree growth in southeast Alaska. *Forest Science* 15:296-298.

Stephenson, N, A. Das, R. Condit, S. Russo, P. Baker, N. Beckman, D. Coomes, E. Lines, W. Morris, N. Ruger, E. Alvarez, C. Blundo, S. Bunyavejchewin, G. Chuyong, S. David, A. Duque, C. Ewango, O. Flores, J. Franklin, H. Grau, Z. Hao, M. Harmon, S. Hubbell, D. Kenfrack, Y. Lin, J. Makana, A. Malizia, R. Pabst, N. Pongpattananurak, S. Su, I. Sun, S. Tan, D. Thomas, P. Mantgem, X. Wang, S. Wiser, and M. Zavala. 2014. Rate of Tree Carbon Accumulation Increases Continuously with Tree Size. *Nature: International Weekly Journal of Science* 507(7490). Available online at: http://www.nature.com/nature/journal/v507/n7490/full/nature12914.html

Stewart, A. and A. Lance. 1991. Effects of Moor-Draining on the Hydrology and Vegetation of Northern Pennine Blanket Bog. *The Journal of Applied Ecology* 28(3): 1105–1117.

Stewart, G., J. Dieu, J. Phillips, M. O'Connor, and C. Veldhuisen. 2013. The Mass Wasting Effectiveness Monitoring Project: An examination of the landslide response to the December 2007 storm in Southwestern Washington. Washington Department of Natural Resources, Cooperative Monitoring, Evaluation and Research Report CMER 08-802, Olympia, WA.

Stillwater Sciences. 2012. Forest management and coho salmon population dynamics in Southeast Alaska's Staney Creek Watershed. Prepared by Stillwater Sciences, Portland, Oregon for The Wilderness Society, Anchorage, Alaska.

Stone, K.D., and J.A. Cook. 2000. Phylogeography of black bears (*Ursus americanus*) of the Pacific Northwest. *Canadian Journal of Zoology* 78: 1218–1223.

Strong, D. 2014. Seafood Processors. Large Segment of a Massive Industry. Alaska Economic Trends. November. Volume 34, Number 11, pp. 9-11.

Sturtevant, B.R., J.A. Bissonette, and J.N. Long. 1996. Temporal and spatial dynamics of boreal forest structure in western Newfoundland: silvicultural implications for marten habitat management. *Forest Ecology and Management* 87: 13–25.

Sullivan, K., T.E. Lisle, C.A. Dolloff, G.E. Grant, and L.M. Reid. 1987. Stream channels: the link between forests and fishes. Pages 39-97 in E.O. Salo and T.W. Cundy, editors. *Streamside management: forestry and fishery Interactions.* Institute of Forest Resources Contribution Number 57. University of Washington, College of Forest Resources, Seattle, Washington.

Suring, L.H., S.D. Farley, G.V. Hildebrand, M.I. Goldstein, S. Howlin, and W.P. Erickson. 2006. Patterns of landscape use by female brown bears on the Kenai Peninsula, Alaska. *Journal of Wildlife Management* 70: 1580-1587.

Swanson, F.J., L.E. Benda, S.H. Duncan, G.E. Grant, W.F. Magahan, L.M. Reid, and R.R. Ziemer. 1987. Mass failures and other processes of sediment production in Pacific Northwest forest landscapes. Pages 9-38 in E.O. Salo and T.W. Cundy editors. Streamside management: forestry and fishery Interactions. Institute of Forest Resources Contribution Number 57. University of Washington, College of Forest Resources, Seattle, Washington.

Swanson, F.J., G.W. Lienkaemper, and J.R. Sedell. 1976. History, physical effects, and management implications of large organic debris in western Oregon streams. General Technical Report PNW-56. USDA Forest Service, Portland, Oregon.

Swanson, F.J., and G. W. Lienkaemper. 1978. Physical consequences of large organic debris in Pacific Northwest streams. General Technical Report PNW-69. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon

Swanston, D.N. 1969. Mass wasting in coastal Alaska. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Paper PNW-83. 15pp.

Swanston, D.N. 1974. Slope stability problems associated with timber harvesting in mountainous regions of the western United States. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, General Technical Report PNW-21. 14pp.

Swanston, D.N. 1997. Controlling stability characteristics of steep terrain with discussion of needed standardization for mass movement hazard Indexing: a resource assessment. In: Julin K.R. (Ed.), *Assessments of wildlife viability, old-growth timber volume estimates, forested wetlands, and slope stability*. Gen. Tech. Rep. PNW-GTR-392. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR, pp. 58.

Swanston, D.N. and D.A. Marion. 1991. Landslide Response to Timber Harvest in Southeast Alaska. In: *Proceedings of the Fifth Interagency Sedimentation Conference*, Federal Energy Regulatory Commission, Las Vegas, Nevada. 10pp.

Sweeney, B.W., and J.D. Newbold. 2014. Streamside Forest Buffer Width Needed To Protect Stream Water Quality, Habitat, and Organisms: A Literature Review. *Journal of the American Water Resources Association* 50[3]:560–584.

Szepanski, M.M., M. Ben-David, and V. Van Ballenberghe. 1999. Assessment of anadromous salmon resources in the diet of the Alexander Archipelago wolf using stable isotope analysis. *Oecologia* 120: 327–335.

Taylor, B.L. 1993. The Influence of Wetland and Watershed Morphological Characteristics on Wetland Hydrology and Relationships to Wetland Vegetation Communities. M.S. Thesis. Seattle, WA: University of Washington.

Taylor, P.D., L. Fahrig, K. Henein, and G. Merriam. 1993. Connectivity is a Vital Element of Landscape Structure. *Oikos* 68: 571–573.

Taylor, R.F. 1934. Yield of Second Growth Western Hemlock-Sitks Spruce Stands in Southeast Alaska.

Tessler, D.F, M.L. Snively, and T.A. Gotthardt. 2014. New insights on the distribution, ecology and overwintering behavior of the little brown myotis (*Myotis lucifugus*) in Alaska. *Northwestern Naturalist* 95: 251-263.

Tessler, D.F., J.A. Johnson, B.A. Andres, S. Thomas, and R.B. Lanctot. 2007. Black oystercatcher (*Haematopus bachmani*) conservation action plan. International Black Oystercatcher Working Group, Alaska Department of Fish and Game, Anchorage, AK; U.S. Fish and Wildlife Service, Anchorage, AK; and Manomet Center for Conservation Sciences, Manomet, MA.

Tetra Tech. 2016. Energy Resource Report. Revised Final. Tongass National Forest, Forest Plan Amendment. Prepared for Tongass National Forest. June.

The Tongass 77. Undated. The Tongass 77 Priority Salmon Watersheds. Memorandum. Available at: http://www.americansalmonforest.org

Thedinga, J.F., M.L. Murphy, J. Heifetz, K.V. Koski, and S.W. Johnson. 1989. Effects of logging on size and age composition of juvenile coho salmon and density of presmolts in southeast Alaska streams. *Canadian Journal of Fisheries and Aquatic Sciences* 46:1383-1391.

Thompson, I.D., and A.S. Harestad. 1994. Effects of logging on American martens, and models for habitat management. Pages 355-367 in S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell, editors. *Martens, sables, and fishers: biology and conservation*. Cornell University Press, Ithaca, NY.

Thompson, J., and E. Tucker. 2005. Preliminary Turbidity Monitoring Results, Road 2050000 – Upper Shaheen creek, prince of Wales Island, Tongass National Forest. Unpublished report.

Thompson, J.E. and E. Tucker. 2007. Effectiveness of Best Management Practices for Water Quality, Forest Plan Monitoring – Aquatic Synthesis, Tongass National Forest, Progress Report – July 2007.

Thysell, D. R. and A. B. Carry. 2000. Effects of Forest Management on Understory and Overstory Vegetation: A Retrospective Study. USDA Forest Service. PNW-GTR-488. March 2000.

Tiegs, S.D., D.T. Chaloner, P. Levi, J. Ruegg, J.L. Tank and G.G. Lamberti. 2008. Timber harvest Transforms Ecological Roles of Salmon in Southeast Alaska Rain Forest Streams. *Ecological Society of America* 18(1): 4-8.

Tiegs, S. D., E. Y. Campbell, P. S. Levi, J. R¨uegg, M. E. Benbow, D. T. Chaloner, R. W. Merritt, J. L. Tank, and G. A. Lamberti. 2009. Separating physical disturbance and nutrient enrichment caused by Pacific salmon in stream ecosystems. *Freshwater Biology* 54:1864-1875.

Titus, K. and L. Beier. 1999. Suitability of stream buffers and riparian habitats for brown bears. *Ursus* 11:149-156 (abstract only).

Tonina, D., Luce, C. H., Rieman, B., Buffington, J. M., Goodwin, P., Clayton, S. R., Ali, S. M., Barry, J. J., and Berenbrock, C. 2008. Hydrological response to timber harvest in northern Idaho: Implications for channel scour and persistence of salmonids. Hydrological Processes. Vol. 22. 3223-3235.

Trombulak, S.C., and C.A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14(1):18-30.

Trout Unlimited. Undated. The Tongass 77: A Closer Look. Trout Unlimited, Alaska Program.

Trudel, M., D.W. Welsh., J.F.T. Morris, M.E. Thiess, R. Candy, and T.D. Beacham. 2004. Using genetic markers to understand the coastal migration of juvenile coho (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*). North Pacific Anadromous Fish Commission Technical Report 5.

Trudel, M., J. Fisher, J. Orsi, J. Morris, M. Thiess, R. Sweeting, S. Hinton, E. Fergusson, and D. Welch. 2009. Distribution and migration of Juvenile Chinook Salmon Derived from Coded Wire Tag Recoveries along the Continental Shelf of Western North America. *Transactions of the American Fisheries Society* 138: 1369–1391.

6 References

Trummer, L.T., P.E. Hennon, E.M. Hansen, P. Muir. 1998. Modeling the Incidence and Severity of Hemlock Dwarf Mistletoe in 110-year Old Wind-disturbed Forests of Southeast Alaska. *Canadian Journal of Forest Research* 28: 1501-1508.

Tucker, E. 2011. Fubar Creek Turbidity/Suspended Sediment Stud. Document submitted to ADEC Sept. 1, 2011. US Forest Service, Tongass National Foreste Alaska.

Tucker, E. and J. Caouette. 2008. Statistical Analyses of Aquatic Habitat Variables in the Tongass Nation Forest. Draft 4.5 November 4,2008. USDA Forest Service, Tongass National Forest Petersburg, AK.

Tucker, E., and J. Thompson. 2010. Effectiveness of Best Management Practices for Water Quality Forest Plan Monitoring - Tongass National Forest. July 6, 2010. Available on Forest Service FTP site: ftp://ftp2.fs.fed.us/incoming/chugtong_r10/watershed/SWCA/TongassBMPEffectiveness/TuckerThompson2010.pdf

Tucker, E., M. Becker, and S. Paustian. 2009. Nakwasina River Water Quality and Aquatic Habitat Restoration Assessment. EPA/ ADED 303d category 4b, Demo Project Final Report March 31, 2009 Amended Jun 26, 2009. USDA Forest Service, Tongass Nation Forest, AK.

Tucker, S., M. Trudel, D.W. Welch, J.R. Candy, J.F.T. Morris, M.E. Thiess, C. Wallace, and T.D. Beacham. 2011. Life history and seasonal stock-specific ocean migration of juvenile Chinook salmon. *Transaction of the American Fisheries Society* 140: 1101–1191.

Turner, R. L. 2010. Nonforeted Plant Associations of the Stikine-Taku River Valleys and Stikine River Delta Ecological Subsections in Southeastern Alaska. U.S.D. A. Forest Service, Alaska Region Publication, R10-PR-023, Juneau, Alaska, 115 p.

U.S. Bureau of Labor Statistics. 2015. Labor Force Statistics from the Current Population Survey. Not Seasonally Adjusted. 2005 to 2015. Available online at: http://data.bls.gov/pdq/SurveyOutputServlet

U.S. Bureau of Economic Analysis. 2014a. CA04 Personal income and employment summary. Last updated: May 30, 2014-- revised estimates for 1969-2000. Available online at: http://www.bea.gov/regional/index.htm

U.S. Bureau of Economic Analysis. 2014b. CA34 Wage and salary summary. Last updated: May 30, 2014-- revised estimates for 1969-2000. Available online at: http://www.bea.gov/regional/index.htm

U.S. Bureau of Economic Analysis. 2014c. CA25N Total full-time and part-time employment by NAICS industry. Last updated: November 20, 2014 -- new estimates for 2013; revised estimates for 2001-2012. Available online at: http://www.bea.gov/regional/index.htm

U.S. Bureau of Economic Analysis. 2014d. CA25N Total full-time and part-time employment by NAICS industry. Last updated: November 20, 2014 -- new estimates for 2013; revised estimates for 2001-2012. Available online at: http://www.bea.gov/regional/index.htm

U.S. Bureau of Economic Analysis. 2014e. CA04 Personal income and employment summary. Last updated: November 20, 2014. Available online at: http://www.bea.gov/regional/index.htm

U.S. Bureau of Labor Statistics. 2014a. Annual average unemployment rate, civilian labor force 16 years and over (percent) for the U.S. http://www.bls.gov/cps/prev_yrs.htm

U.S. Census Bureau. 2014a. State and County QuickFacts. Available online at: http://quickfacts.census.gov/qfd/index.html#

U.S. Census Bureau. 2014b. American Community Survey 2009-2013 5-year Estimates. Available online at http://factfinder.census.gov/.

U.S. Census Bureau. 2014c. 2013 Poverty and Median Household Income Estimates - Counties, States, and National. Small Area Income and Poverty Estimates (SAIPE) Program. December.

U.S. Census Bureau. 2013. P2: Hispanic or Latino, and Not Hispanic or Latino by Race. 2010 Census. Revised August 2, 2013. Available online at http://factfinder.census.gov/.

U.S. Census Bureau. 2011. Profile of General Population and Housing Characteristics: 2010. 2010 Census Demographic Profile Data. Available online at http://factfinder.census.gov/.

U.S. Census Bureau. 2001. State & County QuickFacts. http://quickfacts.census.gov/qfd/states/02000.html

U.S. NABCI (U.S. National Bird Conservation Initiative Committee). 2000. Bird conservation region descriptions: a supplement to the North American Bird Conservation Initiative Bird Conservation Regions Map. Available online at: http://www.nabci-us.org/aboutnabci/bcrdescrip.pdf

United Nations Environment Programme. 1991. Fourth Revised Draft Convention on Biological Diversity. United Nations Environment Programme.

URS Corporation. 2006. Mineral Potential Report, Ring of Fire Planning Area, Alaska. Prepared for Bureau of Land Management, Anchorage Field Office. Anchorage, Alaska. July 2006.

USACE (U.S. Army Corps of Engineers). 2007. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region (Version 2.0), ed. J.S. Wakeley, R.W. Lichvar, and C.V. Noble. ERDC/EL TR-07-24. Vicksburg, Missouri. U.S. Army Engineer Research and Development Center.

USACE. 2004. Juneau Field Regulatory Office. Letter signed by John C. Leeds III, February 10, 2004.

USDA (U.S. Department of Agriculture). 2013. Addressing Sustainable Forestry in Southeast Alaska. Memorandum 1044-009. July 2.

USDA Forest Service. 2016a. Natural Resource Information System (NRIS): Current Invasive Plants Inventory. NRIS Invasive Plants Product Page. Available online at: http://data.fs.usda.gov/geodata/edw/datasets.php?dsetParent=InvasiveSpecies. Accessed on: January 12, 2016.

USDA Forest Service. 2016b. Timber Volume Under Contract as of April 2016. Available online at: http://www.fs.usda.gov/detail/r10/landmanagement/resourcemanagement/?cid=fsbdev2_038785

USDA Forest Service. 2015a. Estimates of Carbon Stocks in Forests and Harvested Wood Products for National Forest System Units; Alaska Region. 35 pp. Whitepaper.

USDA Forest Service. 2015b. Forest Health Conditions in Alaska 2014: A Forest Health Protection Report. R10-PR-32. 100 pp.

USDA Forest Service. 2015c. Science Consultation on Tongass Forest Plan Amendment. Young-growth Management in Riparian Teleconference. July 30, 2015.

USDA Forest Service. 2015d. Tongass Salmon Factsheet. USDA Forest Service, Region 10 publication R10-PR-37. June.

USDA Forest Service. 2015e. Species Evaluations for 16 Plants and 3 Lichens on the Tongass National Forest: An Evaluation for Species of Conservation Concern. Unpublished, internal document. 170 pp.

USDA Forest Service. 2015f. National Visitor Use Monitoring Program. (Regional) Annual Visitation Use Estimate. Annual Visitation Use Estimate by Forest. Round 3. Tongass NF-Juneau and Admiralty National Monument, Tongass NF-Sitka and Hoonah, Tongass NF-Yakutat, Petersburg, and Wrangell. Available online at: http://www.fs.fed.us/recreation/programs/nvum/ Downloaded on February 13, 2015.

USDA Forest Service. 2015g. Juneau Icefield 2006-2014 Visitor Numbers. Data provided via email correspondence between R. Havens, Special Use Permit Administrator, Juneau Ranger District/Admiralty Island National Monument and M. Dadswell of Tetra Tech. February 4.

USDA Forest Service. 2015h. Mendenhall Glacier Visitors Center 2006-2014 Visitor Numbers. Data provided via email correspondence between J. Schalkowski, Special Use Permit Administrator, Juneau Ranger District/Admiralty Island National Monument and M. Dadswell of Tetra Tech. February 17.

USDA Forest Service. 2015i. Helicopter Tour Locations by Client and Group, 2014. Data provided via email correspondence between L. Fluharty, Natural Resource Specialist – Wilderness, Wild & Scenic Rivers, Recreation Special Uses and Fees and M. Dadswell of Tetra Tech. February 20.

USDA Forest Service. 2015j. Outfitter/Guide Use by Location Report, 01-01-2013 to 12-31-2013. Data provided via email correspondence between L. Fluharty, Natural Resource Specialist – Wilderness, Wild & Scenic Rivers, Recreation Special Uses and Fees and M. Dadswell of Tetra Tech. February 17.

USDA Forest Service. 2015k. Alaska’s Energy Anxiety. Science Update. Issue 22. Fall 2015. Pacific Northwest Research Station, Portland, OR. 16 pp.

USDA Forest Service. 2015l. Tongass Harvest and Employment, 2012 to 2014 Update. Data on file with Nicole Grewe, Ph.D. Regional Economist, USDA Forest Service, Alaska Region.

USDA Forest Service. 2015m. Annual Review and Update of R10 Limited Export Policy. Memorandum from Beth Pendleton, Regional Forester, Alaska Region to the Forest Supervisor, Tongass National Forest. April 21.

USDA Forest Service. 2015n. Personal email communication between Donald English, NVUM Program Leader, Forest Service and Rachael Katz, Tetra Tech. September 15, 2015.

USDA Forest Service. 2015o. Fish-Stream Identification and Stream Classification on the Tongass National Forest. U.S. Department of Agriculture, Forest Service, Tongass National Forest.

USDA Forest Service. 2014a. 2013 Annual Tongass National Forest Monitoring and Evaluation Report. 14a Stream and Fish Habitat: Fish Passage. Available on line http://www.fs.usda.gov/detail/tongass/landmanagement/planning/?cid=stelprdb5368225 [November 2014]

USDA Forest Service. 2014b. 2013 ATV Game Retrieval Monitoring Yakutat Ranger District Fish and Wildlife Program.

USDA Forest Service. 2014c. Tongass National Forest Energy Program Proposed Project List 2012-2017. June 19.

USDA Forest Service. 2014d. Tongass Young Growth Management Strategy 2014. http://www.merid.org/TongassAdvisoryCommittee/~/media/Files/Projects/tongass/Ecological/USFS%20Tongass%20Young%20Growth%20Strategy%202014.pdf. Accessed 03 29 2015.

USDA Forest Service. 2014e. Natural Resource Manager (NRM): Threatened, Endangered, and Sensitive Plants (TESP) Inventory.

USDA Forest Service. 2014f. Saddle Lakes Timber Sale Draft Environmental Impact Statement. Tongass National Forest. Ketchikan-Misty Fiords Ranger District. R10-MB-740. September.

USDA Forest Service. 2013a. Announcement of intent to modify the Tongass National Forest Management Plan. October 1, 2013. Available online at: http://www.fs.usda.gov/detail/tongass/landmanagement/planning/?cid=stelprdb5437919

USDA Forest Service. 2013b. Climate Change on the Tongass National Forest.

USDA Forest Service. 2013c. 2012 Tongass Monitoring and Evaluation Report. Tongass National Forest.

USDA Forest Service. 2013d. Big Thorne Project Final Environmental Impact Statement. Thorne Bay Ranger District, Tongass National Forest. R10-MB-736c.

USDA Forest Service. 2013e. Forest Service National Strategic Framework for Invasive Species FS-1017. Washington, DC.

USDA Forest Service. 2013f. Economic Impacts of National Forest Recreation in Alaska. Issue Paper.

USDA Forest Service. 2013g. Woody Biomass Energy in Alaska. Issue Paper. April.

USDA Forest Service. 2012a. 2011 Tongass Monitoring and Evaluation Report. Tongass National Forest.

USDA Forest Service. 2012b. National Best Management Practices for Water Quality Management on National Forest System Lands. FS-990a. April 2012. Available online at http://www.fs.fed.us/biology/watershed/BMP.html.

USDA Forest Service. 2012c. Bell Island Geothermal Leases Final Supplemental EIS and Record of Decision. Ketchikan-Misty Fiords Ranger District, Tongass National Forest. R10-MB-750b. December 2012.

USDA Forest Service. 2012d. Timber Supply and Demand: 2011. Alaska National Interest Lands Conservation Act, Section 706(a) Report to Congress. Draft. Report Number 27. USDA Forest Service, Alaska Region. Draft. November 16.

USDA Forest Service. 2011a. Watershed Condition Framework: A Framework for Assessing and Tracking Changes to Watershed Condition. FS-977. May. Available online at: http://www.fs.fed.us/sites/default/files/media/types/publication/field_pdf/Watershed_Condition_Framework.pdf

USDA Forest Service. 2011b. Existing Vegetation Classification and Mapping Technical Guide, Version 1.1. Ecosystem Management Coordination Staff. General Technical Report WO-67. Available online at: http://www.fs.fed.us/emc/rig/documents/protocols/vegClassMapInv/EV_TechGuideV1-1-2.pdf. Accessed December 12, 2014.

USDA Forest Service. 2011c. Timber Supply and Demand: 2010. Alaska National Interest Lands Conservation Act Section 706(a) Report to Congress. USDA Forest Service, Alaska Region. Draft. October 12.

USDA Forest Service. 2010. Alaska Region Energy Program. Program Overview. May 7.

USDA Forest Service. 2009a. 2009 Summary of Cruise Ship Visual Emissions Monitoring by USFS Rangers in Tracy and Endicott Arms.

USDA Forest Service. 2009b. Forest Service Alaska Region Sensitive Species List, Assessment and Proposed Revisions to the 2002 List. Tongass National Forest, Alaska.

USDA Forest Service. 2009c. Record of Decision: Establishment of the Héen Latinee Experimental Forest and Disestablishment of the Young Bay Experimental Forest. Tongass National Forest within the City and Borough of Juneau, Alaska. June. Available online at: https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5367452.pdf

USDA Forest Service. 2008a. Land and Resource Management Plan, Tongass National Forest. R10-MB-603b. January.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan, Final Environmental Impact Statement Plan Amendment. R10-MB-603c. January.

USDA Forest Service 2008c. Tongass Land and Resource Management Plan, Final Environmental Impact Statement Plan Amendment Record of Decision. R10-MB-603a. January.

USDA Forest Service. 2007. Tongass National Forest, 2006 Annual Monitoring and Evaluation Report. USDA Forest Service, Tongass National Forest. R10-MB-609.

USDA Forest Service. 2006a. Soil and Water Conservation Handbook. Forest Service Handbook 2509.22, Region 10 Amendment, July 2006.

USDA Forest Service. 2006b. Parcels Acquired Since TLMP 1997. Unpublished spreadsheet. USDA Forest Service, Alaska Region, Tongass National Forest, Lands Staff. June 2006.

USDA Forest Service. 2006c. Email correspondence/Personal communication between Mike Driscoll of the USDA Forest Service, Recreation and Lands Special Uses and Shaun Brooks, Tetra Tech EC regarding Juneau Icefield Tour passengers. July 26.

USDA Forest Service. 2006d. Email correspondence/Personal communication between Mike Driscoll of the USDA Forest Service, Recreation and Lands Special Uses and Shaun Brooks, Tetra Tech EC. August 30.

USDA Forest Service. 2005. Alaska Region Invasive Plant Strategy. Alaska Region. Juneau, AK.

USDA Forest Service. 2004a. Tongass National Forest: 2004 Annual Monitoring and Evaluation Report: Fish Habitat and Soil and Water. Available online at: http://www.fs.fed.us/r10/tongass/projects/tlmp/monitoring/monitoring.shtml

USDA Forest Service. 2004b. National Strategy and Implementation Plan for Invasive Species Management. FS-805. Washington DC. October 2004.

USDA Forest Service. 2004c. Shoreline Outfitter/Guide Final Environmental Impact Statement. Tongass National Forest, Alaska Region.

USDA Forest Service. 2003a. Tongass land and resource management plan: final supplemental environmental impact statement. R10-MB-481f. Ketchikan, Alaska.

USDA Forest Service. 2003b. Tongass Land Management Plan Revision. Roadless Area Evaluation for Wilderness Recommendations. Final Supplemental Environmental Impact Statement. USDA Forest Service, Alaska Region, Tongass National Forest. Forest Service R10-MB-481a. February.

USDA Forest Service. 2001. USDA Forest Service Handbook, FSH 2090.21 – Aquatic Habitat Management Handbook. USDA Forest Service, Alaska Region, Juneau, Alaska. Amendment No. 2090.21-2001-1. November.

USDA Forest Service. 2000. Forest Service Roadless Area Conservation Rule Final EIS. USDA Forest Service, Washington Office. November. Available online at: http://roadless.fs.fed.us/documents/feis/

USDA Forest Service. 1999. Unidentified USDA Forest Service Document on Rescinding wild and Scenic Recommendation for Niblack Lakes and Streams. USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 1997a. Tongass Land Management Plan Revision, Final Environmental Impact Statement. USDA Forest Service, Tongass National Forest, R10-MB-338dd (Record of Decision, Final Environmental Impact Statement—Part 1 and Part 2, Map Packet, Appendix—Volume 1, Volume 2, Volume 3, Volume 4, and Errata). Alaska Region, Juneau, Alaska.

USDA Forest Service. 1997b. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Record of Decision. Forest Service R10-MB-603a. January.

USDA Forest Service. 1997c. Tongass National Forest Land and Resource Management Plan. R10-MB-338dd. USDA Forest Service, Alaska Region. 1997.

6 References

USDA Forest Service. 1995. Report to Congress, Anadromous Fish Habitat Habitat Assessment. Pacific Northwest Research Station and Region 10. R10-MB-279.

USDA Forest Service. 1993. Status of the Tongass National Forest 1991 Report. R10-MB-238. USDA Forest Service, Alaska Region. July 1993.

USDA Forest Service. 1991. Title 2600 - Wildlife, Fish, and Sensitive Plant Habitat Management. Forest Service Manual 2600.

USDA Forest Service. 1990. Silvics of North America, Volume 1, Conifers. Agricultural Handbook 654.

USDA Forest Service. 1983. Silvicultural Systems for the Major Forest Types of the United States. Agriculture Handbook 445.

USDA Forest Service and ADNR. 2015. Forest Health Conditions in Alaska-2014, A Forest Health Protection Report. Edited by T. Huette and G. Duboise R10-PR-032. February 2015. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3834154.pdf

USDA Forest Service and ADNR. 2014. Forest Health Conditions in Alaska-2013, A Forest Health Protection Report. Edited by E. Graham and T. Huette. R10-PR-035. February 2014. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3797075.pdf

USDA Forest Service and ADNR. 2011. Forest Health Conditions in Alaska-2012, A Forest Health Protection Report. Edited by R. Mulvey and M. Lamb. R10-PR-25. February 2012. Available online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5414306.pdf

USDA Forest Service and ADNR. 2007. Forest Health Conditions in Alaska – 2007, A Forest Health Protection Report. Compiled by C. Snyder, Edited by J. Lundquest. R10-PR-11. April 2007.

USDA Forest Service and ADNR. 2002. Forest Health Protection Report. Forest Insects and Disease Conditions in Alaska – 2001. Compiled by D. Wittwer R10-TP-102. January 2002.

USDA Forest Service and ADNR. 2000. Forest Health Protection Report. Forest Insects and Disease Conditions in Alaska – 1999. Compiled by D. Wittwer R10-TP-82. February 2000.

USDA Forest Service and Sitka Tribe of Alaska. 2003. Katlian Watershed Assessment. Cooperatively produced by the Sitka Ranger District, Tongass National Forest, and Sitka Tribe of Alaska. October. Available online at: http://www.seakecology.org/wp-content/uploads/2013/10/sta_usfs_2003_katlian_assessment.pdf

USDI (U.S. Department of the Interior). 2013. 12-month finding on a petition to list Kittlitz's murrelet as an endangered or threatened species. 78 FR 61764 Available online at: http://www.gpo.gov/fdsys/pkg/FR-2013-10-03/pdf/2013-24172.pdf

USDI. 1994. The Impact of Federal Programs on Wetlands: A Report to Congress by the Secretary of the Interior, Volume II. Chapter 13: Southeast Alaska. Washington, D.C. March. Available online at: http://www.doi.gov/pmb/oepc/wetlands2/v2ch13.cfm (Accessed March 17, 2015).

USFWS (U.S. Fish and Wildlife Service). 2012a. The short-tailed albatross. Available online at: http://alaska.fws.gov/fisheries/endangered/listing.htm

USFWS. 2012c. The Steller's eider. Available online at: http://alaska.fws.gov/fisheries/endangered/listing.htm

USFWS. 2012b. The spectacled eider. Available online at: http://alaska.fws.gov/fisheries/endangered/listing.htm

USFWS. 2012d. Aleutian tern counts from seabird colonies and nearshore marine bird surveys in the Kodiak Archipelago, Alaska 1975-2012. Unpublished Refuge Report 01-12. Prepared by R.M. Corcoran. U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, AK.

USFWS. 2007. Queen Charlotte Goshawk status review. Alaska Region, Juneau Field Office.

USFWS. 2006a. National Wetlands Inventory (NWI). Available online at: http://www.fws.gov/wetlands/

USFWS. 2006b. Available online at: http://alaska.fws.gov/mbsp/mbm/seabirds/pdf/stal.pdf

USGS (U.S. Geological Survey). 2000. Correspondence to Mr. Steve Paustian by Ed Neal, Hydrologist. July 28, 2000. Available in the Logjam Timber Sale planning record.

USGS. 2010. Correspondence to Mr. Steve Paustian by Ed Neal, Hydrologist Neal.

Vaagen, M. 2015. Personal communication between Vaagen Brothers mill and Tetra Tech. October 14.

van Hees, W. W. S. 2001. Summary estimates of forest resources on unreserved lands of the Chatham inventory unit, Tongass National Forest, southeast Alaska, 1998 Resour. Bull. PNW-RB-234. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p..

van Vliet, G. 1993. Status concerns for the "Global" population of Kittlitz's Murrelet: Is the "Glacier Murrelet" receding? Pacific Seabird Group Bulletin 20(1):15-16.

Vercessi, L. 2014. Alaska Salmon Fisheries Enhancement Program 2013 Annual Report. Alaska Department of Fish and Game, Fisheries Management Report 14-12, Anchorage, AK.

Vershuyl, J., S. Riffell, D. Miller, T.B. Wigley. 2011. Biodiversity response to intensive biomass production from forest thinning in North American Forests – A meta-analysis. *Forest Ecoloby and Management* 261: 221-232.

Vose, J.M., D.L. Peterson, and T. Patel-Weynand. 2012. Effects of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector. Gen. Tech. Rep. PNW-GTR-870. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 265 p.

Wagner, M.A. 2011. Habitat selection by red-breasted sapsucker (*Sphyrapicus ruber*) in Southeast Alaska old-growth forest. Master's Thesis. Humboldt State University.

6 References

Wake, D.B., and V.T, Vredenburg. 2008. Are we in the midst of the sixth mass extinction? A view from the world of amphibians. Proceedings of the National Academy of Sciences (PNAS). Volume 105, supplement 1: 11466-11473.

Walker, R.J., C Lones, K. Sundet, A.L. Howe, and A.E. Bingham. 2003. Participation, catch, and harvest in Alaska sport fisheries during 2000. Alaska Department of Fish and Game, Fisheries Data Series No. 03-05, Anchorage, Alaska.

Walters, D. and B. Prefontaine. 2005. Stream Temperature Monitoring Report 1997-2002, Prince of Wales Island, Alaska. Alaska USDA Forest Service, Tongass National Forest, Thorne Bay Ranger District. March 2005.

Walton, K., T. Gotthardt, and T. Fields. 2013a. Little brown myotis. Alaska Species Ranking System Summary Report. Alaska Natural Heritage Program. University of Anchorage. Anchorage, AK. 99501.

Walton, K., T. Gotthardt, and T. Fields. 2013b. Silver-haired bat. Alaska Species Ranking System Summary Report. Alaska Natural Heritage Program. University of Anchorage. Anchorage, AK. 99501.

Walton, K., T. Gotthardt, and T. Fields. 2013c. Keen's myotis. Alaska Species Ranking System Summary Report. Alaska Natural Heritage Program. University of Anchorage. Anchorage, AK. 99501.

Walton, K., T. Gotthardt, and T. Fields. 2013d. California myotis. Alaska Species Ranking System Summary Report. Alaska Natural Heritage Program. University of Anchorage. Anchorage, AK. 99501.

Walton, K., T. Gotthardt, and T. Fields. 2013e. Long-legged myotis. Alaska Species Ranking System Summary Report. Alaska Natural Heritage Program. University of Anchorage. Anchorage, AK. 99501.

Warren, J. 2014. Seafood Harvesting Jobs in 2013. Fishing Employment Up. Alaska Economic Trends. November. Volume 34, Number 11, pp. 4-8.

Webster, J., S. Golladay, E. Benfield, J. Meyer, W. Swank, and J. Wallace. 1992. Catchment Disturbance and stream Response: An Overview of Stream Research at Coweeta Hydrologic Laboratory. Pages 231-253 In: P. Boon and G. Petts(eds). *River Conservation and Management.* John Wiley and Son, Ltd.

Weckworth, B., S. Talbot, G. Sage, D. Person, and J. Cook. 2005. A signal for independent coastal and continental histories for North American wolves. *Molecular Ecology* 14, 917–931.

Weckworth, B.V., S.L. Talbot, and J.A. Cook. 2010. Phylogeography of wolves (Canis lupus) in the Pacific Northwest. *Journal of Mammalogy* 91: 363–375.

Weckworth, B.V., N.G. Dawson, S.L. Talbot, M.J. Flamme, and J.A. Cook. 2011. Going coastal: shared evolutionary history between coastal British Columbia and southeast Alaska wolves (Canis lupus). *PLoS ONE* 6(5): 1–8.

Welch, E.B., J.M. Jacoby, and C.W. May. 1998. Stream Quality. In *River Ecology and Management*, edited by R.J. Naiman and R.E. Bilby. New York: Springer. pp. 69–94.

Wemple, B.C. and J. A. Jones. 2003. Runoff production on forest roads in a steep, mountain catchment. *Water Resources Research* 39(8): 1220. doi: 10.1029/2002WR001744

Wemple, B.C., J.A. Jones, and G.E. Grant. 1996. Channel Network Extension by Logging Roads in Two Basins, Western Cascades, Oregon. *Water Resources Bulletin* 32(6):1195–1207.

Wertheimer, A. C., J.A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2013. Forecasting Pink Salmon Harvest in Southeast Alaska from Juvenile Salmon Abundance and Associated Biophysical Parameters: 2012 Returns and 2013 Forecast. NPAFC doc. 1486. (Available at http://www.npafc.org).

White, E., and D. Stynes. 2010. Characterization of Resident and Non-resident Visitors to Alaska National Forests. Joint Venture Agreement between the USDA Forest Service Pacific Northwest Research Station and Oregon State University. Joint Venture Agreement # 10-JV-11261955-018. August.

Wielgus, R.B., and F.L. Bunnell. 1995. Tests of hypotheses for sexual segregation in grizzly bears. *Journal of Wildlife Management* 59: 552–560.

Wiggins, D.A. 2005. Brown Creeper (*Certhia americana*): a Technical Conservation Assessment. Prepared for the USDA Forest Service, Rocky Mountain Region, Species Conservation Project. January. Available online at: http://www.fs.fed.us/r2/projects/scp/assessments/browncreeper.pdf.

Wilcove, D.S. 1987. From fragmentation to extinction. Natural Areas Journal 7: 23–29.

Wilcove, D.S., C.H. McLelloan and A.P. Dobson. 1986. Habitat Fragmentation in the Temperate Zone in: Soulé, ed. Conservation Biology. The Science of Scarcity and Diversity, p. 237 256. Sinauer Associates, Inc. Sunderland, MA.

Wilcove, D., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. *Bioscience* 48:607-615.

Wilderness.net. 2014. Wilderness Statistics Reports. Acreage by State, Acreage by State Compared to State Land Area, and Acreage by Agency. Available online at: http://www.wilderness.net/NWPS/chartResults. Downloaded December 11.

Williamson, S.J., D. Keppie, R. Davison, D. Bureau, S. Carriere, D. Rabe, and M. Schroeder. 2008. Spruce grouse conservation plan. Association of Fish and Wildlife Agencies. Washington, D.C. 73 pp.

Wing, M.G. 2000. Landslide and Debris Flow Influences on Aquatic Habitat Conditions. 4th International Conference on Integrating GIS and Environmental Modeling (GIS/EM4): Problems, Prospects, and Research Needs. Banff, Alberta, Canada. No. 35. September.

Wipfli, M.S. 1997. Terrestrial Invertebrates as Salmonid Prey and Nitrogen Sources in Streams: Contrasting Old-Growth and Young-Growth Riparian Forests in Southeastern Alaska, USA. Canadian Journal of Fisheries and Aquatic Sciences 54:1259-1269.

Wipfli, M.S. and D.P. Gregovich. 2002. Export of invertebrates and detritus from fishless headwater streams in southeastern Alaska: implications for downstream salmonid production. *Freshwater Biology* 47:957-967.

6 References

Wipfli, M.S., J. Hudson, and J. Caouette. 1998. Influence of Salmon Carcasses on Stream Productivity: Response of Biofilm and Benthic Macroinvertebrates in Southeastern Alaska, U.S.A. *Canadian Journal of Fisheries and Aquatic Sciences* 55: 1503–1511.

Wipfli, M.S, J. S. Richardson, and R.J. Naiman. 2007. Ecological Linkages Between Headwaters and Downstream Ecosystems: Transport of Organic Matter, Invertebrates, and Wood Down Headwater Channels. *Journal of the American Water Resources Association* 43(1): 72-85.

With, K.A. 1999. Is landscape connectivity necessary and sufficient for wildlife management? Pages 97-115 in J.A. Rochelle, L.A. Lehman, and J. Wisniewski, eds. Forest fragmentation: Wildlife and management implications. Leiden, The Netherlands.

Wolfe, R.J. 2004. Local Traditions and Subsistence: A Synopsis from Twenty-Five Years of Research by the State of Alaska. Technical Paper No. 284. Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska. July. Available online at: http://www.subsistence.adfg.state.ak.us/

Wolken, J.M., T.N. Hollingsworth, T.S. Rupp, F.S. Chapin, S.F. Trainor, T.M. Barrett, P.F. Sullivan, A.D. McGuire, E.S. Euskirchen, P.E. Hennon, E.A. Beever, J.S. Conn, L.K. Crone, D.V. D'Amore, N. Fresco, T.A. Hanley, K. Kielland, J.J. Kruse, T. Patterson, E.A. Schuur, D.L. Verbyla, and J. Yarie. 2011. Evidence and Implications of Recent and Projected Climate Change in Alaska's Forest Ecosystem. Ecosphere. November 2011 Volume 2(11) Article 124.

Woodsmith, R.D., J.R. Noel, and M.L. Dilger. 2005. An approach to effectiveness monitoring of floodplain channel aquatic habitat: channel condition assessment. *Landscape and Urban Planning* 72: 177–204.

World Commission on Environment and Development. 1987. Our Common Future, Report of the World Commission on Environment and Development. Published as Annex to General Assembly document A/42/427. Available online at: http://www.un-documenst.net/wccd-ocf.htm.

WRCC (Western Regional Climate Center). 2008. Climate of Alaska. [Internet] Available online at: http://www.wrcc.dri.edu/narratives/alaska/

Zaborski, R.R., M.H. McClellan, and T.A. Handley. 2002. Understory vegetation development following commercial thinning in southeast Alaska: preliminary results from the Second-growth management Area Demonstration Project. In Beyond 2001: a silvicultural odyssey to sustaining terrestrial and aquatic ecosystems – proceedings of the national Silviculture workshop, May 6-10, Hood River OR. USDA Forest Service, PNW Portland, OR. pp 74-82.

Zaborski, R.R., M.H. McClellan, J. Barbour, T.L. Laufenberg, and C.G. Shaw III. 2000. The Southeast Alaska Timber Resource and Industry: What Might the Future Hold? in Proceedings: Linking Healthy Forests and Communities Through Alaska Value-Added Forest Products. USDA Forest Service PNW-GTR-500.

Ziemer, R.R. 1981. Roots and the Stability of Forested Slopes. In: Davies, T. R. H., and Pearce, A. J., eds., *Erosion and Sediment Transport in Pacific Rim Steeplands*, International Association of Hydrological Sciences, p. 343-361.

Zwieniecki, M.A., and M. Newton. 1999. Influence of streamside cover and stream features on temperature trends in forested streams of western Oregon. *Western Journal of Applied Forestry* 14(2):106–113.

CHAPTER 7
GLOSSARY

Glossary

The Glossary for the Final EIS is located in Chapter 7 of the Land and Resource Management Plan volume.

CHAPTER 8
INDEX

Index

8 Index

8 Index