United States Department of Agriculture

Prince of Wales Landscape Level Analysis Project

Final Environmental Impact Statement

Forest Service
Alaska Region

Tongass National Forest
Thorne Bay Ranger District and
Craig Ranger District

R10-MB-833e October 2018

Cover Photo: Prince of Wales Island alpine meadow. Credit: Molly Simonson

Acronyms and Abbreviations

ACHP Advisory Council on Historic Preservation
ADCCED Alaska Department of Commerce, Community, and Economic Development
ADEC Alaska Department of Environmental Conservation
ADF&G Alaska Department of Fish and Game
ADLWD Alaska Department of Labor and Workforce Development
ADNR Alaska Department of Natural Resources
AMHTA Alaska Mental Health Trust Authority
ANCSA Alaska Native Claims Settlement Act
ANILCA Alaska National Interest Land Conservation Act
APDES Alaska Pollutant Discharge Elimination System
APE Area of potential effects
ARD Acid rock drainage
ATM Access travel management
BMP Best management practice
CEQ Council on Environmental Quality
CFR Code of Federal Regulations
CMAI culmination of mean annual increment
DBH Diameter at Breast Height
DEIS Draft Environmental Impact Statement
DHC Deer habitat capability
EDRR Early detection rapid response
EFH Essential fish habitat
EIS Environmental impact statement
EMS Experimental model system
EPA Environmental Protection Agency
ESA Endangered Species Act
ESI Existing scenic integrity
FACTS Forest Service Activity Tracking System
FASTR Financial Analysis Spreadsheet Tool – Residual Value
FCRPA Federal Cave Resources Protection Act
FEIS Final Environmental Impact Statement
FMP Fisheries management plan
FPS Forest Planning and Projection System
FSH Forest Service Handbook
FSM Forest Service Manual
GHG Greenhouse gases
GIS Geographic information system
GMU Game Management Unit
HPOG High-volume productive old growth
HQ Hazard quotient
HUC Hydrologic unit code
IDT Interdisciplinary team
IRA Inventoried roadless area
IRT Interagency review team
LSTA Logging systems and transportation analysis
LTF Log transfer facility
LUD Land Use Designation
LWD Large woody debris
MAF Marine access facility
MBF Thousand board feet
MCS Multiple chemical sensitivity
MIS Management indicator species
ML Maintenance level
MMBF Million board feet
MOU Memorandum of understanding
MRA Minimum requirements analysis
MVP Minimum viable population
MVUM Motor vehicle use map
NEPA National Environmental Policy Act
NFMA National Forest Management Act
NFS National Forest System
NHPA National Historic Preservation Act
NMFS National Marine Fisheries Service
NOA Notice of Availability
NOI Notice of Intent
NRHP National Register of Historic Places
OBML Objective Maintenance Level
OGR Old growth reserve
OHV Off-highway vehicle
OPML Operational Maintenance Level
PCT Precommercial thinning
PDF Project design feature
POG Productive old growth
POW Prince of Wales
POW LAT Prince of Wales Landscape Assessment Team
POW LLA Prince of Wales Landscape Level Analysis
RAW Reasonable assurance of windfirmness
RMA Riparian management area
ROD Record of Decision
ROS Recreation opportunity setting
SD67 Size-density class 6/7
SDM Size-density model
SERA Syracuse Environmental Research Associates
SHPO State Historic Preservation Office
SIO Scenic integrity objective
SOPA Schedule of proposed actions
STS Single-tree selection
TAA Timber analysis area
TES Threatened, endangered, sensitive (species)
TSZ Transient snow zone
TTRA Tongass Timber Reform Act (1990)
USDA United States Department of Agriculture
USDI United States Department of Interior
USGS United States Geological Survey
USFWS United States Fish and Wildlife Service
VCU Value comparison unit
WAA Wildlife analysis area

USDA United States Department of Agriculture | Forest Service | Tongass National Forest Alaska Region | 648 Mission Street Ketchikan, AK 99901 907-225-3101

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Date: October 19, 2018

Dear Planning Participant,

The Tongass National Forest has released the Final Environmental Impact Statement (FEIS) for the Prince of Wales Landscape Level Analysis (POW LLA) Project. This document, with appendices including Activity Cards, Implementation Plan, and the Forest Service's response to comments on the Draft Environmental Impact Statement (DEIS), is available online at http://www.fs.usda.gov/goto/tongass/powlla. Copies of the FEIS are available for review at the Thorne Bay and Craig Ranger Districts, and at the Forest Supervisor's Office in Ketchikan. If you require a copy or need additional information, please contact Delilah Brigham, Project Leader, at 907-828-3232, or send your request to: dbrigham@fs.fed.us.

The Tongass National Forest is proposing a variety of activities on the Thorne Bay and Craig Ranger Districts to meet the following multiple resource objectives: improve forest ecosystem health, support community resiliency, and support economic development on the Thorne Bay and Craig Ranger Districts. The FEIS describes the following four alternatives in detail: No Action (Alternative 1), Proposed Action (Alternative 2), and two additional action alternatives (Alternative 3 and Alternative 5). Another action alternative, Alternative 4, was initially introduced during scoping, but it was not considered in detail in the DEIS or the FEIS. The alternatives are designed to achieve, to a degree, the Purpose and Need for action, while simultaneously addressing the issues raised by the public. Estimated effects of each alternative were analyzed and compared in terms of meeting management objectives and estimated impacts to resources.

I am the Responsible Official for this project, and I will ensure that activities are implemented within the scope of my decision. My preferred alternative is Alternative 2.

Copies of this letter have been mailed or emailed to those who have expressed interest in the project through scoping, comments, consultation, or a request to be on the mailing list.

Along with the POW LLA Project Interdisciplinary Team, I would like to thank those who took the time to review and comment on this project.

Sincerely,

M. Earl Stewart

M. EARL STEWART
Forest Supervisor, Tongass NF

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PRINCE OF WALES LANDSCAPE LEVEL ANALYSIS PROJECT

Final Environmental Impact Statement
Prince of Wales Island, Alaska

Lead Agency:	**USDA Forest Service** **Tongass National Forest**
Responsible Official:	**M. Earl Stewart, Forest Supervisor** **Tongass National Forest** **Federal Building** **648 Mission Street** **Ketchikan, AK 99901**
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Abstract:

In compliance with the National Environmental Policy Act (NEPA), the Prince of Wales Landscape Level Analysis (POW LLA) Project is a large landscape-scale analysis that will result in the decision whether or not to authorize integrated resource management activities on the Prince of Wales Island over the next 15 years. The Tongass National Forest is proposing the POW LLA Project as a way to meet the following resource objectives: improve forest ecosystem health, support community resiliency, and support economic development on the Thorne Bay and Craig Ranger Districts. These objectives will be accomplished through a variety of site-specific activities and management strategies within the following four broad categories: Vegetation Management, Watershed Improvement and Restoration, Sustainable Recreation Management, and Associated Actions.

The analysis in this Environmental Impact Statement (EIS) allows for an adaptive process that is based on the following: defined design criteria or conditions described in the alternatives; resource-specific mitigation or other requirements in the Activity Cards (Appendix A); and an Implementation Plan (Appendix B) that outlines the process under which activities will be implemented in order to ensure all effects are within the scope of the analysis in the EIS. This approach provides flexibility to use site-specific conditions on the ground to determine specific treatments or activities during implementation. Alternatives are used in conjunction with the Activity Cards and Implementation Plan in order to identify and analyze possible activities that could be implemented in the project area. Selecting the most effective options for moving towards the desired conditions is dependent on the potential variability in activities and their responses to resource conditions.

The Final Environmental Impact Statement (FEIS) describes in detail the No Action (Alternative 1) alternative, the Proposed Action (Alternative 2) alternative, and the two other action alternatives (Alternative 3 and Alternative 5). The alternatives are designed to achieve, to a degree, the Purpose and Need for action, while simultaneously addressing the issues raised by the public. This FEIS discusses the effects of implementing each alternative and offers a comparison in terms of meeting management objectives and estimated impacts to resources.

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Summary

Introduction

The Forest Service has prepared this Environmental Impact Statement (EIS) to analyze the potential impacts of a variety of activities on the Thorne Bay and Craig Ranger Districts on Prince of Wales (POW) and surrounding islands, in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Final Environmental Impact Statement (FEIS) discloses the direct, indirect, and cumulative environmental impacts that could result from the proposed action and alternatives.

Geographic information system (GIS) data and product accuracy may vary. All numbers in this document calculated from the GIS should be considered as approximate. Map products in this document are also reproduced from the GIS and subsequently prepared for the use of visual representation by the Forest Service.

1 – What action is proposed?

The Prince of Wales Landscape Level Analysis (POW LLA) Project is a large scale, condition-based analysis to comply with the National Environmental Policy Act (NEPA) that will produce one decision to authorize integrated resource management actions on Prince of Wales Island. Condition-based analysis means that while the range of treatments or activities authorized will be described and analyzed in this environmental impact statement (EIS), the specific locations and methods will be determined during implementation based on defined conditions in the alternative selected in the Decision and Activity Cards (Appendix A). The practice, sometimes referred to as the “toolbox” approach, uses the activity cards to identify and analyze a suite of possible activities that could be implemented in the project area. Although condition-based analysis has the flexibility to be adaptive, it differs from adaptive management. With this approach, treatments can vary in magnitude and intensity to respond to resource conditions, allowing managers to select the most effective options for moving towards desired conditions.

The Tongass National Forest is proposing a variety of activities – based on public input received during project scoping and other collaborative efforts – to implement in an integrated manner over the next 15 years. The proposed activities fall within the following four broad categories: Vegetation Management, Watershed Improvement and Restoration, Sustainable Recreation Management, and Associated Actions.

Vegetation management activities include the following: old-growth commercial harvest, young-growth commercial harvest, young-growth precommercial thinning treatments, timber stand establishment by planting tree seedlings, and wildlife habitat improvement treatments.

Watershed improvement and restoration activities include: fish habitat restoration; fish habitat improvements; aquatic organism passage and fish habitat connectivity by replacing or removing culverts; karst systems improvement by reestablishing original drainage patterns; and invasive plant management through manual or mechanical treatments.

Sustainable recreation management activities include the maintenance of all existing recreation facilities, as well as improvements to some existing facilities and the construction of new facilities. Proposals received through public comment included cabins and three-sided shelters; a variety of trails; campsites and campgrounds; access and enhancements for kayaking, canoeing, and boating; creating interpretive sites; creating winter recreation opportunities; creating day use sites; and further development of existing recreation areas. Outhouse facilities may be necessary to accompany certain proposed recreation sites.

Associated Actions were divided into the following two categories: infrastructure actions and non-infrastructure actions. Examples of infrastructure actions include road construction, road maintenance, and the development of rock pits. Examples of non-infrastructure actions include site preparation, hazard tree removal, and brushing.

The range of treatments or activities to be authorized are described and analyzed in this FEIS based on defined conditions in the alternatives along with the Activity Cards in Appendix A and the Implementation Plan in Appendix B. Specific activities are described in detail on the Activity Cards, and the manner in which they would be implemented is detailed in the Implementation Plan.

2 – Why is the project being proposed?

The POW LLA Project is proposed to respond to goals and objectives of the Tongass Land and Resource Management Plan ("Forest Plan"; USDA Forest Service 2016a), while moving the project area toward the desired conditions described in that Plan, and to meet the needs of Southeast Alaska communities. The Forest Plan includes both forest-wide goals and objectives and area-specific goals, objectives, and desired conditions. The POW LLA Project would respond to a number of Forest-wide Multiple-use Goals and Objectives as detailed in Chapter 1 of this FEIS.

This action is needed to contribute to the economic viability of Prince of Wales area communities by providing a stable level of forest products to help maintain the expertise and infrastructure of the timber industry. Management of young-growth forests is needed to produce future desired resource values, products, services, and forest health conditions that sustain the diversity and productivity of forested ecosystems. Restoration activities are needed in some watersheds to reestablish self-sustaining habitats that promote viable fish, wildlife, and plant populations which contribute to subsistence, traditional, and cultural uses by POW residents. Maintenance and expansion of recreation opportunities on POW and surrounding islands is needed for growth in the recreation and tourism business sector.

The purpose of and need for project action (40 CFR 1502.13) is further explained in Chapter 1 of this document.

3 – Alternatives: What other action would meet the same need?

The proposed action (Alternative 2), the No-Action Alternative (Alternative 1), and two additional action alternatives (Alternatives 3 and 5) were developed in response to key issues, providing a reasonable range of alternatives, and are analyzed in detail in this FEIS. Alternative 4, as noted below, was not carried forward for detailed consideration in the DEIS or FEIS.

With the exception of Alternative 1, all alternatives are designed to achieve the purpose and need for the POW LLA Project, to varying degrees. All action alternatives, including the proposed action, are consistent with the Forest Plan. All applicable Forest Plan direction has been incorporated into the design of the project alternatives. While all alternatives meet Forest Plan direction for all resources, some alternatives have been designed to provide a greater measure of protection than is required by the Forest Plan for some resources. Additional direction comes from applicable laws and Forest Service Manuals and Handbooks. The categories and the types of activities considered for each alternative are described in more detail in Chapter 2, Alternatives Considered in Detail, as well as in the project Activity Cards, Appendix A.

Alternative 1 is the No-Action Alternative in this FEIS. Under this alternative, none of the proposed activities would take place in this project. A no-action alternative is required by CEQ Regulations (40 CFR Section 1502.14(d)) to provide a baseline to measure and compare impacts of the various action alternatives, and represents the existing condition in the project area. This alternative would not meet the purpose and need for the project.

Alternative 2 (Proposed Action Alternative) is the project's proposed action, designed to meet the purpose and need as stated for the project. It incorporates input from a broad collaborative effort, including comments received in response to the Notice of Intent to publish an EIS and during public meetings. The Forest Service received suggestions for a wide array of site-specific activities and management strategies including old- and young-growth timber harvest; precommercial thinning and wildlife habitat improvement; watershed improvement and restoration; recreation facilities maintenance, improvement, and development; and other infrastructure and non-infrastructure activities. A majority of the suggestions from the Prince of Wales Landscape Assessment Team (a local collaborative group) were included in this alternative. Manual and mechanical treatments are proposed for invasive plant management. Alternative 2 does not include recommendations in the *Interagency Wolf Habitat Management Program: Recommendations for Game Management Unit 2* (*Interagency Wolf Habitat Management Program*) per se but there is overlap between recommendations in the *Interagency Wolf Habitat Management Program* with recommendations in the Forest Plan, such as thinning younger-aged young-growth stands. Alternative 2 also includes measures to minimize effects to or improve wildlife habitat on National Forest System (NFS) lands adjacent to communities to benefit subsistence users.

Alternative 3 addresses public concerns from past timber harvest and road construction and its effects to wildlife habitat, watershed function, and subsistence opportunities, while supporting local small mills and providing a limited time for larger mills to increase their utilization of young growth or locate another source of old growth to supplement their timber supply. It incorporates measures beyond those required in the Forest Plan, including less old-growth harvest and other measures to limit the effects of timber harvest, and emphasizes improvements in wildlife habitat on National Forest System (NFS) lands. At the north end of POW Island, in an area bounded by the National Forest System road 2000000 to the south, saltwater to the north, the communities of Point Baker and Port Protection to the west, and western shoreline of Red Bay to the east ("North of the 20 Road"), old-growth stands would only be harvested as part of sales of generally less than 3 million board feet (MMBF) in this alternative. Alternative 3 also includes herbicide treatments for invasive plant populations to address comments on the spread of and eradicating infestations. Alternative 3 also addresses concerns about the amount of stream restoration and recreation site activities in the proposed action by limiting the amount of these proposed activities. This alternative also implements some of the recommendations from *Interagency Wolf Habitat Management Program*, including a variety of young-growth treatments and other recommendations that may benefit both deer habitat and wolves.

Alternative 4 is described in Chapter 2 in the Alternatives Considered but Eliminated from Detailed Study section. It was not carried forward for detailed consideration in the DEIS or FEIS.

Alternative 5 was developed in response to public comments on the December 2017 Draft Issues and Alternatives. This alternative limits old-growth harvest to an average of 5 MMBF per year throughout the life of the project, and excludes old-growth harvest "North of the 20 Road" on the northwest end of the island. Alternative 5 incorporates mitigation measures beyond what is required in the Forest Plan, including reduced old-growth harvest and other measures to limit the effects of timber harvest, and minimizes or improves wildlife habitat on National Forest System lands. Fish habitat improvement activities considered in this alternative include lake fertilization and barrier modifications. Manual and mechanical treatments are proposed for invasive plant management. This alternative fully implements the recommendations from *Interagency Wolf Habitat Management Program*, which includes recommendations for both deer habitat and wolves.

All alternatives are described in more detail in Chapter 2, Alternatives Considered in Detail except for Alternative 4, which is described in Alternatives Considered but Eliminated from Detailed Study.

4 – What would it mean to not meet the need for the project action?

Not meeting the purpose and need is represented by Alternative 1, the No-Action Alternative. Under Alternative 1, natural disturbances and current management of the project area would continue. Ongoing activities such as recreation, firewood gathering, road and trail maintenance, and other routine forest management activities not associated with this decision would continue at current levels, as authorized under previous decisions.

If the need for a continuous supply of timber for forest products is not met, then local mills would need to obtain this timber supply elsewhere on the Tongass or from other non-NFS lands. Local mills that could not obtain their timber supply outside of the project area would close and the local community economies may be impacted. The expertise and skills of these operators would be lost and may delay the development of a young-growth industry.

Harvest from microsales (sales of approximately 50 MBF or less of dead or down timber) may continue to occur within the project area. However, harvest would contribute a minimal amount of wood fiber to the local economies.

Stream segments characterized as "functional at risk" generally have physical processes that are working but an existing water, vegetation, or soil attribute makes them susceptible to degradation. Nonfunctional areas without adequate vegetation, landform, or large wood to dissipate stream energy associated with high flows and thus not reducing erosion, improving water quality, and so forth, likely affecting biological values, would not be restored. Those that were identified as important to local communities would not be improved. This would affect fish habitat and may impact subsistence needs of the local communities.

A sustainable recreation program may be delayed, and maintenance would be focused on health and safety items. Local residents and visitors would be able to continue using the existing recreation sites, but no new sites would be developed. Local tourism may still increase, but Forest Service contribution to this growth or additional amenities could be constrained.

While these activities could continue to be proposed and analyzed as separate projects, they could be subject to longer timelines, availability of funds and personnel, and greater expense than the integrated approach that the POW LLA Project proposes.

5 – What are the effects of the proposed action, and alternative actions, in comparative format?

The Forest Service identified five potentially significant issues from public comments received during scoping, following publication of the Notice of Intent (NOI) to publish an EIS, the Corrected NOI, and during public meetings. See Issues Significant to the Proposed Action in Chapter 1. The POW LLA Project interdisciplinary team (IDT) developed the alternatives to the proposed action to address these issues. Chapter 2, Alternatives, presents the alternatives, describing how they respond to the issues, and compares their management details in Table 5, Comparison of Alternatives. Chapter 3, Environment and Effects, examines the existing condition and compares the potential effects of the alternatives to project area resources and the environment. These issues are alphabetized and not in priority order. The following summarizes these effects:

Issue 1, Invasive Plant Management: Invasive plants displace native plant communities and may cause long-lasting economic and ecological problems within and outside the National Forest. Treatment methods include manual, mechanical, and, for Alternative 3, herbicide application, with advantages and risks associated with each method.

The No Action (Alternative 1) and Alternatives 2 and 5 would continue small-scale manual and mechanical treatments for new and existing weed infestations. Cumulative effects would include small-scale chemical weed treatments for new and existing weed infestations on Forest Service administrative sites, recreation sites, and facilities (36 CFR 220.6 (d) (3) and (6)). Alternative 3 proposes manual, mechanical, and herbicide weed treatments for any existing and new weed infestations on NFS and also analyzes the effects of these treatment on non-NFS lands for potential partnerships with non-federal entities.

Alternatives 1, 2, and 5 would have a higher total cost (approximately three times) over a 15-year period compared to Alternative 3. Alternatives 1, 2, and 5 would have an average cost per restored acre of $1,148 while for Alternative 3 the average cost would be $86. Total acres restored over a 15-year period would be 143 acres for Alternative 1, 2, and 5 and 1,200 acres for Alternative 3.

Alternatives 1, 2, and 5 would have no risk to human health from exposure to herbicides. Alternative 3 would have negligible to low risk to human health (see Table 6 in Chapter 3). Proposed herbicides do not bio-accumulate in people and are rapidly eliminated from the body. The Syracuse Environmental Research Associates, Incorporated (SERA, Inc.) risk assessments (SERA 2007, 2011a and 2011b (Durkin 2007 and 2011)) used for this analysis conservatively evaluated chronic exposure scenarios that would involve the public, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish (Krosse 2018b).

All alternatives would have no to negligible effects on other resources, including soil, wildlife, aquatic resources, and non-target vegetation at a treatment site. Effects to Threatened and Endangered (T&E) Species, Alaska Region Sensitive Species, Management Indicator Species (MIS) and migratory birds are covered in the Herbicide Biological Assessment/Biological Evaluation included in the project record.

None of the alternatives are anticipated to result in measurable effects to any subsistence resource due to proposed weed management activities; therefore, no changes to abundance and distribution of any subsistence resource are expected.

Issue 2, Subsistence: Proposed actions, particularly timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest could affect subsistence resources and lifestyle.

The direct and indirect effects may result in a significant possibility of a significant restriction for subsistence uses of deer in some of the project area wildlife analysis areas (WAA). Deer are considered the “indicator” for potential subsistence resource consequences concerning the abundance and distribution of the resources, given their association with old-growth forest habitat and that they are the largest terrestrial component of subsistence food resources (USDA Forest Service 2016c, p. 3-426).

The direct and indirect effects from all alternatives associated with the project, while they may have an effect on a resource, do not present a significant possibility of a significant restriction of subsistence uses of fish and marine invertebrates, food plants, personal use timber, upland game birds and waterfowl, furbearers, or marine mammals.

The potential cumulative effects of implementing this project, which includes the project No Action and action alternatives, do not present a significant possibility of a significant restriction to subsistence uses fish and marine invertebrates, food plants, personal use timber, upland game birds and waterfowl, furbearers, or marine mammals; however, a significant possibility of a significant restriction may exist for subsistence use of deer (USDA Forest Service 2016b, p. 43).

Issue 3, Timber Supply and Timber Sale Economics: The proposed quantity and quality of old-growth and young-growth timber volume offered by the Forest Service and the logging costs associated with the logging systems and management objectives affect local operators' abilities to contribute to the local economy. Flexibility in the development of timber offers over the life of the project would provide for optimizing volume and net return on timber harvest, and the ability to offer economical timber sales across fluctuating market conditions. Operators need economical timber to stay in business and loss of those operators would have an adverse impact on local economies.

Alternative 2 would offer the most timber volume available and the most old-growth volume, followed by Alternatives 3 and 5, respectively. Alternative 2 would also offer the most flexibility for the Forest Service in the development of timber offers to provide variety in the range of timber products made available, followed by Alternatives 3 and 5, respectively. Alternative 2 offers the best opportunity for the Forest Service to tailor the products made available and design the size of potential timber offers that could help meet industry demands, market conditions, and local needs identified through public involvement. The increased old-growth volume associated with Alternative 2 would also support the most local manufacturing, milling job opportunities, and direct income when compared to Alternative 3 and Alternative 5. Alternative 5 provides the least old-growth volume which may cause some local mills to close if they cannot get their supply from non-NFS lands, which in turn may cause adverse effects to some communities.

More old-growth volume would allow current local manufacturing, milling, and logging operations the most time and revenue to move their operations towards young-growth processing and manufacturing. Alternatives 3 and 5 offer more young-growth volume than Alternative 2. Alternative 2 would also give industry the most time under current practices to develop infrastructure and markets for the project area's extensive young growth. More young growth under Alternative 2 is analyzed to potentially be harvested later in the project, allowing young-growth stands additional time to grow and add volume as compared to Alternatives 3 and 5.

Assuming the full design criteria volume of each action alternative is harvested, the alternatives with more volume would have the greatest potential to support timber industry employment and income in local economies. Local manufacturing jobs are most dependent on the old-growth volume offered since little local manufacturing of young-growth is currently occurring in Southeast Alaska; thus, Alternative 2 with the most old-growth volume could be the most beneficial for local manufacturing. Total estimated timber industry employment supported by old-growth harvest ranges from 339 to 405 total jobs under Alternative 5 (comparing the current limited export policy versus 100 percent domestic processing of Sitka spruce, western hemlock, and western redcedar) to 1,061 to 1,269 total jobs under Alternative 2. Total estimated employment supported from young-growth harvest ranges from 2,005 total jobs for Alternatives 3 and 5 to 1,596 for Alternative 2. It is assumed that no local manufacturing jobs would be supported by the young-growth harvest since little local manufacturing of young-growth currently occurs. Export does support a variety of other jobs such as stevedoring, increasing the diversity of the workforce.

Under Alternative 1 (No Action), no timber would be offered through this project. This may affect the amount of timber available for purchasers involved in timber industry within the project area and other parts of Southeast Alaska. These effects in turn may indirectly affect those communities where residents rely on timber. If their livelihood decreases, this may result in less expenditures on community goods and resources. Potential purchasers would have to rely on timber from other landowners or from other Forest Service projects.

Issue 4, Watershed Function: Proposed logging and road building activities in watersheds that have been impacted by past management may have adverse effects to water quality and fish habitat, and could reverse progress made by previous restoration efforts.

Detectable increases to peak streamflow rates were estimated based on the work of Grant *et al.* (2008). Peak flow rates may be affected by past and proposed road building and timber harvest. Analysis was based on timber harvest that occurred within the past 30 years, existing roads, and any possible road construction and timber harvest identified in the project Logging System and Transportation Analysis (LSTA).

Alternative 2 could result in peak flow rate increases in 36 of the 136 project area watersheds. Increased peak flow rates could result in adverse effects to water quality, fish habitat, and aquatic organisms; adverse effects could include channel and stream bank erosion, sediment transport, and the scouring of salmon redds. Of the 36 watersheds that could see channel altering peak flow rates, four contain previous restoration or watershed improvements and an additional four have recognized drinking water systems. Alternative 2 presents the greatest risk of adverse effects compared to other alternatives. During the implementation process, careful consideration of watershed-specific activities and characteristics will ensure that Forest Plan components and direction for fish habitat and water quality will be met. Alternatives 3 and 5 both require timing timber harvest to lessen the possibility of peak flow rate increases in all project area watersheds. Alternative 1 would not have peak flow rate changes as a result of POW LLA Project activities.

Issue 5, Wildlife Habitat: Concern was expressed that proposed activities, particularly old-growth timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest would affect the amount of remaining productive old-growth (POG) wildlife habitat, and connectivity.

Connectivity between large and medium old growth reserves (OGRs) was reviewed by an Interagency Old Growth Reserve Panel as required by the Forest Plan. These discussions by the panel are located within the project record. The panel's discussion outlined connectivity between OGRs that could be addressed or fixed, or acknowledged that a situation existed but could not be rectified given the situation on the landscape, usually land in other ownership. Effects to connectivity between large and medium OGRs are the same for all action alternatives, and those that are required to be addressed will be implemented.

Wildlife travel corridors, or travelways, should be designated and designed as needed on a stand-by-stand basis by an interdisciplinary team. Wildlife travel corridors are areas that could be left untreated. Within non-development LUDs, such as OGRs, or in areas functioning as wildlife travelways, the wildlife biologist may recommend or require that untreated areas be up to 660 feet wide. Within development LUDs, the travelways should be at least 100 feet wide. The wildlife biologist may require slash treatments and/or trees felled away from and not into the corridor.

The effects of the proposed activities are based on the effects to habitat and some species associated with these habitats such as black bears, Alexander Archipelago wolves, Queen Charlotte goshawk, the endemic Prince of Wales flying squirrel and grouse. The habitat types analyzed here include POG, high-volume POG (HPOG) and large tree POG (SD67). POG is as being 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. POG and HPOG are important for wildlife species because they provide the light needed for forage plants, tree size and spacing, and denning and nesting habitat. HPOG and SD67 also provide specific habitat requires for some wildlife species because the larger trees are more mature and have more decay associated with them. It also includes analysis on specific locations on the landscape such as average snow habitat (POG below 1,500 feet in elevation) and deep snow habitat (HPOG on south-facing stands below 800 feet in elevation). For analysis purposes, the entire LSTA are assumed to be harvested and harvest method is assumed to be clearcut or even-aged harvest.

All action alternatives would result in a similar reduction in habitats at the project area scale on NFS lands, because for analysis purposes, it was assumed that all proposed acres by alternative would be harvested. The analysis at the WAA scale assumes all LSTA stands are harvested using even-aged management prescriptions.

POG: five WAAs (16 percent of project area WAAs) drop to less than 50 percent due to the activities proposed in the POW LLA. Two WAAs (6 percent of project area WAAs) drop to 30 percent or less. The rest of the WAAs in the project area are expected to retain more than 50 percent POG habitat.

Non-winter: one WAA drops (3 percent of project area WAAs) drops to less than 50 percent due to the activities proposed in the POW LLA, the rest of the WAAs in the project area are expected to retain more than 50 percent non-winter habitat.

Average snow habitat: Overall there are seven WAAs that are estimated to retain less than 50 percent habitat or 22 percent of the total WAAs in the project area; two of these seven WAAs are expected to drop to less than 30 percent average winter habitat remaining, or about 6 percent of the total WAAs in the project area. The rest of the WAAs in the project area are expected to retain more than 50 percent average snow habitat.

HPOG: 17 WAAs or 53 percent of the WAAs in the project area are expected to retain at least 70 percent HPOG habitat. Post activities nine WAAs are projected to retain 50 percent or less of the estimated original HPOG habitat; this is about 28 percent of the total WAAs in the project area. About 34 percent of the project area WAAs retain between 30 and 50 percent HPOG habitat. As a result of the proposed activities one WAA is estimated to have between 20 and 30 percent of the original HPOG habitat remaining; about 3 percent of the WAAs in the project area. WAAs with less than 15 percent HPOG habitat remaining include two WAAs or about 6 percent of the WAAs in the project area.

Deep snow habitat: three WAAs (10 percent of project area WAAs) would retain between 50 and 70 percent of the estimated 1954 deep snow habitat; five WAAs (16 percent of project area WAAs) with between 30 and 50 percent; and three WAAs (10 percent of project area WAAs) with less than 30 percent of the estimated 1954 deep snow habitat. The rest of the WAAs in the project area are expected to retain more than 70 percent deep snow habitat.

WAAs with less than literature-recommended habitat thresholds would be at greater risk for not being able to support species that depend on that habitat, relative to WAAs with more habitat remaining.

Past practices indicate that implementing uneven-aged prescriptions in old-growth stands on the Tongass maintains old-growth structure and habitat in the stands post-harvest. Trees retained in implementing uneven-aged management prescriptions maintain approximately the same ratio of species of the original stand composition (see response to comment “Silviculture: Uneven-aged management” in Appendix D).

All alternatives would likely have a reduction in the current habitats' ability to support deer at both the project area and biogeographic province scale. This is based on the reductions to productive old growth and/or from the increase of young-growth acres to the stem exclusion stage as recently harvested stands grow and the canopy closes. All action alternatives would result in young-growth stands that are currently in the stem exclusion stage and providing limited habitat for deer either being moved back into the stand initiation stage and thereby providing more forage (reduced quality) for deer at least in the summer and mild winters, or stands being treated so the develop more old-growth like characteristics sooner than if left untreated.

The proposed activities could result in an indirect effect to wolves through the effects to deer habitat as well as increased access to wolves for hunters and trappers due to increased road densities. Alternatives 3 and 5 focus on minimizing effects to or maintaining the deep snow deer winter habitat, POG below 800 feet in south-facing stands, which should help to mitigate the effects to wolves. Alternative 3 allows for old-growth harvest in these areas by STS selection only, and Alternative 5 allows no old-growth harvest in these areas. Alternative 2 includes harvest by uneven-aged prescription only within 5 miles of communities.

6 – What factors will be used when making the decision among alternatives?

Factors that will influence the decision among alternatives include how the activities integrate to meet multiple resource objectives that will improve forest ecosystem health, support community resiliency, and support economic development on Thorne Bay and Craig Ranger Districts. Additional factors include how they address issues related to:

- invasive plant management effectiveness,
- risk of exposure to herbicides,
- subsistence resources and lifestyle,
- the local timber industry and contributions to local economies,
- water quality and fish habitat especially in watersheds that have been impacted by past logging, and
- wildlife habitat.

In addition, the decision will be influenced by submitted public comments and how the alternatives respond to the Forest Plan's multiple-use direction and how they move the project area toward desired conditions in the Plan.

7 – Are there ways to mitigate adverse effects?

All action alternatives are consistent with Forest Plan direction, LUDs, and Best Management Practices (BMP) designed for the protection and management of forest resources, as well as other relevant federal and state laws and regulations, and Forest Service Manual and Handbook direction. Possible adverse impacts may occur from implementing the actions proposed under each alternative. Measures have been formulated to mitigate or reduce these impacts, guided by direction in the Forest Plan. Activity Cards prepared for the project (Appendix A) describe concerns related to resources for each considered activity, and how these concerns would be mitigated or avoided in the design of each activity, as well as BMPs and resource-specific guidelines.

Resource concerns and mitigation measures may be refined further by specialists during final project design when specific activity locations and details are identified, and documented on Implementation Plan resource checklists, unit cards, road cards, or other activity cards, as applicable (Appendix B).

8 – What monitoring is necessary?

Tongass National Forest staff annually conducts a review of water quality BMPs implementation and effectiveness using a national protocol. The results of this and other monitoring are summarized in a Tongass National Forest Biennial Monitoring and Evaluation Report. This report provides a summary of relevant changes and measures progress toward meeting Forest Plan desired conditions and objectives, which allows the Responsible Official to determine if a change in Forest Plan direction or content may be needed or if changes using adaptive management should be considered.

Alternative 5 also includes incorporating the *Interagency Wolf Habitat Management Program* treatments for deer habitat and wolf habitat protections. This plan includes monitoring and research needs that may be conducted when funding becomes available.

Resource specialists, such as but not limited to fisheries biologists, soil scientists, hydrologists, foresters and engineers, would provide technical advice during project implementation. Monitoring requirements are identified by resource on the Activity Cards for this project, in Appendix A, such as, but not limited to:

- Heron, marbled murrelet, and raptor nests will monitored for activity and buffers will be applied according to Forest Plan direction.
- All management activities will be monitored during and after implementation for potential spread or establishment of invasive species in aquatic and terrestrial areas within the project area.
- Monitoring thinning and slash activities to ensure that thinned material would be bucked small enough to allow the largest wood pieces to touch the ground to aid in faster wood fungi colonialization and decomposition rates. This recommendation is multi-purpose for enhancing the creation of wildlife travel ways and conditions that allow more light to penetrate to the forest floor that encourages vascular plant growth.
- Monitor good cone crop years and schedule cone collection for seed procurement when necessary.
- Monitor Log Transfer Facilities according to Log Transfer Facility Guidelines, Appendix G, of the Forest Plan.
- Monitor road density and acres of timber harvest for each watershed to avoid adversely affecting water quality.
- For lake fertilization and egg/fry stocking activities, regular long-term monitoring is required to identify and address any water quality concerns, as well as status of algae and zooplankton communities.

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Chapter 1. Purpose of and Need for Action

Introduction

The Forest Service has prepared this Environmental Impact Statement (EIS) to analyze the potential impacts of a variety of activities on the Thorne Bay and Craig Ranger Districts on Prince of Wales and surrounding islands, in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Final EIS (FEIS) discloses the direct, indirect, and cumulative environmental impacts that could result from the proposed action and alternatives.

The Prince of Wales Landscape Level Analysis (POW LLA) Project is a large landscape-scale NEPA analysis that will result in a decision whether or not to authorize integrated resource management activities on Prince of Wales Island over the next 15 years. This approach provides flexibility for achieving desired conditions at a landscape scale, while also taking the required hard look. The action alternatives describe the conditions being targeted for treatments and what conditions cannot be exceeded in an area, or place limits on the intensity of specific activities such as timber harvest. The range of treatments or activities considered is described and analyzed in this FEIS. The site-specific locations and methods will be determined during implementation based on defined conditions in the alternative selected in the Record of Decision (ROD) in conjunction with the Activity Cards in Appendix A and Implementation Plan in Appendix B, which will accompany the Record of Decision.

The Activity Cards are used to identify and analyze a suite of possible activities that could be implemented in the project area. With this approach, activities can vary in magnitude and intensity to respond to resource conditions, selecting the most effective options for moving towards desired conditions.

The effects analysis for each resource is contingent on adhering to the requirements within the Activity Cards and following the processes described in the Implementation Plan. The Implementation Plan was developed to ensure the site-specific resource information and public involvement needed to design activities is within the scope of the decision for this project. The Activity Cards and Implementation Plan are an integral part of this landscape-level project for accountability, tracking, decision-making, and documentation purposes. The Responsible Official will have the responsibility to ensure that activities are implemented within the bounds of the analysis and the decision made.

Document Organization for the FEIS and ROD

Chapter 1 – Purpose of and Need for Action: This chapter explains the purpose and need for the proposed action, decisions to be made, relationship to the Forest Plan, public involvement activities conducted to date, key issues identified by the IDT and through public, agency, and tribal involvement, and federal and state permits, licenses and certifications, and applicable laws and executive orders.

Chapter 2 – Alternatives, Including the Proposed Action: This chapter describes the proposed action and alternatives to the proposed action, explains how alternatives were developed, compares alternatives by issues and effects, and explains alternatives considered but eliminated from detailed consideration.

Chapter 3 – Environment and Effects: This chapter discloses the potential environmental direct, indirect, and cumulative effects of the proposed action and alternatives on various resources and the existing condition.

Chapter 4 – References and Lists: This chapter contains the list of preparers, FEIS distribution list, references, glossary, and index.

Appendix A – Activity Cards: Appendix A describes all activities considered within the project area. Information about each activity includes what it usually accomplishes, how it is typically implemented, what constraints and resource-specific guidelines apply, and when it would be implemented. Appendix A was published as an appendix to the DEIS, as well to this FEIS. Appendix A will also be released with the draft ROD as Appendix 1.

Appendix B – Implementation Plan: Appendix B outlines the process by which each activity would be implemented to ensure that all effects were analyzed in the FEIS, it is allowed under the Selected Alternative in the ROD, and all resource-specific guidelines and protection measures are incorporated. Appendix B was published as an appendix to the DEIS, as well as to this FEIS. Appendix B will also be released with the draft ROD as Appendix 2.

Appendix C – Present and Reasonably Foreseeable Future Activities in the POW LLA Project Area: Appendix C lists other activities on all ownerships that are present and reasonably foreseeable in the project area, which were considered during the analysis for this project. Appendix C was published as an appendix to the DEIS as well as to this FEIS.

Appendix D – Response to Comments: Appendix D is a new appendix to the FEIS containing the Forest Service's responses to comments received on the DEIS.

Draft ROD: The draft ROD with Appendix 1 (Activity Cards), Appendix 2 (Implementation Plan) and Appendix 3 (Road Management) will be released at the same time as the FEIS.

All documents are available online at http://www.fs.usda.gov/goto/tongass/powlla.

Additional documentation, including more-detailed analyses of project-area resources is in the project record.

Project Area

The project area includes both the Thorne Bay and Craig Ranger Districts, encompassing Prince of Wales Island (POW) and surrounding islands in Southeast Alaska. See Figure 1. There are about 1.8 million acres of National Forest System (NFS) land and about 480,000 acres of non-NFS land within the project area. Table 1 displays the amount of NFS land within the project area in each land use designation (LUD).

Prince of Wales Island and many of the outer islands are mountainous, with elevations ranging from sea level to nearly 4,000 feet. A "temperate rainforest", the maritime climate results in temperatures normally ranging 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. Annual precipitation may exceed 100 inches, with the highest rainfall occurring during October and lowest in June. Individual storms vary dramatically over short distances and can produce intense rainfall and high winds. Most of the forested land is comprised of both old-growth and young-growth conifers, while red alder is common along streams, beach fringes, and on soils disturbed by management activities and landslides.

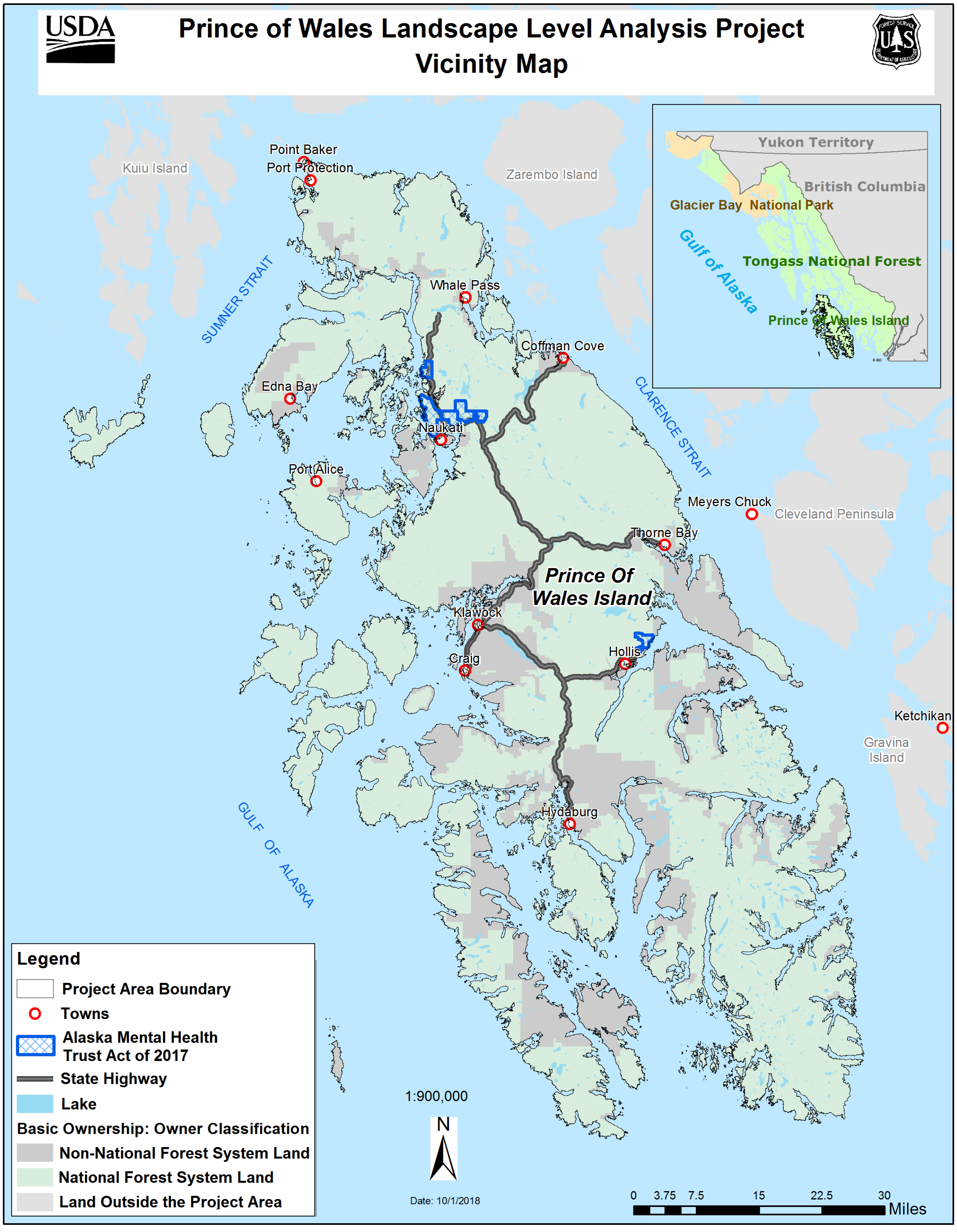

Figure 1. Vicinity map

There are twelve communities within the project area with a total 2014 population of 3,553 (USDA Forest Service 2016c, pp. 3-537 to 678). Employment in natural resource-based industries remains important in many of these communities. Many communities continue to depend primarily on fishing, timber, and subsistence uses.

Purpose and Need for Action

Purpose

The purpose of the POW LLA Project is to respond to the Forest Plan's multiple-use goals and objectives, while moving the project area toward the desired conditions in that Plan (USDA Forest Service 2016a, p. 2-1). The POW LLA Project seeks to meet multiple resource objectives through an integrated approach that will improve forest ecosystem health on Thorne Bay and Craig Ranger Districts, help support community resiliency, and support economic development, consistent with the multiple-use goals and objectives of the Forest Plan. It is the purpose of this project to implement Forest Plan direction and work toward achieving its goals and objectives, including, but not limited to, the following:

Local and Regional Economies—Goals and Objectives (USDA Forest Service 2016a, p. 2-3)

> *Goal:* Provide a diversity of opportunities for resource uses that contribute to the local and regional economies of Southeast Alaska.
>
> *Objective:* Support a wide range of natural resource employment opportunities within Southeast Alaska's communities.

Fish—Goals and Objectives (USDA Forest Service 2016a, p. 2-3)

> *Goal:* Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms.
>
> *Objective:* Design and implement fish habitat improvement projects annually across the Forest.

Biodiversity—Goals and Objectives (USDA Forest Service 2016a, p. 2-3)

> *Goal:* Maintain ecosystems capable of supporting the full range of native and desired nonnative species and ecological processes. Maintain a mix of representative habitats at different spatial and temporal scales.
>
> *Objective:* c) Manage the Forest in order to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of invasive species.
>
> *Objective:* e) Restore watersheds to provide healthy, diverse terrestrial and aquatic habitat.

Recreation and Tourism—Goals and Objectives (USDA Forest Service 2016a, p. 2-4)

> *Goal:* Provide a range of recreation opportunities consistent with public demand, emphasizing locally popular recreation places and those important to the tourism industry.
>
> *Objective:* Maintain existing Forest Service system trails to a standard that provides for the health and safety of all users. Construct or reconstruct trails to encourage a healthier lifestyle for the public. Emphasize projects that facilitate community use or community connections.
>
> *Objective:* Maintain existing recreation sites and facilities to provide for the health and safety of all users. Construct or reconstruct facilities in locations where the need for the facilities are

supported by either known use, partnerships for long-term maintenance, or repeated safety concerns. Remove facilities that are no longer needed or are not affordable.

Subsistence—Goals and Objectives (USDA Forest Service 2016a, p. 2-5)

Goal: Provide for the continuation of subsistence uses and resources by rural Alaskan residents.

Objective: Evaluate and consider the needs of subsistence users in making project land management decisions.

Timber—Goals and Objectives (USDA Forest Service 2016a, p. 2-5)

Goal: Provide for the continuation of timber uses and resources by the timber industry and Alaska residents.

Goal: Manage the timber resource for production of saw timber and other wood products from suitable forest lands made available for timber harvest, on an even-flow, long-term sustained yield basis and in an economically efficient manner.

Objective: Manage young growth to provide commercial timber products and to maintain or improve habitat for wildlife and fish at the stand or landscape level.

Objective: Precommercial thin previously harvested suitable forest land.

Objective: Provide about three years supply of volume under contract to local mills and then establish NEPA-cleared volume to maintain flexibility and stability in the sale program.

Objective: Review the timber sale program and work with state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

Wildlife—Goals and Objectives (USDA Forest Service 2016a, p. 2-6)

Goal: Maintain the abundance and distribution of habitats, especially old-growth forests, to sustain viable populations in the planning area.

Goal: Maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities.

Objective: Design and implement structural and nonstructural wildlife habitat improvement projects.

Objective: Include a young-growth management program to maintain, prolong, and/or improve understory forage production, and to improve habitat distribution, including future old-growth characteristics in young-growth timber stands for wildlife on lands both suitable and not suitable for timber production.

Need

The Forest Service is under national direction to provide for multiple use of the national forests (Organic Administration Act of 1897, Multiple-Use Sustained Yield Act of 1960, and National Forest Management Act [NFMA] of 1976). The underlying need for the POW LLA Project comes in part from the Forest Service's obligation, subject to applicable law, to seek to provide a supply of timber from the Tongass National Forest that meets market demand annually and for the planning cycle, and to restore and improve forest resources to a condition where they provide increased benefits to society (Tongass Timber Reform Act, Section 101). The Forest Plan, which was prepared under the direction of NFMA, was amended in 2016 and incorporates this direction.

1 – Purpose and Need

Much of Southeast Alaska and, more locally, the Prince of Wales Island economy is largely dependent on natural resource industry sectors including forest products, minerals development, resource-related tourism and seafood harvest and processing. Industries dependent on natural resources tend to fluctuate on the request for products and the availability of resources. Although the overall size of the timber industry sectors have substantially diminished, the remaining jobs and small businesses are critically important to rural community economies and household livelihoods. The forest products industry is an important component of the island social fabric, cultural identity, and heritage.

At this time, a need exists to contribute to the economic viability of Prince of Wales area communities by providing a sustainable level of forest products to help maintain the expertise and infrastructure of the timber industry. Timber harvest would be integrated with restoration opportunities in a sustainable manner that meets multiple economic, forest, and watershed objectives. There is a need for young-growth forest management now to produce future desired resource values, products, services, and forest health conditions that sustain the diversity and productivity of forested ecosystems. Timber stand establishment and timber stand improvement activities (such as planting and precommercial thinning) that enhance early seral forests are necessary to achieve this. There is a need for restoration activities in some watersheds to reestablish self-sustaining habitats that promote fish, wildlife, and plant habitat and populations which contribute to commercial, sport, subsistence, traditional, and cultural uses by POW and surrounding island residents. Activities are needed to restore ecological function in some streams and watersheds to promote their recovery from floods and likely effects of a changing climate. Restoration projects also provide economic opportunities for POW communities. For example, the Harris River Restoration Project awarded contracts to local businesses to complete restoration activities. There is a need to maintain and expand recreation opportunities on POW and surrounding islands for growth in the recreation and tourism business sector. A sustainable recreation program in terms of operations and maintenance is needed to maintain recreation infrastructure at a functional level.

Proposed Action

The Forest Service is proposing a multi-year project involving a variety of activities to implement over the next 15 years, designed to improve forest ecosystem health, support community resiliency, and support economic development on Thorne Bay and Craig Ranger Districts. The proposed action was developed with input from an independently-formed, broadly-based collaborative group as well as from the broader public's comments. **Alternative 2 represents the proposed action.** The proposed action, and alternatives to the proposed action, are presented in more detail in Chapter 2 of this FEIS.

During initial scoping and throughout the collaborative process, the Forest Service received suggestions for a wide array of site-specific activities and management strategies on NFS lands in the project area. The activities and management strategies fell within four broad categories: 1) Vegetation Management, 2) Watershed Improvement and Restoration, 3) Sustainable Recreation Management, and 4) Associated Actions. Proposed activities are described on the Activity Cards in Appendix A. The activity types and management strategy categories are summarized below.

Vegetation management activities include: Old-growth commercial harvest; young-growth commercial harvest; young-growth intermediate silvicultural treatments including precommercial thinning, pruning, and girdling; timber stand establishment (*e.g.*, tree seedling planting); and wildlife habitat improvement treatments (Activity Cards 1 through 24).

Watershed improvement and restoration activities include: Fish habitat restoration, fish habitat improvements, aquatic organism passage and fish habitat connectivity (replace or remove culverts), karst systems improvement (reestablish drainage patterns), and invasive plant management (manual or mechanical treatments) (Activity Cards 25 through 35).

Sustainable recreation management activities include: Maintenance of all existing recreation facilities, as well as improvements to some existing facilities and construction of new facilities. Proposals received through public comment included cabins and three-sided shelters; a variety of trails; campsites and campgrounds; access and enhancements for kayaking, canoeing, and boating; creating interpretive sites; creating winter recreation opportunities; day use sites; and further development of existing recreation areas. Outhouse facilities may be necessary to accompany certain proposed recreation sites. A wide array of locations were suggested (Chapter 2); however, on the ground conditions will determine where activities will be implemented (Activity Cards 36 through 46).

Associated actions include a number of activities associated with implementing the various proposed management activities that would be necessary, in addition to some associated actions which were proposed through public input and comments. Associated actions were divided into two categories: infrastructure actions and non-infrastructure actions. Examples of infrastructure actions include road construction, road maintenance, and development of rock pits. Examples of non-infrastructure actions include site preparation, hazard tree removal, and brushing.

Decisions to be Made

The Responsible Official for this project is the Forest Supervisor for the Tongass National Forest. Based on the environmental analysis in this EIS, consideration of the proposed action and other alternatives (including No-Action) and their effects, consideration of public comments, and in accordance with Forest Plan goals, objectives, and desired conditions, the Forest Supervisor will decide:

- Whether to select the No-action Alternative, an action alternative, or a modification of an action alternative;
- If an action alternative is selected, the range of treatments or activities to be authorized for: 1) vegetation management activities such as commercial old-growth and young-growth harvest, precommercial young-growth thinning treatments, timber stand establishment, and wildlife and riparian habitat improvement treatments; 2) watershed improvement and restoration treatments such as fish habitat restoration, fish habitat improvements, aquatic organism passage, fish habitat connectivity, karst system improvements, and invasive plant management; 3) recreation management activities such as maintenance of existing recreation facilities, improvements to existing facilities, construction of new facilities, and decommissioning recreation infrastructure and sites; and 4) associated infrastructure activities such as road construction, road maintenance, and development of rock pits, and associated non-infrastructure activities such as site preparation, hazard tree removal, and brushing;
- If there are any timing or location restrictions for any activities, not already described in the Selected Alternative, Activity Cards, or Implementation Plan; and
- Mitigation measures and monitoring requirements.

Relationship to the Forest Plan

National forest planning takes place at several levels: national, regional, forest, and project. The Forest Plan is an extensive forest-level analysis. It provides land and resource management direction for the Tongass National Forest. The POW LLA Project is a project-level analysis; its scope is confined to addressing the significant issues and environmental effects specifically related to this project. It does not attempt to address decisions made at higher levels. However, it does implement direction provided at those higher levels, and is designed to achieve the management direction of the Forest Plan as outlined in the purpose and need statement. Where appropriate, the POW LLA Project EIS tiers to the analysis done for the Forest Plan, the supplement, and subsequent amendments as encouraged by regulations at 40 CFR 1502.20. Unless otherwise specified, all references to the Forest Plan are to the current Forest Plan, December 2016.

The Forest Plan uses land use designations (LUD), which are broad geographic zones that emphasize various resource values and outputs, to guide management of the Tongass National Forest. Each LUD provides direction on the types of activities, practices, and uses to be emphasized in specific areas. The POW LLA project area includes 15 LUDs (see Figure 2). Project area land use designations, goals, objectives, and desired future conditions of all LUDs are described in detail in the Forest Plan, Chapter 3. The acreage of each LUD in the POW LLA project area is shown in Table 1.

Table 1. Land use designation (LUD) acreages in the POW LLA project area

LUD	Acres
Wilderness LUD Group	
Wilderness	162,655
Natural Setting LUD Group	
LUD II	261,772
Remote Recreation	4,016
Semi-Remote Recreation	237,113
Old-Growth Habitat	304,101
Municipal Watershed	3,278
Research Natural Area	1,335
Special Interest Area	37,177
Wild River	10,693
Scenic River	10,452
Recreational River	3,719
Development LUD Group	
Experimental Forest[1]	10,644
Scenic Viewshed	18,173
Modified Landscape	187,885
Timber Production	572,018
TOTAL	**1,825,031**

1 Experimental Forest is included in this grouping even though it is technically not a Development LUD (Table 1 in Forest Plan ROD p. 9)

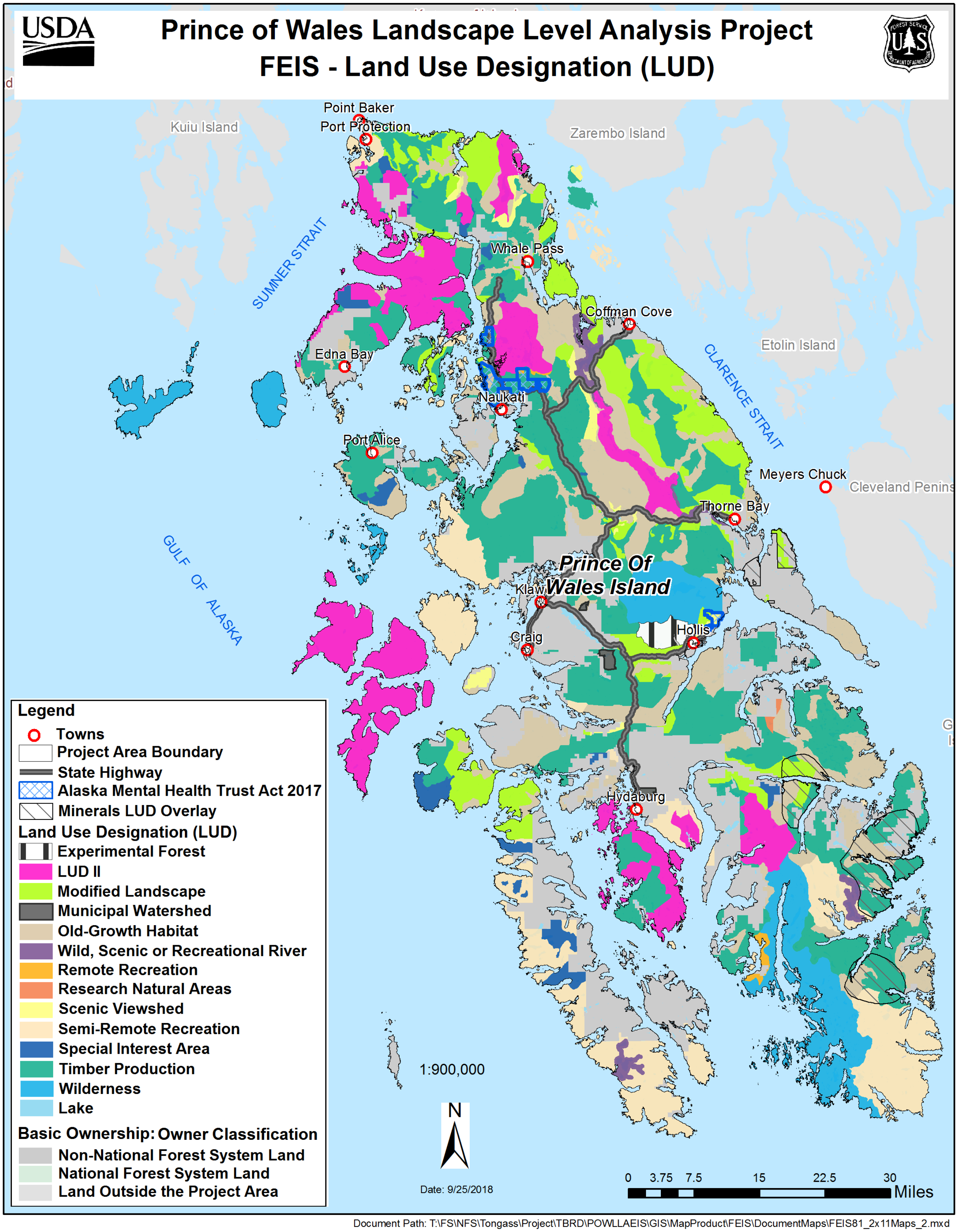

Figure 2. Project area land use designations

Public, Agency, and Tribal Involvement

Public involvement is a key component of the planning process. The public has been involved from the earliest stages of the project. In May of 2016, a local, independent, broadly-based collaborative group – the Prince of Wales Landscape Assessment Team (POW LAT) – formed. The group's mission focused on developing and providing proposed activities to be considered by the Forest Service in the POW LLA Project development and analysis process. After a year of deliberations, the POW LAT submitted their list of suggested activities. These were considered along with input received internally and suggestions from the broader public in developing and refining the proposed action and alternatives.

Scoping

The Council on Environmental Quality (CEQ) defines scoping as "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 Code of Federal Regulations [CFR] 1501.7). The scoping process is used to invite public participation, to help identify public issues, and to obtain public comment at various stages of the environmental analysis process, continuing until a decision is made. The project was first listed in the Schedule of Proposed Actions (SOPA) in the 4th quarter of 2016 (beginning October 1st) for the Tongass National Forest.

Notice of Intent

The Notice of Intent (NOI) was published in the Federal Register on November 30, 2016. The NOI informed the public of the opportunity to comment on the proposal from November 30 to December 30, 2016.

In response to public comments on the proposed action received from initial scoping, as well as internal comments, the Forest Service refined the project purpose and need, developed a more-detailed proposed action, and published a Corrected NOI (CNOI) in the Federal Register on July 6, 2017. The Forest Service requested public comment on the CNOI by August 7, 2017. Using the comments from the public, other agencies, tribes, collaborative groups, and others, the interdisciplinary team identified a list of issues to address.

Public, Agency, and Tribal Meetings and Mailings

As part of the public involvement process, the Forest Service engaged in the following public outreach through letters, meetings, presentations, and requests for comment, summarized below.

- October 31, 2016: Sent out letters to tribal governments and corporations to notify them of the project, purpose and need, and proposed action to-date, and to initiate government-to-government consultation.
- November 2, 2016: Sent letter to Alaska Department of Natural Resource State Historic Preservation Officer (ADNR-SHPO) initiating communication on Section 106 determination.
- November 29, 2016: Scoping letter requesting comment on the project proposal sent to interested individuals, agencies, and organizations.
- November 30, 2016: NOI published in Federal Register.
- December 1, 2016: GovDelivery bulletin (email) announcing NOI publication on November 30, 2016, initiating opportunity to comment during scoping period, sent to POW LLA Project mailing list of 555 recipients.

- November–December 2016: Public outreach through information tables at POW Island craft fairs, during Natural Resources Day, and by providing information to POW LAT.
- December 12, 2016: Public scoping meeting in Thorne Bay 4:30-6:00 p.m. to provide information and solicit comments/suggestions.
- December 13, 2016: Public scoping meeting in Naukati 4:00-5:30 p.m. to provide information and solicit comments/suggestions.
- December 15, 2016: Public Info Fair 10:00-4:30 p.m. in Craig, a collaborative event organized by POW LAT, the POW LLA Project IDT, and other entities.
- December 15, 2016: Public scoping meeting held in Craig 4:30-6:00 p.m. to provide information and solicit comments/suggestions.
- June 13, 2017: Letter inviting government-to-government consultation sent to tribes, as well as to native corporations, with draft CNOI language included.
- June 16, 2017: Public scoping meeting in Point Baker, at the request of Point Baker and Port Protection communities, 11:00 a.m. – 1:00 p.m. to provide information and solicit comments/suggestions.
- July 6, 2017: CNOI published in Federal Register.
- July 5-6, 2017: Letter requesting comment on the project proposed action as described in the CNOI, including draft Activity Cards, was sent to interested individuals, agencies, and organizations. A GovDelivery bulletin (email) was sent to 620 email addresses subscribed to the project.
- July 13, 2017: Public information meeting in Klawock 6:00-8:00 p.m. hosted by the Thorne Bay and Craig Ranger Districts to discuss invasive plant treatment options on National Forest System lands.
- December 4, 2017: Letter sent to tribal governments notifying them of the Draft Issues and Alternatives available for 14-day review and comment period December 5-19, 2017.
- December 5, 2017: Legal notice placed in the Ketchikan Daily News, the newspaper of record, for a 14-day comment period December 5-19, 2017, on Draft Issues and Alternatives. A GovDelivery bulletin (email) was sent to 636 email addresses subscribed to the project.
- March 15, 2018: Formal consultation with Sealaska Corporation held in Juneau, AK 10:00-11:30 a.m.

Draft EIS

Availability of the DEIS for Comment

The Notice of Availability for the DEIS was published in the Federal Register on May 4, 2018, starting a 45-day comment period. A legal notice for Opportunity to Comment was also published in the *Ketchikan Daily News*, the newspaper of record, on May 3, 2018. Notification of the availability of the DEIS was mailed or emailed to all names on the POW LLA Project mailing list, including federal and state agencies, municipal offices, federally recognized tribes, Alaska Native Claims Settlement Act (ANCSA) corporations, non-federally recognized tribes, and any others requesting it, including a hard copy or electronic media if requested. The DEIS was also available for review at the Thorne Bay and Craig Ranger Districts, or electronically at http://www.fs.usda.gov/goto/tongass/powlla.

The Forest Service sent letters inviting government-to-government consultation and provided information on the DEIS to the following federally recognized tribal governments: Craig Tribal Association; Hydaburg Cooperation Association; Klawock Cooperation Association; Ketchikan Indian Corporation; Metlakatla Indian community; Organized Village of Kasaan; Organized Village of Kake; Organized Village of Saxman; and Wrangell Cooperative Association.

Public Comments on the DEIS

The Forest Service received more than 50,000 written comments from agencies, organizations, and individuals during the 45-day DEIS comment period. Most of these were form letters created by special interest organizations, available on their websites for members to sign and send using a provided link. All letters received were considered by the interdisciplinary team (IDT), both individually and collectively, as many of the letters had the same or similar concerns.

Substantive comments (within the scope of the proposal, specific and related to the proposal, and that include supporting rationale for the Responsible Official to consider) have been addressed and incorporated into the FEIS to the extent practicable. Some comments ask for clarification or additional information in the Final EIS, others requested certain information be considered, or requested modification to or creation of a new alternative. Chapter 2, Changes between Draft and Final EIS, summarizes changes, clarifications, and updates to the Final EIS both as a result of public comment and internal refinement. See also Appendix D, Response to Comments on the Draft EIS, for more information on the public comments and how the Forest Service responded to them.

Subsistence Hearings

Following publication of the DEIS in 2018, subsistence hearings were held in Whale Pass (May 29), Klawock (May 30), and Hydaburg (May 31) to accept testimony from users of subsistence resources on how the proposed activities within the project area may potentially affect them. These testimonies were considered for this analysis. Due to the request for more hearings, additional subsistence hearings were held in Point Baker (September 6), Kasaan (October 9), Klawock (October 10), and Naukati (October 11) to determine if there were any new issues that had not been previously raised. All written comments received were considered for this analysis and are in the project record.

Final EIS

A Notice of Availability for this FEIS has been published in the Federal Register. A legal notice has been placed in the *Ketchikan Daily News*, the newspaper of record. Notification of the release of the FEIS has been mailed or emailed to the POW LLA Project mailing list, including federal and State agencies, municipal offices, tribes, and others requesting it, including a copy if previously requested. The FEIS is also available for review at the Thorne Bay and Craig Ranger Districts, or electronically at http://www.fs.usda.gov/goto/tongass/powlla.

Draft and Final Record of Decision

The draft Record of Decision (ROD) is released to give the public an opportunity to review the proposed decision (Selected Alternative). Under the 36 CFR 218 objection process, the public will be notified of the availability of the draft ROD through a legal notice published in the newspaper of record, the *Ketchikan Daily News*, starting the 45-day objection filing period. Detailed information on objection rights and procedures will be included in the section “Administrative Review—Opportunity to Object” at the end of the draft ROD. Notification of the release of the draft ROD will be mailed or emailed to the POW LLA Project mailing list, including federal and state agencies, municipal offices, tribes, and any others requesting it, including a copy if previously requested. An electronic copy of the legal notice and the draft ROD will be posted on the Prince of Wales Landscape Level Analysis

Project website at http://www.fs.usda.gov/goto/tongass/powlla. The draft ROD will also be available for review at the Thorne Bay and Craig Ranger Districts.

The Responsible Official may sign the final ROD when administrative review requirements under 36 CFR 218.12 have been met. Implementation of decisions subject to the objection process may begin immediately after a final decision is signed. There is not a requirement to publish notification of the decision. The final ROD will be posted on the project website and an email will be sent to the POW LLA Project mailing list notifying the public of the availability of the final ROD.

Public Involvement during Implementation

Should an action alternative be selected in the ROD, the Forest Service will continue to encourage public involvement through solicitation of comments on activities proposed for implementation in any given year. Appendix B, the Implementation Plan, describes the process for continued public involvement by holding public meetings to invite comment and suggestions on proposed activities, with times and locations determined by location of potential activities and to facilitate the greatest participation by the public. See Appendix B, section “Step 1”.

Issues Significant to the Proposed Action

The Forest Service identified the following significant issues through input received from comments during scoping (40 CFR 1501.7), following publication of the NOI to publish an EIS, the CNOI, and during public meetings. To describe and compare how the alternatives affect the resources related to the issue, units of measure are chosen that are quantitative where possible, predictable, responsive to the issue, and linked to cause-and-effect relationships. These issues, related resources, and how the alternatives address the issues are discussed in more detail in Chapter 3, Environment and Effects.

Issue 1: Invasive Plant Management

Issue statement: Using only manual or mechanical treatments for invasive plant control may not effectively reduce the establishment and spread of invasive plant populations on Prince of Wales and surrounding islands. Use of herbicides in combination with other treatment methods increases effective invasive plant treatment strategies. However, using herbicides increases the level of exposure to the chemical properties contained within the herbicide to humans, soil, wildlife, aquatic resources, and non-target vegetation at a treatment site. There is an additional invasive plant section in Chapter 3 of this FEIS (Invasive Plants) which analyzes the effects of various alternative activities on the introduction and spread of invasive plants.

Invasive plants displace native plant communities and may cause long-lasting economic and ecological problems within and outside the National Forest. They can degrade fish and wildlife habitat, out-compete native plants, impair water quality and watershed health, and adversely affect other resource values such as scenic beauty and recreational opportunities. Invasive plants can spread rapidly across the landscape to all land ownerships.

The ability to minimize the adverse impacts of invasive plants and achieve eradication is greatest when infestations are small, at the early stages of invasion, and using the proper method based on the response to the treatment method by the species. Treatment costs, including the need for retreatments, are directly related to the methods used (manual, mechanical, or herbicide) and the response of targeted invasive plant species to the treatment. Often a combination of all three methods provides the most effective and cost efficient control.

In some instances, herbicide application is the recommended treatment of difficult-to-control invasive plants. Treatment extent, rate and method of application, and the properties of the chemicals proposed influence the degree of risk. Mitigation measures and project design criteria minimize the risks associated with chemical use. Chemical toxicities and exposure scenarios will be evaluated for each proposed chemical for each resource, including human health.

Units of Measure

- Relative cost and treatment effectiveness by treatment method;
- Herbicide toxicology (chemical properties) and exposure (application rate in pounds per acre) for the herbicides, in terms of:
    - ♦ Herbicide impacts on human health (workers and the public);
    - ♦ Herbicide impacts on non-target vegetation (*e.g.*, subsistence use or culturally significant plants)
    - ♦ Herbicide impacts on soils, wetlands and karst ecosystems;
    - ♦ Herbicide impacts on water/aquatic organisms;
    - ♦ Herbicide impacts on wildlife; and
    - ♦ Effects to Wilderness area characteristics from manual, mechanical, and herbicide treatments.

Issue 2: Subsistence

Issue statement: Proposed activities, particularly timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest would affect subsistence resources and lifestyle.

Units of measure are designed to assess abundance and distribution of subsistence resources, access to subsistence resources, and competition for those resources. The wildlife portion of the subsistence analysis focuses on effects to deer because deer is the only subsistence resource that is potentially significantly affected.

Units of Measure

- Effects to aquatic resources (see Issue 4 in this chapter).
- Effects to deer habitat (see Issue 5);
- Changes in access to subsistence resources by road density and
- Percentage of deer harvested based on ADF&G information of the estimated deer habitat capability (DHC) by both federally qualified subsistence users (direct and indirect effects) and all users (cumulative effects) by WAA.

Issue 3: Timber Supply and Timber Sale Economics

Issue statement: The proposed quantity and quality of old-growth and young-growth timber volume offered by the Forest Service and the logging costs associated with the logging systems and silvicultural prescriptions would affect local operators' abilities to contribute to local economies.

Units of Measure

- Timber volume (old-growth and young-growth) in million board feet (MMBF) for the life of the project (15 years);

- Cost of harvest, including logging, camp, and haul per thousand board feet (MBF) by "timber analysis area";
- Transportation cost per MBF; and
- Number of annualized direct jobs supported for both domestic processing and Region 10 limited export policy (see 2016 Forest Plan Amendment FEIS Appendix H, USDA Forest Service 2016e) for old-growth and 100 percent for young-growth (15 years).

Issue 4: Watershed Function

Issue statement: Proposed logging and road building activities in watersheds that have been impacted by past management may have adverse effects to water quality and fish habitat, and could reverse progress made by previous restoration efforts.

Units of Measure

- Number of watersheds with past restoration that could experience increased peak flow rates in response to potential timber harvest and road construction.
- Miles and percent of roads traversing slopes greater than 50 percent by 6th level HUC[1] watershed;
- Number of watersheds that could experience increased peak flow rates as a result of past (30 year moving window) and proposed harvested and roaded area by 6th level HUC watershed;
- Total existing and proposed road miles within 300 feet of Class I and Class II streams and lakes by 6th level HUC watershed;
- Number of new fish stream crossings;
- Miles of existing and proposed trails;
- Miles of proposed stream restoration;
- Total existing and proposed road miles and area by 6th level HUC watershed; and
- Total acres of harvest in the past 30 years and proposed vegetation management by 6th level HUC watershed.

Issue 5: Wildlife Habitat

Issue statement: Proposed actions, particularly timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest would reduce the amount of remaining productive old-growth (POG), high volume POG (HPOG) and large tree POG (SD67) wildlife habitat. Past actions have also impacted wildlife habitat by converting old-growth forest into young-growth forests. Proposed actions in young-growth stands can improve wildlife habitat. These same activities would also affect current wildlife habitat connectivity provided by productive old-growth as well as older young-growth stands at different elevations and across the landscape.

[1] Hydrologic units (HUCs) are watershed boundaries organized in a nested hierarchy by size from the largest (regions) to the smallest (cataloging units), and can be viewed as the "address" of a particular watershed. Watersheds are spatially located landscape features uniformly mapped for the entire United States at multiple scales. The 6th level HUC is the scale commonly used to determine the potential effects of management activities.

Units of Measure

- Acres harvested of non-winter, POG, HPOG, and SD67 habitat by Wildlife Analysis Area (WAA) and Game Management Unit (GMU) 2;
- Acres harvested of HPOG habitat in south-facing stands below 800 feet in elevation (deep snow habitat), and
- Acres harvested of POG habitat below 1,500 feet in elevation (average snow habitat).
- Literature thresholds for remaining habitat acres by WAA; and
- Total (open and closed) road density below 1,200 feet in elevation on NFS lands by WAA.

Other Issues and Concerns

Each comment received during scoping was considered a potential issue, but some concerns and suggestions were not considered alternative-driving issues or their resolution was beyond the scope of this project. Other concerns are addressed in the Forest Plan through direction on the protection and management of forest resources outlined in individual resource components and LUD components. Where possible, suggestions about the project were incorporated into the design of the proposed action and alternatives (see Chapter 2: Alternatives, Including the Proposed Action). Additionally, some concerns and suggestions were considered but eliminated from detailed analysis for the reasons discussed in Chapter 2 (Alternatives Considered but Eliminated from Detailed Study).

Federal and State Permits and Authorizations

Prior to implementation of activities, the Forest Service would ensure all necessary permits or authorizations from other federal and state agencies are in place. These may include the following:

(1) State of Alaska, Department of Environmental Conservation (DEC), Alaska Pollutant Discharge Elimination System (APDES):

- General permit for Log Transfer Facilities in Alaska;
- Review Spill Prevention Control and Countermeasure Plan;
- Certification of Compliance with Alaska Water Quality Standards (401 Certification) Chapter 20;
- Storm Water Discharge Permit/National Pollutant Discharge Elimination System review (Section 402 of the Clean Water Act);
- Solid Waste Disposal Permit;

(2) US Army Corp of Engineers:

- Approval of discharge of dredged or fill material into the waters of the United States under Section 404 of the Clean Water Act;
- Approval of the construction of structures or work in navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899;

(3) State of Alaska, Division of Natural Resources:

- Authorization for occupancy and use of tidelands and submerged lands.

(4) State of Alaska, Department of Fish and Game:

- Fish Habitat Concurrence (Title 16).

Availability of the Project Record

An important consideration in preparing this EIS is reduction of paperwork specified in 40 CFR 1500.4. This FEIS provides sufficient site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and ways to mitigate the impacts. The project record contains supporting material that documents the NEPA process and analysis from the beginning of the project through project implementation.

The project record is available electronically upon request from the Thorne Bay Ranger District office in Thorne Bay, Alaska and the Craig Ranger District office in Craig, Alaska. Reference documents, such as the Forest Plan, National Interest Lands Conservation Act of 1980 (ANILCA) and the TTRA, are available for review at public libraries and Forest Service offices throughout Southeast Alaska. The Forest Plan and its FEIS are available on CD-ROM and online (http://www.fs.usda.gov/goto/R10/Tongass/PlanAmend). The Forest Plan planning record is also available electronically.

Map and Data Disclaimers

All map products in this document are reproduced from geospatial information prepared by the Forest Service. Geographic information system (GIS) data and product accuracy may vary. Using GIS products for purposes other than those for which they were created may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify, or replace GIS products without notification. For more information, contact the Thorne Bay Ranger District or the Craig Ranger District.

In addition, the accuracy of calculations made from GIS layers varies with the quality of the mapping itself. Numbers presented in tables in this document may not sum correctly due to rounding. Other slight anomalies due to rounding may also occur. Therefore, all numbers calculated from GIS should be considered as approximate. These numbers are accurate enough for comparison of alternatives and for a decision to be made.

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Chapter 2. Alternatives, Including the Proposed Action

Introduction

This chapter describes and compares the alternatives considered for the Prince of Wales Landscape Level Analysis (POW LLA) Project. This section also defines the differences between each alternative, providing a clear basis for choice among options by the Responsible Official. See Table 4. Effects Comparison of Alternatives by Issue using Units of Measure Identified for each Issue, at the end of this chapter. Some of the information used to compare the alternatives is based upon the design of the alternative, while some of the information is based upon the environmental, social, and economic effects of implementing each alternative. Examples of alternative design could include helicopter logging versus the use of ground-based equipment, or whether or not to develop new and/or maintain existing recreation sites. Effects-based information, for example, could include the amount of erosion caused by helicopter logging versus skidding, or where, when, how much, and what kind of recreation opportunities have been requested by the public.

Changes between Draft and Final EIS

Changes throughout the FEIS

Changes and updates in the FEIS have been made as a result of public comment received on the DEIS, consideration of updated or additional information, regulatory changes, clarification of potential resource effects of the project, and editorial changes for grammar, phrasing, and punctuation. Some table locations and format were rearranged to better facilitate reading flow. These changes are minor and do not change the effects conclusions or activities under any of the alternatives. Some specific updates include the following:

Chapter 2

All action alternatives were updated to allow limited, short-term (up to 3 years) public access along proposed temporary roads, where there are no specific safety or resource concerns, to gather firewood or biomass, once timber harvest activities are complete. These roads will then be decommissioned. This short term allowance will not change the overall effects analysis for resources. Each road will be reviewed during harvest activities for availability of firewood and biomass. If temporarily leaving the road open for utilization of this material causes undo resource impacts, the road would be decommissioned immediately.

Proposed National Forest System roads designated for storage (Maintenance Level 1) will remain open (Maintenance Level 2) for 3-5 years once timber harvest activities are complete to allow for firewood or biomass collection. These roads will then be placed into storage to reduce maintenance costs. This short term allowance will not change the overall effects analysis for resources. Each road will be reviewed during harvest activities for availability of firewood and biomass. If temporarily leaving the road open for utilization of this material causes undo resource impacts, the road would be stored immediately.

Table 4, Comparison of Alternatives by Issue, was added near the end of Chapter 2 to summarize how the alternatives address the five issues for this project.

Chapter 3

Clarifying information has been added to Air Quality and Climate Change

Clarifying information has been added to Inventoried Roadless Areas

Issue 1: Invasive Plant Management

- Clarification of cost effectiveness statistics between alternatives.
- Added text clarifying how our analyses under Herbicide Exposure address recent court rulings related to glyphosate exposure and toxicity as a carcinogen.
- Text and analyses that included EDRR in Chapters 2 and 3, where it was included as a component of Alternatives 2 and 5, was removed. This clarified that EDRR was only to be considered as a component of Alternative 3.

Issue 3: Timber Supply and Timber Sale Economics

- Discussion about falldown was added.
- Past export information has been added.
- Annual timber demand was updated for FY 18.

Issue 4: Watershed Function

- Effects of Forest Management Practices of Salmonid Stocks in the Affected Environment section.
- Remediation score for aquatic organism passage (AOP) was included in the project record.
- Temporary Barge Beach Access Points to the Effects Common to All Alternatives.
- Estimates of stream survey miles included in Methodology.
- Added references to Affected Environment and minor information additions made to tables in this section.

Issue 5: Wildlife Habitat

- Wildlife Habitat added discussion regarding migratory birds.
- Literary habitat thresholds were changed due to comments and to better reflect effects to habitat.
- Research and other documents requested by commenters were either determined to not apply to the POW LLA Project or were included in the FEIS.
- Discussion of the ermine was added to FEIS.

Socioeconomics

- Added cumulative effects of action alternatives
- Added information and reference about industrial capacity in Southeast sawmills
- Edited entire section for length and clarity

Appendices

- Appendix A (Activity Cards), Appendix B (Implementation Plan), and Appendix C (Present, and Reasonably Foreseeable Future Activities in the POW LLA Project Area) have minor editorial changes.

- Appendix C (Present and Reasonably Foreseeable Future Activities) – All lands estimated timber volume amounts has been updated to reflect most updated information.
- FEIS Appendix A and Appendix B will also be published as Appendix 1 and Appendix 2 with the draft ROD.
- FEIS Appendix D, Response to Comments, responds to public comments on the DEIS and identifies changes made in the FEIS as a result of public comments.

Regulatory Changes

The 2001 Roadless Area Conservation Rule (Roadless Rule) generally prohibits cutting trees and building roads in inventoried roadless areas (IRAs) on NFS lands. The 2016 Forest Plan Record of Decision (ROD, page 6) includes in the Selected Alternative that no old-growth or young-growth harvest will occur in IRAs identified in the 2001 Roadless Rule.

On August 30, 2018, the Forest Service published a Notice of Intent initiating an environmental impact statement (EIS) and public rulemaking process to address the management of IRAs on the Tongass National Forest within the State of Alaska. This rulemaking is the result of a petition submitted by Governor Bill Walker's administration in January 2018 on behalf of the State of Alaska, pursuant to the Administrative Procedures Act. The Forest Service has established a web page (https://www.fs.usda.gov/roadmain/roadless/alaskaroadlessrule) to update people on the process. This process is planned to be completed by summer of 2020.

The Alaska Roadless Rule will not make any changes to the 2016 Forest Plan or projects currently being implemented or proposed for implementation. Since no on-the-ground actions would be authorized through the rulemaking process, the Responsible Official determined that it would be unnecessary and inefficient to delay moving forward on the POW LLA Project until a potential Alaska Roadless Rule is reached.

Land Ownership Changes

There have been no changes to land ownership since the DEIS that would affect the project. The Alaska Mental Health Trust (AMHT) Land Exchange that was identified in the DEIS and on maps has not yet been finalized.

Alternatives Considered in Detail

The Forest Service is analyzing four alternatives, including No Action (Alternative 1), the proposed action (Alternative 2), and two additional action alternatives (Alternatives 3 and 5), in response to issues raised by the public. Alternative 4 was removed from detailed consideration in the DEIS (see *Alternatives Considered but Eliminated from Detailed Study* section, below). However, since Alternative 4 was included during the public comment period for preliminary Issues and Alternatives in December 2017 while the DEIS was being prepared, it was decided to not renumber the remaining alternatives in the DEIS or FEIS. The following section describes the four alternatives considered in detail.

Alternative 1 – No-Action

Alternative 1, the No-Action Alternative, required by the CEQ Regulations (40 CFR Section 1502.14(d)), provides a baseline to measure and compare impacts of the various action alternatives against and represents the existing condition in the project area. Under Alternative 1, none of the specific management activities in the FEIS would be implemented to accomplish project goals and objectives. Natural disturbances and current management of the project area would continue as before. Ongoing activities such as recreation, firewood gathering, road and trail maintenance, invasive plant treatments, and other routine forest management activities not associated with this decision would continue as authorized by previous decisions. As a result, this alternative does not meet the purpose and need for this project.

Action Alternatives 2, 3, and 5

Alternatives 2, 3, and 5 provide a range of options for meeting the purpose and need of this project and represent different ways of addressing the significant issues (see Chapter 1). Features common to all the action alternatives are described below followed by features specific to Alternatives 2, 3 and 5. Table 5 at the end of this chapter provides a comparison of actions alternatives by activity, including activities common to all action alternatives. More information regarding specific activities is included on the Activity Cards, Appendix A. Activities would be implemented when funding and personnel become available.

Features Common to All Action Alternatives

Alternatives were designed by describing the conditions being targeted for treatments, what thresholds cannot be exceeded in an area, or placing limits on the intensity of specific activities. GIS queries were used to determine potential areas in which some activities may occur based on existing conditions. This included but was not limited to existing vegetation, known invasive plant populations, stream reaches, existing recreation sites, and road barriers to fish passage (Red crossings). This information enabled the Forest Service to develop alternative design criteria for the action alternatives. The design criteria for each alternative are described below.

Logging System and Transportation Analysis

The Logging System and Transportation Analysis (LSTA) identifies potential stands for timber harvest as well as the transportation network needed to access those stands. See Commercial Vegetation Management Map, online at http://www.fs.usda.gov/goto/tongass/powlla.

No alternative would harvest all stands identified in the LSTA, only the acreage needed to meet the harvest level for the alternative would be harvested (see Table 2 below). Similarly, no alternative would construct all roads identified in the LSTA, only those needed to harvest the selected stands. The total acreage and maximum miles of road construction under any one alternative is expected to change based on the logging systems used and where harvest occurs on the landscape, but would not exceed the amount identified within that alternative (see Table 2 below).

The old-growth volume per acre is estimated at 14 MBF per acre across the project area based on a weighted average of reconnaissance strata data, explained in detail in Issue 3. For young-growth analysis, Alternative 2 used 25 MBF per acre to determine which stands may potentially be treated. This gives a conservative estimate on the volume per acre needed to reach an economical offering, but does reduce the acreage and volume available earlier in the project time line. Alternatives 3 and 5 used 22 MBF per acre to determine which young-growth stands may be potentially treated. This would increase the acreage and volume available in the earlier portions of the project timeline while still striving to meet the minimum volume per acre for economical timber offerings.

The Activity Cards and Implementation Plan further detail the requirements to implement timber harvest or road construction.

Table 2. Potential harvest volume acres and associated miles of road construction by alternative.

	Total LSTA	Alt 1	Alt 2	Alt 3	Alt 5
Harvest Levels by Alternative (MMBF) for 15 years					
Old Growth	423	0	235	115	75
Young Growth	Alt 2: 758 Alts 3 & 5: 743	0	421	529	529
Total volume			656	644	604
Harvest Levels by Alternative (acres)					
Even-aged Management Old-growth harvest	-	0	9,972	3,253	4,244
Uneven-aged Management Old-growth harvest	-	0	13,297	9,760	2,122
Total Old Growth	48,140	0	23,269	13,014	6,365
Even-aged Management Young-growth harvest	-	0	15,156	15,630	15,630
Uneven-aged Management Young-growth harvest	-	0	4,210	21,040	21,040
Total Young Growth	77,389	0	19,366	36,670	36,670
Road Construction Associated with Harvest (miles)					
Temporary Road	505	0	129	173	180
NFS Road	138	0	35	48	49

Access and Travel Management Plan and Travel Analysis

The POW LLA Project EIS incorporates by reference the decision on the Access and Travel Management Plan Environmental Assessment for Prince of Wales and Surrounding Islands (USDA Forest Service, 2009, as amended). This document will continue to guide travel management within the project area and no changes to objective maintenance levels for existing roads are proposed as part of the POW LLA Project. Designated routes and areas are reviewed annually and when approved changes are implemented. The Motor Vehicle Use Map (MVUM) shows the designated routes and areas along with class of vehicles authorized and, if appropriate, times of year for which use is authorized. The annual review of the Access and Travel Management Plan will be conducted as described in Appendix B.

A travel analysis for this project was conducted in accordance with FSH 7709.55 for proposed NFS roads. The recommended operational and objective maintenance levels for each road were assigned and a proposed travel management strategy assigned. The project travel analysis is found in the project record.

Fish Habitat Restoration and Improvement

Activities will be implemented based on the ROD and the availability of funding and personnel. Activities could occur in the following locations in any of the action alternatives (see also Watershed Improvement and Restoration Treatments Map online at http://www.fs.usda.gov/goto/tongass/powlla).

Fish habitat restoration

108 Creek
142F Creek
Alder Creek
Big Salt Lake
Buster Creek
Camp Creek
Chuck Creek
Coffman Creek
Deer Creek
Dog (Chum) Creek
Dolores Creek
Eagle Creek
Flicker Creek
Harris River
Hatchery Creek
Hydaburg River
Inlet Creek
Klawock Lake
Logjam Creek
Luck Lake
Maybeso Creek
Port Saint Nicholas Creek
Ratz Creek
Red Bay Creek
Reynolds Creek
Rio Beaver
Sal Creek
Salt Chuck
Saltery Creek
Shaheen Creek
Slide Creek
Slow Creek
Snug Creek
Staney Creek
Thorne River
Turn Creek
Twelvemile Arm
Yatuk Creek

Fish habitat improvement

Control Creek/Balls Lake
Devil Lake
Eek Lake
Manhattan Creek
Nichols Lake
Rio Roberts
Sarkar Creek
Welcome Lake

Recreation Activities

Similar to fish habitat activities, recreation activities will be implemented based on the ROD and the availability of funding and personnel and could occur in the following locations in any of the action alternatives (see also Sustainable Recreation Map online at http://www.fs.usda.gov/goto/tongass/powlla):

Three-sided shelters and/or cabins at or near:

Canoe Point
The Palisades
Fern Point
Point Gertrudis
Eagle Island, Sea Otter Sound
Hydaburg
Near South POW Wilderness
Mable Bay
Jackson Island
Port Refugio LTF
Sal Creek
Cape Ulitka
Little Veta Bay
Arena Cove
Winter recreation alpine areas

New trails or trail improvements:

Luck Creek
Honker Divide Trail
Deweyville
Rio Beaver
Rio Roberts Fish Pass
Sunnahae
Sarkar canoe route/portages
Suemez Island
Rabbit Ears—ORV Trail (Coffman Cove)
Roller Bay to Cape Ulitka
Port San Antonio to Little Veta Bay
Port Refugio to Arena Cove
Memorial Beach
Through old-growth forests
Convert roads to trails
Harris River trail system connecting Gándlaay Háanaa Trail and Harris River interpretive sites and a hut-to-hut trail system

Campsites and Recreation Vehicle (RV) pads:

Luck Lake day-use area	El Capitan	Near Hydaburg

Winter recreation:

Upper Steelhead	Baird Peak	Ridge lines east of the
One Duck	Sunnahae	North Thorne drainage
Barron Mountain	West Ridge near Polk Inlet	Near Control Lake

Develop, improve, and/or enhance maintenance of the existing recreation infrastructure:

El Capitan	Control Lake Cabin	Cutthroat Road
Ratz Harbor	Balls Lake	
Memorial Beach	Eagles Nest Campground	

- New boat launches and/or docks included Calder Bay, Port Refugio, and Port San Antonio.
- Improve signage and maintenance of the Salt Chuck Mine site.
- A picnic day-use area was identified near Neck Lake.

Wilderness

All action alternatives include manual and mechanical treatment of invasive plants across the project area, including in designated wilderness. The Forest Service has conducted a minimum requirements analysis (MRA) to determine if the treatment of invasive plant species is necessary for the administration of wilderness, and the minimum activity to accomplish the action. The final MRA determination has been made by the Regional Forester. The MRA allows for site-specific, professional judgment when determining weed treatment options, including: hand-pulling, tarping, and various means of applying herbicides.

With the exception of invasive plant treatment, activities proposed under this project in wilderness areas were not included in any alternative because the authority to make decisions in wilderness areas is reserved to the Chief of the Forest Service or the Regional Forester, or because activities require additional procedures beyond those required by the National Environmental Policy Act. They may be analyzed in the future as separate projects.

Watershed Restoration

Watershed restoration activities would improve watershed condition and restore aquatic habitat degraded by past management. A 2015 assessment identified about 30 watersheds in the project area with known restoration needs (*High Potential Restoration Watersheds* spreadsheet in the project record). Public involvement recommended stream restoration activities in twenty of these watersheds. The Watershed Classification and Assessment Tracking Tool (WCATT) scores with larger numbers indicate poorer watershed conditions. Watersheds with a score of 1 indicate that essential projects have been completed. The 22 watersheds with the highest potential for restoration in the project area are listed in Table 3.

Table 3. Forest Service watershed restoration priorities according to WCATT scores and correlation to public input

6th Level HUC[1]	HUC Name	2015 WCATT Score (NFS land)	Correlates to public input[2]
190101031003	Staney Creek	1.6	yes
190101030205	Rio Beaver	1.6	yes
190101030207	Outlet Thorne River, Falls, Gravelly	1.6	yes
190101030303	Twin Island Lake-Big Creek-108 Creek	1.6	yes
190101030307	Eagle Creek	1.6	yes
190101030308	Ratz Creek	1.6	yes
190101030309	Slide Creek-Frontal Clarence Strait - Sal	1.6	yes
190101030310	Thorne Bay-Frontal Tolstoi Bay - Deer Creek	1.6	yes
190101030501	Twelvemile Creek	1	yes
190101030503	Maybeso Creek	1.6	yes
190101030506	Karta Bay-Frontal Kasaan Bay	1.5	no
190101030502	Indian Creek-Harris River	1	yes
190101030504	Twelvemile Arm-Frontal Kasaan Bay	1.4	yes
190101030904	Flicker Creek	1.4	yes
190101030101	Headwaters Logjam Creek	1.4	yes
190101030103	Outlet Logjam Creek	1.4	yes
190101031005	Shaheen Creek	1.4	yes
190101031007	Warm Chuck Inlet-Frontal Tonowek Bay - Chuck Creek	1.4	yes
190101030901	Red Lake-Big Creek	1.3	yes
190101030903	Buster Creek	1.3	yes
190101030102	Hatchery Creek	1.3	yes
190101030204	190101030204-Marty Mountain (Thorne River)	1.3	yes

1 Hydrologic Unit Code
2 Public input from Attachment 3 POW LAT letter 06/05/2017, project record # 833_0926.

Watershed Restoration Action Plans (WRAP) will be developed to identify the essential activities necessary to improve watershed condition. The WRAPs are informed by existing data and field assessments of roads and drainage structures, streams, riparian vegetation, landslides, and invasive species.

Stream assessments completed to date are displayed on the Watershed Improvement and Restoration Treatments Map (see Watershed Improvement and Restoration Treatments Map online at http://www.fs.usda.gov/goto/tongass/powlla). Additional streams may be considered for restoration if future assessments determine that fish habitat and or hydrological condition have been degraded. Restoration activities could occur on both NFS lands and non-NFS lands in cooperation with other landowners.

Other Activities

These are additional activities common to all action alternatives, not listed above:

- The Forest Service proposes to precommercially manage approximately 4,500 acres of young-growth stands annually using various treatments to achieve timber, wildlife, or riparian objectives for the stands.
- The Forest Service proposes to plant tree seedlings within selected harvest units to enhance species composition if post-harvest evaluation determines that artificial reforestation is beneficial. Seed may be obtained by cone collection, for the purposes of tree seedling generation.
- The Forest Service proposes wildlife tree creation using methods such as blasting, girdling, and fungal inoculation in young-growth stands.
- The Forest Service proposes that stream-crossings within the project area that do not allow for fish and aquatic organism passage at all flows, referred to as ‘‘Red crossings,’’ may be replaced with appropriate structures, removed, or permitted with the Army Corps of Engineers.
- The Forest Service proposes to improve karst systems that have been impacted from past management by removing blockages to restore natural water flows into karst features. Young-growth stands adjacent to impaired karst systems may be thinned to increase precipitation throughfall to increase spring flow and to flush accumulated sediment.
- Development or improvement of up to 70 sites (FS Agreement No. 06MU-11100100-151 MOU between Forest Service and State of Alaska, in the project record) for marine access facilities (MAF) within the project area for recreation or timber removal. This Memorandum of Understanding (MOU) is effective through December 31, 2018 it may however be extended by written mutual consent of the parties to the MOU. MAFs may include log transfer facilities (LTF), docks, boat ramps, floats, buoys, anchorages, breakwaters, boat haulouts, and similar improvements and facilities. These sites are not always associated with a road but may be used for a shoreline location such as near a cabin or shelter.
- The Forest Service will consider opportunities for fresh- and saltwater canoe and kayaks access points, which could include spur trails, roadside pullouts, and shoreline improvements to mitigate bank degradation.
- Infrastructure actions: Road maintenance and use; management of system and temporary roads, including construction, maintenance, and potential storage of system roads and decommissioning of temporary roads after project implementation (maintenance level changes may occur); collection and placement of various materials (rocks, trees, logs) for stream restoration, use and development of new and existing rock pits (for both road needs and personal use); reconstruction and maintenance of marine access facilities and log transfer facilities; and infrastructure to access recreational sites. The Forest Service may construct up to two new LTFs.
- Non-infrastructure actions: Site preparation, hazard tree removal, wildlife-proof garbage can installation and maintenance, brushing and brush disposal, and viewshed improvement.

Features Specific to the Action Alternatives

Alternative 2 – Proposed Action

Alternative 2 is the project’s proposed action, designed to meet the purpose and need as stated for the project. A highly collaborative, public process was used to develop Alternative 2. During scoping and throughout the collaborative process, the Forest Service received suggestions for a wide array of site-specific activities and management strategies. Input from local youth, Prince of Wales Landscape

Assessment Team (a local independent collaborative group), tribes, and the general public were used to finalize the proposed action.

The intent of Alternative 2 is to provide a variety of management activities that would support a stable long-term economy for the local communities while maintaining important fish and wildlife habitat. The proposed old-growth and young-growth harvest volume would provide an opportunity for local mills to shift to a primarily young-growth industry as outlined in the Forest Plan.

Vegetation Management

- Alternative 2 could offer up to an average of 25 MMBF of old-growth timber annually from suitable timber lands during the first 5 years of implementation, and up to an average of 15 MMBF of old-growth timber annually during the next 5-year period. An evaluation of the amount of old-growth timber remaining within the project area would occur 10 years after the decision, to determine if economical offerings are still available from the suitable timber land base during the last 5-year period of the project. This evaluation would be conducted using the Implementation Plan process. Based on this evaluation up to 10 MMBF of old-growth timber may be offered for years 10 and 11 of the project and up to 5 MMBF of old growth timber for the final 3 years.
- Alternative 2 would offer an average of 3 MMBF annually of young growth during the first 7 years of implementation and an average of 50 MMBF of young-growth timber annually during the next 8-year period, from suitable lands as defined under the Forest Plan. Young growth harvested under this alternative would occur in stands that generally have not reached 95 percent of culmination of mean annual increment (CMAI). Commercial harvest stands will, however, have generally reached a level of growth where at least 50 percent of the total volume occurs in trees with a merchantable height suitable to produce two 34-foot logs.
- An old-growth small sales strategy was developed to address concerns raised through public comment. The strategy would ensure economical old-growth timber is available for small operators within the project area, including availability beyond the 15-year timeline of this project, until sufficient young-growth timber is available to supplement their volume needs.

  For each old-growth large sale greater than 10 MMBF, an amount equal to 25 percent of that sale volume must be identified from the remaining potential old-growth timber stands and placed in a pool for small sales offerings. Those designated stands should meet the following criteria: 1) be generally within ¼ mile of existing or planned road connected to the road system on POW and Kosciusko Islands; 2) contain green timber with volume, species composition, and economic viability suitable for small operators; 3) be compatible with yarding systems in use by and available to small operators, generally ground-based and short-span cable systems; and 4) generally be offered with less than 3 MMBF per contract to meet the harvest and milling capacities of small operators.
- Old- and young-growth commercial harvests would use various prescriptions and logging systems, and would provide material to local mill operators through large sales, small sales, salvage sales, and microsales. Harvested trees generally are removed without the limbs and tops attached. However, the limbs, tops, and cull material could potentially be used as biomass, or other products. Commercial harvest of both old and young growth within a 5-mile radius around communities would use harvest prescriptions to improve or maintain deer habitat and existing wildlife corridors.
- Alternative 2 uses various treatments including thinning, girdling, pruning, and slash treatments to improve wildlife habitat in young-growth stands. Treatments would be prioritized in deep snow habitat (south-facing stands below 800 feet in elevation) when consistent with stand objectives and desired future conditions.

Watershed Improvement and Restoration Treatments

- Alternative 2 includes instream restoration activities on up to 200 miles of stream within the project area in any watershed identified as having need to restore proper functioning condition, including but not limited to those listed in Table 3. The Forest Service would consider opportunities for interpretive signs within restored watersheds for public education.
- Alternative 2 includes multiple fish habitat improvements such as lake fertilization, egg incubation boxes, fry stocking, and barrier modifications for fresh water systems to improve wild sockeye salmon runs in areas that historically produced larger runs, or to improve/provide Pacific salmon access to spawning and rearing habitat.
- Alternative 2 includes the use of manual and mechanical treatments, as part of an integrated pest management approach, to eradicate or control existing and new infestations of non-native, invasive plants. No herbicide would be used to treat invasive plants under this alternative.

Sustainable Recreation Management

Possible recreation activities on National Forest System lands include maintenance of existing recreation infrastructure, improvements to existing facilities, and construction of new infrastructure. As funding allows, construction may include outhouse facilities to accompany certain proposed recreation sites. Sustainable Recreation Management activities include:

- Alternative 2 includes development of up to three new cabins and up to twelve new shelters that are boat or road accessible. Existing cabins may be decommissioned, but would be replaced in a more accessible location that has a higher potential for use. The goal is to have no net loss of cabins.
- Alternative 2 includes development of up to 50 miles of new trails. Trail uses may include walking, hiking, bicycling, mountain biking, and off-highway vehicles. Maintenance on existing trails would continue, but improvements would only occur on trails that have regular use and a need for improvements. Spur trails to recreation structures may be developed. Interpretive information along new or existing trails would also be considered. Road-to-trail conversions would be considered.
- Alternative 2 includes development of up to three new campgrounds and decommissioning Harris River Campground in exchange for developing the campground at El Capitan.
- Alternative 2 includes development of interpretative and informational signs that would be associated with recreation infrastructure and along roads and trails.
- Alternative 2 includes development of up to eight winter sport access points and areas for over-the-snow vehicle use. This may include pullouts, vegetation clearings wide enough (up to 60 feet) to facilitate snow cover of clearings and provide access to subalpine/alpine locations, and warming huts.
- Alternative 2 includes development of a picnic day-use area near Neck Lake. In addition, to support input from local youth, the Forest Service would consider permitting a day use area on the island for uses such as Frisbee golf, archery, and other youth activities.

Associated Actions

The Forest Service could construct about 35 miles of NFS road and about 129 miles of temporary road associated with the amount of commercial timber volume offered (Table 2).

Alternative 3

Alternative 3 addresses public concerns from past management and its effects to the spread of invasive plants (Issue 1), subsistence opportunities (Issue 2), watershed function (Issue 4) and wildlife habitat (Issue 5) while supporting local small mills and providing a limited time for larger mills to increase their utilization of young-growth or locate another source of old-growth to supplement their timber supply (Issue 3). It reduces old-growth harvest, emphasizes more young-growth harvest sooner, and incorporates other design criteria beyond what is required in the Forest Plan to limit the effects of harvest and emphasizes improvements in habitat on NFS lands adjacent to non-NFS land. Also see Table 5.

This alternative addresses all issues to some degree in its design, but emphasizes Issues 1, 2, and 5 by maintaining and improving wildlife habitat across the landscape, increasing the use of uneven-aged management to achieve wildlife habitat goals, and including herbicides to control invasive plant populations. It emphasizes a more rapid shift to primarily young-growth harvest, requiring mills to increase their utilization of young-growth or locate another source of old-growth to supplement their timber supply (Issue 3). It has a reduced amount of stream restoration and fish habitat improvement activities proposed, but would avoid increases to peak flow rates in all watersheds (Issue 4).

Vegetation Management

- Alternative 3 could offer up to an average of 10 MMBF of old-growth timber annually from suitable timber lands within the project area during the first 5 years of implementation, up to an average of 8 MMBF of old-growth timber annually during the next 5-year period, and up to an average of 5 MMBF old-growth timber annually during the last 5-year period. The old-growth stands in the area "North of 20 Road" would only be harvested as part of sales of less than 3 MMBF (see Commercial Vegetation Management Map).
- Alternative 3 could offer an average of 7 MMBF annually of young growth during the first 7 years of implementation and an average of 60 MMBF of young-growth timber annually during the next 8-year period, from suitable lands as defined under the Forest Plan. Young growth harvested under Alternative 3 would occur in stands that generally have not reached 95 percent of culmination of mean annual increment (CMAI). Commercial harvest stands will, however, have generally reached a level of growth where at least 50 percent of the total volume occurs in trees with a merchantable height suitable to produce two 34-foot logs.
- An old-growth small sales strategy was developed to address concerns raised through public comment. The strategy would ensure economical old-growth timber is available for small operators within the project area, including availability beyond the 15-year timeline of this project, until sufficient young-growth timber is available to supplement their volume needs.

  For each old-growth large sale greater than 10 MMBF, an amount equal to 60 percent of that sale volume must be identified from the remaining potential project old-growth timber stands and placed in a pool for small sales offerings. Those designated stands should meet the following criteria: 1) be generally within ¼ mile of existing or planned road connected to the road system on POW and Kosciusko Islands; 2) contain green timber with volume, species composition, and economic viability suitable for small operators; 3) be compatible with yarding systems in use by and available to small operators, generally ground-based and short-span cable systems; and 4) generally be grouped and offered with less than 3 MMBF per offer to meet the harvest and milling capacities of small operators.
- Old- and young-growth commercial harvests would use various prescriptions and logging systems, and would provide material to local mill operators through large sales, small sales, salvage sales, and microsales. Harvested trees generally are removed without the limbs and tops

attached. However, the limbs, tops, and cull material could potentially be used as biomass, or other products.

- Alternative 3 includes use of slash treatments in harvested young-growth stands in beach buffers, old-growth reserves (OGR), and on south-facing stands below 800 feet in elevation (high-value deer winter habitat) when consistent with stand objectives and desired future conditions.
- Alternative 3 includes use of uneven-aged management prescriptions for young-growth treatments on south-facing stands below 800 feet in elevation in WAAs with greater than 10 percent estimated deer harvest of the estimated deer habitat capability (DHC).
- Alternative 3 includes single-tree selection (STS) harvest of old growth on south-facing stands below 800 feet in elevation in Wildlife Analysis Areas (WAA) with estimated deer harvest greater than 10 percent of the estimated DHC and in VCU 5280.
- Alternative 3 incorporates various young-growth harvest recommendations from the *Interagency Wolf Habitat Management Program* (see Table 15).
- Prescribed burning may occur in young growth treated stands and would be limited to south-facing stands less than 800 feet in elevation in an effort to promote longer-term sustained deer forage in high-value deer winter habitat within non-development LUDs. The proposed blocks of burning would average less than 10 acres in size.
- Alternative 3 emphasizes maintaining or improving wildlife habitat by using uneven-aged management prescriptions and maintaining or creating wildlife travel corridors in areas with previous or proposed harvest.

Watershed Improvement and Restoration Treatments

- Alternative 3 limits instream restoration activities to a total of 80 miles of stream within the project area, representing the highest priority based on field assessments and public input to address public concerns about an increase in the amount of stream restoration activities.
- Alternative 3 only includes barrier modifications for fresh water systems for improving Pacific salmon access to spawning and rearing habitat.
- Alternative 3 avoids increasing peak flow rates in all watersheds through design and scheduling of canopy openings created by timber harvest.
- Alternative 3 would authorize the use of manual, mechanical, and herbicide treatments, as part of an integrated pest management approach, to eradicate or control existing and new infestations of non-native invasive plants.

Sustainable Recreation Management

Alternative 3 was designed to address public concerns about developing more recreational sites within the project area. Alternative 3 fosters a sustainable recreation program by: 1) focusing on maintenance of existing recreation site; 2) limiting development of new sites so there is no net increase in the number of recreation sites, and to those where maintenance costs are anticipated to be low; and 3) decommissioning low-use sites with high maintenance costs.

Alternative 3 Sustainable Recreation Management activities may include:

- Limiting outhouse development to vault toilets at existing road accessible locations.
- Decommissioning existing cabins where use levels do not justify the maintenance cost.
- Improvement of popular and high use trails, which support the associated maintenance and development costs.

- Implementation of road to trail conversions after evaluating public input and district staff assessments of development and maintenance costs.
- Establishing up to twelve semi-developed sites, with a tent platform/pad, picnic table, and fire ring. Site selection would be based on road or boat accessibility.
- Decommissioning or downsizing the Harris River Campground.
- Developing informational signs associated with new recreation sites.
- Developing winter sport access points and areas where documented public support indicates potential high use for over-the-snow recreation. Development would include pullouts and vegetation clearing (up to 60 feet) to facilitate snowmobile access to open sub-alpine/alpine areas.

Associated Actions

Alternative 3 includes construction of about 48 miles of NFS road and about 175 miles of temporary road in association with the amount of commercial timber volume offered.

Alternative 5

Alternative 5 was developed in response to public comments on the December 2017 *Draft Issues and Alternatives* document. Concerns were expressed that the Forest Service did not fully consider reducing the amount of old-growth timber for offer. The other components of this alternative are similar to either Alternative 2 or 3 for each activity listed, depending on which best aligned with comments received during this comment period (see Table 5).

Alternative 5 addresses all issues to some degree in its design, but emphasizes Issues 2, 4, and 5 by incorporating up to 200 miles of stream restoration, maintaining and improving wildlife habitat across the landscape and requiring mitigating efforts to avoid detectable increases to peak flow rates. It incorporates manual and mechanical treatments to eradicate, control, or contain populations of invasive plants (Issue 1). Like Alternative 3, it emphasizes a more rapid shift to primarily young-growth harvest which would require local mills to increase their utilization of young-growth or locate another source of old-growth to supplement their timber supply (Issue 3).

Vegetation Management

- Alternative 5 could offer up to an average of 5 MMBF of old-growth timber annually from suitable timber lands within the project area throughout the life of the project. The area “North of the 20 Road” would not be considered for old-growth harvest (see Commercial Vegetation Management Map).
- Alternative 5 could offer an average of 7 MMBF annually of young growth during the first 7 years of implementation and an average of 60 MMBF of young-growth timber annually during the next 8-year period, from suitable lands as defined under the Forest Plan. This is the same as in Alternative 3.
- Old- and young-growth commercial harvests would use various prescriptions and logging systems, and would provide material to local mill operators through large sales, small sales, salvage sales, and microsales. Harvested trees generally are removed without the limbs and tops attached. However, the limbs, tops, and cull material could potentially be used as biomass, or other products.
- The wildlife habitat treatments in commercial young-growth stands are the same as Alternative 3 including slash treatments and use of uneven-aged management prescriptions.

- Alternative 5 includes no old-growth harvest on south-facing stands below 800 feet in elevation in Wildlife Analysis Areas (WAA) with estimated deer harvest greater than 10 percent of the estimated deer habitat capability (DHC) and in VCU 5280.
- Alternative 5 incorporates all of the recommendations from the *Interagency Wolf Habitat Management Program,* which include broader mitigation measures for wolves and deer habitat, such as young-growth treatments to improve deer habitat.
- Prescribed burning may be use to promote long-term deer forage in all deer habitats. The proposed blocks of burning would average less than 10 acres in size.
- Alternative 5 emphasizes maintaining or improving wildlife habitat by using uneven-aged management prescriptions and maintaining or creating wildlife travel corridors in areas with previous or proposed harvest.

Watershed Improvement and Restoration Treatments

- Alternative 5 includes instream restoration activities on up to 200 miles of stream in any watershed identified as having need to restore proper functioning condition. The Forest Service would consider opportunities for interpretive signs within restored watersheds for public education. This is the same as in Alternative 2.
- Alternative 5 includes lake fertilization and barrier modifications only in freshwater systems to improve wild sockeye salmon runs in areas that historically produced larger runs or to improve/provide Pacific salmon access to spawning and rearing habitat.
- Alternative 5 includes use manual and mechanical treatments, as part of an integrated pest management approach, to eradicate or control existing and new infestations of non-native, invasive plants. This is the same as in Alternative 2.

Sustainable Recreation Management

Alternative 5 recreation activities on National Forest System lands include maintenance of existing recreation infrastructure, improvements to existing facilities, and potential construction of new infrastructure. As funding allows, construction may include outhouse facilities to accompany certain proposed recreation sites. Sustainable Recreation Management activities are the same as in Alternative 2 and include:

- Alternative 5 includes development of up to three new cabins and up to twelve new shelters that are boat or road accessible. Existing cabins may be decommissioned, but would be replaced with a more accessible location that has a higher use potential. The goal is to have no net loss of cabins.
- Alternative 5 includes development of up to 50 miles of new trails. Trail uses may include walking, hiking, bicycling, mountain biking, and off-highway vehicles. Maintenance on existing trails would continue, but improvements would only occur on trails that have regular use and a need for improvements is identified. Spur trails to recreation structures may be developed. Interpretive information along new or existing trails would also be considered. Road-to-trail conversions would be considered.
- Alternative 5 includes developing up to three new campgrounds and decommissioning Harris River Campground in exchange for developing a campground at El Capitan.
- Alternative 5 may develop interpretative and informational signs that would be associated with recreation infrastructure and along roads and trails.

- Alternative 5 includes developing up to eight winter sport access points and areas for over-the-snow vehicle use. This may include pullouts and vegetation clearings (up to 60 feet) to provide access to subalpine/alpine locations, and warming huts.
- Alternative 5 includes a picnic day-use area near Neck Lake. In addition, to support input from local youth, the Forest Service would entertain proposals to permit a day use area on the island for uses such as Frisbee golf, archery, and other youth activities.

Associated Actions

Alternative 5 could construct about 49 miles of NFS road and about 180 miles of temporary road associated with the amount of commercial timber volume offered.

Identification of the Preferred Alternative

In the DEIS, no alternative was identified as the preferred alternative. After consideration of public input during scoping and comments to the DEIS, the Responsible Official has identified Alternative 2 as the preferred alternative that will best contribute to economic and social resilience of project area communities and the wellbeing of the forest. However, any of the alternatives, or portions of them, could be selected by the Responsible Official in the Record of Decision.

Design Criteria and Mitigation Common to All Action Alternatives

All action alternatives comply with Forest Plan direction, LUDs, and Best Management Practices (BMP) designed for the protection and management of forest resources, as well other relevant federal and state laws and regulations. Additional direction comes from applicable laws and Forest Service Manuals and Handbooks.

The analysis documented in this FEIS discloses both beneficial and adverse effects that may occur from implementing the actions proposed under each alternative. Both design criteria and mitigation measures alleviate potential adverse effects from natural or human-caused disturbances. Mitigation includes doing any, or a combination, of the following: (a) avoiding the impact altogether by not taking a certain action or parts of an action, (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation, (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment, (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action, and (e) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

Project-specific design criteria and mitigation measures are included as part of the action alternatives, as applicable, and described in the Activity Cards, Appendix A. The Activity Cards describe each potential activity and the related resource considerations. Resource specialists used on-the-ground inventories, computer (GIS) data, and aerial photographs to assess project area conditions and resource-specific concerns, describing on the cards how these concerns would be mitigated (if not completely avoided) for each activity. See Appendix A. Resource concerns and mitigation measures may be refined further by specialists after specific activity locations and details are identified, and documented through the Implementation Plan process.

Alternatives Considered but Eliminated from Detailed Study

Federal agencies are required to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the proposed action provided suggestions for alternative methods for achieving the purpose and need. Some of these alternatives were outside the scope of the project, did not meet the purpose and need of the project, were similar to the alternatives considered in detail, or were determined to include components that would cause unnecessary environmental harm. Therefore, the following four alternatives were considered, but dismissed from detailed consideration for reasons summarized below.

1. An alternative was considered that would:

- offer no old-growth sales;
- limit the amount of young-growth offered for sale until it meets culmination of mean annual increment (CMAI) requirements;
- require all young-growth prescriptions to be uneven-aged management; and
- maximize watershed restoration, wildlife habitat improvements and recreation opportunities.

This alternative was eliminated because timber volumes under this alternative would not sustain a local timber industry to meet the purpose and need of this project. It does not meet the need for a sustainable level of forest products to contribute to the economic viability of Prince of Wales area communities and does not address the need for young-growth forests to produce future desired resource values, products, services, and forest health conditions that sustain the diversity and productivity of forested ecosystems.

2. An alternative was considered that would:

- limit old-growth offerings to 5 MMBF annually for small purchasers and cottage industry only;
- only allow uneven-aged management prescriptions in high-value wildlife habitat;
- allow offerings of 9.2 MMBF annually of young-growth harvest for the first 10 years post decision and maximizing offerings as possible using the authorities in the Forest Plan;
- decommission some existing low-use recreation facilities and focus on maintaining highly used existing facilities; and
- focus restoration activities on protecting the existing instream investments (Harris River, Sal Creek, Twelvemile, Staney Creek, and Luck Creek); and
- implement precommercial thinning activities.

This alternative was eliminated because the young-growth, recreation, and restoration activities fall within the range of alternatives considered in detail. Alternatives 3 and 5 have a reduced amount of old-growth harvest that would support local small mills or "cottage industry" while providing a limited time for larger mills to increase their utilization of young-growth or locate another source of old-growth to supplement their timber supply. Alternatives 2, 3, and 5 address high-value habitat needs by maintaining or improving wildlife habitat and corridors across the landscape and implement instream habitat restoration activities, and Alternatives 3 and 5 stagger entries to minimize peak flow rate increases.

3. An alternative was considered that would:

- maximize the old-growth offering up to 100 MMBF annually;
- require even-aged prescriptions to be used where cable or shovel yarding is feasible;
- reclaim rock from existing roads to build new roads;
- not allow young-growth offerings until stands meet CMAI requirements;
- not allow timber stand improvement or timber stand establishment treatments to be implemented;

- decommission existing low-use recreation facilities, focus on maintaining highly used existing facilities, and not construct any new recreation facilities; and
- not implement any new restoration activities.

This alternative was eliminated because it does not meet the purpose and need for this project. It does not meet the need for young-growth forests to produce future desired resource values, products, services, and forest health conditions that sustain the diversity and productivity of forested ecosystems. Nor does it meet the need for restoration activities in some watersheds to reestablish self-sustaining habitats that promote viable fish, wildlife, and plant populations. It does not meet the need to expand opportunities for growth in the recreation and tourism business sectors. The amount of old-growth volume requested could eliminate all currently available old growth within 10 years and does not meet the need to provide a sustainable level of forest products to contribute to the economic viability of communities in the project area into the future.

4. An alternative, initially introduced as Alternative 4, which would:

- allow young-growth and old-growth timber harvest in 2001 Roadless Area Conservation Rule Inventoried Roadless Areas (IRA), phase II and III lands identified in the Tongass Timber Program Adaptive Management Strategy, T77 watersheds, and The Nature Conservancy/Audubon Conservation Priority Areas;
- increase the number of recreation sites within the project area and would not decommission any existing recreation facility;
- consider fish habitat improvements such as lake fertilization, egg incubation boxes, and barrier modifications for fresh water systems that have shown a decrease in fish population or have potential for increased habitat;
- conduct stream restoration activities on up to 200 miles of stream within the project area in any watershed identified as having need to restore proper functioning condition;
- allow manual, mechanical, and herbicide treatments; and
- be deferred until agency rulemaking potentially modifies the regulations at 36 CFR 294.13(b)(4) (2001) (the "Roadless Rule") and any needed subsequent Forest Plan amendments.

This alternative was introduced during the comment period on Issues and Alternatives in December 2017 as Alternative 4, primarily designed in response to address public comments requesting that we maximize the available productive timber stands for harvest by expanding the potential timber base into areas not available for commercial harvest under the Forest Plan, such as Inventoried Roadless Areas, Tongass 77 Watersheds, and The Nature Conservancy/Audubon Conservation Priority Areas. This would require a Forest Plan amendment in addition to changes to existing legislation or rulemaking. The Responsible Official decided to not amend the Forest Plan through this project to narrow the scope of analysis. This matches the corrected Notice of Intent published in the Federal Register for this project. All other proposed activities within Alternative 4, besides the expanded timber base and additional telecommunication sites that require a Forest Plan amendment, are included within one of the other alternatives being analyzed in detail. Therefore, Alternative 4 was eliminated from detailed consideration.

Comparison of Alternatives by Issue

Table 4. Effects Comparison of Alternatives by Issue using Units of Measure Identified for each Issue

Issue 1: Invasive Plant Management				
Unit of Measure	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 5**
Relative cost and treatment effectiveness by treatment method	Treatment costs would be lowest under the current funding levels for treating weeds under the existing CE. Avg. treatment cost per acre: $288 Avg. annual cost for assumed treatment target: $10,944 Estimated maximum acres treated annually: 38 acres Total acres restored over 15 years: 143 (about 25 percent restoration effectiveness) Avg. cost per restored acre: $1,148.	Treatment costs would be lowest under the current funding levels for treating weeds under the existing CE. Avg. treatment cost per acre: $288 Avg. annual cost for assumed treatment target: $10,944 Estimated maximum acres treated annually: 38 acres Total acres restored over 15 years: 143 (about 25 percent restoration effectiveness) Avg. cost per restored acre: $1,148	Avg. treatment cost per acre: $103 Avg. annual cost for assumed treatment target: $6,800 Estimated maximum acres treated annually: 100 acres Total acres restored over 15 years: 1,200 (about 80 percent restoration effectiveness) Avg. cost per restored acre: $86	Treatment costs would be lowest under the current funding levels for treating weeds under the existing CE. Avg. treatment cost per acre: $288 Avg. annual cost for assumed treatment target: $10,944 Estimated maximum acres treated annually: 38 acres Total acres restored over 15 years: 143 (about 25 percent restoration effectiveness) Avg. cost per restored acre: $1,148
Herbicide impacts on human health	Minor amounts of herbicide use would be used to treat invasive plant populations under this alternative under the existing CE at administrative and recreation sites and facilities. Exposure to human would be minimized by adhering to label instructions and additional project design features (PDF). Negligible Risk.	Minor amounts of herbicide use would be used to treat invasive plant populations under this alternative under the existing CE at administrative and recreation sites and facilities. Exposure to human would be minimized by adhering to label instructions and additional project design features (PDF). Negligible Risk.	No effect[1]– Imazapyr, Glyphosate, & Adjuvants for enhancing herbicide performance. Negligible effect – Aminopyralid. Negligible Risk.	Minor amounts of herbicide use would be used to treat invasive plant populations under this alternative under the existing CE at administrative and recreation sites and facilities. Exposure to human would be minimized by adhering to label instructions and additional project design features (PDF). Negligible Risk.
Herbicide impacts on non-target vegetation (includes rare and sensitive plants)	Minor effect[2]	Minor effect[2]	Minor effect[2]	Minor effect[2]

Herbicide impacts on soils	Minor short-term[2] effect to soil productivity and associated physical and biological components and processes. Adverse long-term effect could increase due to continued expansion of current infestations, establishment of new populations, and increased soil erosion in localized areas.	Minor short-term[2] effect to soil productivity and associated physical and biological components and processes. Adverse long-term effect could increase due to continued expansion of current infestations, establishment of new populations, and increased soil erosion in localized areas.	Minor short-term[2] effect to soil productivity and associated physical and biological components and processes. Beneficial long-term effects due to anticipated increase in native plant species.	Minor short-term[2] effect to soil productivity and associated physical and biological components and processes. Adverse long-term effect could increase due to continued expansion of current infestations, establishment of new populations, and increased soil erosion in localized areas.
Herbicide impacts on aquatic organisms	Cumulatively, short-term – minor effects[2] due to low number of infestations occurring within RMAs, near Class I and II streams and along shorelines and low toxicity of proposed herbicides under an existing CE. Potential long-term – adverse effect to aquatic organisms expected as weed populations grow and reduce productivity of riparian areas.	Cumulatively, short-term – minor effects[2] due to low number of infestations occurring within RMAs, near Class I and II streams and along shorelines and low toxicity of proposed herbicides under an existing CE. Potential long-term – adverse effect to aquatic organisms expected as weed populations grow and reduce productivity of riparian areas.	Cumulatively, short-term – minor effects[2] due to low number of infestations occurring within RMAs, near Class I and II streams, and along shorelines, and low toxicity of proposed herbicides. Long-term – effects are expected to be beneficial due to improved aquatic habitat. There could be some localized effects to aquatic macrophytes with the use of imazapyr. Glyphosate may cause sub-lethal effects to fish.	Cumulatively, short-term – minor effects[2] due to low number of infestations occurring within RMAs, near Class I and II streams and along shorelines and low toxicity of proposed herbicides under an existing CE. Potential long-term – adverse effect to aquatic organisms expected as weed populations grow and reduce productivity of riparian areas.
Herbicide impacts on water quality and riparian condition	Short-term – negligible[4] adverse effects to water quality and riparian condition for small infestations. Long-term – moderate, adverse effects in localized areas resulting from the expected spread of	Short-term – negligible[4] adverse effects to water quality and riparian condition for small infestations. Long-term – moderate, adverse effects in localized areas resulting from the expected spread of	Short-term – negligible[4], localized and adverse impacts on water quality and riparian condition. Long-term – negligible, localized and beneficial impacts to water quality and riparian condition.	Short-term – negligible[4] adverse effects to water quality and riparian condition for small infestations. Long-term – moderate, adverse effects in localized areas resulting from the expected spread of

	invasive weeds, particularly reed canarygrass.	invasive weeds, particularly reed canarygrass.		invasive weeds, particularly reed canarygrass.
Herbicide impacts on wildlife	Threatened and Endangered Species - No effect[3] Sensitive Species - No effect[3] MIS - Negligible effects[4] Migratory Birds - Negligible effects[4]	Threatened and Endangered Species - No effect[3] Sensitive Species - No effect[3] MIS - Negligible effects[4] Migratory Birds - Negligible effects[4]	Threatened and Endangered Species - No effect[3] Sensitive Species - May affect[5] MIS - Negligible effects[4] Migratory Birds - Negligible effects[4]	Threatened and Endangered Species - No effect[3] Sensitive Species - No effect[3] MIS - Negligible effects[4] Migratory Birds - Negligible effects[4]
Effects to Wilderness area characteristics from manual, mechanical, and herbicide treatments	Short-term localized impacts to the untrammeled and opportunities for solitude qualities of Wilderness would decline due to repeated entries to manually treat weeds or the placement of tarps. Long-term decrease in natural quality as weeds remain present and potentially spread.	Short-term localized impacts to the untrammeled and opportunities for solitude qualities of Wilderness would decline due to repeated entries to manually treat weeds or the placement of tarps. Long-term decrease in natural quality as weeds remain present and potentially spread.	Short-term localized impacts to the untrammeled, opportunities for solitude, and primitive and unconfined recreation qualities due to the presence of work crews or the placement of tarps. Full suite of treatment options would result in the long-term beneficial impact on natural quality.	Short-term localized impacts to the untrammeled and opportunities for solitude qualities of Wilderness would decline due to repeated entries to manually treat weeds or the placement of tarps. Long-term decrease in natural quality as weeds remain present and potentially spread.

1 This conclusion is based on the hazards (*i.e.*, formulated end-use products highest toxicity category IV; "not likely" to be carcinogenic; and no basis to assert the herbicide would cause an adverse effect on nervous system, immune system, endocrine functions, reproduction and development) and dose response and risk characterization longer-term and short-term exposure calculations were below the level of concern.
2 Minor effects cause observable and short-term changes to natural conditions, but do not reduce the integrity of a resource.
3 No effect: the proposed action will not affect listed species or critical habitat.
4 Negligible effects may or may not cause observable changes to natural conditions; regardless, they do not reduce the integrity of the resource. Negligible effects are also when the change would be so small that it would not be of any measurable or perceptible consequence to the individuals or populations
5 May affect is an official determination for sensitive species (FSM 2670) and is separate from a no effect, negligible effect or minor effect.

Issue 2: Subsistence

Unit of Measure	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Effects to the distribution and abundance of, access to, and competition for aquatic subsistence resources	No direct or indirect effects. Cumulatively, effects would remain similar to current conditions.	Improvements to the distribution and abundance of aquatic subsistence resources from activities that address fish habitat fragmentation and improve fish habitat. Minor adverse effects to the distribution and abundance of aquatic subsistence resources from road building, timber harvest, and MAF development. Temporary and localized or short term disruptions on access to aquatic subsistence resource from project activities.		

		Minor changes the competition for aquatic subsistence resources as a result of project activities are expected. None of the project alternatives would present “a significant possibility of significant restriction” of subsistence uses for salmon, other fin fish, seaweed, and marine invertebrates.		
Effects to deer habitat	No direct effects. Indirect effects of 2 to 8 percent decrease in DHC by WAA as previously harvested stands move from stand initiation to stem exclusion stage	The Forest Plan estimates that some WAAs in the project area may retain 50 percent or less of the estimated deer habitat capability; WAAs 1420 and 1422. The Forest Plan estimates that with full implementation of the Forest Plan that the North Central Prince of Wales Province (#14) is predicted to retain between 52 and 55 percent of the estimated 1954 DHC; the Southern Outer Islands Province (#16) about 80-82 percent DHC; Dall Island and Vicinity (#17) about 66 percent DHC and South Prince of Wales (#18) about 81-82 percent DHC (Table 3.10-16 Forest Plan FEIS p. 3-288)		
Changes in access to subsistence resources by miles of proposed new road	No NFS or temporary road would be built under this project under Alternative 1.	About 35 miles of NFS road construction and 129 miles of temporary road construction may occur, total 164 miles.	About 48 miles of NFS road construction and 175 miles of temporary road construction may occur, total 223 miles	About 49 miles of NFS road construction and 180 miles of temporary road construction may occur, total 229 miles.
WAAs with concerns for percent harvest of DHC		WAAs 1214, 1315, 1317, 1318, and 1420		
Issue 3: Timber Supply and Timber Sale Economics				
Unit of Measure	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 5**
Timber volume (old-growth and young-growth) in million board feet (MMBF) for the life of the project (15 years)	No timber harvest would occur under this project for Alternative 1. Timber harvest under other projects would continue as planned.	Old growth: 235 MMBF Young growth: 421 MMBF Total: 656 MBF	Old growth: 115 MMBF Young growth: 529 MMBF Total: 644 MBF	Old growth: 75 MMBF Young growth: 529 MMBF Total: 644 MBF
Transportation cost per MBF	-0-	$50.78	$68.23	$74.37
Number of annualized direct jobs supported for both domestic processing and Region 10 limited export policy for old-growth and 100 percent for young-growth	-0-	<u>Old growth</u> Domestic process: 1,269 R10 limited export: 1,061 <u>Young growth</u> 100 percent export: 1,596	<u>Old growth</u> Domestic process: 519 R10 limited export: 621 <u>Young growth</u> 100 percent export: 2,005	<u>Old growth</u> Domestic process: 339 R10 limited export: 405 <u>Young growth</u> 100 percent export: 2,005

Issue 4: Watershed Function				
Unit of Measure	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 5**
Number of watersheds with past restoration that could experience increased peak flow rates as a "worst case scenario" in response to potential timber harvest and road construction	-0-	5 (Table 36)	-0-	-0-
Cumulative miles of existing roads and potential roads traversing slopes greater than 50 percent	183	187	185	185
Number of watersheds that could experience increased peak flow rates as a result of past (30 year moving window) and proposed harvested and roaded area by 6th level HUC watershed ("worst case scenario")	-0-	36 (Table 37)	-0-	-0-
Total existing and proposed road miles on NFS lands within 300 feet of Class I and Class II streams and lakes	785	907	907	903
Total existing and proposed road miles on NFS lands	4,008	4,262	4,349	4,317
Number of new fish stream crossings on NFS land	0	432	432	425
Miles of existing and proposed trails	Existing trails: 89 Proposed trails: 0	Existing trails: 89 Proposed trails: 50	Existing trails: 89 Proposed trails: 0	Existing trails: 89 Proposed trails: 50
Miles of proposed stream restoration		Up to 200 miles of stream within the project area in any watershed identified as having need to restore proper functioning condition.	Total of 80 miles of stream within the project area, representing the highest priority based on field assessments and public input	Up to 200 miles of stream within the project area in any watershed identified as having need to restore proper functioning condition.
Total acres of proposed timber harvest	-0-	42,665	49,684	43,035

Issue 5: Wildlife Habitat (NFS land only)				
Unit of Measure	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 5**
Acres of non-winter habitat harvested	Only what would occur under separate NEPA for small and micro sales	23,269 acres	13,014 acres	6,365 acres
Acres of POG harvested	Only what would occur under separate NEPA for small and micro sales	23,269 acres	13,014 acres	6,365 acres
Acres of average snow harvested (assume all POG is <1500 feet)	Only what would occur under separate NEPA for small and micro sales	23,269 acres	13,014 acres	6,365 acres
Acres HPOG harvested (47% POG)	Only what would occur under separate NEPA for small and micro sales	10,936 acres	6,116 acres	2,992 acres
Acres of deep snow habitat harvested (6% of HPOG)	Only what would occur under separate NEPA for small and micro sales	656 acres	367 acres	180 acres
Acres of SD67 harvested (19% of POG)	Only what would occur under separate NEPA for small and micro sales	4,421	1162	568
Qualitative discussion on literature thresholds for % remaining and acres of non-winter habitat	1,625,718 acres or 9% reduction from 1954	Project may result in one WAA 1525 dropping below 50% and a 2% reduction in total habitat	1% reduction in total habitat	< 1% habitat reduction in total habitat
Qualitative discussion on literature thresholds for % remaining and acres of POG	814,912 acres or 18% reduction from 1954	Project may result in seven WAAs dropping below 50% habitat remaining and a 3% reduction in total habitat	2% reduction in total habitat	1% reduction in total habitat
Qualitative discussion on literature thresholds for % percent remaining and acres of average snow habitat (POG habitat below 1,500 feet in elevation)	750,618 acres or 19% reduction from 1954	Project may result in five WAAs dropping below 50% habitat remaining and a 3% reduction in total habitat	2% reduction in total habitat	< 1% reduction in total habitat
Qualitative discussion on literature thresholds for % remaining and acres of HPOG habitat	379,176 acres or a 32% reduction from 1954. There are five WAAs that are currently below 50% habitat remaining	Project may result in two WAAs dropping below 50% habitat remaining and a 3% reduction in total habitat	2% reduction in total habitat	1% reduction in total habitat

Qualitative discussion on literature thresholds for % remaining and acers of deep snow habitat (HPOG habitat in south-facing stands below 800 feet in elevation)	49,449 acres or 33% reduction from 1954. There are seven WAAs that currently below 50% habitat remaining	Project may result in three WAAs dropping below 50% habitat remaining and 1% reduction in total habitat	< 1% reduction in total habitat	No habitat loss
Qualitative discussion on literature thresholds for % remaining and acres of SD67 habitat	158,805 acres or a 27% reduction from 1954. There are four WAAs currently below 50% habitat remaining.	Project may result in three WAAs dropping below 50% habitat remaining and 3% reduction in total habitat	1% reduction in total habitat	< 1% reduction in total habitat

Comparison of Action Alternatives by Activity

This section provides a summarized comparison of action alternative components. Information in the table is focused on activities and different levels of effects or outputs that can be distinguished quantitatively or qualitatively among alternatives.

Table 5. Comparison of Action Alternatives

Activity	Alternative 2	Alternative 3	Alternative 5
	Activities Common to all Action Alternatives		
Salvage opportunities for wood energy and other products	Salvage opportunities for wood energy and other products may occur as allowed by the Forest Plan. Within Old Growth Habitat LUD, opportunities are limited to within one tree length from a road or landing.		
Precommercial thinning of young-growth stands	Precommercially treat up to 4,500 acres of young-growth stands annually for timber production, wildlife habitat improvement, and/or riparian improvement (see Precommercial Vegetation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla). Slash treatments may occur in thinned stands for wildlife habitat improvement.		
Tree planting and inter-planting	Tree planting and inter-planting may occur in any post-harvest unit to achieve desired species composition or regeneration requirements.		
Cone collection	Cone collection may occur to acquire native seed for tree planting.		
Marine access facilities	Up to 70 sites may be developed or improved for marine access facilities (MAF) within the project area for recreation or timber removal. Developments may include log transfer facilities (LTF), docks, boat ramps, floats, buoys, anchorages, breakwaters, boat haulouts, and similar improvements and facilities. These sites are not always associated with a road but may be used for a shoreline location such as near a cabin or shelter. MAFs associated with recreation are displayed on the Sustainable Recreation Management Map and the LTFs are displayed on the Commercial Vegetation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla.		
Log transfer facilities	About 13 existing LTFs may be used and about 2 new LTFs may be constructed (see Commercial Vegetation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla).		

Roads on the National Forest	Roads may be opened, stored or decommissioned through a travel management analysis during project implementation. All new temporary roads would be decommissioned.		
Fish stream crossing structures	All newly installed fish-stream crossing structures must meet fish passage requirements. Existing stream-crossings within the project area that do not allow for fish and aquatic organism passage at all flows, referred to as ‘‘Red crossings’’, may be replaced with appropriate structures, removed, or permitted by regulatory agencies as funding allows (see Watershed Improvement and Restoration Treatments Map online at http://www.fs.usda.gov/goto/tongass/powlla).		
Harvesting wood for stream restoration needs	Harvesting rootwad trees, cut trees, and salvage of cull logs and stumps to provide a source of Large Woody Debris (LWD) for stream restoration activities where trees and trees with rootwads are needed to achieve stream restoration objectives.		
Wildlife trees	Wildlife trees may be created using methods such as blasting, girdling, and fungal inoculation in young-growth stands.		
Restoration of historical surface flows to karst features	Historical surface-water flow paths may be restored to address past management activities that impeded natural water flows or created unnatural water flows to karst features. For example if a road drainage ditch captures and directs surface flow to a karst feature where it naturally would not have drained, corrections may be taken. These opportunities are not currently mapped and would be identified during field inventory.		
Recreational view improvements	To enhance recreation experiences, view improvement activities may occur at recreation sites, trails or along roads to provide or improve vistas, including timber stand thinning, pruning, or vegetation clearing.		
Canoe and kayak access points	Opportunities for fresh- and saltwater canoe and kayaks access points would be considered (not identified in the 70 MAFs above), which could include spur trails, roadside pullouts, and shoreline improvements to mitigate bank degradation.		
Soil Restoration	May restore soil productivity where detrimental soil conditions approach or exceed 15 percent of an activity area.		
Associated Actions	Infrastructure actions: Road maintenance and use; management of system and temporary roads: including construction, maintenance, and potential storage (maintenance level changes may occur); and use and development of new and existing rock pits. Non-infrastructure actions: Site preparation, hazard tree removal, wildlife-proof garbage can installation and maintenance, brushing and brush disposal, and viewshed improvement.		
Activities that vary by Action Alternative			
Activity	**Alternative 2**	**Alternative 3**	**Alternative 5**
Invasive plant management (See Invasive Plant Management Map at http://www.fs.usda.gov/goto/tongass/powlla)	▪ No herbicide would be used to treat invasive plant populations under this alternative with the exception of administrative and recreation sites and facilities covered under CE for this activity. ▪ Use manual treatments (*e.g.*, hand pulling and tarping) and mechanical treatments (mowing) to eradicate, control, or contain populations of invasive plants. The analysis area is the project area, which includes both NFS and non-NFS lands, to allow for a comprehensive approach to weed management, and enable	▪ Use an integrated weed management approach, which includes manual treatments (*e.g.*, hand pulling and tarping), mechanical treatments (mowing), and herbicides (spot, broadcast, and hand/selective applications) to eradicate, control, or contain populations of invasive plants within the project area. ▪ The analysis area is the project area, which includes both NFS and non-NFS lands, to allow for a comprehensive approach to weed management, and enable partnerships with other landowners if	Same as Alternative 2

	partnerships with other landowners if funding becomes available through federal grants or other initiatives. ▪ The number of treatment acres is based on the current inventory of invasive plants, approximately 2,300 acres of known infestations (see Invasive Plant Management Map online at http://www.fs.usda.gov/goto/tongass/powlla), including lands of other ownership. It is likely that additional undocumented infestations would be treated. Infestations selected for treatment would be addressed on a yearly basis through an annual treatment plan.	funding becomes available through federal grants or other initiatives. ▪ The number of treatment acres is based on the current inventory of invasive plants, approximately 2,300 acres of known infestations (see Invasive Plant Management Map online at http://www.fs.usda.gov/goto/tongass/powlla), including lands of other ownership. It is likely that additional undocumented infestations would be treated. Infestations selected for treatment would be addressed on a yearly basis through an annual treatment plan. ▪ To provide flexibility to respond to newly discovered invasive plant infestations, an adaptive management tool called Early Detection Rapid Response (EDRR) would be used. With this tool, new infestations would be treated using the range of methods and design criteria described in the alternatives.	
Commercial young-growth harvest (See Commercial Vegetation Management Map at http://www.fs.usda.gov/goto/tongass/powlla)	Offer a variety of young-growth timber sale sizes post-decision: ▪ Years 1-7 an average of 3 MMBF of young growth annually; and ▪ Years 8-15 an average of 50 MMBF of young growth annually. ▪ An estimated average of 25 MBF per acre would be used to determine which stands may potentially be treated. This gives a conservative estimate on the volume per acre needed to reach an economical offering, but does reduce the acreage and volume available earlier in the project time line. ▪ In young-growth stands surrounding communities, leave untreated areas as wildlife travel ways (corridors) to benefit deer to benefit subsistence users. ▪ Prescriptions that improve or maintain wildlife habitat would be used in both	Offer a variety of young-growth timber sale sizes post-decision: ▪ Years 1-7 an average of 7 MMBF of young growth annually; and ▪ Years 8-15 an average of 60 MMBF of young growth annually. ▪ An estimated average of 22 MBF per acre would be used to determine which stands maybe potentially treated. This will allow for increased acreage and volume in the earlier portions of the project timeline while still striving to meet the minimum volume per acre for economical timber offerings. ▪ To improve deer habitat, slash treatments may occur in beach buffers, OGRs, and on all south facing stands below 800 feet in elevation. ▪ In WAAs with >10 percent estimated subsistence deer harvest of the estimated deer habitat capability (DHC), all young-	Same as Alternative 3.

	young-growth and old-growth stands within a 5-mile radius of communities to benefit subsistence users.	growth treatments on south-facing stands below 800 feet in elevation would be treated with uneven-aged management prescriptions.	
Commercial old-growth timber harvest (See Commercial Vegetation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla)	Offer a variety of old-growth timber sale sizes post-decision: ▪ Years 1-5 up to an average of 25 MMBF of old growth annually; ▪ Years 6-10 up to an average of 15 MMBF of old growth annually; and ▪ Years 11-15 evaluate the remaining amount of old growth available. For analysis an assumption was used where: -years 11-12 up to 10 MMBF annually, and -years 13-15 up to 5 MMBF annually. ▪ Prescriptions that improve or maintain wildlife habitat would be used in both young-growth and old-growth stands within a 5-mile radius of communities to benefit subsistence users.	Offer a variety of old-growth timber sale sizes post-decision: ▪ Years 1-5 up to an average of 10 MMBF of old growth annually; ▪ Years 6-10 up to an average of 8 MMBF of old growth annually; and ▪ Years 11-15 up to an average of 5 MMBF of old growth annually. ▪ In WAAs with >10 percent estimated subsistence deer harvest of the estimated DHC allow 25 percent removal of old-growth using single tree selection on south-facing stands below 800 feet in elevation. ▪ At the north end of POW Island, in an area bounded by the National Forest System road 2000000 to the south, saltwater to the north, the communities of Point Baker and Port Protection to the west, and western shoreline of Red Bay to the east (“North of the 20 Road”), old-growth stands would only be harvested as part of sales of generally less than 3 MMBF. See Commercial Vegetation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla	Offer an average of 5 MMBF annually with sales offered each year (1-15). ▪ In WAAs with >10 percent estimated subsistence deer harvest of the estimated DHC, do not allow old-growth harvest on south-facing stands below 800 feet in elevation. ▪ North of the 20 Road, old-growth stands would not be harvested (see Commercial Vegetation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla).
Old-growth small sales strategy	An old-growth small sales strategy was developed to address concerns raised through public comment. The strategy would ensure economical old-growth timber is available for small operators within the project area, including availability beyond the 15-year timeline of this project, until sufficient young-growth timber is available to supplement their volume needs. ▪ For each old-growth large sale greater than 10 MMBF, an amount equal to 25 percent of that sale volume must be identified from the remaining potential	Same as Alternative 2, except: ▪ For each large sale offered greater than 10 MMBF, an amount equal to 60 percent of that sale volume must be identified from the remaining potential project old-growth timber stands and placed in a pool for small sales offerings. ▪ Assumption 2) calculations were based off the total alternative volume of 115 MMBF in Years 1 through 15 post-decision (thus, no need for Assumptions 3 and 4).	No old-growth small sale strategy is developed for this alternative.

	project old-growth timber stands and placed in a pool for small sales offerings. ▪ Those designated stands should meet the following criteria: 1) be generally within ¼ mile of existing or planned road connected to the road system on POW and Kosciusko Islands; 2) contain green timber with volume, species composition, and economic viability suitable for small operators; 3) be compatible with yarding systems in use by and available to small operators, generally ground-based and short-span cable systems; and 4) generally be grouped and offered with less than 3 MMBF per offer to meet the harvest and milling capacities of small operators. ▪ Assumptions include: 1) a minimum annual average of 2 MMBF of old-growth timber is needed for small operators within the project area for 25 years, though designated volume for after Year 15 is not considered part of the harvest allowed in the decision; and 2) calculations were based off the total alternative volume of 200 MMBF in Years 1 through 10, and an assumption that: 3) Years 11 and 12 would have a maximum annual average of 10 MMBF offered and 4) Years 13 through 15 would have a maximum annual average of 5 MMBF offered.		
Peak Flow Rates	No restriction would be placed on location and timing of timber harvest activities as relates to peak flow rate increases. During the implementation process, careful consideration of watershed-specific activities and characteristics will be necessary to	Project activities will be located and timed so that no increases to peak flow rates would be anticipated in any project area watershed.	Same as Alternative 3.

	ensure that fish habitat and water quality are not degraded by peak flow rate increases.		
Stream restoration (See Watershed Improvement and Restoration Treatments Map online at http://www.fs.usda.gov/goto/tongass/powlla)	Conduct stream restoration activities on up to 200 miles of stream within the project area in any watershed identified as having need to restore proper functioning condition. The Forest Service is including watersheds that have both NFS and non-NFS lands in the project area to allow for a comprehensive approach to stream and floodplain restoration, and enable partnerships with other landowners.	Same as Alternative 2 except limiting instream restoration activities to a total of 80 miles of stream within the project area, representing the highest priority based on field assessments and public input	Same as Alternative 2.
Fish habitat improvements (See Watershed Improvement and Restoration Treatments Map online at http://www.fs.usda.gov/goto/tongass/powlla)	Consider multiple fish habitat improvements such as barrier modifications, lake fertilization, egg incubation boxes, and fry stocking to improve Pacific salmon access to spawning and rearing habitat, and to improve wild sockeye salmon runs in areas that historically produced larger runs.	Consider only barrier modifications to improve Pacific salmon access to spawning and rearing habitat.	Consider only lake fertilization and barrier modifications to improve Pacific salmon access to spawning and rearing habitat, and to improve wild sockeye salmon runs in areas that historically produced larger runs.
Connectivity of old growth between Port Protection and Calder Bay	Current LUD designations provide connectivity for this area. No restrictions for old-growth harvest in VCU 5280.	Current LUD designations provide connectivity for this area. Allow only STS prescriptions for old-growth stands in VCU 5280.	Current LUD designations provide connectivity for this area. Allow no old-growth harvest in VCU 5280.
Incorporation of recommendations made by the *Interagency Wolf Habitat Management Program: Recommendations for Game Management Unit 2.* Management Bulletin R10-MB-822. USDA Forest Service, USDI Fish and Wildlife Service,	Will meet Forest Plan direction.	**DEER** Young Growth (0-25 years): ▪ Aim to thin all young growth prior to about 25 years post-harvest in medium to high productivity stands. ▪ Leave untreated or unthinned strips (leave strips) to provide elevational movement corridors for wildlife to maintain or enhance connectivity between higher and lower elevations. Promote/maintain redcedar and yellow-cedar through thinning and planting if needed. Young Growth (26-60 years):	▪ The *Interagency Wolf Habitat Management Program* recommendations would be implemented fully. ▪ Use a mean buffer of 2,400 feet in radius (about 0.5 mile) for reproductive wolves at den sites as suggested in Draft Preliminary Wolf Buffer Analysis (ADF&G 18 Oct 2017)

and Alaska Department of Fish and Game. Wolf Task Committee Wolf Technical Committee (2017)		▪ Leave untreated or unthinned strips that provide elevational movement corridors for deer to maintain or enhance connectivity between higher and lower elevations. Use 400 feet as a guide to space travel corridors within thinning treatments in the absence of existing routes, terrain features, or other habitat connectivity drivers. ▪ Consider a variety of treatment combinations including variable-spaced thinning, girdling, pruning, small gap creation, and slash treatments, with the goal of creating deer forage and movement corridors in proximity to each other. ▪ Reduce or abate effects of slash on deer mobility in treated stands. <u>Older Young Growth (>60 years):</u> In areas where succession towards old-growth conditions is identified as a dual objective (*i.e.*, Old-growth Habitat LUDs, beach and estuary fringe, and Riparian Management Areas outside of Tongass Timber Reform Act buffers that are within Development and Old-growth Habitat LUDs): ▪ Without compromising continued succession towards old-growth conditions, design treatments that provide understory deer forage and reduce effects of stem exclusion and slash to support long-term deer habitat. Treatments could include variable-density thinning, thinning favoring dominant trees, creating small gaps and narrow openings, and pruning. ▪ Incorporate unthinned or untreated leave strips of intact canopy, especially along ridgelines, to promote elevational movements during severe winters and minimize distance between deer and foraging opportunities across the landscape. ▪ Consider vulnerability to predation when designing sizes and shapes of multi-aged	

		class-rotational configurations, decreasing deer vulnerability on flatter slopes by creating smaller and more dispersed treatments. **WOLF** Den: Protect the integrity of known wolf dens (active and inactive) with noncircular buffers generally centered on the den with consultation with Alaska Department of Fish and Game (ADF&G) and the United States Fish and Wildlife Service (USFWS). ▪ Retain roadless, gently sloping (about 25 percent) old-growth forest within 330 feet of major lakes and streams (defined in Wolf Plan) to preserve denning habitat and den-site options for wolves. ▪ In Forest Plan Legacy VCUs, retain acres to create large buffers along major lakes and streams as defined in Wolf Plan. See Legacy standards and guidelines in the Forest Plan. ▪ Use a mean buffer of 2,400 feet in radius (about 0.5 mile) for reproductive wolves at den sites as suggested in Draft Preliminary Wolf Buffer Analysis (ADF&G 18 Oct 2017) Road Density: ▪ During implementation, prioritize roads for closure based on wolf harvest vulnerabilities. ▪ Focus road closures in areas to benefit wolves.	
Recreation infrastructure (See Sustainable Recreation Management Map at http://www.fs.usda.gov/goto/tongass/powlla)	Recreation infrastructure inventory may increase or be realigned to improve recreation opportunities in areas with road or boat based access and potential for higher use and decrease infrastructure in those areas with difficult access and limited use. Develop new recreation infrastructure in areas identified by the public, and that are accessible by road or boat.	A reduction in recreation infrastructure inventory is likely. Develop new sites to realign and improve recreation and tourism opportunities. Development should not exceed the current inventory by decommissioning sites. New sites would be accessible by road or boat.	Same as Alternative 2.

	Improvements at existing and newly developed recreation sites would be implemented to enhance recreation opportunities. Maintain and improve existing infrastructure. Development of infrastructure (*e.g.*, outhouses, structures, trails) must consider maintenance needs and limitations of available and foreseeable program resources (see Sustainable Recreation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla). Decommissioning recreation facilities could occur; facilities considered for decommissioning may be evaluated by level of use comparatively against other POW district infrastructure, ease of access, and maintenance requirements. To maintain inventory levels, may develop new facilities in lieu of decommissioned sites.	New recreation sites design should require less program investment and maintenance commitment. Develop or improve sites to reduce maintenance requirements; this shift could be achieved through limiting the amenities provided such as outhouses and trash receptacles, and the use of durable materials and construction methods. Decommission some recreation infrastructure and sites where the amount of use does not justify the maintenance cost. Facilities considered for decommissioning will be evaluated by level of use comparatively against other POW district infrastructure, ease of access, and maintenance requirements.	
Interpretive and informational signs	Interpretative and informational signs would be associated with existing and new recreation infrastructure and along roads and trails.	Informational signs would be associated with existing or new recreation sites.	Same as Alternative 2.
Trail Management (See Sustainable Recreation Management Map at http://www.fs.usda.gov/goto/tongass/powlla)	Maintenance would continue on existing trails. Improve regularly used trails if a need is identified. Up to 50 miles of new trails may be developed. Spur trails to recreation structures may be developed.	Only trails with enough use to justify the cost of maintenance would be improved. No new trails would be developed. Use levels would be based on public input and district staff experience.	Same as Alternative 2.
Road to trail conversions	Consider road-to-trail conversions.	Road to trail conversions would be minimal and limited to routes with documented public support indicating the potential for high use and district staff knowledge.	Same as Alternative 2.
Winter sport access and warming huts	Up to eight winter sport access points and areas would be developed for over-the-snow vehicle use (see Sustainable Recreation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla).	Only winter sport access points and areas with documented public support indicating the potential for high use would be developed for over-the-snow recreation. Development would include pullouts and standard OHV	Same as Alternative 2.

	This may include pullouts, vegetation clearings (up to 60 feet), providing access to subalpine/alpine locations, and warming huts.	width trails (up to 50 inches) to sub-alpine/alpine elevations.	
Outhouses	Consider outhouse development for all existing and proposed recreation facilities. Install outhouses based on anticipated use levels and maintenance requirements. Maintenance must be sustainable with available and foreseeable program resources.	Outhouse development would be limited to vault toilets at existing road accessible locations.	Same as Alternative 2.
Campgrounds and campsites (See Sustainable Recreation Management Map at http://www.fs.usda.gov/goto/tongass/powlla)	Consider development of three campgrounds: Hydaburg, El Capitan, and Luck Lake. Decommission Harris River Campground in exchange for developing the campground at El Capitan.	Selection of campgrounds or campsites would be limited by maintenance costs to program resources and projected use levels. The Harris River campground would be decommissioned. Consider up to 12 semi-developed sites (where 12 shelters were proposed in Alternative 2). These sites would be developed with a tent platform/pad, picnic table, and fire ring. Site selection would be based on road or boat accessibility.	Same as Alternative 2.
Cabins and shelters (See Sustainable Recreation Management Map online at http://www.fs.usda.gov/goto/tongass/powlla)	About 3 cabins and 12 shelters may be developed that are boat or road accessible.	No new cabins or shelters would be developed.	Same as Alternative 2.
Cabin decommissioning	Cabins may be decommissioned. Cabins selected for decommissioning could be replaced with a cabin in a more accessible location, with potential for higher use; no net loss of cabins.	Cabins would be decommissioned where the amount of use does not justify the maintenance cost.	Same as Alternative 2.
Transportation management (See Commercial Vegetation Management Map online at	All existing roads may be used to implement proposed activities. ▪ About 35 miles of new NFS road construction may occur. ▪ About 129 miles of new temporary road construction may occur.	All existing roads may be used to implement proposed activities. ▪ About 48 miles of new NFS road construction may occur. ▪ About 175 miles of new temporary road construction may occur.	All existing roads may be used to implement proposed activities. ▪ About 49 miles of new NFS road construction may occur. ▪ About 180 miles of new temporary road construction may occur.

http://www.fs.usda.gov/goto/tongass/powlla)		More miles are needed since more young growth would be harvested.	More miles are needed since more young growth would be harvested.
Prescribed burning for wildlife habitat improvement in young growth harvested stands	No prescribed burning.	Prescribed burning may occur in non-development LUDs. Prescribed burning would be limited to south-facing areas less than 800 feet in elevation to promote long-term sustained deer forage in high-value deer winter habitat. The proposed blocks of burning would average less than 10 acres in size.	Prescribed burning may be use to promote long-term deer forage in all LUDs. The proposed blocks of burning would average less than 10 acres in size.

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Chapter 3. Environment and Effects

Introduction

This chapter describes the affected environment within the project area and the environmental impacts of the alternatives. The Forest Plan FEIS provides additional background information and analyses not included here.

Geographic Information System Database and Quantification for this EIS

The Forest Service uses its computerized geographic information system (GIS) database to conduct spatial analysis of alternatives and effects and to display resource information in map format. Much of the GIS data consist of map "layers," each representing a particular resource or attribute (such as forest type, soil type, or recreation places). These GIS data layers originated from aerial imagery interpretation and are updated from field inventories using standard data collection procedures. GIS layers facilitate consistency by using the same base data for individual resource effects analysis. GIS data and product accuracy may vary.

This analysis used the best available information and included habitat variables such as vegetation, slope, and elevation. Potential habitat is based on the presence of habitat characteristics as described in available scientific literature, previous habitat surveys, recorded observations, and other credible sources of biotic information. This project was analyzed and assessed with consideration of the best available science, Forest Plan direction, research and life history literature, approved survey protocols, and professional judgment. The assumptions about proposed treatments used to make the determination of effects are found in the individual resource sections below.

The baseline numbers used to describe the existing condition may depend on overlaying of multiple layers, which may not always line up (*e.g.*, along property boundaries, saltwater shorelines, lake edges). This may produce variation in acreage estimates. The differences can amount to hundreds of acres or more, especially because the calculations are for a large project area. The slivers of area creating these discrepancies, on a percentage basis, are insignificant.

Numbers presented are rounded to the nearest whole acre, whole mile, or whole percent, except for road densities. No attempt has been made to adjust the numbers to force the sums of rounded numbers to equal the totals. Therefore, the sum of rounded individual numbers may be different than the expected sum, and all numbers calculated from GIS should be considered as approximate.

Conditions and GIS data are always changing. GIS data generated for analysis represent what is on the ground at the time that the analysis is conducted.

Ecological and Administrative Land Divisions

The land area of the Tongass National Forest has been divided in several different ways to describe resources and allow analysis of how they may be affected by Forest Plan and project-level decisions. These divisions vary by resource since the relationship of each resource to geographic conditions and zones varies. The allocation of Forest Plan land use designations (LUD), discussed in Chapter 1, is one such division. Other divisions important to describe the affected environment and perform effects analyses are described briefly here.

Biogeographic Province (BP)

A biogeographic province designation refers to 21 ecological subdivisions of Southeast Alaska identified by generally distinct ecological, physiogeographic, and biogeographic features (see map in the 2016 Forest Plan Amendment FEIS, p. 3-186). Four biogeographic provinces: 14, 16, 17, and 18, overlay the POW LLA project area.

Game Management Unit (GMU)

Game management units are geographical areas defined by the Alaska Department of Fish and Game (ADF&G) to manage wildlife populations. GMU 2 includes Prince of Wales Island and most of the outer islands. Coronation Island is in the project area and is in GMU 3.

Inventoried Roadless Area (IRA)

Inventoried Roadless Areas (IRA) are undeveloped areas typically exceeding 5,000 acres that met the minimum criteria for wilderness consideration under the Wilderness Act and that were inventoried during the Forest Service's Roadless Area Conservation Review (RARE II) process (1979). Some of these areas have been modified since that review due to land transfer (for example the 2015 Sealaska Land conveyance impacted some upland roadless acres in VCUs 5280 and 5310) and development, road construction, and timber harvest that occurred before the 2001 Roadless Area Conservation Rule or while the Tongass National Forest was exempt from the 2001 Rule. The Forest Service Roadless Area Conservation Rule, Final Environmental Impact Statement Volume 2 dated November 2000 contains maps that display the IRAs analyzed for this project. The POW LLA Project includes 24 IRAs (see https://www.fs.usda.gov/nfs/11558/www/nepa/109834_FSPLT3_4431593.pdf).

Value Comparison Unit (VCU)

Value comparison units are distinct geographic areas, each encompassing a drainage basin containing one or more large stream systems. The boundaries usually follow major watershed divides. The POW LLA project area includes 207 VCUs. The POW LLA Project VCU map is available in the project record (file 833_1024).

Watershed

Activities for this project were analyzed at the 6th level Hydrologic Unit Code (HUC). HUCs are unique identifiers used in a standardized watershed classification system, the Watershed Boundary Dataset (WBD), developed by the USGS. Hydrologic units are watershed boundaries organized by size and location, and can be viewed as the "address" of a particular watershed. Watersheds defined as HUCs are uniformly mapped for the entire United States. The project boundary contains 136 (HUC6 level) watersheds (see Map 6: Watersheds) with at least a portion of their drainage areas within the project area.

Wildlife Analysis Area (WAA)

Wildlife analysis areas are land divisions used by the ADF&G for wildlife analysis and regulating wildlife populations. The project area includes 32 WAAs. The wildlife and subsistence analyses use information by WAA for estimating effects.

Analyzing Effects

Environmental effects are the effects of implementing an alternative on the physical, biological, social, and economic environment. The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) include the following specific categories for the analysis of environmental effects.

Direct, Indirect, and Cumulative Effects

Direct environmental effects are those occurring at the same time and place as the initial cause or action. Indirect effects occur later in time or are spatially removed from the activity. Cumulative effects result from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions.

In the Environmental Effects sections, the direct and indirect effects are presented first, followed by cumulative effects. For most resources, private lands and other public lands, as well as waters outside the jurisdiction of the Forest Service (*i.e.*, submerged islands, marine waters, Alaska State Parks) are not included in the direct and indirect effects analysis. However, for aquatics and invasive plants, all lands in the project area were considered for direct and indirect effects analysis because some activities may extend into other land ownerships for continuity and integration of planning and implementation. Any such project must be supported and authorized by the other landowners, usually through formal agreements. For evaluating cumulative effects, the interdisciplinary team (IDT) considered all lands in the project area. For some resources, an expanded boundary was evaluated. The direct, indirect, and cumulative effects analysis area for each resource is described in the appropriate section later in this chapter.

Past, Present, and Reasonably Foreseeable Future Projects

Past Projects

Past projects considered in cumulative effects analysis generally are physically located on the landscape, such as roads. The past projects combined with the natural environment, represent the affected environment described for each resource in this chapter. These projects include timber harvest, thinning of harvested stands, recreation developments, road construction and Log Transfer Facility (LTF) construction; stream restoration and enhancement, and highway construction.

To understand the contribution of past actions to the cumulative effects of project alternatives, this analysis assumes that current environmental conditions are a result of effects from past actions. This is because existing conditions reflect the aggregate effect of all preceding human actions and natural events that have affected the environment and might contribute to cumulative effects.

Cumulative effects discussions contained in the POW LLA Project do not attempt to quantify the effects of past actions by adding up all previous actions on an action-by-action basis. The reasons for not taking this approach are as follows:

- Existing conditions are a result of numerous actions (*i.e.*, timber harvesting, road construction, off-highway vehicle use) over the past decades, and trying to isolate the individual actions that continue to have residual effects would be impractical. GIS layers include all past harvest and roads. These layers were used in the analysis to describe existing condition.
- Revealing specifics of past actions on an individual basis would not be advantageous in determining the cumulative effects of the proposed action or other alternatives. Focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental effects of individual past actions, and one cannot reasonably determine each and every action over past decades that has contributed to current conditions. Also, it is uncertain how the effects of past natural events, together with human-caused events, have cumulatively shaped the current landscape. By looking at existing conditions, we are more likely to convey the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects.

- Public scoping for this project did not identify any public interest or need for detailed information on individual past actions.
- Finally, the Council on Environmental Quality issued an interpretive memorandum (Connaughton 2005) regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

For these reasons, the analysis of past actions in the POW LLA Project is based on current environmental conditions.

Present and Reasonably Foreseeable Future Projects

Present and reasonably foreseeable future projects are cataloged in the *Catalog of Present and Reasonably Foreseeable Future Activities* table (Appendix C).

The following types of projects are either present actions or are considered reasonably foreseeable future activities and are combined with past projects (represented by the existing condition for each resource) to be considered in the cumulative effects analysis. Existing conditions are a result of numerous actions (*e.g.*, timber harvesting, road construction, off-highway vehicle use) over the past decades, and trying to isolate the individual actions that continue to have residual effects would be impractical. Revealing specifics of past actions on an individual basis would not be advantageous in determining the cumulative effects of the proposed action or other alternatives. Focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental effects of individual past actions, and one cannot reasonably determine each and every action over past decades that has contributed to current conditions. Also, it is uncertain how the effects of past natural events, together with human-caused events, have cumulatively shaped the current landscape. By looking at existing conditions, we are more likely to convey the residual effects of past human actions and natural events, regardless of which particular action or event contributed those effects.

Reasonably foreseeable future projects are those with either a developed proposed action or a GIS layer or map displaying a spatial location. There are four future actions within Appendix C that have a timeframe of "unscheduled" or "unknown". The two "unknown" timeframes are associated with two mining projects, Niblack and Bokan Dotson-Ridge. These mining projects were included in Appendix C because the owners have recently invested funds in advancing the development of these mines. Jobs estimates have been disclosed in press releases (July 2017 and January 2018) that could be used in the cumulative effects analysis for Socioeconomics resource. Neither of these mining projects have submitted a "plan of operations" for which ground disturbance analysis could be conducted.

The two "unscheduled" timeframes are associated with pending legislation that have either a GIS layer or map displaying a spatial location along with full description of all activities involved. These are discussed in the two following sections.

ANCSA Admiralty Island Land Exchange Finalization Act of 2017

On June 29, 2017, the *ANCSA Admiralty Island Land Exchange Finalization Act of 2017* (S. 1484) and the *Alaska Native Claims Settlement Improvement Act of 2017* (S. 1481) were introduced in the U.S. Senate and propose a land exchange between the Sealaska Corporation (Sealaska) and the Forest Service. The proposed land exchange is for 23,000 acres of subsurface estate on Admiralty Island at Cube Cove currently owned by Sealaska Corporation in exchange for Federal land involving a combination of Surface and Subsurface estates near Kitkun & Lancaster Cove. This is noted on the maps "Sealaska Land Exchange—U.S. Forest Service Lands" and dated March 10, 2016 (in the project record) and in the legislative text of S. 1481 and S. 1484. These acres are located in

Cholmondeley Sound between Lancaster Cove and Kitkun Bay on Prince of Wales Island. The Forest Service would acquire, as part of the exchange, sub-surface estate on Admiralty Island near Juneau, Alaska, outside of the project area. This land exchange is analyzed in the cumulative effects analyses for each resource later in this chapter.

State National Forest Management Act of 2017

The *State National Forest Management Act of 2017* is not addressed in cumulative effects analyses for each resource because of the wide-ranging effects it would have on the POW LLA Project. Potential effects from this legislation are presented here.

During the 115th Congress, the *State National Forest Management Act of 2017* (H.R. 232) was introduced. This bill authorizes States to select and acquire certain National Forest System lands to be managed and operated by the State for timber production and for other purposes under the laws of the State.

State of Alaska officials and interested parties have advocated to establish an additional Alaska State Forest managed to provide income for state government programs. The Alaska Department of Natural Resources has a preliminary GIS layer depicting preferred areas, totaling 2 million acres in Southeast Alaska, which would require transfer of areas of Tongass NFS lands to the State of Alaska. This preliminary GIS layer (available in the project record) provides a way to analyze potential effects if this land conveyance is authorized through legislation.

If this legislation were passed by Congress it would impact the POW LLA Project. About 665,226 acres lie within the project area as depicted in the map provided by the state. The majority of these acres are also suitable forest land and included as part of the project LSTA. About 44,710 acres (93 percent) of old growth and 68,122 acres (88 percent) of young growth would be removed from the project LSTA.

About 60 percent of the existing discrete (cabins, shelters, day-use areas) and linear (trails) recreation sites are within the state preferred areas. About 44 percent of proposed discrete and about 90 percent of proposed linear recreation sites would be removed from the project.

About 11 miles of existing restored stream reaches (86 percent) are within the state preferred areas. Of the proposed lake acres and miles of stream reaches for fish habitat improvement consideration, about 306 lake acres (14 percent) and about 7 miles (16 percent) would be removed from the project. An additional 95 miles of stream reaches (47 percent) considered for fish habitat restoration activities would be removed from the project.

If HR 232 becomes law, the POW LLA Project would not be able to meet the purpose and need. The proposed old-growth and young-growth LSTA, sustainable recreation activities, and fish habitat improvement and restoration activities were developed to give opportunities for community resilience and economic development while improving forest ecosystem health across the landscape. With the removal of different proposed activities and potential conveyance of existing infrastructure to the state, the POW LLA Project and its alternatives and effects analysis would need to be reconfigured or canceled.

Incomplete and Unavailable Information

There is incomplete knowledge about many of the relationships and conditions of wildlife, fish, forests, climate change, jobs, and communities. The ecology, inventory, and management of a large forest area is a complex and developing science. The biology of fish and wildlife species prompts questions about population dynamics and habitat relationships; and the interaction of resource supply, the economy, and communities is the subject of an inexact science. However, the basic data and central relationships are sufficiently well-established in the respective sciences for the Responsible Official to make a reasoned choice between the alternatives, and to adequately assess and disclose the possible beneficial and adverse environmental effects.

Comprehensive stream, rare and sensitive plant, invasive plant, geology, soil, landslide, wetlands, wildlife, and cultural surveys have not been conducted within the entire project area, but are ongoing throughout the project planning process. In addition, as more resources or technology become available, they will also contribute to the process of gathering more information on the project area and continuing to refine existing condition information. For example, the Tongass National Forest has begun an effort to compile extensive coverage of this project area from a type of remote sensing called LiDAR (Light Detection and Ranging), which will help inform decision making on the project. It is likely that additional streams, plant populations, karst features, unsuitable soils, landslides, wetlands, nests, dens, and cultural sites will be found prior to implementation in currently un-surveyed areas, though knowledge of these additional occurrences is not essential for a reasoned choice among alternatives. Any newly discovered sites would receive the appropriate protections under the Forest Plan and relevant laws or regulations. Additional field surveys prior to implementing activities may be required as identified on the Activity Cards, Appendix A.

With karst terrain underlying portions of the project area, the watershed boundaries do not capture subsurface flow patterns. Dye tracing studies have allowed us to understand some of the subsurface flow paths, but many insurgence locations, resurgence locations, and their connectivity are still unknown. Refer to the Karst section for more information on subsurface flows. Additional karst features may be identified prior to implementation. These features would receive the appropriate protections under the Forest Plan and relevant laws or regulations.

Visitation and public use levels are an important, but incomplete, piece of information for a qualitative analysis of recreation infrastructure use levels. Cabin reservations and campground receipts provide only a partial count of actual use. Currently no system is in place to quantify the number of people that use POW's other recreation sites, beyond anecdotal information from the public and staff. However, anecdotal information and general public comments do provide recreation staff with a relative sense of recreation use across the districts.

In some cases, community-level demographic and economic data are unavailable or suppressed due to privacy concerns. In the affected environment section, this is particularly the case for economic data in the smallest communities in the project area.

The physical condition of transportation resources are subject to change from natural events and normal use. Although inventory and condition surveys record current conditions, changes may occur at any time. Traffic counts are not routinely collected on NFS roads, although the roads are generally designed and managed as low volume roads, *i.e.*, roads with less than or equal to 400 vehicles per day.

Research on the benefits of young-growth management to wildlife is ongoing. Active management is proposed to improve habitat conditions in young stands; however, questions remain regarding the trade-offs associated with the benefits and costs of different types and timing of treatments (USDA Forest Service 2008b).

Unavoidable Adverse Effects

Implementation of any action alternative could cause adverse environmental effects that cannot be effectively mitigated. Unavoidable adverse effects often result from managing the land for multiple resources. Proposed activities are reflected in the Activity Cards (Appendix A); the interdisciplinary process used for making these cards incorporated design criteria that could eliminate or lessen adverse effects. The application of Forest Plan direction, Best Management Practices (BMP), and project-specific mitigation measures are all intended to limit the extent, severity, and duration of potential effects. Alternatives and their actions are designed to reduce or avoid adverse environmental effects; however, some adverse impacts to the environment that cannot be completely mitigated could occur. This chapter discloses beneficial and adverse effects in the issues discussions and resource sections.

Short-term Use and Long-term Productivity

Short-term uses and their effects are those that occur annually or within the first few years of project implementation. Long-term productivity refers to the capability of the land and resources to continue producing goods and services long after the project has been implemented. Under the Multiple-Use Sustained Yield Act and the National Forest Management Act, all renewable resources are to be managed so that they are available for future generations. By meeting Forest Plan direction, this project meets the requirements of the Multiple-Use Sustained-Yield Act and the National Forest Management Act.

Irreversible and Irretrievable Commitments of Resources

Irreversible Commitments is a term that describes the loss of future options. It applies primarily to the effects of using nonrenewable resources, such as minerals extraction or loss of cultural resources, or factors such as soil productivity, that are renewable only over extremely long periods of time.

Loss of soil due to erosion and mass failures is an irreversible commitment of resources. The loss of soil resources would be minimized to the extent feasible for all activities by following Region 10 Soil Quality Standards, incorporating BMPs and applying mitigation measures specified in this document.

Road construction is an irreversible action because of the time it takes for a constructed road to revert to natural conditions. The development or expansion of rock quarries for roadbuilding or other uses is also an irreversible commitment. See also the Transportation section in this chapter.

Soils and wetlands displaced by road construction activities are irreversible commitments of project resources, due to the long-term loss of soil productivity. It is irreversible because the soils and wetland resources have deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or because the wetland soils have been destroyed or removed. In road construction, wetland soils are either scraped away or are buried beneath road fill, greatly limiting their pre-disturbance productivity. See also the Soils section and the Wetlands section in this chapter.

Loss of heritage resource sites resulting from accidental damage or vandalism would be an irreversible commitment of resources. Standards and guidelines, survey methodology prior to activities, and mitigation measures specified in this document provide reasonable assurance that no irreversible loss of heritage resources would occur. See also the Cultural Resources section in this chapter.

Irretrievable Commitments applies to the loss of production, harvest, or use of natural resources. These decisions are reversible, but the production opportunities foregone are irretrievable. Old-growth forest structure converted to even-aged forest structure by timber harvest can be considered an irretrievable commitment of the old-growth structure, especially if the land is continually managed for optimum timber production. It is not expected that old-growth characteristics would naturally reoccur within harvest areas for 150 years or more; however, old-growth forest structure would eventually return to the landscape. Foregoing timber harvest opportunities in certain areas at this time, due to resource concerns or economics, may represent an irretrievable commitment of resources because that volume cannot be harvested. The commitment is irretrievable rather than irreversible because future entries could harvest those areas if they are still classified as part of the suitable timber base.

The reduction in the visual quality of an area due to timber harvesting would be an irretrievable commitment of resources. The commitment is irretrievable because viewsheds will typically heal from a visual quality standpoint after about 40 years. Young-growth trees will have the color and height needed so as not to be evident to the casual observer after this time.

Resources Not Discussed in Detail

Resources that are likely to remain unaffected by this project, or those that do not have measureable effects are discussed briefly here.

Air Quality and Climate Change

The affected environments for Climate, Climate Change, and Air Quality are described in detail in the 2016 Forest Plan Amendment FEIS (pp. 3-11 to 3-19).

Air quality and climate change are related issues that are often separated in politics and research. Both issues are addressed for the Tongass National Forest in the Forest Plan (USDA Forest Service 2016c). This section describes climatic change and air quality specifically for the POW LLA Project. The spatial scale for this project is the entirety of POW and outlying islands, for which the conditions are considered similar to the Tongass National Forest. How carbon storage, carbon sequestration, timber harvest, vegetative regrowth and carbon emissions interact over time is very complex, making it unrealistic to define a temporal scope of analysis.

Affected Environment

Air Quality

Air quality in the project area is regarded as generally very good. Considering the prevailing winds off of the Pacific Ocean, the small size of the human population on POW, the low levels of industrial development, and the lack of large-scale wildland fire smoke emissions, there are not many long-term or large-scale air pollutant sources on POW. However, temporary localized air pollution does occur in the form of marine vessel emissions, vehicle and diesel power emissions, wood smoke, incinerators or refuse burning, and dust from vehicle traffic on unpaved roads.

To determine if national and state ambient air quality standards are being met, an annual review of Environmental Protection Agency (EPA) and Alaska Department of Environmental Conservation (ADEC) reports are conducted at the Forest level. Currently there are no non-attainment areas in the vicinity of POW. Air quality is monitored in the five wildernesses in project area. Lichens are monitored as sensitive indicators of air quality every 10 years for 26 air pollutants including sulfur, nitrogen and heavy metals (K. Dillman 2016a).

Climate Change

Climate is important to local ecosystems as well as human health and infrastructure, since temperature, precipitation, wind speed, and metrological events (*e.g.*, timing of the first and last frosts, or severe storms causing flooding) all influence the distribution of water, soil, plants, and wildlife across the project area. Significant, lasting change to existing and historical weather patterns is commonly called “climate change”. Impacts of climate change include increases in prolonged periods of high temperatures, heavier precipitation, increases in wildfire frequency and size, increase in severity of drought, ocean rise, and ocean acidification. The term “greenhouse gases” (GHG) refers to a variety of gases in the Earth's atmosphere that react with sunlight in a way that influences global air temperature. GHGs are a function of air quality and include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (EO 13514).

Long-term climate trends and decadal climate cycles have always occurred in Southeast Alaska (Neal *et al.* 2002). There is a growing body of literature on the topic of climate change and the likely effects on aquatic and terrestrial ecosystems of the Tongass National Forest (see the 2016 Forest Plan FEIS for detailed discussion).

Climate changes likely to impact streams and aquatic organisms are discussed briefly in the Watershed Function – Aquatics (Issue 4) section of this FEIS.

Carbon Sequestration

Atmospheric carbon, as well as other gases (*e.g.*, methane, nitrous oxide, and water molecules) trap the sun's heat to create the natural "greenhouse effect" which makes life possible on Earth (McPherson and Simpson 1999). The balance of carbon dioxide in the atmosphere is regulated by complex interactions between the atmosphere, terrestrial environment, marine environment, and geologic processes. Forest ecosystems, such as those managed on the Tongass National Forest, represent a large terrestrial sink for carbon, such that the United Nations Framework Convention on Climate Change has recognized forest management as an effective strategy for off-setting GHG emissions (Wilson *et al.* 2013). A widely recognized ecosystem service provided by the Tongass is carbon flux regulation.

The relationship between timber harvests, reforestation, wood building materials, and the net storage of carbon is complicated. For example: carbon is stored in building materials, but the storage value does not last as long as a living old-growth tree, as carbon stored in buildings generally outlives its usefulness or is replaced within decades (Law *et al.* 2018). When considering land management practices that mitigate the loss of carbon, reforestation contributes the most to carbon sequestered, followed by reduced timber harvest practices (Law *et al.* 2018). For more details on carbon sequestration see the Forest Plan FEIS (USDA Forest Service 2016c, pp. 3-13 to 16).

Yellow-cedar Decline

Temperature and precipitation changes have an impact on forested lands (Haufler *et al.* 2010). A decline in Alaska yellow-cedar distribution in Southeast Alaska has been attributed to changes in temperature and precipitation linked to climate change. Although yellow-cedar distribution has been undergoing change over the last century, scientists are indicating that an acceleration in change is due to decreasing snow pack related to climate change (Hennon and Shaw 1997, Beier *et al.* 2008, Hennon *et al.* 2016). Yellow-cedar decline is discussed in more detail in the Silviculture section of this chapter.

Environmental Effects

Analysis of the effects of climate and air resources was qualitatively evaluated by comparing differences in the amount of old- and young-growth timber harvest as well as road building activities between alternatives. A qualitative discussion of air pollution sources, GHG emissions, and carbon sequestration was taken for disclosing air pollution and climate change implications. This qualitative discussion includes an evaluation of how climate change may modify conditions in the project area and how the proposed actions may influence levels of GHG and therefore, climate change. Although most Forest Service projects are considered very small in terms of global carbon flux, this qualitative comparison of alternatives provides insight into how proposed actions for each alternative could impact the carbon flux.

Air Quality

Each of the action alternatives considered for the POW LLA Project FEIS would involve harvesting of wood products over a period of time, as described in the POW LLA Project FEIS Chapter 2. For the POW LLA Project, the action Alternatives 2, 3, and 5, as well as the No-action Alternative 1, all result in a net release of air pollution into the atmosphere through varying amounts of road construction, timber harvest, use of administrative vehicles of all kinds, mining, recreation development and use, and other land management actions. Some proposed activities involve removing vegetation, grading and contouring the ground, hardening roads, extraction of materials such as gravel, soil, rock, and minerals from POW sources, and constructing bridges, all of which require fuel-burning construction machinery and an increase in construction related vehicle traffic for the next 15-year period. All these construction activities would increase GHG and other fossil fuel combustion emissions, airborne dust, and particulate matter from wood burning.

The expected direct effects on air quality from forest management and other activities would be temporary and limited in location. These may be dust and vehicular emissions as described above from logging operations, administrative, and recreational use of Forest roads, as well as short-term smoke emissions due to limited prescribed burning to enhance wildlife habitat. Alternatives 3 and 5 contain proposed activities to promote long-term deer forage through prescribed burns in select areas less than 10 acres. This activity would also be seasonal in timing and not occur in the same location over 15 years.

Alternatives 1, 2, 5, and 3 would result in progressively more potential total harvest and wood processing, while Alternatives 1, 2, 3, and 5 would result in progressively more potential road building and harvest-related vehicle use. Therefore, these proposed activities could subsequently result in progressively more potential emissions by alternative (including emissions of GHG). Alternatives 3 and 5 would result in progressively more potential prescribed burning in 10-acre blocks. However, due to the short-lived nature of these activities coupled with the dynamic weather patterns throughout Southeast Alaska continually circulating the air sheds within the project area (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 conditions could result from the use of the harvested trees from a timber sale such as in operating of industrial processing sites, firewood burning, as well as emissions and dust from the private vehicles using unpaved roads. These indirect effects can be aesthetically displeasing, or have potential health risks to both humans and sensitive ecosystems of the Forest. The periodic monitoring of lichens in sensitive ecosystems in Wilderness help determine if non-Wilderness pollution emissions are impacting wilderness air quality. Additionally the EPA and the ADEC have regulatory responsibility under the Clean Air Act to manage emissions from permanent point 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 are expected to occur in any POW LLA Project alternative, from activities such as timber harvesting.

Climate Change

Each of the action alternatives considered for the POW LLA Project involves old-growth and young-growth timber harvest along with road construction. The action Alternatives 2, 3, and 5, as well as the No-action Alternative 1, all result in a net release of GHG and other pollutants into the atmosphere through varying amounts of road construction, timber harvest, use of administrative vehicles of all kinds, mining, recreation development and use, and other land management actions. Some proposed activities involve removing vegetation, grading and contouring the ground, hardening roads, extraction of materials such as gravel, soil, and rock from POW sources, and the construction of bridges, all of which require fossil fuel-burning machinery and an increase in construction vehicle traffic for the next 15-year period. All these construction activities would increase GHG and other fossil fuel combustion emissions.

Considering the total estimated timber harvest, and the percentage of old-growth timber harvest for the action alternatives, Alternative 2 with an estimated 42,665 acres total harvest (54 percent being old growth) appears to be the most impactful for carbon storage, followed by Alternative 3 with 49,684 acres (26 percent being old growth), with Alternative 5 seeming to be the least impactful with 43,035 acres total harvest (15 percent being old growth). Action Alternatives 2 and 3 have identical potential road building (400 miles) leading to similar vehicle use, and Alternative 5 has slightly less road building with an estimate of 373 miles. This adds to the qualitative conclusion that the impacts to carbon flux are the greatest with Alternative 2, with Alternative 3 being similar, and Alternative 5 being the least impactful of the action alternatives. However, the extent and scope of cumulative effects on climate change and carbon sequestration depends on: 1) the amount and condition of total forest land harvested (worldwide, as well as locally within the project area); 2) the use to which the harvested wood is put, and how the timber ground is further managed (worldwide, as well as locally); 3) the amount of carbon released during harvest, processing and transporting wood products; 4) the decomposition rates of organic materials; and 5) non-timber related factors such as the amount of new hydro-electrical or other renewable energy power projects that are built which may offset diesel generated power, future community expansion, and other economic development in the region.

It is anticipated that, in general, communities in the SE Alaska region along with the population worldwide will continue to increase, while some specific locations will decrease; thus, the socio-economic factors driving resource extraction will vary over time and space. Uncertainty also exists concerning how forested lands outside the U.S. would be managed by their respective governments or landowners, but it is likely that many areas will continue to be managed under forest practices that respond to global timber and other markets. However, within POW private and State-owned lands, it is likely that they will be managed for production of forest products for all alternatives considered in this analysis. Products resulting from harvest are primarily lumber and other building materials; therefore, there is a potential that the carbon held within these products would be stored for long period of time, such as the life of a building or longer (Marmon *et al*. 1990). Short-term uses are considered to be paper products and fuel, and the carbon storage capacity is less. Any temporary storage of carbon in lumber products may be offset by carbon released during and after harvest, transportation and processing. Therefore each of the alternatives would cumulatively add to the global effects of climate change by contributing to the net release of carbon into the atmosphere.

The Forest Plan discusses the risk of possible effects and the considerable uncertainty concerning specific predictions of how the climate may change, and even more uncertainty regarding the effects of climate change on the resources of the Tongass. Predictions include increased temperature and precipitation, increased flooding, reduced snowpack, changes and timing of stream flow, and shifts in anadromous salmon distribution and productivity, among many others (Shanley *et al*. 2005). Therefore, the overall rate of carbon sequestration and climate change would likely continue at the current rate for several years regardless of the action alternative. Based on the literature presented in the 2016 Forest Plan Amendment, the rate of carbon sequestration would be higher under the No-action Alternative compared to the action alternatives. Carbon sequestration would be variable but probably lower under Alternative 1, but still very dependent on harvest volume, regeneration rates, decomposition rates etc. In this context, climate change considerations are not essential for a reasoned choice among the alternatives considered in this project analysis. The Tongass National Forest will continue to monitor potential effects of climate change through the existing Forest Plan monitoring programs, and other studies that are happening regionally and nationally.

Inventoried Roadless Areas

The Forest Service's Roadless Area Conservation Review process (2000) identified undeveloped areas, typically exceeding 5,000 acres, which met the minimum criteria for wilderness consideration under the Wilderness Act. For analyses, the Tongass National Forest uses the inventoried roadless areas (IRA) identified in a set of maps, associated with the *Forest Service Roadless Area Conservation Rule, Final EIS, Volume 2*, dated November 2000. There are 24 IRAs within the project area. The Tongass completed an SEIS (2003) to the 1997 Forest Plan revision to review inventoried roadless areas. The assessment looked at potential impacts to the unique or outstanding biological, physical, or social values of the IRAs. Some of the IRAs identified on the November 2000 map have been modified due to land exchanges and development, road construction, and timber harvest that occurred while the Tongass National Forest was exempt from the 2001 Roadless Area Conservation Rule. These changes are considered as the current condition.

None of the alternatives propose old-growth or young-growth harvest, new roads, or road construction or reconstruction within IRAs. No direct impacts are expected from timber harvest or road construction for any of the alternatives.

There are winter sports areas recommended in the Ratz, Thorne River, Karta, Twelvemile, and Eudora IRAs. These winter sports areas are adjacent to existing road systems and would allow travel into the IRAs by foot, skis, snowshoes, snowmobiles, or other off-highway vehicles. These impacts would be limited because no roads or timber harvest is planned for these winter sports areas. The Roadless Rule recognizes that this type of "dispersed recreation opportunities such as hiking, camping, picnicking, wildlife viewing, hunting, fishing, cross-country skiing, and canoeing" and "the use of mountain bikes, and other mechanized means of travel is often allowed." As long as the roadless character is provided for in implementation of the activities, there will be no direct effect to the character of the IRAs (Federal Register /Vol. 66, No. 9 / Friday, January 12, 2001 /Rules and Regulations page 3245). Roadless area characteristics are identified in § 294.11 as: (1) High quality or undisturbed soil, water, and air; (2) sources of public drinking water; (3) diversity of plant and animal communities; (4) habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, relatively undisturbed areas of land; (5) primitive, semi-primitive non-motorized, and semi-primitive motorized classes of dispersed recreation; (6) reference landscapes; (7) naturally appearing landscapes with high scenic quality; (8) traditional cultural properties and sacred sites; and (9) other locally identified unique characteristics (FEIS Vol. 1, 3–3 to 3–7).

The action alternatives include dispersed recreation activities, three-sided shelters and beach access, in the Outer Islands, Suemez Island, Sukkwan, and Nutkwa IRAs. This dispersed recreation is limited to small beach accessible areas on the edges of the IRAs. These activities fall within the Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized classes of dispersed recreation activities discussed in the Roadless Rule. As long as the roadless area characteristics are provided for in implementation of the activities, there will be no direct or indirect effect to the character of the IRAs (Federal Register /Vol. 66, No. 9 / Friday, January 12, 2001 /Rules and Regulations page 3245).

Watershed improvement activities are also included in the action alternatives. The Roadless Rule also addresses ecosystem health including wildlife and fisheries habitat improvement, if it is designed to maintain or help restore ecosystem composition or structure to conditions within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period. This will allow the agency to manage for the full range of habitat types needed to support the diversity of native and desired nonnative species (Federal Register /Vol. 66, No. 9 / Friday, January 12, 2001 /Rules and Regulations page 3257). As long as the roadless area characteristics are provided for in implementation of the activities, there will be no direct or indirect effect to the character of the IRAs.

None of the indirect or incremental cumulative effects associated with the alternatives should adversely affect the values of the IRAs within the project area. None of the alternatives would change how the IRAs meet the minimum criteria for Wilderness consideration.

Land Status

The federal land within the project area administered as National Forest System (NFS) land is part of the Tongass National Forest. In addition to the federal lands in the project area, approximately 487,810 non-federal acres are owned by a variety of landowners, including the State of Alaska, Alaska Native Village Corporations and Regional Corporations, communities, and private landowners.

None of the action alternatives propose to acquire or dispose of any property. There would be no effect to lands and minerals resources since no alternative would interfere with permits or mineral opportunities. Future Forest Service projects under other decisions would be analyzed at that time and an up-to-date review on then-existing authorizations and mineral claims would be researched. Property boundaries may need to be surveyed if an activity is proposed within one-quarter mile of non-NFS lands. This would be accomplished prior to implementation.

On May 5, 2017, the Consolidated Appropriations Act, 2017, Public Law 115-31, Div. G, Section 431(a)(2) (*Alaska Mental Health Trust Land Exchange Act of 2017* or “the Act”) was enacted and authorized an equal value land exchange between the Alaska Mental Health Trust Authority (AMHTA) and the Forest Service. Since this law has been passed, but the final transfer of lands has not been completed, the Forest Service must determine if this project has any direct, indirect, or cumulative effects that may affect the equal value of the land exchange. The land exchange is comprised of about 18,000 acres of AMHTA land and 21,000 federal acres across nine areas in Southeast Alaska. The Act established a framework to facilitate and expedite the land exchange over a 2-year period in two separate phases. Phase 1 (planned to be completed by the end of 2018) includes approximately 2,400 acres of NFS land near Naukati on Prince of Wales Island (POW), Alaska in exchange for approximately 2,500 acres near Ketchikan, Alaska. Phase 2 (planned for completion by May 2019) of the land exchange includes the remaining approximate 18,600 acres of NFS land near Hollis and Naukati on POW, and Shelter Cove near Ketchikan, Alaska, in exchange for 15,500 acres of AMHTA land adjacent to communities across the Tongass National Forest.

Within the project area, the NFS lands to be exchanged to the AMHTA totals about 12,421 acres. Of the 12,421 acres, approximately 10,883 are located near Naukati, Alaska as depicted on Map 8 of the Act, and approximately 1,538 acres are near Hollis, Alaska as depicted on Map 9 of the Act. Since this land exchange is not final it was considered a “present” activity on the *Catalog of Present and Reasonably Foreseeable Future Activities* table (Appendix C). However, all alternatives were designed as if the land exchange was final and proposed activities within these lands were limited to stream restoration, fish habitat improvement, and invasive plant management activities only through an agreement with AMHTA. None of the direct, indirect, or incremental cumulative effects associated with the alternatives would affect the value of the land exchange and no alternative would interfere with the land exchange. For these reasons, no effects to the land exchange between AMHTA and the Forest Service are expected and no further analysis is necessary.

The cumulative effects analysis on the affect that the land exchange may have on the individual resources are below in their respective sections.

Land ownership within the Tongass National Forest is complex, and land ownership has been shaped by multiple public land laws including the *Alaska Native Claims Settlement Act* (ANCSA), (ANILCA), *Alaska Native Allotment Act*, *Alaska Statehood Act*, and the *National Defense*

Authorization Act for Fiscal Year 2015 (Sealaska Finalization Act). Many of these public land laws still have pending adjudication by the Bureau of Land Management. Over the past few years, multiple pieces of legislation have been introduced that, if enacted, may result in additional transfer of lands out of federal ownership in the project area.

Wild, Scenic, and Recreational Rivers

Certain segments of rivers on Prince of Wales Island have been recommended to Congress for inclusion in the National Wild and Scenic Rivers System. Within the project area, the recommended designations include 40 miles of wild, 29 miles of scenic, and 20 miles of recreational rivers. The Forest Plan describes desired conditions for wild, scenic, and recreational rivers and management prescriptions to achieve Forest Plan goals and objectives (USDA Forest Service 2016a, pp. 3-76 to 3-96), to ensure free-flowing condition, water quality, river classifications, and outstandingly remarkable values will be maintained until Congress makes a decision about these rivers. No appreciable effect is expected with the implementation of this project that would cause these river segments to deviate from the desired condition or preclude them from inclusion by Congress in the National Wild and Scenic Rivers System. Recreation and tourism use and activities will continue to be managed consistent with the Forest Plan and the ANILCA. For these reasons, effects to river segments recommended for inclusion, or managed under the Wild, Scenic, or Recreational River classifications are expected to be negligible and no further analysis is necessary.

Environment and Effects by Significant Issue

The Council on Environmental Quality (CEQ) issues guidance to federal agencies to determine the significant issues concerning any proposal and to eliminate those issues that are not significant or that are outside the scope of this document. With the help of the public and other agencies, the Forest Service has identified five issues (see Chapter 1) to be examined in detail for the proposed project. The following sections describe the environmental effects of each alternative by issue. Effects to other resources are discussed in this chapter as well (see section Environment and Effects for Other Resources).

Issue 1: Invasive Plant Management

Issue statement: Using only manual or mechanical treatments for invasive plant control may not effectively reduce the establishment and spread of invasive plant populations on Prince of Wales and outer Islands. Use of herbicides in combination with other treatment methods increases effective invasive plant treatment strategies. However, using herbicides increases the level of exposure to the chemical properties contained within the herbicide to humans, soil, wildlife, aquatic resources, and non-target vegetation at a treatment site.

Background: Invasive plants displace native plant communities and may cause long-lasting economic and ecological problems within and outside the National Forest. They can degrade fish and wildlife habitat, out-compete native plants, impair water quality and watershed health, and adversely affect other resource values such as scenic beauty and recreational opportunities. Invasive plants can spread rapidly across the landscape to all land ownerships.

The ability to minimize the adverse impacts of invasive plants is greatest through prevention and by treating infestations while they are small (typically at the early stages of invasion). This section discusses the effects of treating infestations using an integrated weed management approach. The section on Invasives later in this Chapter 3 describes the effects of all other project activities on preventing further spread of weeds in the project area.

Treatment costs, including the need for retreatments, are directly related to the methods used (manual, mechanical, or herbicide) and the response of targeted invasive plant species to the treatment. Often a combination of all three methods provides the most effective and cost efficient control.

In some instances, herbicide application is the recommended treatment of difficult-to-control invasive plants. Treatment extent, rate and method of application, and the properties of the chemicals proposed influence the degree of risk. Mitigation measures and project design criteria minimize the risks associated with chemical use. Chemical toxicities and exposure scenarios will be evaluated for each proposed chemical for each resource, including human health.

Units of Measure

- Relative cost and treatment effectiveness by treatment method;
- Herbicide toxicology (chemical properties) and exposure (application rate in pounds per acre) for the herbicides, in terms of:
  - ♦ Herbicide impacts on human health (workers and the public);
  - ♦ Herbicide impacts on non-target vegetation (*e.g.*, subsistence use or culturally significant plants);
  - ♦ Herbicide impacts on soils, wetlands and karst resources;
  - ♦ Herbicide impacts on water/aquatic organisms;
  - ♦ Herbicide impacts on wildlife; and
  - ♦ Effects to Wilderness area characteristics from manual, mechanical, and herbicide treatments.

Desired Conditions

The desired future condition stated in the Tongass National Forest Land and Resource Management Plan (USDA Forest Service 2016a):

"Viable populations of native and desired nonnative species and their habitat are maintained and are not threatened by invasive species…."

Forest Plan Goals and Objectives include Biodiversity Goal (p. 2-3), "Maintain ecosystems capable of supporting the full range of native and desired nonnative species and ecological processes. Maintain a mix of representative habitats at different spatial and temporal scales."

Objective (c), "Manage the Forest in order to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of invasive species."

Forest Plan Wilderness goals and objectives include:

Wilderness Goal (p. 2-6), "Manage designated Wilderness to maintain an enduring wilderness resource while providing for the public purposes of recreational, scenic, scientific, educational, conservation, and historical use, as provided in the Wilderness Act of 1964 and ANILCA."

Objective, "Preserve and perpetuate biodiversity. Inventory and reduce or eliminate invasive species in Wilderness."

Methodology

There are two parts to the invasive plant issue: 1) effectiveness and costs of control methods, and 2) herbicide exposure to humans, non-target plants, soil, water/aquatic organisms, wildlife, and Wilderness area characteristics.

For effectiveness and costs of control methods, alternatives are compared by:

- Average cost per acre
- Average annual cost for an assumed treatment target
- Total cost over a 15-year period

The following assumptions are built into the cost analysis for consistent alternative comparison purposes:

- Each year's treatment is expected to be 80 percent effective where herbicides are an available method (Alternative 3), and 25 percent effective if herbicide use is restricted (Alternatives 1, 2 and 5) (USDA Forest Service 2005).
- Alternative 3 is assumed to follow a pattern of declining herbicide use over time, even though the analysis assumes 100 percent herbicide treatment methods being used for years 1 through 15 on certain invasive plant species.
- All alternatives maintain the same treatment acres per year given funding constraints.
- Calculations are based on current infestation acres only.

The estimated average cost of treatment for the project area is approximately $288 per acre per year for manual and mechanical treatments and $103 per acre per year for herbicide treatments. This information was derived from budget allocations and accomplishment reporting between 2008 through 2017 for the Tongass National Forest (Krosse 2018a). This figure is used to provide a relative comparison of the cost-effectiveness of the general treatment methods. However, a very limited acreage of weeds have been treated using herbicides (less than 5 acres over the past 4 years), thus average cost per acre for herbicide treatments cover a much briefer period (4 years) compared to costs associated with manual and mechanical methods.

For herbicide exposure, the primary information evaluated in this analysis is based on laboratory and field studies of herbicide toxicity, exposure, and environmental fate to estimate the risk of adverse effects to humans and non-target organisms. Formal risk assessments were done by Syracuse Environmental Research Associates, Inc. (SERA) using peer-reviewed articles from the available scientific literature and current Environmental Protection Agency (EPA) documents and were used for this analysis.

Additional information incorporated into the herbicide exposure analysis is based on herbicide product labels and the State of Alaska, Department of Environmental Conservation (DEC) pesticide use website (http://www.dec.state.ak.us/eh/pest/index.htm).

Following Forest Service Manual 2320.2 and Forest Plan direction, effects on Wilderness character were also analyzed using the five qualities of Wilderness: untrammeled, natural, undeveloped, outstanding opportunities for solitude or primitive and unconfined recreation, and other features of value.

Spatial and Temporal Context for Analysis

The direct, indirect, and cumulative effects from the use of any herbicide depends on the type (its toxic properties/hazards) and extent (the level of exposure to the herbicide at any given time, and the duration of the exposure). The spatial context for the analysis of effects of herbicides and herbicide treatment methods on humans, soil, wildlife, aquatic resources, and non-target vegetation includes the project area, both NFS and non-NFS land. The analysis area includes lands other than National Forest System lands to provide a comprehensive approach to weed management, and enable partnerships with other landowners if funding becomes available. The temporal context is seasonal for direct and indirect effects and over the life of the project (15 years) for cumulative effects.

Unless otherwise stated, the project area is the area of analysis for direct, indirect, and cumulative effects.

Affected Environment

The Thorne Bay and Craig Ranger Districts are currently treating non-native, invasive weeds (to a very limited degree) under a Categorical Exclusion (CE) which allows the Forest Service to use chemical treatments at administrative and recreation sites. Manual and mechanical treatments are also currently being implemented throughout the districts which are generally small scale at locations where invasive plants infestations are of the highest concern. Total known weed infestation currently mapped within the project area is approximately 2,288 acres (less than 0.01 percent of the project area), including close to 100 non-native plant species. Most field inventories were conducted in disturbed areas — along road systems and within rock pits, at Forest Service administrative sites, and in areas used for recreation such as campgrounds, dispersed recreation sites, cabins, and trails; thus, that is where most of the known weed infestations occur. Weeds occur in wilderness areas as well (less than 1 acre of known infestations).

Most weeds do not grow well under the shade of natural vegetation; however, some species such as orange hawkweed can persist, and even thrive, in forested settings. Existing weed infestations are spreading and increasingly there are new populations discovered. Expansion varies by species, whether pathways for spread are near existing infestations (*e.g.*, roads, trails, flowing water), and by the amount of existing disturbance. Based on data from the Pacific Northwest, weed expansion occurs at an annual rate of 1 to 5 percent for infestations not actively treated, and can be as high as 15 percent.

Environmental Effects

Several measures and processes minimize potential adverse effects of weed control methods on resources of concern: different treatment options proposed in the action alternatives, project design feature (PDF) implementation, strict adherence to herbicide label requirements, the Pesticide Use Proposal (PUP) process, and permitting or regulatory requirements.

The ability to minimize the adverse impacts of invasive plants and achieve eradication is greatest when infestations are treated while they are small, at the early stages of invasion, and using the proper method based on the response to the treatment method by the species. Treatment costs, including the need for retreatments, are directly related to the methods used (manual, mechanical, or chemical[2]) and the response of targeted invasive plant species to the treatment. Often a combination of all three methods provides the most cost efficient and effective control.

Specialists have analyzed the most ambitious treatment scenarios for the action alternatives to provide a comparison of effects by treatment type. For Alternative 3, specialists analyzed the environmental effects of using all available treatment methods (manual, mechanical, and chemical) in combination with an early detection-rapid response (EDRR) management strategy within the project area. For Alternatives 1, 2, and 5, specialists analyzed the treatment of weeds using only manual and mechanical techniques. In addition, all analyses incorporate applicable resource-specific project design criteria.

The full analyses for each resource, including methods, assumptions and literature, are the same as those described in resource reports cited in Table 6 and elsewhere in this document. All reports, which include a full analysis of effects including use of scientific risk assessments are available as separate reports in the project record and are synthesized in Krosse (2018d).

Table 6. Comparison of alternatives by resource and/or issue measures (citations are for specific resource reports which provide detailed analysis of each resource or issue measure)

Resource or Issue Measure	Alternatives 1, 2, and 5	Alternative 3
Treatment methods and where they can occur	Under an existing CE, small-scale manual, mechanical, and/or chemical weed treatments for new and existing weed infestations would continue to take place. Chemical use limited to Forest Service administrative sites, recreation sites, and facilities; manual/mechanical use used in other sites across the project area. No EDRR.	Manual, mechanical, and/or chemical weed treatments proposed for all existing and new weed infestations on NFS and non-NFS lands. EDRR.
Estimated maximum acres treated annually (Krosse 2018a)	38	100
Average treatment cost per acre (Krosse 2018a)	$288	$103
Average annual cost for an assumed treatment target (Krosse 2018a)	$10,944	$6,800

[2] Treatment types for manual and mechanical methods include hand pulling, digging, clipping and tarping. Mechanical methods include mowing. Treatment types for chemical methods include broadcast spray, spot spray, and hand-selective methods (e.g., wicking, wiping, and other stem and leaf application; stem injection; and cut-stump). No aerial application is proposed for this project.

Resource or Issue Measure	Alternatives 1, 2, and 5	Alternative 3
Total acres restored over 15-year period[1] (Krosse 2018a)	143	1,200
Average cost per restored acre (Krosse 2018a)	$1,148	$86
Risk to human health (Krosse 2018b)	No risk	No effect[2]– Imazapyr, Glyphosate, and Adjuvants (for enhancing herbicide performance) Negligible effect – Aminopyralid
Aquatic Organisms (Schneider 2018)	Cumulatively, short-term – minor [3] due to low number of infestations occurring within RMAs, near Class I and II streams and along shorelines and low toxicity of proposed herbicides under an existing CE. Potential long-term – adverse effect to aquatic organisms expected as weed populations grow and reduce productivity of riparian areas.	Short-term – minor effects due to low number of infestations occurring within RMAs, near Class I and II streams, and along shorelines, and low toxicity of proposed herbicides. Long-term – effects are expected to be beneficial due to improved aquatic habitat. There could be some localized effects to aquatic macrophytes with the use of imazapyr. Glyphosate may cause sub-lethal effects to fish.
Wilderness Character (Fluharty 2018)	Short- and possible long-term spread of weeds can adversely affect wilderness character, including to ecosystem processes and visual integrity. Short-term – localized impacts to the untrammeled and opportunities for solitude qualities of Wilderness would decline due to repeated entries to manually treat weeds or the placement of tarps. Long-term – decrease in natural quality as weeds remain present and potentially spread.	Short-term – localized impacts to the untrammeled, opportunities for solitude, and primitive and unconfined recreation qualities due to the presence of work crews or the placement of tarps. Long-term – full suite of treatment options results in a beneficial impact on natural quality.
Wildlife and Fish (M. Dillman 2018a)	Threatened and Endangered Species – May affect, not likely to adversely affect Sensitive Species - No effect[4] MIS Negligible effects[4] Migratory Birds - Negligible effects	Threatened and Endangered Species - May affect, not likely to adversely affect Sensitive Species - May affect[6] Migratory Birds - Negligible effects
Subsistence (M. Dillman 2018b)	Abundance and distribution - No effect Access - No effect Competition - No effect	Abundance and distribution - No change Access - No effect Competition - No effect
Recreation (Recreation Opportunity Setting [ROS] and Recreation Places/Sites) (Cisneros 2018)	ROS The proposed activities would not affect remoteness, access, activities, and experiences in a way that would change the recreation setting from one class to another. Recreation Places Weed populations could increase to the point that they are no longer practical or reasonable to treat. Temporary visual impact from implementation of manual and	ROS The proposed activities would not affect experiences in a way that would change the recreation setting from one class to another. Recreation Places Short-term – temporary displacement of forest visitors due to area closures for herbicide spraying; temporary visual impact from implementation of manual

Resource or Issue Measure	Alternatives 1, 2, and 5	Alternative 3
	mechanical treatments, such as the presence of tarps. The naturalness of the area would decrease.	and mechanical treatments, such as the presence of tarps. Long-term – naturalness of the area would increase.
Air Quality (Krosse 2018c)	No effect	No effect
Adverse Impacts to non-target vegetation (includes rare and sensitive plants) (K. Dillman 2018b)	Minor effect[3]	Minor effect[3]
Impact to soil productivity (Foss 2018)	Minor short-term[3] effect to soil productivity and associated physical and biological components and processes. Adverse long-term effect could increase due to continued expansion of current infestations, establishment of new populations, and increased soil erosion in localized areas.	Minor short-term[2] effect to soil productivity and associated physical and biological components and processes. Beneficial long-term effects due to anticipated increase in native plant species.
Impacts to wetlands (Foss 2018)	Short-term – no effect Long-term – adverse effect expected due to continued expansion of infestations and establishment of new populations. Reduction in extent of native species.	Negligible, short- and long-term adverse effects. Beneficial long-term effects expected due to anticipated increase in native plant species.
High vulnerability Karst (open karst systems) (Foss 2018)	No effect	No effect due to implementation of hydrology and aquatic PDFs
Hydrology (water quality and riparian condition) (Whitacre 2018)	Short-term – negligible[5] adverse effects to water quality and riparian condition for small infestations. Long-term – moderate, adverse effects in localized areas resulting from the expected spread of invasive weeds, particularly reed canarygrass.	Short-term – negligible, localized and adverse impacts on water quality and riparian condition. Long-term – negligible, localized and beneficial impacts to water quality and riparian condition.
Climate Change (Krosse 2018c)	Does not respond to potential increases in infestations due to potential changes in climate.	Consistent with recommendations to respond to potential changes in climate.
Cultural	Not Determined[7]	Not Determined[7]

1 Based on current inventory and not EDRR.
2 This conclusion is based on the hazards (*i.e.*, formulated end-use products highest toxicity category IV; "not likely" to be carcinogenic; and no basis to assert the herbicide would cause an adverse effect on nervous system, immune system, endocrine functions, reproduction and development) and dose response and risk characterization longer-term and short-term exposure calculations were below the level of concern.
3 Minor effects cause observable and short-term changes to natural conditions, but do not reduce the integrity of a resource.
4 No effect: the proposed action will not affect listed species or critical habitat.
5 Negligible effects may or may not cause observable changes to natural conditions; regardless, they do not reduce the integrity of the resource. Negligible effects are also when the change would be so small that it would not be of any measurable or perceptible consequence to the individuals or populations
6 May effect is an official determination for sensitive species (FSM 2670) and is separate from a no effect, negligible effect or minor effect.
7 All new proposed activities proposed are subject to Section 106 on a case by case basis as discrete activities are identified.

Cost Effectiveness: Direct, Indirect, and Cumulative Effects by Alternative

Alternatives 1, 2, and 5

Alternatives 1, 2, and 5 have a higher total cost (in terms of infested acres) over a 15-year period compared to Alternative 3. Additionally, due to the relatively low effectiveness of the treatment methods in these alternatives, only about 143 acres of infested area would be restored (the invasive plants eradicated) over the 15-year period, a figure slightly more than 50 percent of the total treated acres during the 15-year period. This equates to about 6 percent of the currently known infestations. The result would be a very minor net reduction of the total invasive plant infestations within the project area over time (Krosse 2018a).

Overall, fewer acres of infested areas would be treated (assumed to be the average of current treatments of 38 acres per year), due to budget limitations. Because of the difference in effectiveness rates for manual/mechanical treatments (25 percent), compared to chemical methods (80 percent), Alternatives 1, 2, and 5 require many more acres to be retreated year after year. Therefore, progress toward treating new acres of previously untreated infestations would be much less in Alternatives 1, 2, and 5. Over the long term, invasive plants would continue to grow and spread, ultimately costing tax payers even more through time. Alternatives 1, 2 and 5 would take an indefinite number of years of treatment to eliminate all currently known 2,288 acres. The high costs of not treating these infestations in the next 15 years can be compared to the burdensome costs of the lower 48 states in their annual treatment costs (USDA Forest Service 1998).

Alternative 3

In terms of cost efficiency, Alternative 3 would provide for the lowest cost of treatment over the next 15 years due to the ability to use herbicides in combination with other mechanical and manual treatment methods (analyzed under Alternatives 1, 2, and 5). Each year of treatment is assumed to reduce a population size by 80 percent of the treated area, given the range of tools that would be available. Information on effectiveness of this treatment method indicates that it would take fewer years to eliminate or control invasive plant infestations by including the use of herbicides. Given the currently known infestations within the project area, Alternative 3 would take over 20 years of treatment to eliminate all currently known 2,288 acres within the project area (not including future infestations). Herbicide use is expected to decrease with time as the infestation acreage decreases for those plants that respond to herbicides, allowing for more manual and mechanical treatment methods to treat the smaller infestation acres.

Total cost of treating the 2,288 acres of known infestations is lower in Alternative 3 than Alternatives 2 and 5 by approximately $62,000; and more total acres would be treated (1,500) over the 15-year period. Alternative 3 would have the highest amount of restored acres (1,200) of any of the alternatives. Restored acres are those that no longer infested by invasive plant and are functioning as near natural plant communities. In addition, higher treatment accomplishments per year are possible under this alternative with the use of herbicides because application costs are lower by approximately $4,100 resulting is less labor needed as opposed to manual and mechanical treatment methods alone.

Alternative 3 decreases the known and foreseeable future invasive plant infestations over time, ultimately controlling about 50 percent of known infestations that respond best to herbicide within a 15-year period.

Table 7. Cost and effectiveness comparisons of treating the known weed populations by alternative

Alternative	Maximum annual acres treated	Total acres treated over 15-year period[1]	Total acres restored over 15-year period[2]	Average cost per restored acre	Total cost 2018-2033	Average annual cost
1, 2, and 5	38	570	143	$1,148	$164,160	$10,944
3	100	1,500	1,200	$85	$102,000	$6,800

[1]Assumptions of maximum annual acres treated are based on professional judgement using historical accomplishments combined with budget outlooks for the future (Krosse 2018a). This assumes current budgets for financing the Invasive Plant program on the Tongass NF will not increase.
[2]Based on only the known infestations and not EDRR.

Herbicide Exposure

Risk of exposure to the chemical properties contained within the proposed herbicides to human health and other resources such as soil, wildlife, aquatic resources, and non-target vegetation at a treatment site is the second part of the Invasive Plant Treatment issue. Table 6 provides a comparison of effects of each alternative by resource. Due to the specific concerns regarding effects on human health, the information provided below focuses on this topic, while the citations to reports containing more detail on effects to other resources are referenced in Table 6. A synopsis of all effects are summarized in Krosse (2018d).

A very low level of herbicide use (less than 5 acres of weeds treated annually using herbicides) from past activities are known in the project area and therefore pose a very low level of risk to human health and other resources. Most people are subject to some background level of chemical exposure; the most common known exposure is use of herbicide-based products for personal use (*e.g.*, the use of Roundup, which is a glyphosate-based, commercially available herbicide, in gardening), or consumption of fruits or vegetables containing herbicide residue.

The Alaska Department of Transportation and Public Facilities is not currently using herbicides for vegetation management along the roads on Prince of Wales Island that they maintain.

Alternatives 1, 2, and 5

Direct, Indirect, and Cumulative Effects

Alternatives 1, 2, and 5, with the exception of very limited treatments authorized under an existing Categorical Exclusion for five administrative and recreation sites within the project area, could have very limited direct, indirect, or cumulative effects to human health and other resources related to herbicide use. Effects to human health and other resources with respect to herbicide treatments are analyzed in Alternative 3.

Alternative 3

All Resources

See Table 6 above under Environmental Effects for a comparison of effects by alternatives on all resources concerning invasive plant treatments. Citations are included to the resource-specific reports available in the project record.

Human Health

Human health and safety are special concerns when considering a weed management project due to the potential for herbicide exposure to applicators, the public, and employees. Exposure could occur from direct contact, drinking contaminated water, eating contaminated plants, gathering and using special forest products, or as a result of recreational users coming into contact with contaminated vegetation. However, the likelihood of harm from such exposure is extremely low as the proposed herbicides are considered to have low toxicity[3] levels and are taken up by plants quickly. Glyphosate, for example, is taken up into the plant within about 6 hours of application. Further, implementing project design features (PDF), strictly adhering to label requirements, the Pesticide Use Proposal (PUP) process, and permitting or regulatory requirements comprise the many layers of caution included in this project.

Direct and Indirect Effects

The SERA Herbicide Risk Assessments include analyses for both workers and the general public. The three herbicides proposed for use in this project pose negligible to low risk to workers and the public, based on the risk assessments.

Direct and Indirect Effects to Workers

This section focuses on the risks of proposed herbicide application to applicators themselves. Herbicide applicators are more likely than the general public to be exposed to herbicides, and may handle undiluted herbicide concentrate during mixing and loading. In routine broadcast and spot applications, workers may contact and internalize herbicides mainly through exposed skin, but also through the eyes, mouth, nose, or lungs. Worker exposure is influenced by the application rate selected for the herbicide, the number of hours worked per day, the acres treated per hour, and variability in human dermal absorption rates.

All herbicides can cause irritation and damage to the skin and eyes if mishandled. Eye or skin irritation would likely be the only overt effect because of mishandling these herbicides. These effects can be minimized or avoided by prudent industrial hygiene practices during handling. Worker exposure can be effectively managed through ordinary prudent practices and use of personal protective equipment (PPE) required for applicators.

Human Health Risk Assessment for the three proposed herbicides summarize risks for backpack and broadcast spraying under normal application and typical exposures. Exposure levels that were evaluated range from predicted average exposure to worst-case exposure. Risks from accidental/incidental exposures are also displayed. Backpack spray exposures assume that workers on average treat a little more than 4 acres per day (ranging from 1.5 to 8 acres per day) and broadcast spray exposures assume that workers average 112 acres per day (ranging from 66 to 168 acres per day). For all scenarios, it is assumed that the workers do not receive any protection from exposure provided by clothing.

Accidental worker exposures are most likely to involve splashing a solution of herbicides into the eyes or on the skin. Two general types of exposure are modeled: one involving direct contact with a solution of the herbicide and another associated with accidental spills of the herbicide concentrate onto the surface of the skin. Exposure scenarios involving direct contact with herbicide solutions are characterized by immersing unprotected hands for 1 minute or wearing contaminated gloves for 1 hour. Workers are not likely to immerse their hands in herbicide; however, the contamination of gloves or other clothing is possible.

Exposure scenarios involving chemical spills onto the skin are characterized by a spill onto the lower legs as well as a spill onto the hands. In these scenarios, it is assumed that a solution of the chemical is spilled onto a given surface area of skin and that a certain amount of the chemical adheres to the

[3] Toxicity is defined as the degree to which a substance is able to damage an organism.

skin. Surfactants or other adjuvants to enhance herbicide performance could be used according to label and PDF-HH-9. Many surfactants could cause eye irritation.

The maximum rates proposed for use in the project were evaluated for this FEIS. Most of the herbicides proposed for use have low potential to harm workers. In most cases, even when maximum rates and upper exposure estimates were considered, hazard quotient (HQ) values were below the threshold of concern. Hazard quotients are a ratio of exposure to toxicity and if the HQ value is below 1, the risk is considered acceptably low.

Direct and Indirect Effects to the Public

The general public is unlikely to be exposed to high levels of any herbicides used in the implementation of this project. The SERA Risk Assessments considered several exposure scenarios including direct contact, consumption of sprayed vegetation, consumption of drinking water adjacent to a spray operation, and consumption of fish in water adjacent to a spray operation. Accidental exposures including drinking water from a pond contaminated by a large spill were also considered. No reportable spills have occurred on similar projects in the Alaska Region. A requirement for usage of herbicides in this project is a District-level Herbicide Safety Plan which prevents spills from occurring or becoming large.

Direct Contact: Exposure is quantified from direct spray and contact with sprayed vegetation scenarios. At the maximum application rates proposed in any alternative, low risk to human health are indicated from direct contact. No scenarios for direct spray or contact with sprayed vegetation resulted in HQs greater than 1. One Project Design Feature (PDF) for hydrology includes specific notification and posting requirements for administrative and recreation sites to further reduce the possibility of inadvertent direct spray of a member of the public.

Indirect Contact: Quantitative estimates of exposure were conducted for an adult female swimming for 1 hour in water contaminated by runoff from a treated 10-acre slope. All herbicides had HQs orders of magnitude below 1 for this scenario, indicating no plausible risk to the public from this exposure.

Eating Contaminated Vegetation or Fruit: The public could be exposed to herbicide if they eat contaminated vegetation or fruit after spraying, such as berries, mushrooms, or other plants. Directly sprayed plant materials would likely show signs of either death or herbicide damage, reducing the likelihood they would be consumed. Non-target berries or mushrooms could also be contaminated by drift or uptake from the soil, which would result in lower herbicide residues than direct spraying. The risk assessments considered both one-time acute exposure (eating 1 pound) and chronic 90 day consumption scenarios for eating contaminated vegetation and fruit. These scenarios also approximate the effects of eating other contaminated products, such as mushrooms. Only under the highest exposure scenario for eating contaminated vegetation (a highly implausible scenario) did HQ exceed 1 for glyphosate (HQ 1.4). All other calculated HQs were many orders of magnitude below the threshold of concern.

Drinking Contaminated Water: Acute and long-term exposures from consumption of contaminated water were evaluated in the risk assessments. Risks from drinking contaminated water were evaluated for an accidental spill as well as water contaminated by runoff. The risk assessments also evaluated an accidental exposure scenario where a small child drinks 1 liter of water from a quarter-acre pond, into which the contents of a 200-gallon tank that contains herbicide solution is spilled, immediately following a spill. The District-level Herbicide Safety Plan is the mechanism which prevents spills from occurring or becoming large.

No herbicides resulted in HQs greater than 1 for drinking contaminated water in either acute or chronic scenarios at typical exposures. Only under the highest exposure scenario for a child drinking contaminated water (a highly implausible scenario) did the HQ exceed 1 for glyphosate (HQ 2.0). All other calculated HQs were many orders of magnitude below the threshold of concern.

Consuming Contaminated Fish: Both acute and long-term exposure scenarios involving the consumption of contaminated fish were evaluated using the herbicide concentrations in the contaminated water scenarios described above. Acute exposure was based on the assumption that an angler consumes fish taken from contaminated water shortly after an accidental spill into a pond. Chronic exposures were assumed to occur over a lifetime of eating contaminated fish. People who subsist on fish (for example Alaska Native residents, rural communities) could have higher exposure rates than recreational anglers. However, based on a lifetime of subsistence fish consumption, no HQ values greater than 1 are associated with the herbicide use proposed in any alternative.

Glyphosate and Cancer: Many recent articles have circulated announcing that in March 2015, the International Agency for Research on Cancer (IARC) has categorized glyphosate as “probably carcinogenic to humans.” This is not based on new studies; the studies that were used in IARC’s designation have been out a long time. The SERA 2011a Glyphosate Risk Assessment thoroughly discusses the carcinogenic, mutagenic, and genotoxic potential for glyphosate, using many of the same studies reviewed by the IARC.

In 2014, EPA reviewed over 55 epidemiological studies conducted on the possible cancer and non-cancer effects of glyphosate. Their review concluded that this body of research does not provide evidence to show that glyphosate causes cancer, and it did not warrant any change in EPA’s cancer classification for glyphosate.

Glyphosate is currently approved for use under 36 CFR 220.6 (d) (3) and (6) for administrative and recreation sites for Alternatives 1, 2 and 5. Best available science indicates that glyphosate proposed for use in this project would not increase anyone’s risk of cancer with any of the alternatives.

Endocrine Disruption: The potential for the proposed herbicides to cause endocrine disruption effects was addressed in each risk assessment. Based on the chronic bioassays and several additional sub-chronic bioassays in mice, rats, dogs, and rabbits, there is no basis for asserting that Aminopyralid would cause adverse effects on the immune system or endocrine function (SERA 2007 (Durkin 2007)).

The glyphosate risk assessment (SERA 2011a (Durkin 2011)) stated that “some recent studies raise concern that glyphosate and some glyphosate formulations may be able to impact endocrine function through the inhibition of hormone synthesis, binding to hormone receptors, or the alteration of gene expression” (all references as cited in SERA 2011a). Evaluation of the studies indicates that endocrine disruption effects were indicated for surfactants in the formulations rather than glyphosate itself. A commercial surfactant would be added to glyphosate when preparing the solution for application, but the surfactant type of choice is methylated seed oil/crop oil concentrate, which is typically a corn oil derivative and not implied in causing endocrine effects. No polyoxyethyleneamine (POEA) or nonylphenol polyethoxylate-based (NPE) surfactants would be used – these being the culprit in terrestrial glyphosate formulations.

In the review of the mammalian toxicity data on Imazapyr, U.S. EPA Office of Pesticide Programs concluded that “there was no evidence of estrogen, androgen and/or thyroid agonistic or antagonistic activity shown.” SERA found that this conclusion was reasonable, based on their review of current information in the 2011b Imazapyr risk assessment.

While the potential for the proposed herbicides to cause endocrine disruption effects is a current data gap, the potential for these effects to actually occur are greatly reduced by measures such as required use of proper protective equipment, public notification, use of licensed applicators, and limited application rates (PDF).

Multiple Chemical Sensitivity: The following information was adapted from USDA 2012, Gypsy Moth Management in the United States, a Cooperative Approach. Some people feel that they suffer from Multiple Chemical Sensitivity (MCS), which is sometimes referred to as Idiopathic Environmental Intolerances (IEI). In general, individuals with MCS report that they experience a variety of adverse effects as a result of very low levels of exposure to chemicals (including herbicides) that are generally tolerated by individuals who do not have MCS.

Forest Service risk assessments incorporate an uncertainty factor of 10 to account for sensitive individuals, which may or may not eliminate risk that an individual may suffer symptoms. However, the uncertainty factor for sensitive individuals addresses variability in tolerances within a normal population.

Individuals reporting MCS assert, either explicitly or implicitly, that they are atypically sensitive. There is no current consensus on the diagnosis and cause of MCS. Until the etiology and pathogenesis of MCS has been clarified, an organic cause of the MCS-associated symptoms and symptom complexes cannot be entirely ruled out. The Forest Service has no way to resolve concerns for MCS at the project level.

Cumulative Effects

Workers and the public may be exposed to herbicides used to treat invasive plants under Alternative 3 in this project. Cumulative doses are possible within the context of this project, or when combined with herbicide use on adjacent lands or home use by a worker or member of the public. However, the risk is very small that a person would receive additive exposures during the time period in which the herbicide remained in their body.

The SERA Risk Assessments evaluated chronic exposure scenarios that would involve the public, including repeated drinking of contaminated water, repeated consumption of contaminated berries, and repeated consumption of contaminated fish.

The potential for cumulative human health effects from any herbicide use proposed in this project, combined with other potential herbicide applications in the project area, would be encompassed in the health risks estimated for chronic exposure scenarios. These herbicides do not bio-accumulate in people and are rapidly eliminated from the body. Chronic (daily over 90 days) worker exposure was considered in SERA. Risk Assessments did not result in HQ values greater than 1 for any “central” estimate. Of the known herbicide use on adjacent lands, some may pose greater risk to workers or the public than the herbicide use proposed for this project, especially on State Highways. However, the State of Alaska Highway Division in Southeast Alaska is not currently using herbicides for vegetation management along road corridors. Therefore, the potential contribution to cumulative pesticide use by any alternative is not significant. The small and scattered nature of the infestations make it unlikely that exposures exceeding a level of concern would occur from simultaneous herbicide treatments on Forest Service and other lands.

The Forest Service Region 6 2005 FEIS, (Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants Final Environmental Impact Statement) considered the potential for synergistic effects of exposure to two or more chemicals: “Combinations of chemicals in low doses (less than one-tenth of Reference Dose) have rarely demonstrated synergistic effects”. Review of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects. The Region 6 FEIS based their analysis on the limited data available on chemical combinations involving the twelve herbicides considered in their FEIS and concluded that it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in their analysis. Synergistic or additive effects, if any, are expected to be insignificant." (USDA Forest Service 2005, R6 2005 FEIS p. 4-3).

To avoid the synergism between glyphosate and adjuvants, Alternative 3 proposes only aquatically labeled formulations of glyphosate (*e.g.*, Aquamaster®) and low-risk aquatically approved surfactants (e.g., Agri-Dex®, Class Act® NG®, Competitor®). This feature would eliminate potential impacts from surfactants that have high levels of POEA, since high levels of this chemical also have adverse effects to aquatic wildlife species.

Cumulative effects from the use of herbicides on human health include the potential use of herbicides proposed on non-National Forest System lands. At this time, there is no weed management plan for the Prince of Wales communities, but a plan could be developed in the future. However, workers and the general public within the project area could use some of the proposed herbicides outside the project area for personal activities (*e.g.*, treating weeds on their own property).

Glyphosate likely has the highest risk for cumulative effects because it is the most common herbicide sold to the general public to treat weeds.

Overall, herbicide use associated with Alternative 3, even at full implementation, would contribute no measurable effects when combined with the effects of other past, present, and reasonably foreseeable future activities. To further minimize the cumulative risk of herbicide use on human health and safety, PDFs have been developed and would be implemented as necessary.

Herbicide Treatment Conclusions

The types of herbicide proposed for use are considered to have low toxicity levels and consequently the inherent level of health risk is minimal and readily mitigated through full compliance with worker training requirements, herbicide label stipulations, and PDFs for safe herbicide storage, transportation, use, and disposal.

While herbicide use in Alternative 3 does carry a greater risk of effects to human health than Alternatives 1, 2, or 5, it provides an effective form of treatment for many weed populations. Combining the EDRR treatment strategy with herbicide use while populations are small and scattered is expected to reduce overall treatment costs with less chemical use over the life of the project, and less disturbance due to fewer entries than may be necessary with manual and mechanical treatments.

Issue 2: Subsistence

Issue statement: Proposed actions, particularly timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest, would affect subsistence resources and lifestyle.

Background: Title VIII of ANILCA addresses the legal context of subsistence use. ANILCA, Section 801, 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..." ANILCA Section 803:

> "the customary and traditional uses by 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."

Subsistence hunting, fishing, trapping, and gathering activities are a major focus of life for many residents on Prince of Wales Island. Reasons given for the participation in subsistence activities include the ability to provide food or supplemental income, the perpetuation of cultural customs and traditions, and the importance of values associated with self-reliance (USDA Forest Service 2016c, p. 3-417).

The effects of landscape changes caused by timber harvest and road construction and improvement on the availability of subsistence resources are important because the harvest of resources is an important cultural practice and food source. Timber harvest may influence the abundance and distribution of subsistence resources through changes in suitable habitat, access to subsistence resources (through changes in habitat and through road development or management), and competition for subsistence resources (through changes in resource abundance or access).

Commenters expressed concerns about timber harvest and road construction effects to subsistence use in the project area, especially deer. Concerns also included impacts to the harvest of salmon, berries, and mushrooms, and firewood gathering. The cumulative effects of the proposed activities on subsistence resources and associated habitats from past and future activities on both NFS and non-NFS lands were noted concerns.

The Forest Plan FEIS (p. 3-545) determined that 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 Forest Plan alternatives.

Deer are considered an "indicator" for potential subsistence resource effects concerning the resources associated with old-growth forest habitat, and they are the largest terrestrial component of subsistence food resources; therefore, they are addressed in detail in this analysis. The units of measure used for effects to deer as a subsistence resource are the same as the units of measure used in Issue 5, with the addition of the use of the deer harvest data from ADF&G.

Units of Measure

- Effects to aquatic resources (see Issue 4 in this chapter).
- Effects to deer habitat (see Issue 5);
- Relative changes in access to subsistence resources by road density;

- Percentage of deer harvested based on ADF&G information of the estimated deer habitat capability (DHC) by federally qualified subsistence users (direct and indirect effects) and all users (cumulative effects) by WAA.

Methodology

In order to determine if the project poses a significant possibility of significant restriction on subsistence resources, the magnitude of effects from project activities were analyzed and compared using the units of measure mentioned above. For aquatic subsistence resources, the conclusions from the aquatic resources effects analysis (see Issue 4 in this chapter) were used to analyze the effects of the project on the distribution and abundance of, access to, and competition for aquatic subsistence resources in the project areas. Wildlife subsistence resources were analyzed using the above units of measure and ADF&G deer harvest data.

Spatial and Temporal Context for Analysis

The spatial boundaries for analyzing the effects to aquatic subsistence resources are watersheds and near shore areas within the project area. Watersheds were used because they are the boundaries of a drainage basin in which aquatic effects are contained. Near shore areas were used because some aquatic species harvested for subsistence use are located in these areas.

The spatial boundaries for analyzing the effects to wildlife subsistence resources are at the WAA and GMU scales. These were used because the ADF&G analyzes and regulates wildlife at these scales. While ADF&G does not manage deer at the WAA scale, the harvest data is collected by WAA. ADF&G manages deer at the GMU scale.

See the temporal boundaries for Watershed Function (Issue 4) and Wildlife Habitat (Issue 5) for their respective analyses. The subsistence analysis for deer uses an additional temporal scale of the last 10 years for harvest trend data.

Affected Environment for Subsistence Species other than Aquatic Resources and Deer

Past harvest activities on both NFS and non-NFS lands have resulted in acres of old-growth forested stands being converted into young-growth stands. Old-growth harvest in general reduces the quality of habitat for most wildlife species. The conversion of old-growth stands into the stand initiation stage of stand development can provide forage opportunities to deer in the short term, but over the long term the habitat capability is reduced as these stands move into the stem-exclusion stage. In untreated stands, the stem-exclusion stage can last for many years until the stand is 100 to 150 years old or older. Overall the project area currently has about 42,579 acres of young growth that is older than 50 years.

Distribution and Abundance of Resources

Subsistence food plants occur in many locations within the project area including along roads, in previously harvested areas, and near beach and estuarine areas. Many species occur throughout the project area year-round, including upland gamebirds such as spruce grouse and ptarmigan; however, waterfowl like the Vancouver Canada goose occur primarily during spring and fall migration and primarily on lakes and estuaries. Marine mammals occur in the marine waters adjacent to the project area. Additional information on the abundance and distribution of marine mammals and identified critical habitat is included in the Biological Assessment/Biological Evaluation (BA/BE) in the project record.

Access to Resources

Road networks provide access to subsistence resources to the Prince of Wales Island portion of the project area, affecting subsistence both positively and negatively. Some of the outer islands, such as Kosciusko, Suemez, and Heceta also have NFS roads, but these roads are not connected to the Prince of Wales Island road system and, except for the road system on Kosciusko Island, are not connected to any communities. Some outer islands also contain roads that are not on federally owned lands. Roads and road building associated with timber harvest can provide access to previously inaccessible areas, providing greater opportunities for subsistence harvest, disperse hunting and fishing pressure, and also create the potential for increased competition for favored hunting areas among communities connected by the existing road system, including from non-resident hunters (USDA Forest Service 2016c, pp. 3-418 to 419). Changes in access can also affect the level of effort required, time involved, and the effectiveness of the hunt (USDA Forest Service 2009). The existing road network is described in the Transportation section. Road closures in the project area are scheduled under the *Prince of Wales Access and Travel Management Plan* (POW ATM; see the Transportation section); the proposed road closures in the POW ATM would reduce access to some areas. If roads are determined to remain open for some set period of time, then for that timeframe that could result in a positive effect to subsistence users by allowing users access to new areas, but it could also result in a negative effect by increasing competition between subsistence users, as many users access the same new area or areas.

Competition for Resources

Competition for subsistence resources may occur when access is available to local and non-local communities. Increased competition can occur between different subsistence user groups, as well as between subsistence hunters and sport hunters. The existing road system in most of the project area has created relatively large areas that are easily accessed. Boat access is also widely used to access outlying islands, saltwater, and shoreline. The ferry system and small planes allow relatively easy access from off-island communities, both rural and non-rural. Under ANILCA, in times of resource scarcity or when demand exceeds biologically sound harvest levels, subsistence harvest (rural) has priority over other use of resources, including non-rural harvest. Proposed recreation structures could increase opportunities for subsistence users by providing shelter in subsistence use areas. These same shelters could also result in increased competition as more users may want to use these new sites.

Subsistence Communities

There are numerous communities that either currently or historically used the project area for subsistence use, including Coffman Cove, Craig, Edna Bay, Hollis, Hydaburg, Kasaan, Klawock, Metlakatla, Meyers Chuck, Naukati Bay, Petersburg, Point Baker, Port Protection, Saxman, Thorne Bay, Whale Pass, and Wrangell. Of these communities, all but Saxman, Metlakatla, Meyers Chuck, Petersburg, and Wrangell are located in the project area. There are records of use of the project area by other communities. Some communities that report use of the project area do not qualify as federal subsistence communities, such as Ketchikan. Recent Federal Subsistence Board action may result in all rural residents of GMUs 1 through 5 becoming eligible to harvest deer under the Customary and Traditional use determination.

Environmental Effects

Subsistence resources other than aquatic species and deer include food plants and personal use timber, upland gamebirds and waterfowl, furbearers, and marine mammals.

The effects of landscape changes caused by timber harvest on the availability of wild game are important when the harvest of wild game is a critical cultural practice, food source, and recreational activity. Timber harvest may influence the abundance and distribution of subsistence resources (through changes in suitable habitat), access to subsistence resources (through changes in habitat and through road development or management), and competition for subsistence resources (through changes in abundance and/or access).

Direct and Indirect Effects

All action alternatives propose both old-growth and young-growth harvest as well as the precommercial treatment of young-growth acres. Road building associated with timber harvesting can provide greater access to areas previously not accessible and can affect subsistence both positively and negatively by providing access, dispersing hunting and fishing pressure, and creating the potential for increased competition for favored hunting areas among communities connected by the existing road system.

Food Plants, Firewood, and Personal Use Timber

None of the alternatives are expected to adversely affect the abundance or distribution of subsistence food plants because these resources are generally abundant along roads and in previously harvested areas. Food plants are expected to increase in harvested stands in the short term during the early successional stage, declining thereafter. Herbicide use is not allowed under Alternatives 2 or 5. This would have the short-term benefit of not exposing herbicides to food plants; however, it could result in a long-term effect of fewer food plants if invasive species are not contained or eliminated. See Issue 1 for information on herbicide use. Project design features described in Activity Card 35 address issues related to subsistence food and plants, and outline specific measures to mitigate short- and long-term negative effects on these resources.

The project would not preclude Alaska residents from obtaining personal use timber, including firewood. New roads under Alternatives 2, 3, and 5 may temporarily increase access to areas where food plants and personal use timber may be gathered. Some roads may be closed to public use for safety reasons during active timber harvesting, but any reduction in access would be both temporary and localized. Temporary roads may remain open for a set period of time post-activities. These roads could provide increased access for subsistence users to food plants, firewood, and personal use timber.

Given the positive effect to the abundance and distribution of food plants, and that the effects to access would be both temporary and distributed throughout the project area over time, no changes in competition for food plants or personal use timber would be expected.

Upland Game Birds and Waterfowl

All action alternatives would reduce upland game bird habitat (HPOG) and have the potential to increase vulnerability to harvest associated with increased access. The presence of old-growth reserves in the project area and implementation of Forest Plan direction that maintains connectivity within matrix lands would help sustain local populations.

No measurable effects to waterfowl are expected to occur, given that most species occur in the project area only during migration and on lakes and estuaries, except the Vancouver Canada goose which uses forested wetlands, and would be minimally affected by project-related activities. See Wetlands section of Chapter 3 for discussion on effects to habitat used by the Vancouver Canada goose.

No significant changes in the abundance or distribution of upland game birds and waterfowl are anticipated under any of the alternatives. The number of hunters may temporarily increase in the project area due to increased access along project roads, but competition would likely remain about the same because upland birds and waterfowl do not contribute a large percentage of the foods for the subsistence communities. Harvest activities proposed in the POW LLA Project would affect HPOG habitat used by upland gamebirds; however, this effect does not result in a significant possibility of a significant restriction for upland gamebirds. Alternative 2 would likely have the greatest effect to HPOG habitat as it harvests the most old-growth acres overall, followed by Alternative 3 and then 5. See effects to Prince of Wales spruce grouse habitat in Issue 5.

Furbearers

Estuary, riparian, and forested coastal habitats receive the greatest use by furbearers, such as river otters and ermine, and are included in the Forest Plan Conservation Strategy. Therefore, the project is not likely to affect the abundance or distribution of these species.

The Forest Plan allows young-growth harvest in areas used by furbearers including the beach fringe and riparian management areas (RMA) outside of TTRA buffers in development Land Use Designations (LUD) and the Old-growth Habitat LUD.

The intent is that determinations of prescriptions and opening sizes of young-growth treatments in the beach fringe consider spatial and temporal conditions of adjacent landscapes. It is expected that treatment prescriptions facilitate a more rapid recovery of the late-seral (successional) forest characteristics, while also producing commercial timber byproducts (Forest Plan p. 5-5).

Some furbearers seem to show a preference for habitat near water, both fresh and salt (see Issue 5). Activities in these areas, such as along streams or in the beach buffer, could affect some furbearers' habitat. The potential effect to this habitat could be mitigated because commercial young-growth harvest in the beach and estuary fringe is limited to a one-time only entry and in the first 15 years unless best available scientific information shows that additional entries are: a) warranted, and b) meet the LUD objectives. Additionally, the created opening for commercial timber harvest in beach and estuary fringe must not exceed 10 acres, and a maximum removal of up to 35 percent of the acres of the original harvested stand is allowed. Commercial thinning is limited to 33 percent of the stand's basal area. A combination of the two treatments may be used, with no more than 35 percent of the total stand removed in either basal area and/or acres. Commercial harvest within the beach and estuary fringe is not allowed within a minimum 200-foot forested buffer beginning at mean high tide (that is, a no commercial harvest buffer), that does not preclude wildlife enhancement projects and providing access to timber harvest units as long as process group objectives can be met in the RMA. The limited harvest in the beach buffer and along streams will likely mitigate effects to furbearers.

Timber harvest with removal of POG, and the associated fragmentation and road building which increases access, could affect the local distribution and abundance of marten and wolves. Marten and wolves become more vulnerable to harvest due to increased access. This could increase competition among local communities, particularly if increased access in currently accessible areas results in overharvest of furbearers. These effects could be somewhat mitigated through road access management. However, this effect would not result in a significant possibility of a significant restriction for marten and wolves. Alternative 2 would likely have the greatest effect to furbearer habitat as it harvests the most acres of old growth overall, followed by Alternative 3 and then 5. See discussion in Issue 5 for effects to marten habitat and wolves.

Marine Mammals

Marine mammals have the potential to be exposed to disturbance and noise associated with marine access facilities (MAF) activity, potential collisions with vessels, and fuel or oil spills associated with vessel traffic. Alternatives 2, 3, and 5 have the potential to result in a minor increase in activity, including vessel and the rafting of logs, at the existing and proposed MAFs and in association with the export of logs. However, this activity would be infrequent, and would be spread over 15 years.

Vessels used to transport logs are not likely to affect the abundance or distribution of marine mammals around the project area, given the transient nature of these species and the fact that such vessels typically operate at low, constant speeds. This gives the marine mammal species time for avoidance, and vessels would operate at infrequent intervals. Additionally, it is assumed that all vessels operating on behalf of the project would adhere to the requirements of the Marine Mammal Protection Act, Endangered Species Act (ESA), and National Marine Fisheries Service (NMFS) guidelines for approaching marine mammals, as required under the Forest Plan. Therefore, no change in abundance and distribution, access to, or competition for, marine mammals would occur as a result of the project. Affects to marine mammals are included in the Biological Assessment/Biological Evaluation in the project record.

None of the project alternatives would present “a significant possibility of a significant restriction” of subsistence uses for most subsistence resources (food plants, personal use timber, upland game birds and waterfowl, furbearers, and marine mammals).

Cumulative Effects

Since the project would have no significant direct or indirect effect to the abundance or distribution of, access to, or competition for most waterfowl, furbearers, food plants, personal use timber and marine mammals, the project would make no contribution to cumulative effects to these species. Exceptions are the Prince of Wales spruce grouse (upland gamebird), and marten and wolves (furbearers) which may be affected by reductions in upland POG habitat and/or increased road densities and related effects associated with increased human access under all the action alternatives. Alternative 2 would likely have the greatest effect to habitats used by the species listed above as it harvests the most old-growth acres overall, followed by Alternative 3, then 5. While the proposed activities may have an effect on habitat used by these species, the effect would not result in a determination of a significant possibility of a significant restriction for these species. All alternatives propose to build a similar amount of road, resulting in little difference between alternatives. See Issue 5 for effects to marten and spruce grouse habitat and wolves.

Conclusion

None of the project alternatives would present “a significant possibility of significant restriction” of subsistence uses for food plants, personal use timber, upland game birds and waterfowl, furbearers, and marine mammals.

Affected Environment for Aquatic Subsistence Resources (salmon, other fin fish, seaweed, and marine invertebrates)

Aquatic subsistence resources that could be affected by project activities include salmon, other finfish, seaweed and beach greens, and marine invertebrates. Refer to the Affected Environment for Aquatics (Issue 4) in this FEIS.

Environmental Effects

Alternative 1 – No Action

Direct and Indirect Effects

No POW LLA Project activities would occur in this alternative, so there would be no direct or indirect effects to aquatic subsistence resources and the user groups who rely on them.

Cumulative Effects

POW LLA Project activities that might help offset adverse effects from past land management practices would not occur. Cumulative effects to aquatic subsistence resources would remain similar to the present condition in this alternative.

Past, present, and reasonably foreseeable future activities in the project area could affect aquatic subsistence resources and their users. Previous land management practices like harvesting riparian trees, yarding logs in streams, and building roads in floodplains have had adverse effects to water quality, fish habitat, and the capability of habitat to support aquatic subsistence resources like salmon.

Timber harvest and road building on state, private, and federal land in the project area contribute to changes in peak flow rates which can affect the capability of habitat to support aquatic subsistence resources. Road paving on Prince of Wales Island may have increased competition for aquatic subsistence resources in some communities. Upgrading and paving the road from the Neck Lake turn-off to the Whale Pass boat launch may increase competition for aquatic subsistence resources in Whale Pass.

Action Alternatives 2, 3, and 5

Direct and Indirect Effects

Distribution and Abundance

All action alternatives include fish passage improvement at road–stream crossings and riparian thinning. These activities would address fish habitat fragmentation and improve fish habitat, and therefore improve the distribution and abundance of salmon for subsistence use.

All action alternatives allow for some amount of fish habitat improvement including bioenhancement, and some amount of instream restoration. These activities would improve water quality, fish habitat, and/or access to fish habitat, and therefore improve the distribution and abundance of salmon for subsistence use. Alternative 2 allows for fish habitat improvement and bioenhancement activities like lake fertilization, egg incubation boxes, fry stocking, and barrier modifications. Alternative 3 only allows for barrier modification. Alternative 5 only allows barrier modification and lake fertilization. Alternatives 2 and 5 allow for 200 miles of stream restoration, and Alternative 3 allows for only 80 miles of stream restoration.

All action alternatives include the use and improvement of at least 13 existing LTF sites and the construction of two new LTF sites, as well and the development or improvement of up to 70 other MAF sites. Effects to the distribution and abundance of aquatic subsistence resources would be minimized by following direction in the LTF and MAF Activity Cards (Appendix A), which outline required BMPs, Forest Plan direction, and require identification of site-specific mitigations during implementation planning.

All action alternatives allow for some amount of timber harvest and road construction, reconstruction, and maintenance. Alternative 3 proposes up to 49,684 acres of timber harvest, followed by Alternative 5 with 43,035 acres, and then by Alternative 2 with 42,635 acres (Table 38). Direct and indirect effects to the abundance and distribution of aquatic subsistence resources would be minor because no-harvest buffers along fish streams preserve the riparian portion of the stand needed for shade, nutrient input, and habitat complexity. Effects would be further minimized by following Activity Card direction which outlines required BMPs and Forest Plan direction, and requires identification of site-specific mitigations during implementation planning.

Roads can directly affect water quality, fish habitat, and access to fish habitat, especially if roads are built on steep slopes or within 300 feet of a fish stream. Alternative 5 proposes to build the most new roads with 229 miles, followed by Alternative 3 with 223 miles, and then Alternative 2 with 164 miles (Table 2). Alternatives 2 has the most existing and potential roads on steep slopes at 187 miles, followed by Alternatives 3 and 5 with 185 miles (Table 29). Alternatives 2 and 3 have the most existing and potential roads within 300 feet of a fish stream with 907 miles, followed by Alternative 5 with 903 miles (Table 29).

Adverse effects of project activities to the abundance and distribution of aquatic subsistence resources from roads are minimized by following Activity Card guidance, which includes BMPs and Forest Plan direction. Any new fish stream crossing structures will provide for fish passage, and any instream work will occur during species' specific timing windows which are designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water.

Access

None of the action alternatives would directly limit the use of public lands for gathering aquatic subsistence resources. There may be some temporary and localized disruptions during the construction and maintenance of roads, trails, recreation and MAF sites, and while logging is occurring. There may also be some short-term disruptions from young-growth harvest in the beach fringe for subsistence users who use a boat as a primary method of access.

Subsistence use patterns may change slightly from the development of new trails, MAF sites, and roads. Nearly all new roads would be closed or decommissioned following harvest so they would not be accessible by highway vehicles or high-clearance vehicles, but they could be accessed by other methods, such as foot, bicycle, ATV, or snowmachine, and affect subsistence use patterns.

Competition

Competition for aquatic subsistence resources is affected by many factors. For this analysis, it is assumed that:

- Demand for aquatic subsistence resources would increase slightly or remain constant if habitat capability declines or remains the same over time.
- Competition would increase if access from surrounding or off-island communities increases.
- Competition would increase if resource populations decrease from overharvest or loss of habitat.
- Project activities and protection measures should maintain or improve habitat capability for salmon, and therefore the demand for aquatic subsistence resources should decrease or remain constant.
- Restoration activities are intended to bring impaired channels back to a properly functioning state, which would improve its capability to support fish and other aquatic organisms over time.
- Fish habitat improvement and bioenhancement activities are intended to improve wild sockeye salmon runs in areas that historically produced more salmon.
- For barrier modification activities, ADF&G regulations already prohibit fishing within 300 feet of a fish ladder or similar structure. Additionally, proposed fish passes are intended to improve/provide Pacific salmon access to spawning and rearing habitat.
- Fish passage improvement activities at road crossings would increase access to habitat that is currently inhibited by Red crossings, or crossing structures that are not passable to fish at all flows.

- No-harvest buffers, BMPs, Forest Plan direction, and other requirements listed in the Activity Cards will further minimize the effects of timber harvest and road building on the capability of fish habitat.
- New roads, trails, and MAF sites like boat launches might increase access to fishing locations, and could disperse competition for aquatic subsistence resources within the project area.
- While there would be new road construction, most of those roads are temporary, which means subsistence users would have to use methods other than highway vehicles or high-clearance vehicles to access new fishing locations once a road is closed.

Given the above assumptions, effects to the competition for aquatic subsistence resources would be minor. POW LLA Project activities are not expected to result in the over-harvest of aquatic subsistence resources. POW LLA Project activities like stream restoration, fish habitat improvement including bioenhancement, riparian thinning, and fixing fish passage at roads may improve the habitat capability; however, there still may be concerns about over-harvest and the subsequent effects on competition for aquatic subsistence resources on Prince of Wales Island. These can be addressed by working with the State of Alaska, and the Federal Subsistence Board through the Southeast Alaska Subsistence Regional Advisory Council (SEASRAC). The State of Alaska manages populations and harvest limits for commercial, sport, and state-run subsistence fisheries, and the Federal Subsistence Board establishes federal subsistence regulations for NFS land within the project area. POW LLA Project subsistence hearings, Project Implementation Plan public meetings, as well as SEASRAC meetings provide opportunities for local residents to express concerns about the effects of project activities on the distribution and abundance of, access to, and competition for aquatic subsistence resources.

Cumulative Effects

Cumulative adverse effects to distribution and abundance of, access to, and competition for aquatic subsistence resources would increase slightly in each of the action alternatives.

Alternative 2 presents a greater risk of adverse effects compared to Alternatives 3 and 5. During the implementation process, careful consideration of watershed-specific activities and characteristics will be necessary to ensure that fish habitat and water quality will not be degraded, and capability of habitat to support aquatic subsistence resources like salmon would be maintained. Alternatives 3 and 5 require that timber harvests be planned so no watersheds have peak flow rate increases.

Past, present, and reasonably foreseeable future activities in the project area could affect aquatic subsistence resources and their users.

Previous land management practices like harvesting riparian trees, yarding logs in streams, and building roads in floodplains have had adverse effects to water quality, fish habitat, and the capability of habitat to support aquatic subsistence resources like salmon. Timber harvest and road building on state, private, and federal land in the project area contribute to changes in peak flow rates which can affect the capability of habitat to support aquatic subsistence resources. Past and present road improvement for highway vehicle access on Prince of Wales Island may have increased competition for aquatic subsistence resources in some communities. Upgrading and paving the road from the Neck Lake turn-off to the Whale Pass boat launch may increase competition for aquatic subsistence resources in Whale Pass.

POW LLA Project activities may help offset adverse effects from previous land management practices. Stream and karst restoration, riparian thinning, fish habitat improvement activities including bioenhancement, and fixing fish passage issues at road crossings can all help improve habitat capability to support aquatic subsistence resources.

Direction in Activity Cards outline BMPs, Forest Plan direction, and other protections so that adverse effects to aquatic resources from project activities are minimized.

Conclusion

None of the project alternatives would present “a significant possibility of significant restriction” of subsistence uses for salmon, other fin fish, seaweed, and marine invertebrates.

Affected Environment for Sitka Black-tailed Deer

The conversion of an old-growth forest stand into a stand at the stem initiation stage of development results in a temporary increase in deer forage availability and deer habitat capability; however, this is a relatively short-term increase (about 25 years post-harvest) and then the deer habitat capability (DHC) declines through the stem exclusion stage, which is more long term (years 26 to about 150) and generally has less forage availability than the original old-growth stand. Road construction can also affect subsistence by providing subsistence hunters with ready access to areas that may have been previously inaccessible. This effect may be perceived as either positive, providing increased access to a new area, or negative, 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.

In the first 20 to 30 years following timber harvest, deer habitat capability tends to increase due to more available forage. However, after this timeframe, populations tend to decline due to forage availability as the canopy in even-aged managed stands closes, resulting in lower habitat quality (less forage). Reductions in habitat quality in these young-growth stands can be mitigated to some extent through management activities such as thinning. Deer may indirectly benefit as stands become older and move into the stem exclusion stage, as deer become harder to see in these stands, making them less visible to hunters.

Effects to deer habitat are discussed below in Abundance and Distribution and in Issue 5. Research has identified deer winter range as the likely limiting habitat for deer (see Issue 5 for more information).

Abundance and Distribution

Hunter harvest data for the number of deer taken from 2006 to 2016 were used in this analysis. The deer harvest data were obtained from ADF&G and are included in the project record. This likely underestimates actual number of deer harvested as it does not include hunters who were not successful in taking any deer or took fewer deer than they desired. The analysis of direct and indirect effects uses deer harvest by federally qualified users only and the cumulative effects analysis includes all users. The ADF&G data do not differentiate between NFS and non-NFS lands in WAAs so the analysis for the POW LLA Project is done at the scale of all lands.

A deer population at carrying capacity is assumed to support a sustainable hunter harvest equal to approximately 10 percent of the deer habitat capability while also providing a reasonably high level of hunter success in the WAA (USDA Forest Service 2008b, p. 3-576). Populations may be nearing carrying capacity in portions of Game Management Unit 2 and managers are concerned that in some drainages a severe winter could result in a substantial die-off (ADF&G: Deer Management Report of Survey-Inventory Activities, 1 July 2012–30 June 2014). Hunter success can be expected to decline, through reduced hunter efficiency and the moderate difficulty in obtaining deer in areas (WAAs) where harvest equates to between 10 and 20 percent of habitat capability. If harvest exceeds 20 percent of habitat capability, the harvest of deer by hunters may be directly affected either through restriction in seasons and bag limits or indirectly through reduced hunter efficiency and increased difficulty in obtaining deer relative to historical rates (USDA Forest Service 2008b, p. 3-428).

Table 8 shows the percent of reported deer harvested of the estimated deer habitat capability, and the five WAAs of concern are 1214, 1315, 1317, 1318 and 1420. These WAAs are near the communities of Thorne Bay, Coffman Cove, Hollis and Klawock. Road densities are discussed in the Wolf Mortality section of Issue 5.

Table 8. Estimated percent harvest of estimated DHC by year and WAA by Federally-qualified subsistence users

WAA	Current DHC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
901	1659	1.5	2.9	1.7	2.0	4.5	6.5	5.8	4.0	5.1	2.1
902	4471	0.8	2.1	2.3	2.8	2.2	1.5	1.1	1.6	1.0	0.6
1003	1692	2.1	2.1	1.2	3.0	2.1	1.7	2.0	0.9	2.2	2.0
1105	4782	0.5	0.8	0.4	0.7	0.8	1.1	2.4	1.9	1.8	1.9
1106	318	4.7	1.3	2.8	3.5	0.6	1.9	1.6	3.8	2.2	1.9
1107	4343	1.5	2.3	2.3	3.1	4.1	4.1	2.0	2.6	1.7	1.1
1108	2909	0.0	0.4	0.2	0.4	0.5	0.7	0.0	1.3	0.2	0.0
1209	2929	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.2	0.0	0.1
1210	2445	0.0	0.0	0.2	0.1	0.3	0.2	0.3	0.5	1.1	0.3
1211	1413	0.3	0.0	0.3	0.0	0.0	0.6	0.1	1.3	0.3	0.7
1212	897	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.3	0.4	0.0
1213	881	0.1	0.6	0.1	1.0	0.2	0.8	0.8	0.2	0.2	0.6
1214	1028	**16.5**	**11.8**	**12.4**	**14.7**	**13.3**	**10.6**	**13.5**	**13.4**	**12.4**	**9.3**
1315	1436	**14.8**	**12.4**	**17.8**	**16.4**	**14.3**	**11.0**	**13.1**	**14.4**	**15.0**	**13.0**
1316	920	0.4	1.6	3.3	0.3	2.5	0.4	0.9	0.1	0.2	1.2
1317	1004	7.5	7.5	8.4	8.4	**15.6**	**13.6**	**11.1**	**11.6**	**12.4**	9.1
1318	1046	**13.5**	**17.6**	**15.7**	**19.3**	**19.4**	**19.0**	**19.5**	**16.3**	**22.1**	**15.2**
1319	2543	7.6	6.7	5.2	5.5	6.2	7.0	7.2	8.5	8.1	5.3
1323	1480	0.9	2.0	1.0	0.5	0.6	1.4	0.5	0.8	1.9	1.4
1332	1718	5.0	4.2	4.0	6.2	3.3	3.6	3.8	3.0	3.2	3.1
1420	747	**19.7**	**18.1**	**16.9**	**20.3**	**24.9**	**18.7**	**20.2**	**26.2**	**19.9**	**20.5**
1421	2403	3.5	3.5	3.7	2.5	4.4	2.0	2.9	4.5	3.7	2.9
1422	3148	7.1	7.6	8.3	8.4	6.6	5.5	6.5	6.0	8.7	8.5
1524	470	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1525	1333	1.0	0.9	1.0	1.1	1.7	2.3	2.0	1.8	0.5	0.8
1526	2198	0.1	0.5	0.3	0.1	0.9	0.5	0.8	1.2	0.7	0.5
1527	995	0.7	1.7	2.0	1.0	0.7	1.7	0.2	0.3	1.7	1.2
1528	446	3.6	4.3	5.2	8.1	6.3	2.9	10.8	6.5	9.9	9.4
1529	2089	3.3	4.1	3.2	3.9	2.3	2.9	2.4	4.9	4.9	7.1
1530	1408	3.8	4.7	2.2	3.8	5.3	3.9	5.3	9.4	6.9	8.1
1531	967	2.0	2.7	2.1	2.4	4.4	3.6	0.8	1.0	3.7	1.2

*Shaded values indicate where estimated percentage exceeded 10 percent more than five times within this 10-year period.

See Issue 5 for effects to non-winter, average snow, and deep snow deer habitat.

Access

Conditions in unmanaged young-growth stands can reduce access to deer, increase undesirable habitat for deer hunting (Brinkmann *et al.* 2009) and make them harder to see in these stands and therefore less visible to hunters. This could be perceived as a negative effect, by reducing access for hunters. Roads in the project area provide access to subsistence resources. Young growth and road densities are discussed in Issue 5 under Wolves.

Competition

Hunter efficiency and success may decrease in the five WAAs of concern and there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher.

Proposed roads can affect subsistence both positively and negatively by providing access to areas previously not accessible, dispersing hunting pressure, and creating the potential for increased competition for favored hunting areas among communities connected by the existing road system (USDA Forest Service 2016c, pp. 3-418 to 419).

Environmental Effects

Alternative 1

Direct and Indirect Effects

Distribution and Abundance

There would be indirect effects to deer habitat or the deer habitat capability over time, as existing harvested stands move from the stand initiation stage into the stem-exclusion stage, reducing the amount of forage for deer. Conditions in unmanaged young-growth stands can reduce access to deer and increase undesirable habitat for deer hunting (Brinkmann *et al*. 2009). Thus, over time, reductions in habitat capability for deer may reduce deer abundance, or increase abundance by decreasing hunter success.

The decrease in deer habitat capability from current by WAA is shown in Table 9.

Table 9. Decrease in DHC from current by WAA for Alternative 1

WAA	Location	% Decrease
901	Suemez Island	5
1003	Heceta Island	2
1211	Cholmondeley Sound	3
1214	Twelvemile Arm	5
1315	Thorne Bay	8
1317	Hollis	2
1318	Klawock	3
1319	West of Thorne Bay	2
1420	Coffman Cove	5
1421	West of Coffman Cove	3
1422	Naukati	4
1527	Calder Bay	3

Hunter success can be expected to decline, through reduced hunter efficiency and the moderate difficulty in obtaining deer, in WAAs where hunter deer harvest equates to between 10 and 20 percent of the estimated deer habitat capability (WAAs 1214, 1315, 1317, 1318, and 1420; see Table 10). Alternative 1 may result in negligible changes to this table due to the indirect effects of changes in DHC and access.

Access

Under Alternative 1, no new roads would be constructed; however, current access may be reduced as existing roads would continue to be closed under the POW ATM. Road closures would result in a change in access and may affect competition by concentrating hunters in the remaining accessible areas.

Competition

Reductions in deer habitat capability at stem exclusion is primarily the result from the progression of previously harvested stands transitioning into the stem exclusion stage. As hunter efficiency and success decrease in areas that transition into stem exclusion, there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher.

Cumulative Effects

Since Alternative 1 does not result in any significant effects to abundance and distribution, access or competition, it would not have significant contribution to the cumulative effects.

Distribution and Abundance

The cumulative effects analysis for subsistence includes the estimated effect to deer by all hunters.

When considering the impact of all hunters on deer, WAA 1422 is added to the list of WAAs where there has been more than 10 percent harvest of the estimated DHC (see Table 10).

It is assumed that both old-growth and young-growth timber harvest would continue to occur on non-NFS lands. The old-growth timber harvest would result in the conversion of old-growth stands into the stand initiation stage of development. In the short term, these acres would provide habitat for deer, especially in the summer and mild winters. Over the long term, if these acres are not treated, they would transition into the stem exclusion stage that provides limited habitat and would result in a reduction of deer habitat capability. The harvest of young-growth stands would likely result in an increase in deer habitat capability due to the conversion of stands currently in the stem exclusion stage (that provide limited habitat) back into the stand initiation stage (that provides forage habitat at least during summer and mild winters). See Issue 5 for effects to deer habitat (non-winter, average snow, and deep snow habitat).

Access

Road building on non-NFS lands would result in an increase in access to subsistence resources. These road networks provide greater access to areas previously not accessible and can affect subsistence both positively and negatively by providing access, dispersing hunting and fishing pressure, and creating the potential for increased competition for favored hunting areas among communities connected by the existing road system (USDA Forest Service 2016c, pp. 3-418 to 419).

Competition

As hunter efficiency and success decrease in areas that transition into stem exclusion, there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher.

Alternatives 2, 3, and 5

Direct and Indirect Effects

Effects to deer habitat have been addressed by looking at effects to habitat: non-winter, average snow, and deep snow habitat. While research has not identified any thresholds for these habitat types for deer in Southeast Alaska, effects to these habitat types are discussed in Issue 5. Research has identified deep snow habitat as the likely limiting habitat for deer (see Issue 5).

Distribution and Abundance

WAAs with 10 percent or more deer harvested of the estimated deer habitat capability (DHC) include WAAs 1214, 1315, 1317, 1318, and 1420. These WAAs have potential subsistence harvest concerns.

All the WAAs, except 1214, with 10 percent or more deer harvested of the estimated deer habitat capability (DHC) receive some timber harvest mitigation in Alternative 2. Alternative 2 includes wildlife prescription treatments, generally uneven-aged harvest (see Issue 5 for definition) for both old-growth and young-growth harvest within 5 miles of a subsistence community in the project area. This would occur in WAA 1107 (Hydaburg), WAA 1315 (Thorne Bay), WAA 1317 (Hollis), WAA 1318 (Craig/Klawock), WAAs 1420 and 1421 (Coffman Cove), WAAs 1422 and WAA 1525 (Edna Bay), WAA 1529 (Port Protection and Point Baker), WAA 1530 (Whale Pass), and WAA 1531 (Naukati). The wildlife-centric prescriptions should help mitigate effects to or lead to short-term benefits to deer habitat.

All the WAAs with 10 percent or more deer harvested of the estimated DHC receive some timber harvest mitigation in Alternatives 3 and 5. Alternative 3 allows only single-tree selection (STS) for old-growth harvest on south-facing stands below 800 feet in elevation. Alternative 5 would allow no old-growth harvest on south-facing stands below 800 feet in elevation in these WAAs. Maintaining acres in these locations helps to mitigate the overall effects to deep-snow deer winter habitat in these WAAs.

Of the WAAs with 10 percent or more deer harvested of the estimated DHC, WAAs 1214, 1315, 1317, and 1420 would have both the timber harvest restriction measures discussed above as well as include the VCUs in which the Forest Plan Legacy Standard and Guideline would be applied. Both help to mitigate the effects to deep snow habitat. Additionally, Alternatives 3 and 5 include peak flow rate mitigations in WAAs 1214, 1315, 1317, 1318, and 1420.

Alternative 2 would likely result in the greatest negative effect to deer habitat in that it harvests the most acres of old growth. Long-term, Alternative 3 would have less of a negative effect to deer habitat in that it harvests about half the acres of old growth than what is proposed in Alternative 2, and about 75 percent of those acres are proposed for uneven-aged harvest treatments. The old-growth harvest proposed in Alternative 5 is fewer acres than proposed in either Alternative 2 or 3, about half (49 percent) of the acres proposed in Alternative 3 and a quarter (27 percent) of the acres proposed in Alternative 2; however, a smaller percentage of Alternative 5's proposed acres would include uneven-aged harvest prescriptions. Overall, Alternative 5 would probably have the least negative impact to deer habitat compared to Alternative 2 and 3, mostly due to fewer acres proposed for old-growth harvest, and of those acres almost a third are proposed for uneven-aged harvest. The negative effects of Alternative 3 would likely be more than Alternative 5 (more acres of old-growth harvest) but less than Alternative 2. The higher number of old-growth harvest acres proposed in Alternative 3, relative to Alternative 5, are mitigated somewhat due to about 75 percent of those acres being harvested using uneven-aged harvest prescriptions. Alternative 2 would have the greatest negative impact to deer habitat relative to Alternatives 3 and 5 due to both more overall old-growth acres proposed for harvest and the small percentage of those acres harvested using uneven-aged prescriptions (see Table 38 in Issue 5).

Even-aged harvest of both old- and young-growth may result in a short-term increase in deer availability, but may decrease over the long term in the absence of any further treatments. Uneven-aged harvest would result in less of an increase in deer habitat in the short term, but also less of decrease over the long term. Even-aged timber harvest could increase access to deer over the short term, due to the clearing of vegetation which makes them more visible to hunters.

The abundance and distribution of deer may be affected in Alternatives 2, 3, and 5, mostly due to the loss of deep snow habitat (loss of available forage in winter) in some WAAs (see Issue 5). This potential loss of deep snow habitat increases the importance of treating the young-growth acres on south-facing low-elevation stands to try to offset the effect that a severe winter may have to deer in these areas. The change in abundance and distribution of deer could have an effect on competition because as hunter efficiency and success decrease in areas that transition into stem exclusion, there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher.

The Forest Plan estimates that with full implementation of the Forest Plan, WAAs 1420 and 1421 in the project area may retain 50 percent or less of the estimated deer habitat capability. The Forest Plan estimates that with full implementation of the Forest Plan that the North Central Prince of Wales Province (#14) is predicted to retain between 52 and 55 percent of the estimated 1954 DHC; the Southern Outer Islands Province (#16) about 80 to 82 percent DHC; Dall Island and Vicinity (#17) about 66 percent DHC, and South Prince of Wales (#18) about 81 to 82 percent DHC (Table 3.10-16 Forest Plan FEIS p. 3-288).

Access

All action alternatives would include road construction.

Road building would result in an increase in access to subsistence resources. These road networks provide greater access to areas previously not accessible and can affect subsistence both beneficially and adversely by providing access, dispersing hunting pressure, and creating the potential for increased competition for favored hunting areas among communities connected by the existing road system (USDA Forest Service 2016c, pp. 3-418 to 419). The effect of the proposed road building would be expected to be similar across all action alternatives.

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 (USDA Forest Service 2016c, p. 3-428).

Roads remaining open could provide increased access for subsistence users to deer. This effect may be perceived as either positive, providing increased access to a new area, or negative, 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.

Alternative 2 proposes about 35 miles of NFS road construction and 129 miles of temporary road construction, totaling 164 miles; Alternative 3 proposes about 48 miles of NFS road construction and 175 miles of temporary road construction, totaling 223 miles; and Alternative 5 proposes about 49 miles of NFS road construction and 180 miles of temporary road construction, totaling 229 miles.

Competition

If hunter efficiency and success decrease in areas that transition into the stem exclusion stage, there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher. All alternatives include the clearcut harvest of old-growth acres. In the short term (about 25 years) the clearcut acres result in a stand with more forage availability for deer, and the area being more open and the deer being more visible to hunters. This could result in an increase in both hunter efficiency and success in the short term. In the long term, as these stands move from stand initiation stage into the stem exclusion stage, hunter efficiency and success could decrease. Treatments of the young-growth stands that postpone the stem exclusion stage or at least open the stand enough to both increase forage availability to deer and visibility to hunters could help mitigate the effect to both deer and hunters.

Cumulative Effects – Alternatives 2, 3, and 5

The estimated future POG harvest on non-NFS lands is about 101,272 acres. It is unknown how much young-growth harvest would occur on non-NFS land. It is estimated that about 566 miles of road building could occur on non-NFS lands. For this analysis it is assumed that all acres on non-NFS land would be harvested. Cumulative effects includes the analysis of all hunters on deer.

Abundance and Distribution

The cumulative effects analysis for subsistence includes the estimated effect to deer by all hunters (data provided by ADF&G; ADF&G harvest data does not differentiate between NFS and non-NFS lands in a WAA).

When considering the impact of all hunters on deer, WAA 1422 is added to the list of WAAs that exceed the 10 percent harvest of the estimated DHC. See Table 10 below.

Table 10. Number of years harvest in WAA was between 10 to 20 percent or exceeded 20 percent* of DHC from 2007 through 2016

WAA	Federally Qualified Subsistence Users		All Users	
	10-20 %	>20%	10-20%	>20%
1214	9	0	1	10
1315	11	0	1	10
1317	5	0	9	1
1318	9	1	2	7
1420	5	6	0	11
1422	0	0	7	0

*Some WAAs had years that were less than 10 percent. WAAs that remain less than 10 percent are not included in this table.

Access

It is assumed that road building will occur on non-NFS lands to facilitate timber harvest. Additional roads may increase the access for both subsistence and non-subsistence users to subsistence resources. These road networks provide greater access to areas previously not accessible and can affect subsistence both positively and negatively by providing access, dispersing hunting pressure, and creating the potential for increased competition for favored hunting areas among communities connected by the existing road system (USDA Forest Service 2016c, pp. 3-418 to 419). The cumulative effect of the potential road building on all lands would be expected to be similar across all alternatives.

Competition

It is expected that under all alternatives, the combination of activities on both NFS and non-NFS lands may result in a short-term increase in deer availability, but may result in a long-term decrease in the overall deer availability based on habitat.

Hunter success would be expected to remain high in most WAAs (all lands) included in the project area, because the estimated hunter take would remain below 10 percent of the estimated DHC. Hunter success could be directly or indirectly reduced through harvest restrictions or difficulty obtaining deer in the WAAs that exceed the 10 percent value. Hunter success rates may be lower in WAAs 1214, 1315, 1317, 1318, and 1420 due to the estimated deer harvest exceeding 10 percent of the estimated DHC (see Table 11).

If hunter efficiency and success decrease in areas that transition into the stem exclusion stage of stand development, there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher.

The ADF&G data do not differentiate between NFS and non-NFS lands in WAAs so the analysis for the POW LLA Project is done at the scale of all lands.

Table 11. Estimated percent harvest of Deer Habitat Capability by all user groups for Cumulative effects

WAA	Current DHC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
901	1659	2.9	1.7	3.4	1.7	4.8	4.8	7.5	6.9	4.8	5.5
902	4471	0.9	0.8	2.5	3.0	3.6	2.8	2.0	1.2	1.7	1.2
1003	1692	2.2	2.7	3.3	1.8	3.1	2.9	2.9	2.8	1.5	3.3
1105	4782	0.4	0.9	1.2	1.1	1.2	1.9	2.8	3.8	3.2	2.4
1106	318	6.3	8.2	8.8	4.1	11.0	7.2	6.3	1.6	4.4	4.1
1107	4343	1.8	1.8	3.5	3.2	4.1	4.9	5.2	3.2	3.5	2.9
1108	2909	0.2	0.2	0.6	0.4	0.5	1.2	1.3	0.0	1.7	0.3
1209	2929	0.0	0.0	0.2	0.0	0.1	0.3	0.0	1.1	0.3	1.2
1210	2445	1.8	0.7	0.7	0.9	1.4	1.1	2.3	3.8	4.3	4.9
1211	1413	0.1	0.7	1.1	1.2	3.5	4.2	5.2	6.2	4.5	2.3
1212	897	0.9	0.4	1.2	2.1	2.1	3.0	2.5	2.0	2.9	2.0
1213	881	4.1	3.2	2.3	2.3	4.9	0.9	4.5	2.2	0.3	1.7
1214	1028	16.4	22.7	23.4	26.3	31.6	26.9	26.8	29.0	21.8	24.1
1315	1436	23.7	25.6	22.4	25.6	26.3	23.9	19.5	24.9	29.7	29.7
1316	920	3.0	1.6	4.0	4.8	2.8	5.4	1.6	2.2	1.1	2.0
1317	1004	11.9	9.1	11.1	13.0	14.5	19.9	17.3	17.8	15.9	19.2
1318	1046	9.9	15.9	21.8	20.7	23.7	25.1	23.0	23.7	19.7	27.0
1319	2543	10.9	9.4	8.7	7.2	7.9	8.4	8.3	9.0	10.1	10.5
1323	1480	1.1	1.3	2.2	1.8	0.5	0.6	1.4	0.5	0.8	1.9
1332	1718	4.0	5.2	4.7	5.1	7.5	4.0	4.4	4.7	3.4	4.1
1420	747	66.4	31.5	36.7	38.8	43.8	47.3	34.4	41.6	50.2	44.2
1421	2403	4.0	4.6	5.0	5.2	4.0	5.4	2.5	3.6	5.1	4.5
1422	3148	14.2	10.8	13.1	13.4	13.8	11.4	7.8	8.8	8.6	12.6
1524	470	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

WAA	Current DHC	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1525	1333	0.8	1.0	0.9	1.2	1.3	2.1	2.3	2.1	2.1	1.4
1526	2198	0.8	0.1	0.8	0.8	0.5	1.6	0.5	1.2	2.2	1.1
1527	995	5.7	0.8	1.7	2.6	4.3	1.1	2.0	0.5	0.3	2.3
1528	446	11.9	4.7	4.5	5.4	8.3	8.1	3.6	11.4	6.5	10.3
1529	2089	8.6	7.9	6.8	7.1	6.8	4.1	4.4	4.3	6.3	7.2
1530	1408	9.1	9.2	8.8	6.7	9.4	8.5	6.8	9.2	15.9	13.6
1531	967	4.0	3.1	5.3	5.8	4.2	8.2	4.3	1.0	1.0	3.9

Data for 2006 was not included in information received from ADF&G for all users.
Shaded values indicate where estimated percentage exceeded 10 percent more than five times within this 10-year period.

Conclusion

There is a significant possibility of a significant restriction for the use of deer. The risk of hunting restrictions could be reduced somewhat, through management (thinning) of the existing and future closed-canopy, young-growth forests. Indirect effects associated with increased competition for deer in subsistence use areas could also occur under all alternatives if hunters from other communities were displaced due to timber harvest activity (USDA Forest Service, 2016c, pp. 3-418 to 419).

Alternative 1 would have negligible direct impacts to subsistence because it would result in a negligible indirect reduction in deer habitat capability and no new road building. This could result in changes to access due to no road building. As young-growth stands age and move into the stem exclusion stage, deer may become harder to see, and therefore hunters could have harder time seeing the deer. Acres currently in the stand initiation stage would continue to move into the stem exclusion stage over time. Alternative 1 would benefit from the improvement in deer habitat quality resulting from young-growth treatments on NFS lands that would likely continue to occur under other NEPA decisions. Under Alternative 1, there may be slight changes to the abundance and distribution of, competition for, and access to subsistence resources on NFS lands due to the slight decrease in the DHC as well as no new roads. The effects of activities on non-NFS lands could result in a change to abundance and distribution of, competition for, and access to subsistence resources.

The abundance and distribution of deer may be affected in Alternatives 2, 3, and 5, mostly due to the loss of deep snow habitat in some WAAs (see Issue 5). This potential loss of deep snow habitat increases the importance of treating the young-growth acres on south-facing low-elevation stands to try to offset the effect that a severe winter may have on deer in these areas. The change in abundance and distribution of deer could have an effect on competition because as hunter efficiency and success decrease in areas that transition into stem exclusion, there is the potential for increased competition for deer in areas where habitat capability, and potentially deer abundance, is higher.

All WAAs with deep snow habitat concerns (less than 50 percent remaining) have at least one mitigation measure (relating to subsistence, legacy, or peak flow rates) that would be applied. These measures would reduce the effects to deep snow habitat in these WAAs.

All action alternatives would include road construction. Roads provide greater access to areas previously not accessible and can affect subsistence both positively and negatively by providing access, dispersing hunting pressure, and creating the potential for increased competition for favored hunting areas among communities connected by the existing road system (USDA Forest Service 2016c, pp. 3-418 to 419). Alternative 2 proposes to build about 164 miles of road, Alternative 3 about 223 miles of road, and Alternative 5 about 229 miles of road. Alternatives 3 and 5 would have a similar effect on the access to subsistence resources, while Alternative 2 would be slightly less than Alternatives 3 and 5.

Mitigation measures limit old-growth harvest in Alternatives 3 and 5, including in WAAs with deep snow habitat concerns. For Alternative 3 old-growth harvest would be more limited with more partial harvest prescriptions, and in Alternative 5 no old-growth harvest would occur in deep snow habitat, which is south-facing stands below 800 feet in elevation. Alternative 2 includes wildlife-centric, uneven-aged harvest prescription in proposed harvest areas within 5 miles of a subsistence community within the project area. These measures would limit the effects to deer habitat capability (Alternatives 3 and 5) or both limit the effects to deer habitat capability and increase availability of deer in the vicinity of subsistence communities (Alternative 2).

It is unknown to what degree the amount of timber harvest of deep snow habitat will be on non-NFS lands; however, it can be assumed that most of the remaining deep snow habitat on these lands would be impacted. If so, the loss of deep snow habitat in some WAAs would likely result in an effect to deer habitat that may result in these areas not being capable to support deer in winter. This potential loss of deep snow habitat increases the importance of treating the young-growth acres on south-facing low-elevation stands to try to offset the effect that a severe winter could have to deer in these areas. Mitigation measures include limiting old-growth harvest to partial harvest prescriptions in Alternative 3 or no old-growth harvest in Alternative 5 for deep snow habitat which is south-facing stands below 800 feet in elevation. Alternative 2 includes uneven-aged harvest prescription in proposed harvest areas within 5 miles of a subsistence community within the project area.

Subsistence Findings

The direct and indirect effects from all alternatives associated with the project, as well as the potential cumulative effects associated with implementing the Forest Plan through the entire rotation period (including implementing Alternatives 1, 2, 3, or 5 of this project) do not present a significant possibility of a significant restriction of subsistence uses of fish and marine invertebrates, food plants, personal use timber, upland game birds and waterfowl, furbearers, or marine mammals.

The direct and indirect effects and cumulative effects associated with any of the action alternatives for this project may present a significant possibility of a significant restriction of subsistence use of deer due to potential effects on abundance and distribution, and on competition.

The 2016 Forest Plan Amendment Final EIS (USDA Forest Service 2016c) included a cumulative effects analysis of resource development on subsistence resources. The finding was that full implementation of the Forest Plan "may result in a significant restriction to subsistence use of deer due to the potential effects of projects on the abundance and distribution of these resources, and on competition for these resources." (Forest Plan ROD: USDA Forest Service 2016b, p. 43). For this reason, timber harvest activities cannot completely avoid cumulative landscape effects to subsistence uses.

Section 810 (a)(3) of ANILCA requires that when a use, occupancy, or disposition of public lands may result in a significant possibility of a significant restriction, a determination must be made whether (1) such a restriction is necessary, consistent with sound management principles for the utilization of public lands, (2) the proposed activity involves the minimum amount of public lands necessary to accomplish the purposes of the use, and (3) reasonable steps will be taken to minimize adverse impacts on subsistence uses and resources resulting from the actions.

Necessary and Consistent with Sound Management of Public Lands: The alternatives proposed in this EIS have been examined to determine whether they are necessary and consistent with sound management of public lands. In this regard, the National Forest Management Act, the Alaska National Interest Lands Conservation Act, the Tongass Timber Reform Act, the Wilderness Act, the 2016 Forest Plan Amendment Final EIS, and the Alaska State Forest Resources and Practices Act have been considered.

National Forest land management plans are required by the National Forest Management Act and must provide for the multiple-use and sustained yield of renewable forest resources in accordance with the Multiple-Use Sustained Yield Act of 1960. Multiple-use is defined as “the management of all the various renewable surface resources of the National Forest System so that they are utilized in the combination that will best meet the needs of the American people” (36 CFR 219.3). The alternatives presented herein represent different ways of managing Tongass National Forest resources in combinations that are intended to meet the needs of the American people. The potential restrictions associated with each alternative are necessary and consistent with the sound management of public lands.

Amount of Public Land Necessary to Accomplish the Proposed Action: The amount of land necessary to implement each alternative is, considering sound multiple-use management of public lands, the minimum necessary to accomplish the purpose of that alternative. The entire forested portion of the Tongass is used by at least one rural community for subsistence purposes for, at a minimum, deer hunting. It is not possible to avoid all of these areas in implementing resource use activities, such as timber harvesting and road construction, under any alternative, and attempting to reduce effects in some areas can mean increasing the use of others. The current Forest Plan direction and LUD prescriptions provide for management or limit activities in many of the area’s most important for subsistence uses, such as beaches and estuaries, and areas with high fish and wildlife habitat values.

Reasonable Steps to Minimize Adverse Impacts to Subsistence Uses and Resources: Subsistence use and subsistence resources are addressed specifically in Forest Plan direction for wildlife, fish, riparian areas, and biological diversity, among others. Fish and wildlife habitat productivity would be maintained at the highest level possible under all alternatives, consistent with the overall multiple-use goals of the current Forest Plan.

Issue 3: Timber Supply and Timber Sale Economics

Issue statement: The proposed quantity and quality of old-growth and young-growth timber volume offered by the Forest Service and the logging costs associated with both the logging systems and silvicultural prescriptions would affect local operators' ability to contribute to local economy.

Background: Project design affects the viability of potential sales and the ability to offer them. Flexibility over the life of the project would provide for optimizing volume and net return on timber harvest and the ability to offer economically viable timber sales across fluctuating market conditions. The amount of timber available for sale from national forests and the stability of supply affects local employment and revenues. It is also critical to match the size of sales offered to meet the various needs of industry operators. Operators need economical timber to stay in business and the loss of those operators would have an adverse impact on local economies.

Units of Measure

Measures used to compare the alternatives for the amount of timber supply from potential timber harvest and to estimate financial efficiency for both old growth and young growth include:

- Timber volume (old growth and young growth) in million board feet (MMBF) for life of the project (15 years);
- Cost of harvest, including logging, camp, and haul cost per thousand board feet (MBF) by timber analysis area;
- Transportation cost per MBF; and
- Number of annualized direct jobs supported for both domestic processing and Region 10 limited export policy for old growth and 100 percent export for young growth (15 years).

This section is an analysis of the project's timber available for harvest and the financial efficiency of implementing the action alternatives. The analysis tiers to the effects analyses conducted for the 1997 Forest Plan Revision Final EIS, 2003 Forest Plan Supplemental EIS, 2008 Forest Plan Amendment Final EIS, and the 2016 Forest Plan Amendment Final EIS.

The POW LLA Project proposes commercial old-growth and young-growth timber volume to be made available for future harvest to result in a supply of timber to purchasers for the next 15 years. The amount of timber volume potentially available for both old-growth and young-growth varies by alternative, giving a range of volume that would be available for commercial timber offerings.

Management objectives identified by the interdisciplinary team (IDT) include:

- Provide a predictable level of forest products for the next 15 years
- Provide an estimate of the financial efficiency of timber harvest in various areas of the project area
- Provide for an old-growth small sale strategy to supply smaller mills. This strategy was designed to ensure harvestable old-growth timber is available for small operators and is available for this use during and beyond the 15-year timeline of this project. The volume designated would be available from any of the harvest polygons identified in the project LSTA that meet the criteria of the Old Growth Small Sales Strategy described in the Methodology section below. The Old Growth Small Sales Strategy would not be included in any sale offer exceeding 10 MMBF.
- Meet the Forest Plan direction for other resources, including soils, watershed and aquatics, wildlife habitat, sensitive plants and scenery characteristics.

Further detailed reconnaissance, logging plan development, and an appraisal would be completed prior to offering timber for bid during the implementation phase of this project.

Methodology

Inventory and Analysis Methods

The suitability for timber production is determined at the Forest Plan level using a two-step process described in the Forest Plan, Appendix A considering legal and technical factors and the compatibility of timber production. Following this process, a Logging System and Transportation Analysis (LSTA) plan was developed for National Forest System lands within the project area layer using information from the Forest GIS library, aerial photos, and the Forest Service Activity Tracking System database (FACTS). This plan identifies potential stands for timber harvest and the associated transportation network that would be needed. Following the Implementation Plan (Appendix B, and Appendix 2 in the ROD), the LSTA would be used to identify those stands and roads most likely to offer economically positive opportunities for harvest for the duration the POW LLA Project. No alternative would harvest all potential stands identified within the LSTA. Only the acreage needed to meet the harvest level for the selected alternative would be harvested. Not all roads in the LSTA would be constructed, only those needed to harvest the selected stands. See Chapter 2 for harvest levels by alternative.

During the development and analysis of project alternatives, every reasonable effort is made to make the best estimate of potential economic timber sale harvest volume and acreage. This includes evaluating differences in past projects and utilizing that knowledge to refine our future estimates. As the project moves into implementation, volume estimates may change as harvest areas continue to be refined through additional analysis field reconnaissance. When "falldown" occurs, it can be the result of additional resource concerns being identified on the ground that require protection according to Forest Plan direction. The use of 50 percent reduction factor in the uninventoried old-growth stands was based in part on the falldown experienced from the data collected during the inventory of old-growth stands.

Extensive young-growth inventory data in stands 40 years in age or older have been collected in the project area over the past several years. Two inventories have been conducted. Stands that are 55 years and older were inventoried under the Challenge Cost Share Agreement (CCSA) plot intensity of one plot for every 2.5 acres. Stands that are 40-54 years old were inventoried under the Common Stand Exam (CSE) protocol with a plot intensity of one plot for every 5 acres. This data, combined with past inventories, are being incorporated into the Forest Planning and Projection System database (FPS). The FPS program allows data from inventoried stands to be extrapolated into non-inventoried stands with similar characteristics. FPS also allows stands to be 'grown forward' using a Tongass calibrated growth and yield model. For more information see the Young Growth Inventory Portal at: https://usfs.maps.arcgis.com/apps/MapJournal/index.html?appid=e748ce92139c4100a65ad8b12510d620#.

Information on the vegetation in old-growth stands has been collected using walk-through inventory to stratify potential harvest polygons based on the vegetation series (DeMeo *et al.* 1992) of the polygon and a net standing timber volume estimate (Schroeder, 2017a). An intensive plot inventory was then conducted on each representative stratum (Schroeder, 2017b). These plot data have been entered into an FPS database and extrapolated to the remainder of the inventoried stands in the same vegetation series and volume strata. Areas that do not have plot data or a walk-through inventory use data from Tongass National Forest GIS library, aerial photos, and extrapolation of plot data collected during inventory for the project.

To allow for more site-specific analysis, the project area was subdivided into 18 Timber Analysis Areas (TAA) for this project. These sub-analysis areas were determined based on the island, road system, timber characteristics, and preliminary estimated costs (see Figure 3). This allows for analyzing which areas would provide the best opportunities for economic timber sale offerings. The timber volume and costs were analyzed and estimated for each TAA. No commercial timber harvest is proposed in this project in five of the TAAs as there is no suitable timber available under the current Forest Plan. These are Devilfish Bay, Outer Islands, Sukkwan, Kassa Inlet, and Dall Island/South POW. For young growth, two additional TAAs have no stands determined to be “near term operable”. These are the Greater Suemez and Cholmondeley/Moira TAAs.

Old Growth Small Sale Strategy

This strategy was designed to ensure harvestable old-growth timber is available for small operators during the 15-year project timeline and beyond. For Alternative 2, an amount of old growth equal to 25 percent of the planned harvest volume from each old-growth sale over 10 MMBF must be identified and designated for use in small sale offerings. For Alternative 3, an amount equal to 60 percent of the planned harvest volume from each old-growth sale over 10 MMBF must be identified and designated for use in small sale offerings. The small sale volume counts towards the alternative design criteria volume; it is not additional to the total. The volume designated would be available from any of the potential old-growth stands identified in the project LSTA that generally meet the criteria below:

- Be generally within ¼ mile of existing or planned road, attached to the road system on POW or Kosciusko Islands, unless other areas are identified through public input.
- Contain green old-growth timber with volume, species composition, and economic viability suitable for small operators.
- Compatible with yarding systems in use by and available to small operators, generally ground based and short span cable systems.
- Offerings from this designation would generally contain less than 3 MMBF per offer and strive to meet the harvest and milling capacities of small operators.

Figure 3. Timber Analysis Areas

Logging Systems and Transportation Analysis (LSTA) Development

The LSTA created for this project identified the location of old-growth and young-growth stands that potentially could have commercial timber harvest within the next 15 years and are shown on the Commercial Vegetation Map. These stands were identified through a combination of GIS information, aerial photography interpretation and field inventory.

For this analysis, TAAs that have old-growth inventory completed used the inventoried and extrapolated plot data to predict likely potential harvest stands. “Potential harvest stands” in old-growth refers to those stands identified during reconnaissance to contain over 8,000 board feet net volume per acre and are over 5 acres in size and represent a sub-set of stands identified in the project LSTA. Old-growth stands without inventory use information extrapolated from the inventoried stands, corporate GIS data and information from past area projects. A reduction of 50 percent was applied to the gross acreage from the LSTA stands to estimate un-inventoried old-growth potential harvest stands to account for falldown in acreage and the resultant volume. This reduction is based on project inventoried data, comparing the gross LSTA to those potential old-growth harvest stands and applying this reduction. See Table 13 for further information.

For young-growth stands not yet inventoried, the volume can be averaged and extrapolated from inventoried stands of a similar age class and site index. The following assumptions are used for young-growth stands in the project LSTA the purpose of this analysis:

- An average projected growth of 1 MBF annually per acre will occur in young-growth stands.
- Stands within the 1,000-foot beach and estuary fringe buffer and Old-Growth Habitat LUD will be considered 30 percent operable which is a more conservative estimate than the 35 percent harvest allowed by the Forest Plan.
- Stands outside the 1,000-foot beach and estuary fringe buffer and Old-Growth Habitat LUD and unassociated with karst were considered to be 80 percent operable. Stands outside these areas but associated with karst will be 75 percent operable.
- A 33 percent volume reduction factor across all lands within the suitable land base outside the Old-Growth Habitat LUD and the 1,000-foot beach and estuary buffer is used to estimate potential unmapped moderate vulnerability karst areas.

Young-growth stands estimated to reach minimum volume per acre thresholds (see Chapter 2) within the next 15 years are defined as “near term operable”. For young-growth harvest in Alternative 2, an estimated average of 25 MBF per acre will be used to determine which stands could potentially be treated. This gives a conservative estimate on the volume per acre needed to reach an economical offering, but does reduce the acreage and volume available in the earlier portions of the project time line. For Alternatives 3 and 5, an estimated average of 22 MBF per acre will be used to determine which stands could potentially be treated. This will allows for increased acreage and volume in the earlier portions of the project timeline. This will allow a faster transition to young growth in Alternatives 3 and 5 while still striving to meet the minimum volume per acre for economical young-growth timber offerings. See Table 14 for further information.

As described in the Implementation Plan (Appendix B), at the time a commercial timber offer is planned, further refinement of the LSTA would be made and a logging plan developed. Until the actual units for a timber sale offering (selected from the LSTA) are defined, located, and field-reviewed, reductions in acreage and volume cannot be accurately quantified.

Spatial and Temporal Context for Analysis

The spatial boundary for the direct and indirect effects analysis for timber supply and economics are the timber analysis areas (TAA).

The spatial boundaries for analyzing the cumulative effects to timber supply are 1) Tongass National Forest System lands, since the Tongass timber program is managed on a forest basis and 2) all forested lands within the project area since the timber demand analysis for the Forest Plan included timber from other lands other than National Forest System lands.

The temporal boundary for direct, indirect, and cumulative effects is 15 years to align with the timeline of the project.

Affected Environment

POW LLA Project and the Tongass Timber Program

Across the Tongass National Forest there has been a lack of timber volume available for the Forest Service to offer. This is due to the fact that much of the volume available to offer that has gone through environmental analysis, and has a decision (NEPA), may not be offered at this time because these projects were created during better market conditions and are anticipated to appraise negative. Under the Consolidated Appropriations Act, 2018, timber sales that do not appraise positive using the current Region 10 RV appraisal cannot be offered. This project is needed at this time because it is anticipated that positive timber contracts can be created from the alternatives analyzed.

The Tongass uses a five-year timber sale plan for planning and scheduling purposes, which is consistent with Forest Service Manual 2430. This five-year plan is based on completed and ongoing environmental analyses, and provides a plan that can be adjusted in response to changing market conditions and the NEPA public involvement process on projects. Volume on outlying timber sales are estimates and may adjust considerably over time. The Tongass National Forest posts the five-year plan on the public website at: https://www.fs.usda.gov/tongass/.

For fiscal year 2018, the annual demand goal for volume of timber to be offered is 58 MMBF for the Tongass. This goal is not intended to represent actual timber purchases. Rather, it reflects the estimated volume of timber the Forest Service needs to offer to replace the volume expected to be harvested and to help build a 3-year supply of timber under contract. This allows the industry to respond to market fluctuations. However, the actual volume of timber offered in any given year reflects a combination of factors, including final budget appropriations, completing the NEPA process, the statutory requirement that timber sales offered in the Alaska Region appraise positive, and volume affected by litigation. Due to these factors, the actual amount of timber that is offered and sold may be substantially less than the predicted timber purchases in the annual demand calculations. Grewe, 2018 displays the most recent annual demand calculation and the factors used in these calculations in the document *Briefing Paper April 2018 FY18 Annual TNF Timber Demand-Grewe-Final* which is located in the project record. Notably, the planned annual timber volume offer could include a combination of new, previously offered, and reconfigured timber sales. Both old- and young-growth green timber and salvage sales are components of this program.

The project area, which includes Prince of Wales Island and other associated islands, offers many reasons based on location to include potential timber harvest within the project. Some of these include: the project area’s extensive existing road systems, which could be used to access potential timber stands; existing log transfer facilities, which could be used to aid moving timber to the mill or export facility; other timber harvest infrastructure; and an experienced and available workforce. The project area also includes the one remaining medium-size mill in Southeast Alaska, which could process a larger timber sale, as well as at least 21 smaller operators and mills.

Annual Market Demand

The annual market demand forecast is based on a methodology used to set the short-term goals for the Tongass Timber Program and the volume the Tongass National Forest plans to offer in the current year, pending sufficient funding and sufficient NEPA-cleared volume.

The formulas and procedures used in forecasting annual market demand are described in a Forest Service report titled *Responding to the Market Demand for Tongass Timber* (Morse 2000). These procedures, which have become known as the "Morse Methodology," are based on the premise that:

- Forest product markets are volatile, especially in the short-term.
- Timber purchasers in Southeast Alaska have few alternative suppliers of timber if they cannot obtain it from the Tongass National Forest. Oversupplying this market has relatively few adverse economic effects; undersupplying it can have much greater negative economic consequences.
- It takes years to prepare National Forest System timber for sale, including completion of environmental impact statements.
- It is difficult to estimate demand for timber from the Tongass National Forest, even a year or two in advance.
- Industry must be able to respond to rapidly changing market conditions in order to remain competitive.

Timber Supply

Within the project area LSTA, estimated old-growth tree species composition by volume in potential harvest stands is: western and mountain hemlock (50 percent), Sitka spruce (20 percent), Alaska yellow-cedar (9 percent), western redcedar (20 percent), shore pine and red alder (each less than 1 percent). For potential young-growth harvest stands the estimated species composition by volume is: western and mountain hemlock (54 percent), Sitka spruce (33 percent), western redcedar (10 percent), red alder (3 percent), Alaska yellow-cedar, and shore pine (each less than 1 percent).

The LSTA for old-growth timber is confined to the Developments LUDs with no harvest allowed in Inventoried Roadless Areas, Tongass 77 VCUs, The Nature Conservancy/ Audubon Conservation Priority Areas or Phase II or Phase III of the Tongass Adaptive Management Strategy as described in the Forest Plan Appendix A.

Forest Plan direction that would affect harvest area within the potential old-growth stands include the implementation of the Legacy standard and guideline and the Forest Plan direction for old-growth buffers around goshawk and other raptors nests, great blue heron nests, and wolf dens. Since animals move around and create new home habitats, the actual acreage and volume that could be impacted would not be known until implementation. Other standards and guidelines affect only young-growth harvest such as those that pertain to young-growth harvest in the Old-Growth Habitat LUD, harvest within RMAs, and harvest within the 1000 foot beach buffer.

One factor that may reduce the amount of timber volume that could be harvested is to meet the Scenic Integrity Objectives (USDA Forest Service 2016a, pp. 4-54 to 4-60). In order to meet these objectives, either partial harvest may need to be prescribed or the size of even-aged management units may need to be smaller. These effects on harvest are greatest in the Scenic Viewshed LUD.

The Legacy standard and guideline will be implemented, when required by the Forest Plan, for even-aged old-growth harvest in units over 20 acres in size. For further information on the Legacy standard and guideline, see pages 4-86 to 4-87 in the Forest Plan. The amount of impact from Legacy on the availability of acreage and volume for potential harvest within each TAA cannot be quantified until an actual timber offer is planned and harvest units have been delineated. All of the project's TAAs contain acreage and volume that can expect to see reductions for implementation of the Legacy standard and guideline, except Greater Suemez Island TAA and Cholmondeley/Moira TAA.

The Legacy standard and guideline does not apply to young-growth harvest.

Environmental Effects

The amount of timber volume that could be offered within the next 15 years varies for each of the action alternatives. Each alternative proposes differing amounts of old-growth and young-growth timber for harvest as displayed in Table 5. Proposed timber harvest would include both large and small sales. Timber offered for sale does not necessarily represent the projected actual timber harvest during that time period. When timber harvest occurs depends partly on the length of the contract, the purchasers' operation plan, and weather conditions.

Each alternative proposes different criteria that would affect the availability of some of the potential timber stands to be considered for harvest during any given time. See Chapter 2, Comparison of Alternatives. Other anticipated constraints that can reduce the amount or economics of a proposed timber offer are:

- For Alternatives 3 and 5, timber harvest and roads would be scheduled, located, and designed to prevent detectable increases to peak flow rates according to Grant *et al.* 2008 criteria. This will constrain the amount of harvest in some watersheds and may limit the harvest that could occur over 800 feet in elevation.
- To maintain connectivity of old-growth between Port Protection and Calder Bay, in Alternative 3, only partial harvest of old growth would be allowed in VCU 5280. No old-growth harvest would be allowed in VCU 5280 for Alternative 5 (see Table 13 and Table 15 for estimate of effects). Alternative 2 would follow Forest Plan direction.
- For Alternative 3, WAAs with greater than 10 percent estimated subsistence deer harvest of the estimated deer habitat capability (DHC), allow only 25 percent removal of old-growth using single-tree selection in south-facing stands below 800 feet in elevation and in Alternative 5, allow no harvest in these areas (see Table 13 for estimate of effects).
- In Alternatives 3 and 5, WAAs with greater than 10 percent estimated subsistence deer harvest of the estimated deer habitat capability all young-growth treatments on south-facing slopes below 800 feet in elevation will be treated with uneven-aged management prescriptions (see Table 15 for estimate of effects).
- Guidelines from the *Interagency Wolf Habitat Management Program* would be incorporated partly in Alternative 3 and fully in Alternative 5. Alternative 2 would follow the Forest Plan direction for wolves. Several of the recommendations included in this document would affect either the amount of suitable young-growth or old-growth timber available for offer. These constraints cannot be quantified until implementation and are not part of the reduction factors in Table 13 and Table 15. Some of these recommendations are:
    - ♦ Design commercial young-growth treatments such as variable-density thinning, thinning favoring dominant trees, creating small gaps and narrow openings.

- Incorporate leave strips of intact canopy in young-growth stands, especially along ridgelines, to promote elevational movements.
- In Alternatives 3 and 5, old-growth buffers with a slope of less than 25 percent around “major” lakes and streams would be increased to 330 feet. Major lakes are defined in the *Interagency Wolf Habitat Management Program* as Class I lakes (lakes with anadromous fish or with high value resident fisheries) and Class II lakes (lakes with lower value resident fisheries) that are greater than 3 acres.
- Wolf den buffers for Alternatives 3 and 5 would be increased to 2,400 feet in radius or about 0.5 mile.

The volume, acreage, species composition, and potential harvest stands for old-growth and near term operable young-growth were determined using the methodology and assumptions stated above, under the Affected Environment, and further documented in the following documents (by record number) from the project record: 833_0642, 833_0646, 833_0649, 833_0651, 833_0746, 833_0747, 833_0748, 833_0750, 833_0752, 833_0758, 833_0759, 833_0761, 833_0762, 833_0765 and 833_0766. Table 12, Table 13, Table 14, and Table 15 describe the estimated acreage, volume, and species composition for old-growth and young-growth from within the project LSTA. Young growth acreages displayed in the tables represent that acreage identified in the project LSTA and do not include the potential “falldown” in harvestable acreage. The estimated falldown in volume is reflected for those factors that can be quantified as noted in tables. Near term operable stands represent those stands that are deemed to be of sufficient size and volume during the project time line to be potentially commercially harvested, and represents the estimated maximum potential volume available within the project time line. The volume estimates reflect the volume “falldown” as described above. Old growth and young-growth acreage only includes stands contained in the project LSTA.

Table 12. Project Level Old-growth (OG) Acreage and Volume Estimated for each TAA for Alternative 2

Timber Analysis Area	LSTA OG Acres[1]	OG potential harvest stands Acres[2]	Sitka Spruce volume (21%) MBF	Hemlock volume (50%) MBF	Western Redcedar (20%) MBF	Alaska Yellow-cedar (9%) MBF	Estimated total OG potential stands Volume (MBF)
North 20	2,031	1,599	5,482	13,054	5,221	2,350	26,107
Calder Red Bay	7,177	3,858	11,024	26,248	10,499	4,725	52,496
Whale Pass	5,897	3,637	12,329	29,355	11,742	5,284	58,710
El Cap	1,030	518	1,565	3,726	1,490	671	7,451
Kosciusko Island	1,050	355	1,113	2,650	1,060	477	5,299
Orr and Marble Island	1,557	671	2,436	5,799	2,320	1,044	11,599
Coffman Cove	3,457	2,756	8,039	19,141	7,656	3,445	38,281
Heceta Island	3,729	1,800	6,305	15,012	6,005	2,702	30,024
Greater Staney	7,295	5,267	17,575	41,845	16,738	7,532	83,689
Thorne Bay	2,371	2,226	6,334	15,082	6,033	2,715	30,163
Harris Twelve Polk	8,613	3,766	10,664	25,390	10,156	4,570	50,779
Greater Suemez Island	1,030	274	722	1,720	688	310	3,439
Cholmondeley Moira	3,413	1,507	5,251	12,502	5,001	2,250	25,004
Total	**48,650**	**28,233**	**88,838**	**211,520**	**84,608**	**38,074**	**423,040**

Based on project LSTA of potential harvest stands.
[1] Harvest stand acreage identified in LSTA before "falldown"
[2] Estimated potential harvest acres after "falldown" for quantifiable factors; see methodology and environmental effects in the sections above.

Table 13. Project Level Old-growth Acreage and Volume estimated for Alternative 3 and Alternative 5 including the reductions for the Alternative Design criteria

Timber Analysis Area	OG potential harvest stands Acres[1]	Acreage impacted to meet wildlife concerns	Acreage impacted by avoiding Peak Flows	Volume (MBF) impacted by avoiding Peak Flows	Volume (MBF) impacted to meet wildlife concerns Alt 3	Volume (MBF) impacted to meet wildlife concerns Alt 5	Estimated total OG volume (MBF) potential stands Alt 3	Estimated total OG volume (MBF) potential stands Alt 5
North 20	1,599	0	0	0	0	0	26,107	0
Calder Red Bay	3,858	0	312	4,762	0	0	47,734	47,734
Whale Pass	3,637	0	229	3,169	0	0	55,541	55,541
El Cap	518	0	0	0	0	0	7,451	7,451
Kosciusko	355	0	6	96	0	0	5,203	5,203
Orr Marble Islands	671	0	193	3,431	0	0	8,168	8,168
Coffman Cove	2,756	8	80	744	81	108	37,456	37,429
Heceta Island	1,800	0	82	1,466	0	0	28,558	28,558
Greater Staney	5,267	0	2,023	33,610	0		50,079	50,079
Thorne Bay	2,226	137	208	2,630	1,383	1,844	26,150	25,689

Timber Analysis Area	OG potential harvest stands Acres[1]	Acreage impacted to meet wildlife concerns	Acreage impacted by avoiding Peak Flows	Volume (MBF) impacted by avoiding Peak Flows	Volume (MBF) impacted to meet wildlife concerns Alt 3	Volume (MBF) impacted to meet wildlife concerns Alt 5	Estimated total OG volume (MBF) potential stands Alt 3	Estimated total OG volume (MBF) potential stands Alt 5
Harris Twelve Polk	3,766	772	227	2,735	7,806	10,408	40,238	37,636
Greater Suemez Island	274	0	0	0	0	0	3,439	3,439
Cholmondeley Moira	1,507	0	91	1,050	0	0	23,954	23,954
Total	**28,233**	**917**	**3,451**	**53,693**	**9,720**	**38,467**	**360,077**	**330,881**

[1] Estimated potential harvest acres after "falldown" for quantifiable factors; see methodology and environmental effects in the sections above.
Note: Wildlife design criteria reductions are for subsistence/wildlife WAAs of concern where partial harvest is required in Alternative 3 and no old-growth harvest in Alternative 5.
In Alternative 3, old-growth harvest in the North 20 TAA would be limited to small sales generally under 3 MMBF, and no old-growth harvest would be allowed in Alternative 5.
Reductions in acreage and volume for alternative design criteria is not anticipated for Alternative 2.

Table 14. Project Level Young-growth Acreage and Volume Available by Alternative – Alternative 2

Timber Analysis Area	Total LSTA YG acres[1]	Total YG acres near-term operable[2]	Sitka Spruce volume (32%) MBF	Hemlock volume (54%) MBF	Western Redcedar (10%) MBF	Alaska Yellow-cedar (1%) MBF	Red Alder (3%) MBF	Total YG estimated average volume (MBF)[3]
North 20	634	464	2,768	4,672	865	87	260	8,651
Calder Red Bay	566	393	2,314	3,904	723	72	217	7,230
Whale Pass	9,388	4,562	27,939	47,147	8,731	873	2,619	87,310
El Cap	1,292	661	4,112	6,938	1,285	128	385	12,849
Kosciusko	6,844	3995	24,061	40,603	7,520	752	2,255	75,191
Orr Marble Island	2,296	1,925	9,739	16,435	3,044	304	913	30,435
Coffman Cove	8,460	3,282	21,762	36,724	6,801	680	2,040	68,007
Heceta Island	6,686	2,920	18,265	30,822	5,708	571	1,712	57,078
Greater Staney	12,933	8,316	45,474	76,738	14,211	1,421	4,263	142,107
Thorne Bay	19,629	12,456	50,246	84,790	15,702	1,570	4,711	157,019
Harris Twelve Polk	7,735	6,167	35,939	60,647	11,231	1,123	3,370	112,310
Total	**77,529**	**45,141**	**242,620**	**409,421**	**75,819**	**7,582**	**22,746**	**758,187**

[1]Total YG acres identified in LSTA
[2]Total acres in project LSTA estimated to be near term operable during project. Acreage does not include projected "falldown".
[3] Estimated maximum available volume @ 25 MBF per acre.
For further information see the young-growth operability volume discussion under methodology section above.

Table 15. Project Level Young-growth Acreage and Volume Available by Alternative – Alternatives 3 and 5

Timber Analysis Area	Total YG acres near-term operable[1]	Acreage impacted to meet Alt. design wildlife concerns[2]	Acreage impacted by Alt. design by avoiding Peak Flow	Total YG estimated average volume	Volume (MBF)[2] impacted by Alt. design to meet wildlife concerns	Volume (MBF) impacted by Alt. design by avoiding Peak Flow	Estimated average total YG volume (MBF)[3] Available
North 20	464	0	0	8,672	0	0	8,672
Calder Red Bay	393	0	0	6,386	0	0	6,386
Whale Pass	4,562	0	660	77,156	0	10,890	66,266
El Cap	661	0	0	11,356	0	0	11,356
Kosciusko	3995	0	0	66,608	0	0	66,608
Orr Marble Island	1,925	0	0	30,617	0	0	30,617
Coffman Cove	3,282	416	0	60,107	601	0	59,506
Heceta Island,	2,920	0	0	51,419	0	0	51,419
Greater Staney	8,316	0	1,109	138,333	0	18,482	119,851
Thorne Bay	12,456	2,868	573	182,811	10,969	10,085	161,757
Harris Twelve Polk	6,167	1,616	337	109,654	7,676	5,748	96,230
Total	**45,141**	**4,900**	**2,679**	**743,119**	**19,246**	**45,205**	**678,668**

[1] Total acres in project LSTA estimated to be near term operable during project. Acreage does not include projected "falldown".
[2] Wildlife design criteria reductions are for subsistence/wildlife WAAs of concern.
[3]This is the estimated maximum available volume @ 22 MBF per acre.

Factors Affecting the Economics of Timber Offers

Specific timber sale activities will be developed during implementation and no specific sale design is being analyzed. For the purpose of this analysis, the Timber Analysis Areas were developed to establish a relative comparison between alternatives in relation to logging and transportation costs and the volume of timber available in each area. For this analysis the project LSTA was used to determine the potential timber harvest stands and any needed infrastructure improvements. This provides a means to estimate the potential transportation and logging systems that may be utilized at the landscape level. More detailed information that supports this analysis is in the project record. An appraisal using the latest Residual Value (RV) Appraisal bulletin or the current appraisal method will be done during implementation.

There are many factors that can influence the cost of timber harvest, adding economic risks for potential purchasers and affecting the ability of the Forest Service to offer timber sales. Road construction, helicopter yarding, complex silvicultural prescriptions, setting size and other factors may increase costs, which would then decrease the timber value for the offering. The value of the timber offered must be sufficient to cover costs and offer a percent of profit to purchasers. Because markets fluctuate, volume made available with the POW LLA Project should allow the Forest Service to better respond to these conditions when preparing to offer timber sales. Alternative design including the mitigation for other resources and volume levels affect the flexibility for offering the most economically viable timber sale. Also, the larger the timber sale volume, the greater the ability an operator has to respond to market conditions with the volume they have under contract.

Analysis of Costs

Stump to Truck Logging Costs – These costs include the felling, limbing, bucking, yarding, decking, and loading trucks at a landing along an existing or proposed road. Three logging methods were considered – cable, shovel, and helicopter. Of these, helicopter logging is the most expensive with a range across the timber analysis areas of $362 per MBF to $395 per MBF for old growth. It is assumed no helicopter yarding would occur in young growth. Shovel and cable logging are both considered to be conventional logging systems and will be analyzed for even-aged management. A 20 percent increase in young-growth logging costs has been considered to account for the harvest of stands before reaching Culmination of Mean Annual Increment (CMAI). A range of cost between $303 per MBF and $393 per MBF is predicted for cable systems in old growth. A range in cost of $166 per MBF to $182 per MBF was estimated for ground based systems in old growth. In young growth, the costs for cable and shovel yarding are estimated to be $203 per MBF for cable and $155 per MBF for ground-based systems.

The increased cost of applying partial harvest silvicultural systems was considered due to needing to avoid damaging the residual trees from logging activity. While some uneven-aged management can be done with shovel logging and even with uphill cable logging, in order compare the alternatives prior to identifying harvest units, all uneven-aged management units for old growth were considered to be logged by helicopter and therefore the increased costs of doing partial harvest is factored into the cost of helicopter logging of old growth.

For young growth all harvest is assumed to be even-aged because the amount of partial harvest will not be known until implementation of a young-growth timber offering and silvicultural prescriptions are determined. However it is estimated that partial-harvest prescriptions in young growth will increase logging costs by $5 per MBF for two-aged openings 20 acres in size or less and by $15 per MBF for uneven-aged management with openings of 2 acres or less. If young-growth partial harvest is not adjacent to a haul road, it is estimated logging costs will increase an additional $5 per MBF to $15 per MBF per acre, increasing with distance. The Official R10 Logging Cost Calculator was used to predict the cost for each TAA assuming all the volume available in each TAA would be offered at one time. For further description of the methodology and assumptions used in the cost determinations, see the project record.

Infrastructure Costs – The estimated cost for transportation infrastructure across the alternatives is described in the table below. In some years, public works funds are available to pay for all, or a portion of, NFS road construction or reconditioning costs for roads that would be used for a timber sale as well as the long-term administration of the national forest. See the Transportation section for additional information.

Table 16. Transportation infrastructure costs per MBF

Transportation Infrastructure costs per MBF[1]		
Alt 2	Alt 3	Alt 5
$50.78	$68.23	$74.37

[1]Includes road construction, road reconditioning, road reconstruction, and maintenance and LTF development

Haul Costs – These include all costs of transporting the logs from the landing to a mill or export yard that is capable of handling that amount of timber. This may differ depending on the size of the sale. In order to compare haul costs by alternative for this analysis, the sawmill and adjacent export yard in Klawock, Alaska was chosen as the single point of delivery, even though some smaller sales could be handled by other mills on Prince of Wales Island and may be closer to the proposed Timber Analysis Area.

For this analysis, haul costs are estimated at the TAA level and includes truck haul, marine transport via barge or log raft, or a combination of the two. TAAs connected to the Prince of Wales Island transportation system consider road hauling only and TAAs on other islands or not connected to the Prince of Wales Island transportation system include water transport costs in addition to any associated road haul. The haul costs are predicted to range from $44 per MBF to $117 per MBF across the TAAs. For a description of the methods used for the determination and further assumptions see the haul cost calculation spreadsheets in the project record.

Camp Costs – Camp costs were predicted for each TAA with harvest for either full or partial camp or a combination of both based on volume and location. All helicopter harvest is considered to require a full camp due to the infrastructure needed for these operations. Camp costs are predicted to range between $6 per MBF and $41 per MBF across the TAAs. For a description of the methods used for the determination and further assumptions see log cost and camp cost spreadsheets in the project record.

Table 17. Logging Costs per MBF for all Alternatives

Timber Analysis Area	OG Logging costs stump to truck Short Span Cable-even-aged harvest	OG logging costs stump to truck Shovel-even-aged harvest Net MBF removed	OG Logging costs stump to truck helicopter Partial harvest Net MBF removed	YG Logging costs stump to truck Short span cable	YG Logging costs stump to truck shovel	Adjusted YG Logging costs for harvest before CMAI add 20% short Span Cable	Adjusted YG Logging costs for harvest before CMAI add 20% shovel	Haul costs/ road and tow Net MBF removed	Camp costs Net MBF removed
North 20	$314.00	$170.00	N/A	$168.90	$128.90	$202.68	$154.68	$103.00	$28.00
Calder Red Bay	$320.00	$174.00	$380.00	$168.90	$128.90	$202.68	$154.68	$105.00	$27.00
Whale Pass	$316.00	$170.00	$364.00	$168.90	$128.90	$202.68	$154.68	$75.00	$31.00
El Cap	$323.00	$178.00	$393.00	$168.90	$128.90	$202.68	$154.68	$86.00	$30.00
Kosciusko	$319.00	$167.00	$365.00	$168.90	$128.90	$202.68	$154.68	$88.00	$29.00
Orr Marble Island	$306.00	$174.00	$379.00	$168.90	$128.90	$202.68	$154.68	$75.00	$30.00
Coffman Cove	$303.00	$174.00	$371.00	$168.90	$128.90	$202.68	$154.68	$63.00	$6.00
Heceta Island	$316.00	$170.00	$362.00	$168.90	$128.90	$202.68	$154.68	$96.00	$30.00
Greater Staney	$306.00	$169.00	$378.00	$168.90	$128.90	$202.68	$154.68	$49.00	$6.00
Thorne Bay	$322.00	$176.00	$390.00	$168.90	$128.90	$202.68	$154.68	$44.00	$6.00
Harris Twelve Polk	$325.00	$176.00	$380.00	$168.90	$128.90	$202.68	$154.68	$49.00	$6.00
Greater Suemez Island	$331.00	$182.00	$395.00	N/A	N/A	N/A	N/A	$65.00	$43.00
Cholmondeley Moira	$310.00	$166.00	$386.00	N/A	N/A	N/A	N/A	$117.00	$33.00

Note: Logging costs are anticipated to remain the same across all the action alternatives except in Alternative 3 for the North 20 TAA old-growth stump to truck cost would change due to the small sale design criteria. Those costs are $128.90 per MBF for shovel and 168.90 for cable.
N/A is used for costs that are not anticipated to occur in these TAAs
Logging costs do not include profit and risk factors which will be included at implementation and time of appraisal.
Numbers were derived from cost calculators located in the project record with the following PDF Hyperlinks: 833_0643-833_0645, 833-0647-833_0650, 833_0718-833_0744, 833_749-833_0752 and 833_0760.

Manufacturing Costs – Average manufacturing costs by species are from the Official Residual Value Update Bulletin, July 4, 2017. An average foreign market (export) manufacturing cost of $77.75 per MBF is assumed for all young growth. An average foreign market manufacturing cost of $89.19 per MBF is assumed for Alaska yellow-cedar and 50 percent of the old-growth spruce and hemlock. Average domestic (sawn) manufacturing costs by species is assumed for western redcedar and the remaining 50 percent of old-growth spruce and hemlock.

End Product Selling Value –The average end product selling values ($ per MBF) from the current Residual Value Update Bulletin are shown in the table below to represent a value comparison between species and whether it is expected to be processed in Alaska or exported (foreign market).

Table 18. Timber value from current Residual Value Update Bulletin

Species product	Tongass End-Product Selling Value ($/MBF)	Tongass NF Manufacturing Costs ($/MBF)
Sitka spruce Old-growth Domestic Sawn	$1,307.58	$223.10
Western hemlock Old-growth Domestic Sawn	$533.83	$360.50
Western redcedar Old-growth Domestic Sawn[1]	$1,183.24	$424.86
Sitka spruce Old-growth Foreign market Log Sales	$491.77	$89.19
Western hemlock Old-growth Foreign market Log Sales	$503.27	$89.19
Alaska yellow-cedar Foreign market Log Sales[2]	$644.17	$89.19
Sitka spruce Young-growth Foreign market Log Sales	$559.28	$77.75
Western hemlock Young-growth Foreign market Log Sales	$487.86	$77.75

[1]All western redcedar is assumed to be processed in Alaska.
[2] All Alaska yellow-cedar is assumed to be surplus and exported.

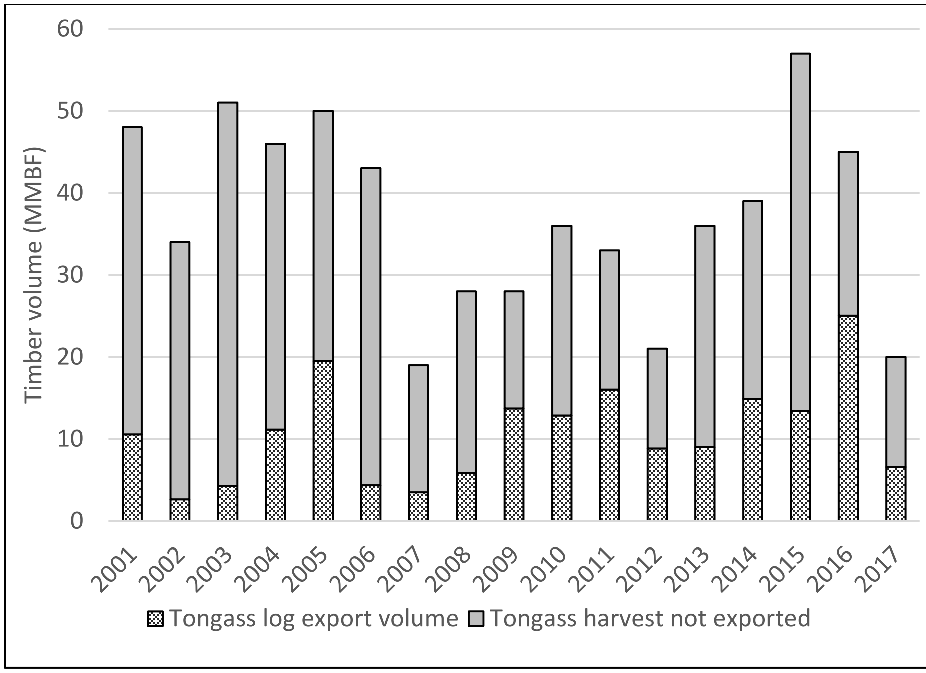
Projected Employment and Income

Direct employment and income likely to result from timber harvest is estimated by converting board feet to jobs and income. The amount of timber volume would have an effect on employment as shown in Table 19, which displays the estimated direct employment that would result from volume if timber sales were offered from this project. The direct employment and income displayed assume the total maximum design criteria of potential volume for each alternative would be harvested, thus reflecting the totals for the 15-year timeline of the POW LLA Project.

Table 19 displays estimated direct logging, transportation, and sawmilling-related employment and income based on old-growth volume. The number of jobs supported and related income shown in Table 19 and Table 20 reflect the difference in domestic processing as compared to differing export percentages for a relative comparison of the alternatives. The number of jobs supported are based on cost collection data from the Alexander 2012 report and may not represent actual jobs supported over time. Table 19 is based solely on old-growth volume and compares the limited export policy and domestic processing (with the exception of Alaska yellow-cedar). The current limited export policy allows 100 percent export of Alaska yellow-cedar, plus the export of western hemlock and Sitka spruce equal to 50 percent of the total net saw log volume. Western redcedar is assumed to be sawn in Alaska due to Section 410 in the Consolidated Appropriations Act, 2018. It is unknown whether this will be the case for the next 15 years but for this analysis that was the assumption used. Young-growth-volume is assumed to be 100 percent export because there is currently no established market for domestically sawn young-growth (see Table 20). This was assumed to be true for the life of this project since the amount of young-growth estimated to be available would not be enough to warrant the construction of a mill especially designed to be able to handle young-growth logs. Recent young-growth contracts with domestic processing have not been fully successful for the purchasers due to a

lack of local markets for sawn young-growth. Contracts where export of young-growth was allowed have been more successful for purchasers. Past log export and interstate shipments are reported annually on the public website:
http://www.fs.usda.gov/detail/r10/landmanagement/resourcemanagement/?cid=fsbdev2_038785

The figure below (Figure 4) shows the total volume of timber harvested from the Tongass and the volume exported as logs to demonstrate the variation in the proportion of exports over time. This includes both international and domestic exports to the lower 48. With the exception of 2016, the majority of timber harvested from the Tongass has not been exported in log form and remained in-state for processing. Timber harvest data were collected from the cut and sold reports that are also available on the Forest Management Reports and Accomplishments page on the Alaska Region website. While this shows past export volume, it gives no indication of the amount of volume that may be exported in the future.



Year	Tongass log export volume (%)	Tongass harvest not exported (%)
2001	22	78
2002	8	92
2003	8	92
2004	24	76
2005	39	61
2006	10	90
2007	18	82
2008	21	79
2009	49	51
2010	36	64
2011	49	51
2012	42	58
2013	25	75
2014	38	62
2015	24	76
2016	56	44
2017	33	67

Figure 4. Tongass National Forest timber harvest volume and proportion of harvest exported in log form, 2011-2017.

The jobs per MBF used for this estimate are based on annualized employment data from sawmill surveys and the Alaska Department of Labor. Annualized jobs are considered to be all the Alaska jobs (excluding indirect jobs) supported by offered timber volume. Actual annualized jobs may vary by timber sale purchaser and specific business practices. Total jobs generated depends on the amount of volume offered from sales that appraise positive at time of advertisement. In other words, deficit value timber sales cannot be offered under current law and would support “zero jobs”. Some TAAs may not appraise positive due to higher costs associated with some areas, and poorer quality of timber.

Alternative 1 would not support timber-related jobs since no timber would be offered. The action alternatives would have indirect impacts to the economies of the local communities. See the Socioeconomics section for additional information. Alternative 2 could offer enough old-growth timber to support the local industry for at least the first 5 years but then this possibility may change as less old-growth is offered and limited young-growth markets make it difficult to appraise positive. Alternative 3 may support smaller operators but may cause the last remaining mid-sized sawmill to reduce the number of employees or the length of time of operation, such as closing for part of the year. This may cause some employees to seek work elsewhere. The design criteria of Alterative 3 may also reduce the desirability of timber contracts to potential timber purchasers. Alternative 5 offers the least amount of old-growth and may have an immediate effect on the timber industry on Prince of Wales Island if operators are unable to secure enough old-growth timber under contract and do not have resources to retool their operations for young-growth harvest. Predicted jobs from young-growth harvest have the best chance of being realized after the first 7 years as young-growth timber grows larger and is more likely to provide economic timber sales. Assuming young-growth timber is exported, offered volume must be sufficient (greater than 4 MMBF) to warrant the arrival of an export ship to come to a port for the wood. Although log export does not provide sawmilling jobs, it does result in other jobs supported such as stevedoring for export ships which helps provide a diversity of employment opportunities.

Table 19. Annualized Timber Industry and Associated Jobs Supported by Alternative for Old growth

Projected Alaskan Employment Income	Alt 1	Alt 2		Alt 3		Alt 5	
	No Action	Current Export policy	*100% domestic Processing of Sitka spruce and Hemlock	Current Export policy	*100% domestic Processing of Sitka spruce and Hemlock	Current Export policy	*100% domestic Processing of Sitka spruce and Hemlock
Local Jobs Related To Logging	0	531	531	260	260	169	169
Local Jobs Related To Sawmill and Export Mfg.	0	258	573	126	280	82	183
Transportation and other Services related to Alaska domestic manufacturing	0	60	133	29	65	19	42
Transportation and other Services related to export	0	212	32	104	16	68	10
Total Jobs	0	1061	1269	519	621	339	405
Direct Income	0	$146,620,933	$145,869,614	$144,242,238	$143,874,474	$135,364,521	$135,124,748

*Assumes all young growth is 100 percent export
Source: FASTR employment spreadsheets located in the project record with the following PDF Hyperlinks: 833_709-833-_0714, 833_0716-833_0717.

Table 20. Annualized Timber Industry and Associated Jobs Supported by Alternative for Young Growth

Projected Alaskan Employment Income	Alt 1 No Action	Alt 2	Alt 3	Alt 5
		100% Export	100% Export	100% Export
Local Jobs Related To Logging	0	951	1,196	1,196
Transportation and other Services related to export	0	644	809	809
Total Jobs	0	1,596	2,005	2,005

Alternative 1 – No-Action

Direct and Indirect Effects

No timber would be offered from this alternative. This may affect the amount of timber available for purchasers involved in timber industry within the project area and other parts of Southeast Alaska. These effects in turn may indirectly affect those communities where residents rely on timber. If their livelihood decreases this may result in less expenditures on community goods and resources. However, at this scale, these cannot be estimated (Alexander 2012).

Cumulative Effects

Under this alternative, no timber would be offered from this project, and therefore no cumulative effects would occur. Potential purchasers would have to rely on timber from other landowners or from other Forest Service projects.

Effects Common to All Action Alternatives

Direct and Indirect Effects

The stump-to-truck logging costs are predicted to remain similar across the alternatives and the project TAAs. Logging equipment mobilization costs would also be similar across the alternatives with the exception of reduced mobilization cost associated with the small sale design criteria for Alternative 3 for the North 20 TAA. The largest factors determining the logging costs of a TAA are distance from the mill and whether the TAA is connected to the existing road system accessing the mill. The Greater Staney, Thorne Bay, Coffman Cove, and Harris/Twelvemile offer the lowest haul and camp costs, and offer access to a growing paved transportation system. The highest cost TAAs are on the outer islands and areas not directly connected to the road system accessing the mill. To illustrate the difference, the Greater Staney TAA has a haul cost of $49 per MBF and a camp cost of $6 per MBF, while the Cholmondeley/Moira TAA has a haul cost of $117 per MBF and camp cost of $33 per MBF. The Greater Staney TAA is a higher volume TAA with shorter hauls, extensive road system, direct access to the mill, and partial camp costs, while the Cholmondeley/Moira TAA is not connected to the road system accessing the mill, requires truck, water haul and truck haul again, as well as full camp costs. TAAs on the northern portion of the project have higher costs even though they are connected to the road system with direct access to the mill due to the long haul distances. These northern TAAs also require full camp costs due to their distance from nearby towns. The TAAs with the best opportunities for economically positive timber offers are also those TAAs that have had some of the highest past harvest and road densities.

The TAAs that appear to have the most economic opportunities for proposing old-growth timber sales are: Staney Creek, Coffman Cove and Harris/Twelvemile/Polk. These areas were identified based on:

inventory, past harvest, local knowledge, favorable species composition under current markets, relatively short hauls, less infrastructure needs to be constructed, reconstructed or maintained, and they contain enough volume to support operation costs. Conversely, the areas that appear to have the least likely prospects to be able to produce an economic old-growth offering are: Cholmondeley/Moira, Greater Suemez, and Calder/Red Bay. This is due to their distance from mill, haul costs that includes truck haul and marine transport via barge or log raft, and overall increased costs of operations due to the distance to communities and other services.

The TAAs that appear to have the best opportunities for proposing positive appraising young-growth timber sales are: Greater Staney, Thorne Bay, and Harris/Twelvemile/Polk, and Whale Pass. These areas were identified based on: inventory, past harvest and local knowledge. They also have a concentration of suitable young-growth timber, require less infrastructure, and have areas of favorable ground based logging systems. Conversely, the TAAs that appear to have the least likely prospects for economical young-growth offers are Orr/Marble Islands, Calder/Red Bay and North 20 due to their higher haul costs and lack of concentrated available young-growth volume. These TAAs also contain portions of the volume that will require the additional expense and operational difficulty associated with yarding previously beach-logged stands that cannot be economically roaded.

The size of both old-growth and young-growth timber offerings will be determined during implementation. It is anticipated that potential timber offerings from this project would be offered in variety of sizes to meet market conditions and industry demand for the 15-year project timeline. At this time, individual sales offered would likely be exclusively old-growth or young-growth timber. This, however, may change over time. Heceta Island TAA has a combination of both young-growth and old-growth volume that could be offered together in a single offer, when market conditions permit, to help offset the increased smaller island operating costs.

The proposed timber salvage activities associated with this project would provide greater opportunities for salvaging dead, dying, and damaged timber than can be salvaged from under the current *Roadside EA Decision Notice* (2003). This is due to things such as the expansion of locations available for salvage to correspond to Forest Plan LUD guidelines, the inclusion of dying trees, as well as trees leaning greater than 45 degrees. For further information see Activity Card 15 (Appendix A).

Cumulative Effects

Past timber sales have contributed to the development of the existing roaded infrastructure that would be used for each action alternative. Timber harvest has been conducted in the project area for more than 70 years. Industrial-scale logging activity began in the mid-1950s.

The POW LLA Project is an important component of the Forest Service's plan to meet the goals of the Forest Plan and provide an orderly flow of timber to local industry. Sawmill employment in Southeast Alaska has historically been supported by Forest Service timber sales, with a smaller contribution from state timber harvest (USDA Forest Service 2012b). Much of the timber from non-National Forest System lands is exported. Since most sawmills within the project area rely on old-growth timber, the timber from this project is considered necessary to maintain these mills.

Present and reasonably foreseeable future timber management projects within the project area, identified for the cumulative effects analysis, are summarized in Appendix C of this document. Identified projects on NFS lands include the volume under contract for sales in this area. Future projects include microsales, an estimated 18 MMBF of old-growth, mostly as small sales generally less than 1 MMBF within Phase 2 lands, and 15 MMBF of young growth from the Big Thorne

Project. The Soda Nick Project, currently under litigation, could provide an additional 3 MMBF depending on the court's ruling.

Other Forest Service projects on the Tongass that may provide timber are the Central Kupreanof, Kuiu, Overlook, Traitors Cove, Scott Peak, Backline, and Navy projects which provide an estimated 40 MMBF of old-growth timber if they appraise positive. On May 24, 2018 a decision was signed for The Vallenar Young Growth Project which proposes 3 MMBF of young-growth harvest. The Central Tongass Landscape Level Analysis has preliminarily identified 150 MMBF in the Notice of Intent August 9, 2018. The South Revilla Integrated Resource Project Notice of Intent was in the Federal Register on August 8, 2018 and proposes 60 MMBF of timber volume.

The State Department of Forestry, University of Alaska, and Alaska Mental Health Trust timber harvest projects identified in the 2018 Land Owners Group 5-Year schedule (available in the project record) within the area are estimated to provide 137 MMBF of old-growth timber and 29 MMBF of young-growth timber for the next 5 years. Timber from Alaska native lands has been estimated at approximate 304 MMBF of old-growth timber and 10 MMBF of young –growth timber for the next 5 years. These numbers are estimated to remain relatively the same by landowner or slightly increase for the years 2022 to 2030 (Daniels *et al.* 2016).

While there is current, proposed legislation for additional land exchanges, the amount of old-growth timber to be offered from various land owners is not expected to drastically increase in the next 15 years. Young-growth timber harvest may increase if harvesting and utilization techniques improve economically.

In the absence of a multiple-year stable supply of economic timber of the desired type and species from the POW LLA Project or elsewhere, the future viability of existing mill operators could be negatively affected. Most of the operators on the island currently sell old-growth and may not be interested in young-growth timber since it does not fit their operations. Closure of one or more mills could result in a further reduction in jobs in the logging and sawmilling industries and could also affect local businesses that provide goods and services to these industries.

Alternative 2

Direct and Indirect Effects

Timber to be offered for purchase is expected to total a maximum of 235 MMBF of old-growth timber and 421 MMBF of young-growth timber for a total volume of 656 MMBF over 15 years over the entire project area. The old-growth volume offered during the last 5 years of the project will be based on an evaluation of the amount of old-growth timber remaining to determine if economical offerings are still available from the suitable timber land base. This evaluation would be conducted using the Implementation Plan process. Based on this evaluation up to a maximum of 10 MMBF of old-growth timber may be offered for years 10 and 11 of the project and up to a maximum of 5 MMBF of old growth timber for the final 3 years. This alternative will provide the largest amount of old-growth timber proposed for harvest. A smaller amount of young-growth timber is proposed under this alternative compared to the other action alternatives (529 MMBF).

Alternative 2 would offer the best flexibility for the Forest Service to provide a variety in the range of timber products made available and the size of potential timber offers to meet industry demands, market conditions, and local needs identified through public involvement. This is because it contains the largest old-growth volume harvest potential, as well as 421 MMBF of young-growth volume. For Alternative 2 the old-growth small sale strategy would have a maximum effect of 30 MMBF of old-growth volume that would be potentially subject to being offered in contracts under 3 MMBF. 30

MMBF affected by the small sales strategy is the same amount as in Alternative 3, but represents a smaller percentage of the overall old-growth volume.

Alternative 2, having the most old-growth harvest, will be subject to the most effects from Forest Plan direction for such things as the implementation of the Legacy standards and guidelines on the total alternative design criteria volume as compared to the other action alternatives. This is because the higher old-growth harvest would require more volume from TAAs that are most impacted by these effects. The larger old-growth volume in Alternative 2 may also require the harvest of old-growth stands with lower volume per acre and lower value due to species composition as compared to the other alternatives. Alternative 2 may also necessitate the combining of volume from the TAAs with better economic potential with the volume of TAAs with lesser economic opportunities to help package offerings that appraise positive throughout the life time of the project. The total amount of young-growth volume potentially available reduces the effect of alternative design and Forest Plan direction by allowing offers to be spread out across the landscape both spatially and temporally.

Overall, this alternative appears that it would best respond to the issue of timber supply and economics for a variety of reasons. First, it has the potential to supply the highest amount of timber volume, which in turn will have the greatest positive economic effect. The larger old-growth volume associated with Alternative 2 would also support the most current local manufacturing and milling jobs when compared to Alternative 3 and Alternative 5. It also offers the highest direct income. This larger old-growth volume would allow local manufacturing, milling, and logging operations the most time under their current old-growth business practices to expand into young-growth. This move towards young-growth operations, and local manufacturing would be necessary to fully utilize the project areas growing young-growth timber resource. This alternative also gives industry the most time under current practices to develop markets for the project area's extensive young-growth which should become commercial during the late 2030s (USDA Forest Service 2016c, p. 3-515).

The young-growth volume potentially offered under Alternative 2 is less than Alternative 3 and Alternative 5. Alternative 2 would still provide enough young-growth volume for potential larger offerings that may prove an incentive for industry to invest in young-growth businesses other than export. The young growth under this alternative is analyzed to potentially be utilized at a larger size from Alternative 3 and Alternative 5. The volume design criteria for Alternative 2 is lower in the first 7 years of the project timeline and the young-growth-stands continue to add volume. Under this alternative, there is potential to allow for increased volume per acre harvests of young-growth stands offered.

Alternative 2 has the best opportunity to supply the current industry with the old-growth timber it needs to supply the existing mills. It also has the best chance at successfully allowing the timber industry to begin to develop a young-growth industry by supplying enough timber to maintain the industry.

Cumulative Effects

Under this alternative, these cumulative effects would be expected to contribute 656 MMBF over the next 15 years on National Forest System lands. An additional 150 MMBF is estimated from the Central Tongass LLA Project, also on National Forest System lands located on the Wrangell and Petersburg Ranger Districts to the north. The current estimate for Alaska Native lands is 50 MMBF a year which would be an additional 750 MMBF. The volume from the State may be less given their budget uncertainties but an estimated 189 MMBF of old-growth and 30 MMBF of young-growth volume may occur based on their predictions for the next 5 years. See the Effects Common to All Action Alternatives, Cumulative Effects in this section.

Alternative 3

Direct and Indirect Effects

Timber to be offered for purchase is expected to total 115 MMBF of old-growth timber and 529 MMBF of young-growth timber for a total volume of 644 MMBF over 15 years. This alternative would provide a similar combined total amount of potential young-growth and old-growth volume compared to Alternative 2 (656 MMBF), while proposing approximately half of the old-growth harvest of Alternative 2 and increased young-growth harvest. Alternative 3 proposes the same potential young-growth volume as Alternative 5.

Alternative 3 would offer opportunities between Alternative 2 and Alternative 5 for the Forest Service to be flexible in providing a range of timber products as well as the size of potential timber offers to meet industry demands, market conditions, and local needs identified through public involvement. This is because it proposes a smaller amount of old-growth harvest when compared to Alternative 2 but more old-growth harvest than Alternative 5, with the same young-growth as Alternative 5. For Alternative 3, the old-growth small sale strategy would have a maximum effect on 30 MMBF of old-growth volume that would be potentially subject to offers of sales under 3 MMBF. This 30 MMBF affected by the small sales strategy is the same amount as in Alternative 2, but in this alternative it represents a larger percentage of the overall design criteria volume.

The lesser old-growth harvest of Alternative 3will lessen the effects from Forest Plan direction for such things as the implementation of the Legacy standard and guideline on the total alternative design criteria volume as compared to Alternative 2. While the effects on potential volume due to design criteria measures will be greater in Alternative 3 than Alternative 2, the lower volume allows that volume to be spread out over the landscape. This lessens those effects when compared to Alternative 2. The potential harvest of Alternative 5 has the ability to even further spread out the harvest when compared to Alternative 3. The lower design criteria volume of Alternative 3 may potentially provide for more of the alternatives design volume to come from the TAAs with the best potential for offers that may appraise positive. In addition it potentially offers stands with higher volume and value when compared to Alternative 2, especially in old growth. The total amount of young-growth volume potentially available reduces the effect of alternative design and Forest Plan direction on young growth by allowing offers to be spread out across the landscape both spatially and temporally.

Overall, Alternative 3 appears to fall between Alternative 2 and Alternative 5 in responding to the issue of timber supply and economics for a variety of reasons. First, it has the potential to supply an amount of timber volume which appears to have the second most positive economic effect. The old-growth volume design criteria associated with Alternative 3 would provide the second most local manufacturing and milling job opportunities and the second highest direct income when compared to Alternative 2 and Alternative 5. The young-growth volume potentially offered under Alternative 3 is less than Alternative 2. Alternative 3 would provide enough young-growth volume for potential larger stable offerings that may prove an incentive for industry to invest in young-growth businesses. The young growth under this alternative is analyzed to potentially be utilized at the same size as Alternative 5, but at a smaller potential size from Alternative 2. This will allow a larger pool of potential harvest stands in the first 7 years of the project timeline when compared to Alternative 2. The total amount of young-growth volume potentially available reduces the effect of alternative design and Forest Plan direction by allowing offers to be spread out across the landscape both spatially and temporally.

This alternative has a fair opportunity to supply the current industry with the old-growth timber it needs to supply the existing mills. However, by applying the wildlife and watershed constraints, the timber offerings may be less economic since more partial harvest would be applied more often and the timber harvest units may be spread out over a wider area requiring more expensive transportation or timing restrictions. It may be successful by supplying enough old-growth timber to maintain the industry while moving towards young growth business operations.

Cumulative Effects

This alternative can be expected to contribute 644 MMBF over the next 15 years on National Forest System lands. An additional 150 MMBF is estimated from the Central Tongass LLA project, also on National Forest System lands located on the Wrangell and Petersburg Ranger Districts to the north. The current estimate for Alaska Native lands, is 50 MMBF a year which would be an additional 750 MMBF. The volume from the State may be less given their budget uncertainties but an estimated 189 MMBF of old-growth and 30 MMBF of young-growth volume may occur based on their predictions for the next 5 years. See the Effects Common to All Action Alternatives, Cumulative Effects in this section.

Alternative 5

Direct and Indirect Effects

Timber to be offered for purchase is expected to total 75 MMBF of old-growth timber and 529 MMBF of young-growth timber for a total volume of 604 MMBF over 15 years. This alternative would provide the least amount of old-growth volume compared to the other action alternatives (75 MMBF). It proposes the same young-growth volume (529 MMBF) as Alternative 3 and more young growth compared to Alternative 2 (421 MMBF).

Alternative 5 would offer the least flexibility for the Forest Service to provide a range of timber products as well as the size of potential timber offers to meet industry demands, market conditions, and local needs identified through public involvement, when compared to the other action alternatives. This is because it proposes the smallest amount of old-growth harvest when compared to Alternative 2 or Alternative 3. For Alternative 5 no old-growth small sale strategy is designed for and potential offers can be of any size as long as they do not exceed the alternative design criteria volume of an average 5 MMBF annually for the 15 years of the project and sales are offered every year.

Alternative 5, having the least old-growth harvest of the action alternatives, will also be affected least from Forest Plan direction on the total alternative design criteria volume. The effects on potential volume due to design criteria measures will be similar to Alternative 3, except mainly the full implementation of the *Interagency Wolf Habitat Management Program: Recommendations for Game Management Unit 2*. The lower alternative old-growth volume design criteria may allow the volume to be spread out across the potential harvest stands lowering the effects of design criteria on old-growth timber harvest activities as compared to the other action alternatives.

The lower design criteria volume of Alternative 5 may potentially provide for more of the alternative's design criteria volume to come from the TAAs with the best potential for offers that may appraise positive, as well as stands with higher volume and value when compared to Alternative 2. This alternative is similar to Alternative 3 in this regard. The total amount of young–growth volume potentially available reduces the effect of alternative design and Forest Plan direction on young growth by allowing offers to be spread out across the landscape both specially and temporally.

Overall, this alternative appears to be the least responsive to the issue of timber supply and economics for a variety of reasons. First, it has the least potential to supply potential old-growth timber volume and will have the least positive economic effect. The old-growth volume design criteria associated with Alternative 5 would provide the least benefit to local manufacturing and milling job opportunities and the least direct income when compared to Alternative 2 and Alternative 3.

Alternative 5 would provide enough young-growth volume for potential larger offerings that may prove an incentive for industry to invest in young-growth businesses. The young growth under this alternative is analyzed to potentially be utilized at the same size as Alternative 3 but at a smaller potential size from Alternative 2. This will allow a larger pool of potential harvest stands in the first 7 years of the project timeline compared to Alternative 2. The total amount of young-growth volume potentially available reduces the effect of alternative design and Forest Plan direction by allowing offers to be spread out across the landscape both spatially and temporally.

Cumulative Effects

This alternative can be expected to contribute 604 MMBF over the next 15 years from National Forest System lands. An additional 150 MMBF is estimated from the Central Tongass LLA project, also on National Forest System lands located on the Wrangell and Petersburg Ranger Districts to the north. The current estimate for Alaska Native lands is 50 MMBF a year from Sealaska, which would be an additional 750 MMBF. The volume from the State may be less given their budget uncertainties but an estimated 189 MMBF of old-growth and 30 MMBF of young-growth volume may occur based on their predictions for the next 5 years. See the Effects Common to All Action Alternatives, Cumulative Effects in this section.

Issue 4: Watershed Function

Issue statement: Proposed logging and road building activities in watersheds that have been impacted by past management may have adverse effects to water quality and fish habitat, and could reverse progress made by previous restoration efforts.

Background: Concern was expressed regarding the amount of past harvest and road construction in the project area, and the potential cumulative effects on watersheds and fish associated with additional harvest. The project area includes a number of streams with high fisheries value.

Units of Measure

The effects of project activities on aquatic resources like water quality, fish habitat, and aquatic organisms are analyzed using both quantitative units of measure and qualitative discussion, depending on the activity.

Quantitative Units of Measure

The quantifiable units of measure for comparing effects of project alternatives on aquatic resources are listed below.

- Number of watersheds with past restoration that could experience increased peak flow rates in response to potential timber harvest and road construction.
- Miles and percent of roads traversing slopes greater than 50 percent by 6th level HUC[4] watershed;
- Number of watersheds that could experience increased peak flow rates as a result of past (30 year moving window) and proposed harvested and roaded area by 6th level HUC watershed;
- Total existing and proposed road miles within 300 feet of Class I and Class II streams and lakes by 6th level HUC watershed;
- Number of new fish stream crossings;
- Miles of existing and proposed trails;
- Miles of proposed stream restoration;
- Total existing and proposed road miles and area by 6th level HUC watershed; and
- Total acres of harvest in the past 30 years and proposed vegetation management by 6th level HUC watershed.

Qualitative Discussions

Some project activities will require a qualitative analysis, and the amounts of these activities would be unknown until Implementation Plan development. However, because the following activities could still have an effect on Aquatic Resources, the effects of doing or not doing these activities will be discussed in the Environmental Effects section.

- Fish Passage

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[4] Hydrologic units (HUCs) are watershed boundaries organized in a nested hierarchy by size from the largest (regions) to the smallest (cataloging units), and can be viewed as the “address” of a particular watershed. Watersheds are spatially located landscape features uniformly mapped for the entire United States at multiple scales. The 6th level HUC is the scale commonly used to determine the potential effects of management activities.

- LTF/MAF/Temporary Barge Beach Access Points
- Thinning
- Fish Habitat Improvement
- Timber Salvage
- Karst Flow Restoration
- Road and Recreation Related Activities

Methodology

The level of effects to aquatic resources from project activities are estimated using the following qualitative descriptors. These descriptors account for how measurable the effect would be, how widespread the effect is likely to be, how long it is likely to last, and whether it is likely to require mitigation. Exceptions to these descriptors are noted as applicable, since they are not a perfect fit for all effects.

- **Negligible**: Neither water quality, water yield, nor fish habitat would be affected, changes would be either non-detectable or if detected, would have effects that would be considered slight, local, and last less than a day.
- **Minor**: Changes in water quality, water yield, or fish habitat would be measurable, although the changes would be small, last less than a week, and the effects would be localized to the affected channel segment. No mitigation measures beyond routine BMPs implementation would be necessary to maintain water quality.
- **Moderate**: Changes in water quality, water yield or fish habitat would be measurable, but would be local to the subwatershed scale and last more than a week. Site-specific mitigation measures associated with water quality or hydrology would be necessary.
- **Major**: Changes in water quality, water yield, or fish habitat would be readily measurable, would last for years or have substantial consequences, and would be noticed on a subwatershed scale. Mitigation measures would be necessary. High-value fish habitat would be affected.

The aquatic resources analyzed for each alternative include Water Quality, Fish Habitat, and Aquatic Organisms. The Essential Fish Habitat determination will be discussed separately. The use of herbicides for invasive plant treatments and its potential effects to aquatic and other resources is analyzed in Issue 1, and will not be discussed further in this Aquatics section.

Geographic Information Systems were used as the primary data source to analyze location, hydrology, road density, culvert and bridge information, and harvest. Field surveys have been completed throughout the project area and will continue prior to project implementation to determine fish presence or absence, stream class, stream type, and stream location to ensure proper layout of stream buffers and road crossing structures. To date approximately 200 stream miles have been field assessed to prepare for potential projects since 2015. Standard procedures are used for field inventory and updating GIS layers.

Estimates of logging and road building locations are provided in the LSTA (in the project record) and the intensity of these activities are described for each alternative. Several of the units of measure described above are location dependent. For these metrics, a pool of potential logging units and roads will be used to illustrate effects.

Appendix A includes the Activity Cards for all proposed project activities. These activities cards were divided into Project Activities groups according to how they would be analyzed. Some activities will have negligible effects to aquatic resources and will not be analyzed in further detail for aquatics. Other activities will be grouped according to how they will be used to calculate the quantitative units of measure. The remaining activities that can't be captured using quantitative units of measure, but still could have effects to aquatics resources, will be discussed individually.

Project Activity Groups

Activities with Negligible Effects to Aquatics

As described by the Activity Cards, the following activities will have negligible effects to aquatic resources and will not be analyzed in further detail:

- Girdling
- Pruning
- Slash Treatment
- Tree planting and inter-planting
- Cone collection
- Wildlife Trees
- Prescribed Burning
- Invasive Plant Treatments Manual and Mechanical
- Harvesting Wood for Stream Restoration Needs
- Signage
- Access Points Kayak Launch
- Viewshed Improvements
- Outhouses
- Campground or Campsites
- Cabins Three Sided Shelters
- Cabin Decommissioning
- Soil Restoration

Activities with Quantitative Units of Measure

Roads

The following activities will be used to calculate the Roads units of measures:

- NFS Road Construction
- NFS Road Reconstruction
- Temporary Road Construction
- Stream Crossing Structures
- Road Maintenance
- Quarry Development

Trails

The following activities will be used to calculate the Trails units of measures:

- Miles of Trails
- Number of Stream Crossing Structures

Timber Harvest

The following activities will be used to compute timber harvest units of measure (Even-aged management assumes 100 percent canopy removal and uneven-aged and two-aged management assumes 50 percent canopy removal):

- Young Growth Even-aged Management
- Young Growth Two-aged Management
- Young Growth Uneven-aged Management
- Old Growth Even-aged Management
- Old Growth Uneven-aged Management

Peak Flow Rate

The following activities will be used to compute the Peak Flow Rate unit of measure:

- Young-growth Even-aged Management
- Young-growth Two-aged Management
- Young-growth Uneven-aged Management
- Old-growth Even-aged Management
- Old-growth Uneven-aged Management
- Quarry Development
- NFS Road Construction
- Non-NFS Road Construction
- NFS Road Reconstruction
- Temporary Road Construction

Restoration

Stream Restoration activities will be used to compute restoration units of measure. See Watershed Improvements and Restoration Treatments map at http://www.fs.usda.gov/goto/tongass/powlla for locations.

Activities with Qualitative Discussions

Fish Passage

The Improve Fish Passage activity will be used for qualitative discussion.

LTF/MAF

These facilities are separated out into their own category so that the effects on Essential Fish Habitat can be analyzed and compared by alternative. The following activities will be used for qualitative discussion:

- Log Transfer Facilities (LTF)
- Marine Access Facilities (MAF)
- Temporary Barge Beach Access Points

Thinning

- The following activities will be used for qualitative discussion:
- Commercial Thinning Young Growth
- Precommercial Thinning
- Riparian Thinning
- Wildlife Thinning

Fish Habitat Improvement

The Fish Habitat Improvement activities will be used for qualitative discussion.

Timber Salvage

The following activities will be used for qualitative discussion:

- Salvage of Dead Dying Damaged Timber
- Wood Energy Product Commercial Salvage

Karst Flow Restoration

The Restore Karst Flows activity will be used for qualitative discussion.

Road and Recreation Related Activities

The following activities will be used for qualitative discussion:

- Road Storage
- Road Decommissioning
- Convert Roads to Trails
- Winter Sport Access Improvements for Over-the-snow Vehicle Use

Spatial and Temporal Context for Analysis

The 6th level HUC is the watershed scale used to determine the potential effects of management activities in the project area; a Watershed map showing the locations of the 136 HUCs in the project area is available at http://www.fs.usda.gov/goto/tongass/powlla. Watersheds are topographical boundaries that contain surface flows therefore effects within one watershed typically do not contribute effects to another watershed. However, within karst landscapes extensive subsurface connections create flow networks underneath surrounding watersheds. Near shore areas were used as a spatial boundary for analyzing effects on marine and estuarine species from LTFs, MAFs, and other activities that may contribute to habitat or water quality degradation.

Management activities have a temporal component associated with recovery of natural processes and environments to pre-management conditions. These timeframes can vary, depending on the activity. For example, hydrologic recovery following clearcut timber harvest is relatively long-term, expected to require between 10 and 30 years (in the Pacific Northwest) to allow sufficient vegetation regrowth (Hicks *et al.* 1991; Jones 2000; Moore and Wondzell 2005), whereas replacing a culvert is expected to have short-term water quality effects lasting from hours to days.

Affected Environment

Water quality and properly functioning watersheds are important for aquatic ecosystems and the services they provide. A coarse assessment following national protocols (USDA FS-977 and FS-978, 2011) concluded that all project area watersheds on NFS lands are properly functioning. Many project area watersheds are in near-natural condition and have not been impacted by past land management. However, about thirty watersheds may be at risk for maintaining ecological function due to past management practices; these watersheds need restoration to prevent further decline in function. Degraded watershed condition in the project area resulted from timber harvest and road building prior to 1990. The Tongass Timber Reform Act (1990) and subsequent Forest Plans (1997, 2008, 2016) greatly increased protection measures for watershed condition and aquatic habitat.

Since 1995, emphasis on stream and watershed restoration has increased with significant funding support from conservation organizations and state and federal partners. Restoration has been substantially completed (or is underway) in the following project area watersheds (Table 21).

Table 21. Watersheds with past or ongoing restoration or improvement projects

6th Level HUC	HUC-Name	Anadromous Waters Catalog (AWC) Number of Mainstem	Restoration Project
190101030307	Eagle Creek	106-10-10300	Luck Creek Large woody debris
190101030502	Hatchery Creek	106-30-10670	Hatchery Creek Fish Pass
190101030502	Indian Creek-Harris River	102-60-10820	Harris River Barrier falls modification and Large woody debris Fubar (Gàndlaay Hàanaa) large woody debris
190101030304	Neck Lake	106-30-10750	Neck lake Fish stocking
190101030309	Slide Creek-Frontal Clarence Strait	106-10-10040	Sal Creek Large woody debris
190101031003	Staney Creek	103-90-10310	Large woody debris
190101030501	Twelvemile Creek	102-60-10720	Twelvemile Creek Large woody debris
190101031401	Dog Salmon Creek	103-60-10570	Dog Salmon Creek Large woody debris
190101031402	190101031402	103-60-10770-2002	Snipe Creek Large woody debris

Properly functioning watersheds achieve the Forest Plan desired condition, goals, and objectives for healthy aquatic habitat and rapid recovery from floods and other catastrophic events. Restoration projects completed to date in these watersheds include road storage and decommissioning, removal and remediation of fish barriers at road–stream crossings, riparian young growth forest treatments, landslide stabilization, and large wood placement to restore floodplain and stream function that provide spawning and rearing habitat (USDA Forest Service 2016f). Restoring watershed function prepares for the likely effects of climate change (EcoAdapt, 2014, Sloat *et al.* 2016). Monitoring reports (available in the project record) provide a means to track restoration efforts.

Water Quality

Drinking Water Protection Areas

The Forest Service recognizes areas defined by the State of Alaska Department of Environmental Conservation (ADEC) Drinking Water Program (Table 22) to meet the requirements of the 1996 Safe Drinking Water Act. Watersheds serving the Community Water System category, including Provisional Protection Areas will be managed under 2016 Forest Plan direction (see Chapters 4 and 5 of the 2016 Forest Plan). While most of the public water systems across the Forest have LUDs that do not allow timber harvest and road construction under any alternative, some watersheds and the associated stream network that supply water may be in a LUD that allows development. Regardless of the activity being proposed, be it one with longer term effects such as imposed by timber harvest or road construction (decades to indefinite), or short term effects such as imposed by culvert replacement, stream restoration, or recreational facilities construction (days to weeks), the effect on water supply in a particular watershed can only be estimated during project implementation planning. The 2016 Forest Plan, Appendix C, 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 in source watersheds for public water systems. The Forest Plan (p. 4-63) prohibits authorization of activities that may cause or allow the pollution or contamination of a public water system. Activities in any of the watersheds listed in Table 22 will be clearly identified during the implementation process, to ensure protection of public water supplies.

Table 22. Location and type of drinking water system (ADEC)

6th Level HUC	Name	Water System Name	Water System Type
190101030906	Port Protection-Frontal Sumner Straight	Port Protection	Community
190101031104	Jinhi Bay-Frontal El Capitan Passage	El Capitan Lodge	Non-community
190101031004	Tuxekan Passage-Frontal Tonowek Bay	Naukati School	Non-transient non-community
190101030309	Slide Creek-Frontal Clarence Strait	Coffman Cove	Community
190101030311	Tolstoi Bay-Frontal Clarence Strait	City of Thorne Bay	Community
190101030507	Kina Creek-Kasaan Bay	Kasaan	Community
190101030504	Twelvemile Arm-Frontal Kasaan Bay	Hollis School	Non-transient non-community
190101031401	Port Saint Nicholas-Frontal Bucareli Bay	Craig Public Works	Community
190101031306	Klawock River	City of Klawock	Community
190101031405	Port Refugio-Frontal Ulloa Channel	Waterfall Resort	Non-community
190101031502	Hydaburg River-Frontal Sukkwan Strait	Hydaburg	Community

6th Level HUC	Name	Water System Name	Water System Type
190101030404	McKenzie Inlet-Frontal Skowl Arm	McKenzie Inlet Logging Camp	Non-transient non-community
190101030405	Skowl Arm-Frontal Kasaan Bay	Sportsman’s Cove Lodge	Non-community
190101031202	Iphigenia Bay-Frontal Pacific Ocean	Steamboat Bay Lodge	Non-community
190101030801	Clover Bay-Frontal Clarence Strait	Clover Bay Lodge	Non-community

Impaired Waterbodies and Contaminated Sites on National Forest System Land

Several creeks in the Sweetwater drainage remain listed on the EPA’s 303d list of impaired waterbodies; however, the Alaska Department of Environmental Conservation (ADEC) has determined that these creeks are no longer water quality impaired (ADEC 2018, http://dec.alaska.gov/water/water-quality/integrated-report/) and EPA concurrence is pending (personal communication ADEC 8/23/2017). Salt Chuck Bay remains listed as 303(d). Thorne Bay LTF remains listed as a Category 4a impaired waterbody but is not 303(d) listed. Fubar Creek (also known as Gàndlaay Hàanaa), was formerly recommended as Category 4 impaired, but now recommended as attaining water quality standards due to restoration actions (EPA 2012).

Table 23. Impaired waterbodies

6th level HUC	Name	Impacted area	Listing type
190101030103	Sweetwater Lake	Several creeks	Awaiting 303(d) delisting
190101030506	Karta Bay-Frontal Kasaan Bay	Salt Chuck Bay	303(d)
190101030310	Thorne Bay-Frontal Tolstoi Bay	Thorne Bay LTF	Category 4a
190101030502	Indian Creek-Harris River	Fubar Creek(Gàndlaay Hàanaa)	Awaiting Category 4b delisting

Acid rock drainage (ARD) is created when iron pyrite, oxygen, and water combine and produce acidified water that dissolves metal compounds resulting in elevated metal concentrations in the water. This is why there were 303d listings in the Sweetwater Lake watershed. The ARD acronym is used for rock containing sulfides such as iron pyrite that break down and produce acidified water. The Descon Formation is an Ordovician to Silurian aged black, thin-bedded shale and/or chert. The use of this pyritic material in roads constructed in the Sweetwater drainage resulted in the generation of ARD which negatively impacted water quality and aquatic environments downstream of the construction. This problem has been mitigated.

Approximately 15 percent (336,840 acres) of the POW LLA project area is underlain by the Descon Formation containing pyrite. However, no other problems have been observed with other roads or associated quarries with a Descon Formation component (Baichtal personal comm. 2011, as cited in Barnhart and Hitner 2013). Further issues are not anticipated.

Stream Flow, Temperature, and Dissolved Oxygen

Salmon and trout have optimum temperature ranges for rearing, spawning, and adult migration. Generally, salmonid require cool stream temperature (approximately 45 – 68 degrees F, depending on species) 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 (Sergeant *et al.* 2017). Low stream flows can affect salmonid survival by reducing the amount of habitat at the stream margins, increasing the risk of predation, increasing the temperature and subsequently decreasing the amount of dissolved oxygen, and can increase the amount of sediment on spawning gravels (Riley *et al.* 2009, Hakala and Hartman 2004).

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.

Roads

There are approximately 4,008 miles of road in the project area. Long-term sediment introduction from roads is influenced by the type of structure at the road–stream crossing, proximity of the drainage structures to streams, road slope, age, maintenance condition, time since last graded, seasonal timing of maintenance activities, amount of traffic, rock quality, weather, hillslope length, soil depth, and cutbank depth (Croke *et al.*, 2005; Wemple and Jones, 2003; Kahklen and Hartsog, 1999; Reid and Dunne, 1984).

Acres of Timber Harvest

There has been an estimated 585,643 acres of timber harvest in the project area of which 136,256 acres have been harvested within the past 30 years (cumulative effects analysis tables are located in the project record). This may have changed the amount and timing of peak flow rates in some watersheds. Elevation, precipitation, climate and many other watershed-specific factors contribute to this change in peak flow rates when associated with timber harvest. The specific scenario of concern would be snow accumulation in a large clearcut in a small watershed followed by a rainstorm which melts the snow, leading to excess surface runoff. Models have estimated that 25 percent peak flow rate increases have increased depth and frequency to streambed scour, causing up to 15 percent added mortality on salmonid embryos (Tonina *et al.* 2008).

Aquatic Organisms

Fish and aquatic resources on the Tongass National Forest are highly valued for subsistence, sport, and commercial fishing as well as for cultural and traditional uses. Abundant rainfall and watersheds with high stream densities provide an unusual number and diversity of freshwater habitats. These abundant freshwater systems on the Tongass National Forest provide spawning and rearing habitat for most of the fish produced in Southeast Alaska.

Species in the Project Area

There are a variety of aquatic ecosystems within the project area that are shaped by the physical characteristics of the habitat as well as the composition of organisms that live there. Aquatic organisms in the project area include vertebrates (fish and amphibians), invertebrates (insects, zooplankton, mollusks, and worms), plants (riparian species and macrophytes [rooted and floating plants]), and microorganisms (algae, protozoa, fungi, and bacteria).

Fish are a major component of the biodiversity of Southeast Alaska. The annual migrations of anadromous fish for spawning are necessary for the function of many plant and animal communities. Anadromous fish mature and spend much of their adult life in the ocean, returning to inland waters to spawn. Resident fish do not undertake migrations like anadromous fish, and many can complete their entire life cycle in fresh water. Some of the fish species in the freshwaters of Prince of Wales have both anadromous and resident populations, and some of the island's resident populations also utilize estuarine habitats. Table 24 lists the fish species that can be found in the freshwaters on Prince of Wales Island.

Table 24. Fish species found in the freshwaters of Prince of Wales Island

Genus and Species	Common Name	Anadromous	Resident
Oncorhynchus kisutch	Coho salmon	X	
Oncorhynchus nerka	Sockeye salmon	X	
Oncorhynchus gorbuscha	Pink salmon	X	
Oncorhynchus keta	Chum salmon	X	
Oncorhynchus mykiss	Steelhead	X	
Oncorhynchus mykiss	Rainbow trout		X
Salvelinus malma	Dolly Varden char	X	X
Oncorhynchus clarki	Cutthroat trout	X	X
Gasterosteus aculatus	Threespine stickleback	X	X
Cottus spp.	Sculpin	X	X

Arctic grayling (*Thymallus arcticus*) were introduced to the high alpine lakes Mellen and Marge on Prince of Wales Island in the 1960s and 1970s, but current information on these populations is limited (phone conversation with Craig Schwanke ADFG).

Two cave obligate amphipod species are being specifically considered in this project: one is *Stygobromus quatsinensis*, described in 1987 (Holsinger and Shaw 1987), and the other is an undescribed species of the same genus (Holsinger *et al.* 1997). These amphipods are being specifically considered in this project because they are thought to be rare and a majority of their documented occurrences are within the project area. *Stygobromus quatsinensis* was initially discovered in caves on Vancouver Island, British Columbia, and a majority of its documented occurrences have been in the project area in springs and caves on Heceta, Dall, Baker, Suemez, and Coronation islands. *Stygobromus* n sp. is only known to occur in El Capitan, Lower El Capitan, and Starlight cave systems on Prince of Wales Island. These cave dwelling species have specific karst habitat requirements and are sensitive to changes in water quality, especially temperature and pH (Holsinger *et al.* 1997).

Species with special status (*e.g.*, Threatened and Endangered Species) and components of fish habitat are discussed in detail in the 2016 Forest Plan FEIS (USDA Forest Service 2016c).

A Biological Assessment was completed for this project and includes effects to threatened or endangered fish species. A determination of "Not likely to adversely affect" was found for listed fish species. The Biological Assessment is included in the project record.

Effects of Forest Management Practices on Salmonid Fish Stocks

The 2016 Tongass Land and Resource Management Plan Environmental Impact Statement (USDA Forest Service 2016c) provides a comprehensive analysis of the effects of past forest management practices on salmonid stocks in Southeast Alaska. Overall trends in Southeast Alaska commercial harvests from 1960 to 2016, including for 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. Forest management is thought to have a greater impact on the abundance of coho and sockeye salmon than pink and chum salmon. Since juvenile coho and sockeye normally spend 1 or 2 years in freshwater, juvenile survival is potentially affected by changes in the quality of stream and lake habitat. It is generally believed that pink and chum salmon abundance is controlled by several factors including stream freezing and the cyclical productivity of the marine environment. Quality of the freshwater habitat, mainly the infiltration of fine sediment into salmon redds, is also important and may be affected by forest management, but is likely overshadowed by the influence of winter freezing and ocean productivity. Effects of forest management practices on salmonid fish stocks are not further discussed in this document; however, potential impacts to fish habitat are discussed below.

Important Components of Fish Habitat

Salmonids use a variety of different stream habitats throughout their life cycle in order to satisfy the demands of spawning, incubation, rearing, and overwintering. Important habitat components include water quality components (discussed above), large woody debris (LWD), food sources, and habitat access and passage.

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, 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). 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. Where floodplain systems have been degraded from past management activities, projects that reintroduce LWD can improve floodplain complexity and benefit anadromous salmonids (Bellmore *et al.* 2013).

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).

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 and/or limit the use of suitable fish habitat especially for anadromous stocks. Man-made barriers in the form of dams, diversions, 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.

Fish Passage at Road Crossings

Crossings by Passage Category

Stream crossing structures on project area roads have been evaluated for their ability to meet juvenile fish passage standards. Structures that meet fish passage standards at all flows are categorized as Green, and structures that do not meet fish passage standards at all flows are categorized as Red. Other passage categories include Gray, Black, and Yellow. Gray crossings are those where the structure measurements need to be run in FishXing software to determine fish passage status. Black crossings are those where additional information is missing for determining fish passage status. Yellow crossings are structures on a watch list, where conditions are assumed to be adequate for fish passage and to meet State of Alaska juvenile fish passage flow standards. However, the potentially insufficient depth of bedload material in the bottom of the culvert elevates concerns about the ability of the bedload to be retained. These culverts are on a more frequent inspection schedule to assure that bedload is retained

In the POW LLA project area, there are 754 Green crossings, 447 Red crossings, 64 Gray crossings, 104 Black crossings, and 7 Yellow crossings.

The watersheds with the most Red crossings include Eagle Creek (HUC 190101030307) with 34 Red crossings, Slide Creek (HUC 190101030309) with 32 Red crossings, and Marty Mountain (HUC 190101030204) with 21 Red crossings.

The Watershed Improvement and Restoration Treatments map on the project webpage http://www.fs.usda.gov/goto/tongass/powlla shows the locations of Red crossings within the project area.

Upstream Habitat

The 447 Red crossings in the project area are inhibiting access to approximately 29,000 meters (18 miles) of Class I upstream habitat, and 114,000 meters (71 miles) of Class II upstream habitat.

The watersheds with the most fish habitat upstream of Red crossings are Staney Creek (HUC 190101031003) with 2,639 meters (1.6 miles) of Class I and 7,819 meters (4.9 miles) of Class II habitat above 19 Red crossings, Slide Creek-Frontal Clarence Strait-Sal (HUC 190101030309) with 548 meters (0.3 miles) of Class I and 8,002 meters (5 miles) of Class II habitat above 32 Red crossings, and Outlet Thorne River, Falls, Gravelly Creek (HUC 190101030207) with 40 meters (0.02 miles) of Class I and 7,758 meters (4.8 miles) of Class II habitat above 19 Red crossings.

Value for fish habitat is determined using an algorithm developed by Forest Service biologists that provides an indication of the biological benefit, known as a remediation score, which takes the area of habitat upstream of the crossing, channel gradient, pool frequency, and proportion of the design flow that fish a blocked into account

A table that shows Red crossings by watershed, amount of upstream habitat and remediation score is available in the project record.

Fish Habitat Improvement – Fish Pass

There are 12 fish passes in the project area. An additional fish pass had been constructed in 1974 on Survey Creek on Kosciusko Island, but it was removed in 2001 (Table 25).

Table 25. Fish passes in the project area

Fish Pass Name	Year Completed	Type	Status
Big Lake Fish Pass	1991	Structure	Functional
Cable Creek Fish Pass	1986	Structure	Functional
Dog Salmon Creek Fish Pass	1989	Structure	Functional
Hatchery Creek Fish Pass	2010	Structure	Functional
Luck Creek Fish Pass	1969	Blast	Functional
North Thorne River Fish Pass	1983	Blast	Functional
Old Franks Creek Fish Pass – Upper	1992	Structure	Functional
Old Franks Creek Fish Pass – Lower	1992	Structure	Functional
Rio Roberts Creek Fish Pass	1989	Structure	Functional
Sunny Creek Fish Pass	1984	Structure	Functional
Survey Creek Fish Pass	1974	Structure	Removed in 2001
Tunga Inlet Creek Fish Pass	1986	Structure	Functional
Upper Harris River Fish Pass	2009	Blast	Functional

Stream Classification and Riparian Management Areas

Fish habitat and water quality values of streams on the Tongass are classified using two classification systems: stream value class and channel type. Channel types, in conjunction with stream class, are used for assigning the Forest Plan Riparian components and delineating associated Riparian Management Areas (RMA).

Stream Value Class

The stream value class is a classification system designed to categorize stream channels based on their fish production and water quality 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. Class IV streams are small streams that do not directly influence downstream water quality or fish habitat capability. Refer to the Fish Standards and Guidelines in Chapter 4 of the Forest Plan for more complete definitions. Amount of stream miles and lake acres by stream value Class I and II are shown in Table 26.

Table 26. Miles of streams and acres of lakes by value class within the entire project area

Stream Value Class	Stream Miles	Lake Acres
Class I	3,474	38,416
Class II	2,035	2,911
Class III*	5,383	1,461
Class IV*	483	25
Total of all Value Classes (I-IV)	**11,375**	**42,813**

* Class III and Class IV stream miles represent incomplete data, more are likely to be found

Channel Types and Process Groups

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 nine distinct process groups, with one additional group for lakes and ponds. 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 the Channel Type User Guide Tongass National Forest Southeast Alaska (Paustian *et al.* 1992, as amended in 2010).

Riparian Management Areas

Riparian Management Areas encompass the zone of interaction between aquatic and terrestrial environments associated with streamsides, lakeshores, and floodplains, and display distinctive ecological conditions characterized by high species diversity, wildlife value, and resource productivity. The desired conditions, objectives, and management direction for each channel type and process group are described in Appendix D of the Forest Plan. RMAs vary in width from the edge of a stream channel according to the process group and stream value class. The Tongass Timber Reform Act (TTRA) requires a minimum 100 foot no-cut buffer along all Class I streams and all Class II streams that flow directly into a Class I stream. The Forest Plan places an additional buffer on Class I, Class II, or Class III streams depending on process group and extent of riparian soils and vegetation. Class III streams are given a slope-break buffer. All stream buffers require additional consideration for windfirmness in high wind risk areas. This riparian management approach effectively addresses fundamental ecological principals to maintain and restore riparian and aquatic ecosystem diversity (Paustian 2004). Protecting riparian function will minimize the potential impacts of climate change.

Stream Restoration

Since 1995, 21 instream restoration projects on Class I streams have occurred in the project area in the Harris River, Fubar (Gàndlaay Hàanaa) Creek, Twelvemile Creek, Dog Salmon Creek, Sal Creek, Luck/Eagle Creek, Snipe Creek, and Staney Creek drainages.

Potential stream restoration sites were identified using GIS to locate fish streams that have had adjacent harvest (see Watershed Improvement and Restorations Treatments map, online at http://www.fs.usda.gov/goto/tongass/powlla). Field assessments, including Proper Functioning Condition (PFC) surveys and Tier II habitat surveys, are underway to evaluate which stream reaches in this sub-set could benefit from restoration activities. The watersheds with the most potential stream restoration reaches are Slide Creek-Frontal Clarence Strait-Sal (HUC 190101030309) with 14.82 miles of stream, Staney Creek (HUC 190101031003) with 7.19 miles of stream, and Natzuhini Bay-Frontal South (HUC 190101031603) with 5.85 miles of stream.

Log Transfer Facilities and other Marine Access Facilities

There are at least 33 Log Transfer Facilities (LTF) in the project area, and 12 of those have current Alaska Pollutant Discharge Elimination System (APDES) discharge permits required to transfer logs into the ocean. A list of existing LTFs in the project area is available in the project record.

Other Marine Access Facilities (MAF) in the project area include docks, boat ramps, floats, buoys, anchorages, breakwaters, and boat haul outs.

Up to 24 temporary barge beach access points may be used for the transport of young growth harvested within the 1,000-foot beach fringe. A map depicting possible access points is available in the project record.

The Thorne Bay LTF is Category 4a listed (impaired water with a final/approved Total Maximum Daily Load) because of bark accumulations from previous log rafting activities, and no APDES permit will be authorized at this site until bark accumulations meet state standards.

Tongass 77 VCUs and TNC/Audubon Conservation Priority Areas

The Forest Plan identifies the "Tongass 77" (T77) and "The Nature Conservancy/Audubon Conservation Priority Areas" (Albert and Schoen, 2007) as high priority for protection due to their outstanding habitat values, fish production, and diversity of fish species present. Old-growth harvest is not allowed in these areas; young-growth timber harvest will be allowed as guided by the underlying LUD. Table 27 shows the amount and location of potential near term operable young-growth harvest in each of these conservation areas.

Table 27. Locations of potential young-growth harvest within Tongass 77 and TNC/Audubon conservation areas

HUC	HUC Name	Acres YG harvest in TNC Audubon	VCU	Acres YG harvest in T77 VCU
190101031006	Nossuk Bay-Frontal Tonowek Bay	18	5910	N/A
190101031008	Tonowek Bay-Frontal Gulf of Esquibel	71	5910	N/A
190101030908	Shakan Bay-Frontal Sumner Strait	255	5311	N/A
190101030309	Slide Creek-Frontal Clarence Strait	9	5820	N/A
190101030207	190101030207	15	5971	N/A
190101030305	Mabel Creek-Frontal Whale Passage	114	5730	30
190101030102	Hatchery Creek	475	5740	475
Total acres potential young-growth timber harvest in conservation areas		**957**		**505**

Environmental Effects

Conclusion Summary

Alternative design criteria (*e.g.*, acres of harvest, miles of roads constructed) is used to discuss direct and indirect effects to aquatic resources. The entire potential pool of LSTA timber stands for harvest and associated road miles are used for cumulative effects (*e.g.*, increases to peak flow rates); this ensures that the maximum impact is analyzed for a worst case scenario. It is unlikely that the entire potential pool of timber stands and associated roads would be implemented.

For cumulative peak flow rate effects from timber harvest and road building, Alternatives 3 and 5 both require timing activities and attention to locations of harvest to avoid peak flow rate increases in all project area watersheds. Alternative 2 may result in peak flow rate increases in 36 of the 136 project area watersheds if all LSTA acres are harvested. Alternative 2 presents a greater risk of adverse effects compared to Alternatives 3 and 5. Peak flow rate increases could have adverse effects to water quality, fish habitat, and aquatic organisms like channel and stream bank erosion, sediment transport, and the scouring of salmon redds. During the implementation process, careful consideration of watershed-specific activities and characteristics will be necessary to ensure that fish habitat and water quality will not be degraded.

Table 37 shows watersheds that have had restoration efforts, the acres of past timber harvest, proposed harvest in the POW LLA Project LSTA, and if detectable changes in peak flow rates may occur. Under Alternative 2, five watersheds that have had restoration could experience channel-altering peak flow rates if all LSTA acres are harvested. Seven watersheds with conservation areas could have a total of 957 acres of young-growth timber harvest, with nearly half of that in the Hatchery Creek watershed (Table 27). Of the 14 watersheds that have drinking water sources identified by ADEC, four could experience changes to peak flow rates under Alternative 2 (Jinhi Bay-Frontal El Capitan Passage, Tuxekan Passage-Frontal Tonowek Bay, and Slide Creek-Frontal Clarence Strait) if all LSTA acres are harvested.

Watersheds with cumulative roaded area exceeding 2 percent are more likely to experience peak flow rate increases (Grant *et al.* 2008). Table 86 and Table 87 in the Transportation section of this document shows the amount of road construction and maintenance proposed for each alternative associated with timber harvest, and Table 87 provides estimates of how many stored roads will be reopened (road maintenance miles). Alternative 5 has slightly less amounts of road building and road reopening than Alternative 3, while Alternative 2 estimates the least amount of road building and reopening. Alternative 3 could be seen as the most impactful in terms of road construction. Other routine road maintenance may continue to occur. Road maintenance in terms of re-opening roads (bringing a Maintenance Level 1 road to Maintenance Level 2 standards) could have minor to moderate effects. Road maintenance is anticipated to have negligible adverse effects to aquatic resources. Although it causes short term, localized increases in sediment, road maintenance is necessary to protect aquatic resources and prevent long term effects to water quality, fish habitat, and aquatic organisms.

For new road construction on slopes greater than 50 percent gradient, Alternative 2 proposes 4 miles and Alternatives 3 and 5 propose 2 miles, bringing the total of roads on steep slopes up to 187 miles in Alternative 2, and 185 miles in Alternatives 3 and 5. Because the amounts are similar across the alternatives, the effects to aquatic resources from road building on steep slopes are similar across all action alternatives. Constructing roads on steep slopes can trigger slope stability concerns (see Soils section), which could result in adverse effects to water quality, fish habitat, and aquatic organisms. The effects to aquatic resources is expected to be minor because the proportion of new road construction on steep slopes is small, and following Activity Cards will help minimize adverse effects.

For new road construction within 300 feet of fish habitat, Alternatives 2 and 3 propose approximately 122 miles and Alternative 5 proposes approximately 118 miles, bringing the total of roads within 300 feet of fish habitat to approximately 907 miles in Alternatives 2 and 3, and 903 in Alternative 5 for the project area. Because the amounts are similar across the alternatives, the effects to aquatic resources from road building within 300 feet of fish habitat is similar across all action alternatives. Effects to aquatic resources are expected to range from minor to moderate. The miles are made up of small segments spread across the entire project area as opposed to long continuous segments within a floodplain. Where these segments do occur near fish habitat, there is a higher risk of sediment related impacts to aquatic habitat.

Quarry development is anticipated to have minor to moderate impacts to aquatic resources considering the estimated 0.45 acre (Table 80) of disturbance for every mile of road construction, with more road construction and resurfacing in Alternatives 3 and 5, there are anticipated to be 74 new quarry acres for Alternative 2, 100 for Alternative 3, and 103 for Alternative 5. Further discussion of quarry development is in the Transportation section.

All of the action alternatives propose stream restoration, with Alternatives 2 and 5 proposing up to 200 miles and Alternative 3 proposing up to 80 miles. These restoration activities could have positive long-term effects to aquatic resources. The greater amount of restoration allowed in Alternatives 2 and 5 could allow for a more comprehensive effort to address restoration concerns across the project area.

All of the action alternatives propose fixing fish passage problems at roads, riparian thinning, and road decommissioning, which could all have positive long-term effects to aquatic resources.

Alternative 2 includes the potential use of a variety of Fish Habitat Improvement activities. Alternative 3 only includes barrier modification, and Alternative 5 only includes barrier modification and lake fertilization. While Fish Habitat Improvement activities may mitigate some of losses to salmon production, greater improvements could be realized by working with partner entities to identify and address the key sources of production loss.

Estimates of the timber harvest acres needed to attain the volume targets for each alternative is shown in Table 28. In this table it can be seen that the total acres cut in each alternative is similar, with Alternative 2 having the least total amount.

Table 28. Estimated acres of proposed timber harvest by Alternative

	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Young-growth Timber Harvest (acres)	0	19,396	36,670	36,670
Old-growth Timber Harvest (acres)	0	23,269	13,014	6,365
Total Timber harvest (acres)	0	42,665	49,684	43,035
Temporary Road (miles)	0	129	173	180
NFS Road (miles)	0	35	48	49
Road Re-opening (miles)	0	90	120	125

Table 29. Total existing and potential road miles by Alternative

	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Total Existing and Potential Roads on NFS Lands (miles)	4,008	4,262	4,349	4,317
Total Existing and Potential Roads on NFS Lands within 300 feet of Fish Habitat (miles)	785	907	907	903
Roads on Slopes 50% or Greater (miles)	183	187	185	185

Note: Discrepancies in total road miles are a result of GIS approximations. Information for roads on slopes 50 percent or greater is available in SOILS_AlternativeCalculationsNEW_02282018.xlsx in the Project Record.

Table 30. Total number of existing and potential fish stream crossings on roads by Alternative

	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Total Existing and Potential Fish Crossings on NFS Lands	1,377	1,809	1,809	1,802

Table 31. Miles of existing and proposed trails (including motorized) by Alternative

	Alternative 1	Alternatives 2 & 5	Alternative 3
Existing Trails (miles)	89	89	89
Proposed Trail (miles)	0	24	0

Table 32. Total number proposed fish stream crossings on trails by Alternative

	Alternative 1	Alternatives 2 & 3	Alternative 5
Proposed Trail fish stream crossings	0	32	0

Table 33. Percent of watershed basin area in roads for the 24 watersheds where roaded area would exceed 2 percent with the maximum proposed project road building based on LSTA

Watershed	Percent of Basin Currently in Roads	Percent of Basin Area in Roads – Existing and Reasonably Foreseeable Future non-NFS road construction	Percent of Basin Area in Roads – Existing, Reasonably Foreseeable Future road construction, and potential POW LLA road construction
Thorne Bay-Frontal Tolstoi Bay	3.3	3.9	4.0
Twin Island Lake-Big Creek	2.9	3.4	3.4
Naukati Bay-Frontal Tuxekan Passage	2.1	2.8	3.4
Coning Inlet-Frontal Cordova Bay	2.8	3.3	3.3
Naukati Creek	2.1	2.5	2.9
Tuxekan Passage-Frontal Tonowek Bay	1.9	2.4	2.8
Edna Bay-Frontal Davidson Inlet	2.0	2.5	2.6
Dora Bay-Frontal Cholmondeley Sound	2.0	2.6	2.6
Twelvemile Creek	2.0	2.4	2.6
Sea Otter Sound-Frontal Davidson Inlet	1.5	2.2	2.5
Neck Lake	1.7	1.9	2.5
Flicker Creek	1.4	1.6	2.4
Warm Chuck Inlet-Frontal Tonowek Bay	1.8	2.0	2.4
Tolstoi Bay-Frontal Clarence Strait	1.8	2.3	2.3
Staney Creek	1.8	2.0	2.3
Outlet Thorne River	1.9	2.1	2.3
Dog Salmon Creek	1.7	1.8	2.3
Red Bay-Frontal Sumner Strait	1.6	1.8	2.2
Big Salt Lake-Frontal Shinaku Inlet	1.8	2.2	2.2
Klawock River	1.5	2.2	2.2
Polk Inlet-Frontal Skowl Arm	1.4	1.8	2.0
Natzuhini Bay-Frontal South Pass	1.8	2.0	2.0

Watershed	Percent of Basin Currently in Roads	Percent of Basin Area in Roads – Existing and Reasonably Foreseeable Future non-NFS road construction	Percent of Basin Area in Roads – Existing, Reasonably Foreseeable Future road construction, and potential POW LLA road construction
Port Johnson-Frontal Clarence Strait	1.5	1.9	2.0
Slide Creek-Frontal Clarence Strait	1.6	1.9	2.0

Note: Roaded area was calculated based on 40-foot minimum clearing widths

Alternative 1 – No Action

Direct and Indirect Effects

No POW LLA Project road work, timber harvest, trail building, LTF construction and use, MAF construction and use, or temporary barge beach access would occur in this alternative so there would be no direct or indirect effects to water quality, fish habitat, or aquatic organisms.

No POW LLA Project rehabilitation efforts would occur either, including stream restoration, correcting fish passage at road crossings, riparian and precommercial thinning treatments, fish habitat improvement, and karst flow restoration.

Road-related activities could have implications for sediment related to water quality, fish habitat and aquatic organisms. Road storage, road decommissioning, road maintenance and converting roads to trails all potentially lead to less water quality impacts to adjacent streams through less intensity of use, or maintaining proper functionality of road related drainage. Quarry development has potentially negative sediment related water quality implications due to the ground disturbance during operation. All of these activities will maintain their status quo for the No-Action Alternative, and would continue to receive routine maintenance.

Cumulative Effects

There are no cumulative effects due to POW LLA Project timber harvest, road construction or implementation of other proposed POW LLA Project activities, such as recreation facilities. Also there are no benefits achieved through the implementation of POW LLA Project watershed restoration activities.

Road Construction: Project road construction (Table 2) and road opening maintenance for action alternatives would not occur under the No-Action Alternative, roads remaining in a closed or ML 1 state would have a minor beneficial effects on aquatic resources as opposed to road opening. Road maintenance conducted under other authority may occur.

Road and recreation-related activities: Roads would continue to receive routine maintenance as scheduled, but the potential benefits of project related road storage, decommissioning, and maintenance activities would not occur, and some cumulative adverse effects to water quality, fish habitat, and aquatic organisms may occur in watersheds with more than 2 percent basin area in roads (Table 33), or for watersheds where roads are already causing water quality concerns.

Timber: Cumulative effects to aquatic organisms, fish habitat and water quality are associated with timber harvest. There are no cumulative effects due to POW LLA Project timber harvest.

Peak flow rates: Cumulative effects for the No-Action Alternative are limited to past harvest, harvest from projects on Forest Service land not related to this FEIS and timber harvest on non-National Forest System land. With no project harvest, there is no cumulative effect.

Restoration: Cumulative adverse effects to aquatic resources may increase due to no stream restoration in this alternative. While stream restoration projects covered by previous NEPA decisions would still occur, streams classified as Nonfunctional or Functional at Risk with a Downward Trend would not be restored in this project and could continue to have adverse effects to water quality and fish habitat into the future. For streams where existing LWD is deteriorating and the surrounding riparian stand is too young to supply natural recruitment of new LWD into the near future, cumulative effects to fish habitat and water quality include loss of habitat complexity and sedimentation from down cutting and/or eroding banks.

Fish passage at road crossings: Cumulative effects to aquatic resources would remain similar to the present condition in this alternative. The 447 “Red crossings” inhibiting aquatic organism passage to approximately 90 miles of habitat would not be fixed as a part of the POW LLA Project. However, ongoing various activities including culvert replacement and removal would be conducted under the *Prince of Wales Access and Travel Management Plan*, and these future actions would have a beneficial cumulative effect on aquatic resources.

LTFs: Cumulative effects to aquatic resources would remain similar to the present condition in this alternative.

MAFs (excluding LTFs): Cumulative effects to aquatic resources would remain similar to the present condition in this alternative.

Temporary Barge Beach Access Points: Cumulative effects to aquatic resources would remain similar to the present condition in this alternative.

Riparian thinning: Cumulative adverse effects to aquatic resources may slightly increase as a result of no thinning treatments in this alternative. Riparian thinning can expedite the return of young-growth stands to old-growth characteristics, which would result in the natural recruitment of large wood into the stream channels sooner. Not thinning these stands, along with not doing any instream restoration activities to bridge the gap in time to natural large wood recruitment, means that some streams with previously harvested riparian stands would continue to be nonfunctional or functional at risk for the foreseeable future.

Fish habitat improvement: Cumulative effects to aquatic resources would remain similar to the present condition in this alternative. Several factors can limit salmon production including water quality, ocean conditions, competition, predation, and fishing pressure. While no POW LLA Project Fish Habitat Improvement activities would occur in this alternative, greater improvements to salmon production could be realized by working with partner entities to identify and address the key sources of production loss.

Timber salvage: Continued timber salvage covered by previous NEPA documents is anticipated to have a negligible cumulative effect to fish habitat, water quality and aquatic organisms.

Karst flow restoration: Cumulative adverse effects to aquatic resources would increase by doing no karst flow restoration in this alternative. Properly functioning karst systems benefit water quality, fish habitat, and aquatic organisms by providing cool clean water with higher alkalinity which can increase a stream’s buffering capacity against contaminants such as acid rain, making these systems more resilient to adverse effects from these inputs. Blockages to karst systems from past management activities have increased surface flow and erosion in some areas. Not correcting these blockages could mean continual sedimentation and adverse effects to downstream water quality, fish habitat, and aquatic organisms.

Conclusion – Alternative 1

Effects to aquatic resources would remain similar to the present condition in this alternative.

Non-project related past, present, and reasonably foreseeable future activities in the project area could continue to cause adverse effects to aquatic resources.

Timber harvest and road building on state, private, and federal land in the project area contribute to changes in peak flow rates which can affect the capability of habitat to support aquatic subsistence resources.

Previous land management practices like harvesting riparian trees, yarding logs in streams, and building roads in floodplains have had adverse effects to water quality, fish habitat, and the capability of habitat to support aquatic subsistence resources like salmon. POW LLA Project activities (such as stream restoration) that would help offset adverse effects from past land management practices would not occur.

Effects Common to All Action Alternatives

Direct and Indirect Effects

Road Construction

Each alternative estimates an amount of road construction, reconstruction and maintenance needed for the amount of potential timber harvest based on the LSTA.

Roads have been found to contribute more sediment to streams than any other land management activity (Gucinski *et al.*, 2001). Road construction in Southeast Alaska requires substantial ground disturbance, which may result in at least short-term increases in sediment transport (Paustian 1987) and studies in Southeast Alaska have correlated higher rates of road erosion with heavy traffic and poor quality rock surfacing (Kahklen and Hartsog 1999).

Long-term sediment introduction from roads is influenced by the type of structure at the road–stream crossing, proximity of the drainage structures to streams, road slope, age, maintenance condition, time since last graded, seasonal timing of maintenance activities, amount of traffic, rock quality, weather, hillslope length, soil depth, and cutbank depth (Croke *et al.*, 2005; Wemple and Jones, 2003; Kahklen and Hartsog, 1999; Reid and Dunne, 1984).

Of the potential new roads to be built, all action alternatives include 1 mile in the vicinity of the Salt Chuck Mine area (303d listed impaired waterbody). New road construction in the Neck Lake, and Twelvemile Creek watersheds (had watershed restoration/investment) could increase the percent roaded area with in these watershed such that changes to peak flow rates could be detectable.

Trails

Although trails do not have the same vehicular use as roads, similar impacts as road construction and use are anticipated from trail clearing and installation of stream crossings including low water ford construction on fish-bearing streams (USDA Forest Service, 2011, Watershed Condition Framework FS-977).

Commercial Timber Harvest

Timber harvest can change streamflow by altering the collection and storage of water, thus altering the amount and timing of water delivery to streams. Reductions in canopy interception and plant transpiration rates resulting from harvest can increase annual water yield as well as peak flow rates in small streams (Jones and Grant 1996). Canopy removal has the effect of changing the rate of precipitation interception, which in turn alters the timing of water delivery to streams, and the nature of evaporation from the forest. Removing trees from the landscape alters transpiration, another important component of water balance. By changing the timing and amount of water delivered to streams, timber harvest can lead to water quality concerns in the form of increased sediment delivery, and increased flow volume, which can change the nature of stream channels. Faster moving and greater amounts of water could change the shape of some stream channels leading to negative impacts for fish habitat and aquatic organisms. Canopy removal can also increase water temperature, which is a negative impact to aquatic habitat.

Restoration

Restoration activities generate short term bursts of sediment while instream work is being done and from ground disturbance in riparian areas to access the stream. These effects are minor (short term), anticipated to reach base line levels of turbidity in the days following the completion of work (Turbidity Monitoring of Fubar (Gàndlaay Hàanaa) Creek Restoration). Stream restoration has major (lasting years) benefits to fish habitat and fishing recreational activities. Additionally, stream restoration may provide the major benefit of reconnecting streams to flood plains which benefit forest health and provide natural mitigation for high flow events.

Fish Passage at Road Crossings

There are 447 currently known Red crossings in the project area, which are inhibiting access to approximately 90 miles of aquatic habitat. All of the action alternatives allow for the replacement or removal of these crossings (which may also be addressed through projects not associated with POW LLA Project).

Removing or replacing Red crossings could have major (lasting for years) positive effects on aquatic organisms because access to upstream habitat would be restored/improved.

There would be some negligible (lasting less than a day) to minor (lasting less than a week) adverse effects to water quality from bursts of sediment during implementation. Adverse effects to fish are minimized by operating during species specific timing windows designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water. Effects to water quality, fish habitat, and aquatic organisms would be further minimized by following direction in the Fish Passage Activity Card (Appendix A), which outlines required BMPs, Forest Plan direction, and requires identification of site-specific mitigations during implementation planning.

LTFs

At least 15 LTFs may be used in the action alternatives; two new LTFs may be constructed, five existing LTFs may be reconstructed, and eight existing LTFs may receive maintenance. Additional existing LTFs may be used as needed. All 33 existing LTFs are listed in the project record.

The two new LTF sites (Commercial Vegetation Map) may potentially be located at Orr Island Southwest and Browns Bay. The five existing sites that may receive reconstruction, including potential expansion, are located on Marble Island, El Capitan Passage, North Red Bay, Orr Island West, and Orr Island East. The eight existing sites that may receive maintenance are Lancaster Cove, Heceta Island, Suemez Island, Calder, Tuxekan Island, Polk Inlet, Thorne Bay, and Coffman Cove.

Of the 13 existing LTF sites, only the Thorne Bay LTF is Category 4a listed (impaired water with a final/approved Total Maximum Daily Load) for known adverse effects from bark accumulations and will be a barge loading only facility to prevent further bark accumulation.

There would be negligible to minor adverse effects to water quality, fish habitat, and aquatic organisms depending on the amount of time required to develop the LTFs, and the characteristics of the locations. 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. 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.

An Alaska Pollutant Discharge Elimination System (APDES) permit is required where log rafting can occur, and several existing LTFs, including 8 of the 13 that are most likely to be used in project, have discharge permits.

Specific locations will be selected and/or reconstructed according to Log Transfer Facility Guidelines (Forest Plan, Appendix G) to minimize adverse effects to aquatic resources. Effects to aquatic resources would also be minimized during LTF construction, reconstruction, maintenance, and use by following direction in the LTF Activity Card (Appendix A), which outlines required BMPs, Forest Plan direction, and require identification of site-specific mitigations during implementation planning.

MAFs (excluding LTFs)

Up to 70 non-LTF Marine Access Facilities, including docks, boat ramps, floats, buoys, anchorages, breakwaters, boat haul outs, and similar may be developed or improved in all action alternatives.

In-water MAF construction, blasting, and/or filling activities can cause adverse effects to aquatic resources. Shallow, near shore areas are used by spawning herring and out-migrating juvenile salmonids in the spring and summer, making these fish susceptible to blasting activities or increased turbidity from construction and filling activities during this time.

There would be some negligible (lasting less than a day) to minor (lasting less than a week) adverse effects to water quality, fish habitat, and aquatic organisms depending on the type of activity being implemented, and the days required to develop the facility.

Additionally, some MAF facilities would be used for equipment barging and storage, including an existing MAF at Thorne Bay. As mentioned in the LTF section above, Thorne Bay is also used as a barge only facility for transporting logs.

Effects to aquatic resources from MAF development, improvement, and use for barging and equipment storage would be minimized by following direction in the MAF Activity Card (Appendix A), which outline required BMPs, Forest Plan direction, and require identification of site-specific mitigations during implementation planning.

Temporary Barge Beach Access

Up to 24 temporary barge beach access points may be used when harvesting Young Growth stands within the 1,000-foot beach fringe.

There could be some negligible to minor short-term adverse effects to water quality, fish habitat, and aquatic organisms. Shade caused by barges and equipment floats can reduce primary production and prey abundance in the water column. Anchoring and moorage could destroy submerged vegetation. Log landings and access trails located within the 1,000-foot beach fringe could increase surface water runoff which can carry sediments, woody debris, and hydrocarbons.

Effects to aquatic resources from temporary barge beach access sites would be minimized by following direction in the Young Growth Harvest Activity Cards (Appendix A) which outline required BMPs, Forest Plan direction, and require identification of site-specific mitigations during implementation planning.

Thinning

Up to 4,500 acres of young-growth stands would be precommercially thinned annually for timber production, wildlife habitat improvement, and/or riparian improvement.

No adverse effects to aquatic resources are anticipated from thinning activities. No-thin buffers on fish streams will protect stream banks, and additional protection measures outlined in the Precommercial Thinning, Riparian Thinning, and Wildlife Thinning Activity Cards (Appendix A), BMPs, Forest Plan direction, and the requirement for site-specific mitigations during implementation planning will further protect aquatic resources.

Beneficial effects include increased growth and vigor in riparian trees for increased bank stability and future sources of instream large wood.

Timber Salvage

It is anticipated that effects to aquatic resources will be minor for the action alternatives. Timber salvage operations are subject to mandatory no-harvest riparian management areas (RMA) and other protections outlined in the Activity Cards (Appendix A) that would minimize adverse effects.

Karst Flow Restoration

Properly functioning karst systems provide cool clean water with higher alkalinity which can increase a stream's buffering capacity against contaminants such as acid rain. These conditions may increase productivity of fish streams if other important habitat features are also present such as well-developed gravel substrates, large wood, and complex pools (Bryant *et al.* 1998). Additionally, a majority of the documented occurrences of cave obligate amphipods *Stygobromus quatsinensis* and *Stygobromus* spp. have been in the project area. In addition to some caves in British Columbia, *Stygobromus quatsinensis* occurs in springs and caves on Heceta, Dall, Baker, Suemez, and Coronation Islands. *Stygobromus* n sp. is only known to occur in El Capitan, Lower El Capitan, and Starlight cave systems on Prince of Wales Island. These cave dwelling species have specific karst habitat requirements and are sensitive to changes in water chemistry, in particular, temperature and pH, and water quality (Holsinger *et al.* 1997).

Diverted water flows from roads and other blockages have increased surface flow and erosion in some areas. In all the action alternatives karst surface water flow paths could be restored where ditches, culverts, slash, and beaver dams/structures are impeding natural water flows or creating unnatural water flows to karst features.

Restoring karst flows could have moderate (measurable, small, less than a week, localized to affected channel segment) to major (readily measurable, last for years, have substantial consequences, notices on a subwatershed scale) positive effects to water chemistry, quality, fish habitat, and aquatic organisms. By restoring blockages and returning karst systems to their proper functioning condition, sources of sedimentation can be corrected and the beneficial effects of karst to aquatic resources can be restored.

Bursts of sediment would occur during implementation. The adverse effects to water quality would be minor because the increased turbidity would be short-term and localized. Adverse effects to fish are minimized by operating during species specific timing windows which are designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water. Effects to water quality, fish habitat, and aquatic organisms would be further minimized by following direction in the Restore Karst Flows Activity Card (Appendix A), which outlines required BMPs, Forest Plan direction, and requires identification of site-specific mitigations during implementation planning. See also Karst and Cave Resources section in this chapter.

Road and Recreation Related Activities

All of the action alternatives propose road maintenance, storage, decommissioning, conversion to trails, and quarry development. The effects of these activities are discussed below.

Road Maintenance

Road maintenance activities may have minor adverse effects on aquatic resources from short term and localized bursts of sediment while equipment is operating, but properly maintained roads reduce the adverse effects to aquatic resources in the long term. Roads contribute more sediment to streams than any other land management activity, and pose the greatest potential risk to watershed resources and fish habitat capabilities. Regular road maintenance is necessary to mitigate adverse effects to aquatic resources. Effects to aquatic resources would be minimized by following direction on the Road Maintenance Activity Card (Appendix A).

Road Storage

Road storage activities may have minor adverse effects on aquatic resources from short term and localized bursts of sediment while equipment is operating, but properly stored roads reduce the adverse effects to aquatic resource in the long term. Road storage puts not needed roads in a condition where less maintenance is required to prevent adverse effects to aquatic resources. Road prisms are stabilized and Level 1 roads receive basic custodial maintenance that focuses on drainage structures and runoff patterns. Effects to aquatic resources would be minimized by following direction on the Road Storage Activity Card (Appendix A).

Road Decommissioning

Road decommissioning activities may have minor adverse effects on aquatic resources from short term and localized bursts of sediment while equipment is operating, but decommissioned roads reduce the adverse effects to aquatic resource in the long term. Roads no longer needed could be decommissioned using a variety of treatments including revegetating the road surface, restoring surface drainage, and recontouring the surface to the natural slope. Effects to aquatic resources would be minimized by following direction on the Road Decommissioning Activity Card (Appendix A).

Convert Roads to Trails

The conversion of road to non-motorized trails may have minor adverse effects to aquatic resources from short term and localized bursts of sediment while equipment is operating, but roads converted for non-motorized use reduce the adverse effects to aquatic resource in the long term. Roads converted to non-motorized use trails are put in a condition that requires less maintenance to prevent adverse effects to aquatic resources.

Roads converted to OHV (off highway vehicle) trails could cause some minor adverse effects to aquatic resources. Roads converted to OHV trails may not be put in a condition that requires less maintenance and the adverse effects to aquatic resources would be similar to the effects from roads. Additionally, designated OHV trails can help mitigate damage to aquatic resources by providing designated routes for travel and stream crossing. Any new/replacement fish stream crossing structures, including low water fords, will be designed to provide for fish passage. Effects to aquatic resources would be minimized by following direction on the Convert Roads to Trails Activity Card (Appendix A).

Quarry Development

Quarry development may have minor effects to aquatic resources. An estimated 0.45 acre of disturbance for every mile of road construction increases the amount of canopy removal in a watershed. Effects to aquatic resources would be minimized by siting quarries outside of RMAs, and by following direction in the Quarry Development Activity Card (Appendix A).

Winter Sport Access Improvements for Over-the-Snow Vehicle Use

Winter sport access improvements could have minor effects to aquatic resources where trail clearing and excavation to sub-grade occurs near streams. The adverse effects include short term and localized bursts of sediment during implementation. Effects to aquatic resources would be minimized by following direction in the Winter Sport Access Improvements for Over-the-Snow Vehicle Use Activity Card (Appendix A).

Cumulative Effects

Peak Flow Rate – Cumulative Watershed Effects for Roads and Timber Harvest

Changes to peak flow rates are the primary cumulative watershed effect considered for aquatic organisms, fish habitat and water quality. 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). Forest canopy openings created by timber harvest may collect more snow which may be exposed to warm rain that rapidly melts snow, which can then increase surface runoff and response as increased streamflow. Roads exceeding two percent of watershed area are assumed to accelerate this effect. Grant *et al.* 2008 provides the state of the science on this issue as a synthesis of relevant studies in western Washington and Oregon.

Potential LSTA harvest stands, proposed timber harvest on non-National Forest System land, past timber harvest within the past 30 years, and the amount of roads on all land jurisdictions were used to determine the degree of cumulative effects for watersheds in the project area.

Young-growth timber estimates for cumulative effects analysis were based on near-term operable stands, and the percentage of stand that was estimated operable. Helicopter-harvested timber stands were assumed to have 50 percent of stand area harvested.

Grant *et al.* 2008 provides a method to estimate a worst-case scenario outcome of potential detectable increases to peak flow rates in a watershed if all LSTA acres and roads were implemented. For this project, if any LSTA acres occur in the transient snow zone (>800 feet elevation), transient snow zone effects are assumed for the entire watershed. For watersheds where no LSTA acres occur in the transient snow zone, rain-dominated effects are assumed for the entire watershed. Rain-dominated watersheds are less likely to experience peak flow rate increases resulting from timber harvest.

Table 34. The percent of watershed area that can be in timber harvest openings younger than 30 years before peak flow rate changes could be observed, by percentage of watershed area in roads (see Table 33) and precipitation zone.

Watershed Area in Roads	Precipitation Zone	
	Rain Dominated Zone (RDZ) (<800 feet elevation)	Transient Snow Zone (TSZ) (>800 feet elevation)
<2%	Up to 45% of basin area in timber harvest openings	Up to 20% of basin area in timber harvest openings
≥2%	Up to 29% of basin area in timber harvest openings	Changes to peak flow rates may already be detectable.

The Implementation Plan specifies additional factors that are considered to evaluate potential peak flow rate increases based on site-specific activities planned and watershed-specific characteristics (Appendix B). These factors include watershed size (watersheds greater than 2,500 acres are less likely to experience detectable peak flow rate increases), recovery of snow interception capability in forest canopy of past harvest acres in the watershed, actual location of canopy openings in rain dominated or transient snow zones within the watershed, canopy opening size and silvicultural prescription (small openings and uneven-age harvest are less likely to accumulate snow), characteristics of stream network connections between canopy openings and alluvial stream reaches (stream density, size, gradients), presence of lakes and wetlands that could diminish peak flow rates, and characteristics of road network (efficiency of surface water transport from open canopy areas to streams). Additionally, the indirect effects of peak flow rate increases on downstream aquatic habitats will be considered, including proximity of low-gradient, alluvial reaches containing redds or spawning habitat (*e.g.*, FP, MM, and AF process groups) prone to scour) and any intervening depositional streams that would lessen peak flow rate effects.

Table 35. LSTA acres (all timber stands considered for cumulative effects)

	Alternative 1	Alternatives 2 & 3	Alternative 5
Potential Old Growth Harvest (acres)	0	42,619	40,501
Potential Young Growth Harvest (acres)	0	34,156	33,823
All Potential Timber Harvest	0	76,775	67,646

Note: Potential harvest areas derived from the LSTA used for cumulative watershed effects. Helicopter units were assumed to be harvested to 50 percent of their area. Young-growth units are near term operable (of appropriate age class for harvest) with estimated operable percentages applied.

Table 36. Watersheds with potential Peak Flow Rate increases from cumulative harvest and road building activities.

Greater than 2% Basin Area as Roads	6th level HUC Watersheds	Percent non-NFS proposed harvest	Percent past harvest since 1989	Percent past harvest since 1989 and potential non-NFS harvest	Percent All Alts 2, 3 potential harvest for NFS (LSTA), non-NFS, and past since 1989	Percent All Alt 5 harvest for NFS, non-NFS, and past since 1989
	Nutkwa Inlet-Frontal Cordova Bay	41	8	49	49	49
*	Naukati Bay-Frontal Tuxekan Passage	20	12	32	48	48
*	Tolstoi Bay-Frontal Clarence Strait	14	35	48	48	48
	Polk Inlet-Frontal Skowl Arm	8	21	29	37	37
*	Twin Island Lake-Big Creek	8	5	13	36	36
*	Thorne Bay-Frontal Tolstoi Bay	10	17	27	35	35
*	Naukati Creek	7	19	25	35	35
*	Big Salt Lake-Frontal Shinaku Inlet	7	27	34	34	34
	North Pass-Frontal Tlevak Strait	19	14	33	33	33
	Tuxekan Passage-Frontal Tonowek Bay	11	9	20	33	33
*	Sea Otter Sound-Frontal Davidson Inlet	21	5	26	33	33
*	Twelvemile Creek	8	10	17	31	31
	190101030907-Perue Peak	28	2	30	30	30
	Port Bazan-Frontal Pacific Ocean	1	29	30	30	30
	Baldy Bay-Frontal Tlevak Strait	8	21	29	29	29
	McKenzie Inlet-Frontal Skowl Arm	20	8	28	28	28
	Hassiah Inlet-Frontal Cordova Bay	28	0	28	28	28
	190101030205	0	9	9	28	28
*	Staney Creek	0	7	7	27	27
*	Slide Creek-Frontal Clarence Strait	4	11	15	27	27
	Flicker Creek	0	4	4	26	22
	Trout Creek	18	0	18	26	26
	Hetta Inlet-Frontal Cordova Bay	1	24	26	26	26
*	Dog Salmon Creek	1	14	15	26	26
*	Neck Lake	1	3	4	25	25

Greater than 2% Basin Area as Roads	6th level HUC Watersheds	Percent non-NFS proposed harvest	Percent past harvest since 1989	Percent past harvest since 1989 and potential non-NFS harvest	Percent All Alts 2, 3 potential harvest for NFS (LSTA), non-NFS, and past since 1989	Percent All Alt 5 harvest for NFS, non-NFS, and past since 1989
	Jinhi Bay-Frontal El Capitan Passage	16	3	19	24	24
	Kitkun Bay-Frontal Cholmondeley Sound	14	8	22	24	24
	Soda Bay-Frontal Tlevak Strait	12	11	23	23	23
*	Klawock River	20	3	22	23	23
	Ratz Creek	0	11	11	23	23
	Karta Bay-Frontal Kasaan Bay	1	19	20	22	22
*	Outlet Thorne River	2	9	10	22	22
	Exchange Creek-Frontal Kashevarof Passage	6	7	13	22	22
	Cholmondeley Sound-Frontal Clarence Strait	7	8	14	22	22
*	Edna Bay-Frontal Davidson Inlet	12	0	12	21	21
	Goose Creek	1	15	17	21	21

There are 24 watersheds in the project area with greater than 2 percent roaded area (Table 33), all of which could trigger peak flow rate concerns once harvest occurs in the TSZ. Based on the potential roads and timber harvest per watershed, 36 watersheds may see increased peak flow rates. This includes all watersheds in the project area regardless of land ownership. Of these 36 watersheds, 21 could avoid peak flow rate increases and resulting impacts to streams and fish habitat by managing the timing of harvest relative to harvest in the past 30 years.

The S.1484 land exchange is within seven watersheds. The anticipated harvest area contains two watersheds already identified with some form of peak flow rate concern (Kitkun Bay-Frontal Cholmondeley Sound and Cholmondeley Sound-Frontal Clarence Strait), and an additional three that are likely to have peak flow rate concerns (North Arm Moira Sound-Frontal Moira Sound, Port Johnson-Frontal Clarence Strait, and Dora Bay-Frontal Cholmondeley Sound).

Fish Passage at Road Crossings

Cumulative adverse effects to aquatic resources would decrease with “Red crossing” removal or replacement activities in the action alternatives. Aquatic organism passage and habitat connectivity problems from previous road building would be prioritized and corrected for NFS maintained roads based on funding and the decision trees in Appendix B.

LTFs

Cumulative adverse effects to aquatic resources from LTF construction would slightly increase in these alternatives.

The Thorne Bay LTF has had bark accumulations that were in exceedance of water quality standards. While the LTF is in operation, the Alaska Department of Environmental Conservation requires annual dive surveys to monitor bark accumulation.

Some pollution discharge from log rafting is allowed for locations with discharge permits. Required LTF monitoring (2016 Forest Plan, p. G-10) and monitoring done by Forest Service contract inspectors would assess activities associated with the construction, operation, and maintenance of the facilities, and ensure that adverse effects will not occur and corrective actions are taken if necessary.

MAFs (excluding LTFs)

Cumulative adverse effects to aquatic resources from non-LTF MAF development or improvement would remain similar to the existing condition.

The footprint of developed and improved sites may expand, but site-selection criteria outlined in the MAF Activity Card, BMPs, and Forest Plan direction will avoid filling of intertidal and subtidal areas to the extent feasible so that cumulative effects to aquatic resources can be minimized.

Temporary Barge Beach Access

Cumulative adverse effects to aquatic resources from Temporary Barge Beach Access sites would slightly increase in these alternatives.

These alternatives would make a minor contribution to the existing potential for oil or fuel spills associated with existing vessel activity.

Thinning

Cumulative adverse effects to aquatic resources would decrease with the thinning treatments proposed in the action alternatives. These treatments would accelerate growth and development of young-growth riparian areas toward a more mature forest structure mirroring the conditions of undisturbed riparian stands. Thinning treatments outside the RMA expedite the transition of young-growth stands towards old-growth characteristics, promoting natural stream runoff conditions.

Timber Salvage

Cumulative effects on aquatic resources are anticipated to be minor considering that this activity is anticipated to be ongoing. However, the intensity of future salvage sales is unknown, since most large salvage operations are triggered by catastrophic events.

Karst Flow Restoration

Cumulative adverse effects to aquatic resources would decrease by doing karst flow restoration in the action alternatives. Past management activities have caused blockages in some systems, which have increased surface flow and erosion in some areas.

Conclusion – All Action Alternatives

All of the action alternatives propose some amount of timber harvest, road building, and the construction and use of LTF and other MAF sites. These activities can cause adverse effects to water quality, fish habitat, and aquatic organisms, but the adverse effects are expected to be minor in all the action alternatives by following additional considerations during the implementation process, required BMP direction in Activity Cards, Forest Plan direction, and other protections that avoid or minimize impacts.

POW LLA Project activities that may help offset adverse effects from previous land management practices would occur in all action alternatives, like stream and karst restoration, riparian thinning, fish habitat improvement activities including bioenhancement, and fixing fish passage issues at road crossings.

Effects by Action Alternatives 2, 3, and 5

Alternative 2 – Proposed Action

Direct and Indirect Effects

Roads

Alternative 2 proposes to construct 35 miles of NFS road, 129 miles of temporary road, and re-open 90 miles of closed road (Table 2).

In Alternative 2, 4 miles of new road could be constructed on slopes greater than 50 percent gradient, which would bring the total up to 187 miles of road on steep slopes in the project area (Table 29). Constructing roads on steep slopes can trigger slope stability concerns (see Soils section), which could result in adverse effects to water quality, fish habitat, and aquatic organisms. The effects to aquatic resources is expected to be minor because the proportion of new road construction on steep slopes is small, and following Activity Card direction will help minimize adverse effects.

Alternative 2 also proposes to construct up to 122 miles of roads within 300 feet of fish habitat, bringing the total up to 907 miles of road in proximity to fish streams in the project area (Table 29). If all 122 miles of new road were to be constructed in this alternative effects to aquatic resources are expected to range from minor to moderate. The 122 miles of new road are made up of small segments spread across the entire project area as opposed to long continuous segments within a floodplain. Where these segments do occur near fish habitat, there is a higher risk of sediment related impacts to aquatic habitat.

Alternative 2, as well as Alternative 3, proposes 432 new fish stream crossings (Table 30). Minor adverse effects to aquatic resources may occur from burst of sediment during implementation, but these effects are expected to be short term and localized. All new fish stream crossings would be constructed to provide for fish passage at all flows.

Trails

Under Alternative 2, as well as Alternative 5, maintenance would continue on existing trails, regularly used trails would be improved as needed, five new trails could be developed, and spur trails to recreation structures may be developed. Considering that maintenance and improvements to existing trails will likely lessen adverse effects to water quality, fish habitat and aquatic organisms and that spur trails built to access recreation structures would likely improve (*e.g.*, boardwalks, gravel surfaces) erodible pathways this alternative will likely impact water quality, fish habitat and aquatic organisms in a beneficial way. Five new trails in the project area are estimated to involve 24 miles of ground disturbance (Recreation map online at http://www.fs.usda.gov/goto/tongass/powlla; Table 31) may cause a potential direct effect to water quality (sedimentation) during construction. The estimated 32 trail fish stream crossings would be designed to provide for fish passage and would have a negligible indirect effect on aquatic resources through increased foot traffic in the area. Adverse effects to aquatic resources would be minimized by following direction in the Trails, Convert Roads to Trails, and Over the Snow Trails Activity Cards (Appendix A).

Timber Harvest

For Alternative 2, an estimated 19,396 acres of young-growth and 23,269 acres of old-growth timber could be harvested for a total of 42,665 acres (Table 28). These acres could be selected from a suitable timber land base that includes areas "North of 20 Road". The timber harvest proposed in this alternative could have minor adverse effects on water quality, fish habitat, and aquatic organisms. While timber harvest can have adverse effects on water quality, fish habitat and fish by altering the amount and timing of runoff, sediment transport/deposition regimes (Sullivan *et al.* 1987), average substrate size (Ross 2013), and stream temperature (Beschta *et al.* 1987), mandatory no-harvest riparian management areas (RMA) and other protections outlined in the Activity Cards (Appendix A) would minimize these adverse effects.

Restoration

Under Alternative 2, as well as Alternative 5, up to 200 miles of stream restoration could occur in the project area over the next 15 years. Restoring reaches that are nonfunctional or functional at risk with a downward trend could have major (lasting for years) beneficial effects on water quality and fish habitat because habitat complexity and floodplain roughness would be restored, sedimentation problems would be corrected, and the added features like LWD would help bridge the gap in time until nearby riparian stands are old enough to recruit large wood into the streams naturally.

Bursts of sediment and ground disturbance would occur during implementation due to use of equipment in streams and riparian areas. The adverse effects to water quality would be minor because the increased turbidity would be short-term and localized. Adverse effects to fish are minimized by operating during species specific timing windows which are designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water. Effects to water quality, fish habitat, and aquatic organisms would be further minimized by following direction in the Stream Restoration Activity Card (Appendix A), which outlines required BMPs, Forest Plan direction, and requires identification of site-specific mitigations during implementation planning.

Fish Habitat Improvement

Fish Habitat Improvement activities proposed in Alternative 2 include lake fertilization, egg incubation boxes, and fry stocking to improve wild sockeye salmon runs in areas that historically produced larger runs, and barrier modifications to improve/provide Pacific salmon access to spawning and rearing habitat. Improvement locations are listed on page 2-23 (see also Watershed Improvement and Restoration Treatments Map online at http://www.fs.usda.gov/goto/tongass/powlla). The direct and indirect effects of these activities are described below.

Lake Fertilization

Lake fertilization activities could have major (readily measurable, last for years, have substantial consequences) positive effects on fish and fish habitat in lakes where sockeye salmon production has been limited by low lake fertility.

Because of the extensive pre and post implementation monitoring required for lake fertilization activities, the adverse effects of POW LLA Project lake fertilization activities on water quality, fish habitat, and aquatic organisms would be minor (small, last less than a week, localized to affected lake). Potential adverse effects to lake fertilization include altering food-web dynamics so that other planktivore species are favored and outcompete juvenile sockeye salmon. Lake fertilization can also stimulate the growth of ungrazable algae, which can be difficult to constrain. The Fish Habitat Improvement Activity Card (Appendix A) and the Fish Habitat Improvement Decision Tree (Appendix B) outline requirements during project planning. This includes assessments of historical abundance, assessment of all potential causes for decreased run sizes, assessment of lake fertility from detailed pre-project monitoring, and habitat capability and feasibility analyses to determine if the foodweb structure is appropriate for lake fertilization. If all pre-project assessments show that historical sockeye salmon abundance had been larger, and that lake fertilization would benefit sockeye salmon, then the required consistent and long-term monitoring following the start of lake fertilization activities would allow for early identification of water quality concerns.

Barrier Modification

Barrier modification activities could have major (readily measurable, last for years, have substantial consequences) positive effects on fish and fish habitat in systems where barriers are limiting or preventing access to spawning and rearing habitat. Desirable consequences include increased overall freshwater ecosystem productivity, increased size or numbers of resident or other anadromous salmonids that prey on supplemented species in freshwater, and overall production of target species as returning adults which provide harvest opportunities. Evaluation of fish production resulting from colonization or wildstock supplementation projects is challenging and can be expensive. Bryant and others (1999) and Wright and others (1997) evaluated ecological impacts of introduced salmon in freshwater habitats in two Southeast Alaska systems where barriers were removed and fish stocking was conducted. Both noted some increased complexity in food webs and changes in resident population characteristics but no broad-scale displacement or replacement by introduced species.

Bursts of sediment would occur during implementation. The adverse effects to water quality would be minor because the increased turbidity would be short-term and localized. Adverse effects to fish are minimized by operating during species specific timing windows which are designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water. Effects to water quality, fish habitat, and aquatic organisms would be further minimized by following direction in the Fish Habitat Improvement Activity Card (Appendix A), which outlines required BMPs, Forest Plan direction, and requires identification of site-specific mitigations during implementation planning.

Egg Incubation Boxes and Fry Stocking

Egg incubation boxes and fry stocking activities could have moderate (measurable, small, less than a week, localized to affected channel segment) to major (readily measurable, last for years, have substantial consequences, notices on a subwatershed scale) positive effects to fish in systems where wild sockeye salmon production had historically been larger, but has been limited by low egg-to-fry survival or where self-perpetuating wild runs could be established or reestablished by fry stocking.

Because of the extensive pre and post implementation monitoring required for egg incubation and fry stocking activities, the adverse effects of POW LLA Project bioenhancement activities on water quality, fish habitat, and aquatic organisms would be minor (small, last less than a week, localized to affected lake). Potential adverse effects to egg incubation boxes and fry stocking include introduction and spread of disease, reduced genetic fitness, competition with wild stocks for aquatic resources, and loss of survival from release timing errors. The Fish Habitat Improvement Activity Card (Appendix A) and the Fish Habitat Improvement Decision Tree (Appendix B) outline requirements during project planning (like assessments of historical abundance, assessment of all potential causes for decreased run sizes, assessment of egg to fry survival, and habitat capability and Feasibility Analyses) to determine if the physical and chemical parameters of the aquatic ecosystem are appropriate for egg incubation boxes and/or fry stocking. If all pre-project assessments show that historical sockeye salmon abundance had been larger, and that egg incubation and/or fry stocking would benefit sockeye salmon, then the required consistent and long-term monitoring following the start of these bioenhancement activities would allow for the regular assessment of the sockeye stocks and the nutrient food-web dynamics.

Road and Recreation Related Activities

Approximately 90 miles of road re-opening is proposed in Alternative 2 (Table 87), which would have negligible to moderate adverse effects to aquatic resources depending on the condition of and the number of stream crossings. Re-installation or repair of fish crossings is expected to have minor adverse effects to aquatic resources.

Quarry development is anticipated to have minor to moderate impacts to aquatic resources. With an estimated 0.45 acre of disturbance for every mile of road construction, there are anticipated to be 74 new quarry acres in Alternative 2. Adverse effects would be minimized by siting quarries outside of RMAs, and following the Quarry Development Activity Card (Appendix A).

Up to eight winter sport access points and areas would be developed in Alternative 2, as well as Alternative 5. Trail clearing and development activities could have minor effects to aquatic resources during implementation, but those effects would be minimized by following direction in the Winter Sport Access Improvements for Over-the-snow Vehicle Use Activity Card (Appendix A).

Cumulative Effects

Roads

Project road building brings the total up to 4,408 miles of road in the project area (Table 29). Cumulatively, 907 miles of road will be located within 300-feet of fish streams. An additional 432 fish stream crossings are proposed, bringing the total to 1,809 fish stream crossings in the project area (Table 30). Roads can cause moderate adverse cumulative effects on aquatic resources by increased sedimentation, and these effects can be minimized by following Activity Cards.

Trails

Five additional trails, as well as trail maintenance and improvements to regularly used trails and spur trails built to access recreational facilities will likely lead to negligible to minor cumulative effects to water quality when considered in conjunction with the existing trails in the project area.

Peak Flow Rates

Alternative 2 could result in changes in peak flow rates in any watershed, including ones that have had past watershed restoration efforts, as a worse-case scenario. Table 37 shows locations of past restoration activities, timber harvest in watersheds that contain the restoration activity, and anticipated changes to peak flow rate. During implementation, careful consideration of activity locations and watershed characteristics will ensure that no adverse effects to aquatic resources will occur. Thirty-six watersheds that may experience peak flow rate changes are shown in Table 36. Four of the watersheds listed in Table 36, Jinhi Bay-Frontal El Capitan Passage, Tuxekan Passage-Frontal Tonowek Bay, Slide Creek-Frontal Clarence Strait and Klawock River have drinking water systems.

Table 37. Watersheds with prior improvements or restoration that could be impacted by POW LLA Project activities

HUC12	Name	Improvement or Restoration Project	All past and present Timber Harvest (acres)	Proposed LLA Acres (LSTA) Harvest (acres)	Detectable change in peak flow rate determined through analysis
190101030307	Eagle Creek	Luck Creek Large Woody Debris	6,896	1,568	No
190101030102	Hatchery Creek	Hatchery Creek Fish Pass	3,875	438	No
190101030502	Indian Creek-Harris River	Harris River Barrier falls modification and Large woody debris and Fubar (Gàndlaay Hàanaa) large woody debris	4,232	4,146	No
190101030304	Neck Lake	Neck lake Fish stocking	3,379	2,498	Yes
190101030309	Slide Creek-Frontal Clarence Strait	Sal Creek Large woody debris	14,156	4,888	Yes
190101031003	Staney Creek	Large woody debris	14,914	8,520	Yes
190101030501	Twelvemile Creek	Twelvemile Creek Large woody debris	6,087	1,662	Yes
190101031401	Dog Salmon Creek	Dog Salmon Creek Large woody debris	4,594	1,179	Yes
190101031402	190101031402	Snipe Creek Large woody debris	6,336	2,437	No

Restoration

Cumulative adverse effects to aquatic resources would decrease with restoration activities in this alternative.

Previous land management practices, like timber harvest in riparian areas or yarding within fish stream corridors, have impaired stream reaches by removing sources for LWD recruitment, degrading stream banks, and in some cases causing down-cutting which incises stream channels, prevents streams from accessing floodplains, and causes continuous sources of sedimentation. While stream restoration activities in this alternative cause short-terms bursts of sediment, these activities correct long-term adverse effects to water quality, fish habitat, and aquatic organisms.

Fish Habitat Improvement

Cumulative adverse effects to aquatic resources would slightly decrease as a result of Fish Habitat Improvement Activities in Alternative 2. Several factors can limit salmon production including water quality, ocean conditions, competition, predation, and fishing pressure. While Fish Habitat Improvement Activities may mitigate some losses to salmon production, greater improvements could be realized by working with partner entities to identify and address the key sources of production loss.

Conclusion – Alternative 2

Alternative 2 would have moderate adverse effects to aquatic resources. In a worst-case scenario of all LSTA acres harvested, peak flow rates could increase in 36 watersheds, including four that have had prior watershed restoration efforts. Depending on where in the watershed timber and road building takes place, previous investments in watershed restoration could be affected. During the implementation process, careful consideration of all activities, including potential increases to peak flow rates, will ensure that no adverse effects to aquatic resources will occur. Four watersheds with drinking water systems could be affected. Up to 200 miles of stream restoration activities help restore the function of streams across the project area watersheds. Fish habitat improvement activities like barrier modification, lake fertilization, fry stocking, and egg incubation may help improve the productivity of salmon systems where productivity had historically been higher.

Along with the other action alternatives, karst restoration, thinning, road decommissioning, and fixing fish passage issues at road crossings would have beneficial effects to aquatic resources.

Alternative 3

Direct and Indirect Effects

Roads

Alternative 3 proposes to construct 48 miles of NFS road, 175 miles of temporary road, and re-open 120 miles of closed road (Table 86 and Table 87).

In Alternative 3, as well as Alternative 5, 2 miles of new road could be constructed on slopes greater than 50 percent gradient, which would bring the total up to 185 miles of road on steep slopes in the project area (Table 29). Constructing roads on steep slopes can trigger slope stability concerns (see Soils section), which could result in adverse effects to water quality, fish habitat, and aquatic organisms. The effects to aquatic resources is expected to be minor because the proportion of new road construction on steep slopes is small, and following Activity Card direction will help minimize adverse effects.

Alternative 3 also proposes to construct up to 122 miles of roads within 300 feet of fish habitat, bringing the total up to 907 miles of road in proximity to fish streams in the project area (Table 29). If all 122 miles of new road were to be constructed in this alternative effects to aquatic resources are expected to range from minor to moderate. The 122 miles are made up of small segments spread across the entire project area as opposed to long continuous segments within a floodplain. Where these segments do occur near fish habitat, there is a higher risk of sediment related impacts to aquatic habitat.

Alternative 3, as well as Alternative 2, proposes 432 new fish stream crossings (Table 30). Minor adverse effects to aquatic resources may occur from burst of sediment during implementation, but these effects are expected to be short term and localized. All new fish stream crossings would be constructed to provide for fish passage at all flows.

Trails

Under Alternative 3, no new trails would be developed (Table 31). Maintenance would occur on the trails with the greatest use, leading to negligible direct and indirect effects to water quality, fish habitat and aquatic organisms.

Timber

For Alternative 3, an estimated 36,670 acres of young-growth and 13,014 acres of old-growth timber could be harvested for a total of 49,684 acres (Table 28). These acres could be selected from a suitable timber land base that includes areas "North of the 20 Road". Any old-growth stands North of the 20 Road would only be harvested as part of sales of generally less than 3 MMBF. The timber harvest proposed in Alternative 3 could have minor adverse effects on water quality, fish habitat, and aquatic organisms. While timber harvest can have adverse effects on water quality, fish habitat and fish by altering the amount and timing of runoff, sediment transport/deposition regimes (Sullivan *et al.* 1987), average substrate size (Ross 2013), and stream temperature (Beschta *et al.* 1987), mandatory no-harvest riparian management areas (RMA) and other protections outlined in the Activity Cards (Appendix A) would minimize these adverse effects.

Invasive Plant Treatments – Herbicidal

Alternative 3 allows for the use of herbicide on invasive plant populations. The guidance and protections outlined in the Activity Cards (Appendix A) ensure that there will be negligible harmful impacts to aquatic resources. The removal of invasive plant populations is considered to be a form of watershed restoration. Successful herbicidal treatments could have moderate to major positive effects for watershed health.

Restoration

In Alternative 3, up to 80 miles of stream restoration could occur in the project area over the next 15 years. Restoring reaches that are nonfunctional or functional at risk with a downward trend could have major (lasting for years) beneficial effects on water quality and fish habitat because habitat complexity would be restored, sedimentation problems would be corrected, and the added features like LWD would help bridge the gap in time until nearby riparian stands are old enough to recruit large wood into the streams naturally.

Bursts of sediment would occur during implementation. The adverse effects to water quality would be minor because the increased turbidity would be short-term and localized. Adverse effects to fish are minimized by operating during species specific timing windows, which are designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water. Effects to water quality, fish habitat, and aquatic organisms would be further minimized by following direction in the Stream Restoration Activity Card (Appendix A), which outlines required BMPs, Forest Plan direction, and requires identification of site-specific mitigations during implementation planning.

Fish Habitat Improvement

Fish Habitat Improvement activities proposed in Alternative 3 only include barrier modification activities to improve/provide Pacific salmon access to spawning and rearing habitat.

The adverse and positive effects from barrier modification are discussed for Alternative 2.

Road and Recreation Related Activities

Approximately 120 miles of road maintenance is proposed in Alternative 3 (Table 87), which would have negligible adverse effects to aquatic resources in the short term, but proper road maintenance has long term benefits to aquatic resources. Adverse effects would be minimized by following direction in the Road Maintenance Activity Card (Appendix A).

Quarry development is anticipated to have minor to moderate impacts to aquatic resources. With an estimated 0.45 acre of disturbance for every mile of road construction, there are anticipated to be 100 new quarry acres in Alternative 3. Adverse effects would be minimized by siting quarries outside of RMAs, and following direction in the Quarry Development Activity Card (Appendix A).

Only winter sport access points and areas with documented public support indicating potential for high use would be developed in this alternative. Trail clearing and development activities could have minor effects to aquatic resources during implementation, but those effects would be minimized by following direction in the Winter Sport Access Improvements for Over-the-snow Vehicle Use Activity Card (Appendix A).

Cumulative Effects

Roads

Project road building brings the total up to 4,408 miles of road in the project area (Table 29). Cumulatively, 907 miles of road will be located along fish streams on all lands. An additional 432 fish stream crossings are proposed, bringing the total to 1,809 fish stream crossings in the project area (Table 30). Roads can cause moderate adverse cumulative effects on aquatic resources by increased sedimentation; these effects can be minimized by following Activity Card direction.

Trails

No new trails would be developed in this alternative, but regularly used trails would continue to receive maintenance and improvements. Ongoing maintenance would have negligible cumulative effects on water quality, fish habitat, and aquatic organisms.

Peak Flow Rates

In Alternative 3, POW LLA Project timber harvest and road building would be planned to avoid peak flow rate increases in all project area watersheds. By minimizing peak flow rates during implementation planning, minor adverse effects to aquatic resources from cumulative timber harvest and road building would be anticipated. Previous restoration efforts and drinking water systems do not have the potential to be affected by peak flow rate changes in this alternative.

Restoration

Cumulative adverse effects to aquatic resources would decrease with restoration activities in Alternative 3.

Previous land management practices, like timber harvest in riparian areas or yarding within fish stream corridors, have impaired stream reaches by removing sources for LWD recruitment, degrading stream banks, and in some cases causing down-cutting which incises stream channels, prevents streams from accessing floodplains, and causes continuous sources of sedimentation. While stream restoration activities in Alternative 3 cause short-term bursts of sediment, these activities correct long-term adverse effects to water quality, fish habitat, and aquatic organisms.

Fish Habitat Improvement

In Alternative 3, cumulative adverse effects to aquatic resources would slightly decrease as a result of barrier modification activities. While barrier modification would provide access to additional habitat, several other factors can limit salmon production including water quality, ocean conditions, competition, predation, and fishing pressure.

Conclusion – Alternative 3

Alternative 3 would have minor to moderate adverse effects to aquatic resources. Timber harvest and road building would be timed to avoid peak flow rate increases in all project area watersheds. Up to 80 miles of stream restoration activities help restore the function of streams across the project area. Barrier modification fish habitat improvement activities may help improve/provide Pacific salmon access to spawning and rearing habitat.

Along with the other action alternatives, karst restoration, thinning, road decommissioning, and fixing fish passage issues at road crossings would have positive effects to aquatic resources.

Alternative 5

Direct and Indirect Effects

Roads

Alternative 5 proposes to construct 49 miles of NFS road, 180 miles of temporary road, and re-open 125 miles of closed road (Table 86 and Table 87).

In Alternative 5, as well as Alternative 3, 2 miles of new road could be constructed on slopes greater than 50 percent gradient, which would bring the total up to 185 miles of road on steep slopes in the project area (Table 29). Constructing roads on steep slopes can trigger slope stability concerns (see Soils section), which could result in adverse effects to water quality, fish habitat, and aquatic organisms. The effects to aquatic resources is expected to be minor because the proportion of new road construction on steep slopes is small and following Activity Card direction will help minimize adverse effects.

This alternative also propose to construct up to 118 miles of roads within 300 feet of fish habitat, bringing the total up to 903 miles of road in proximity to fish streams in the project area (Table 29). If all 118 miles of new road were to be constructed in this alternative effects to aquatic resources are expected to range from minor to moderate. The 118 miles is made up of small segments spread across the entire project area as opposed to long continuous segments within a floodplain. Where these segments do occur near fish habitat, there is a higher risk of sediment related impacts to aquatic habitat.

Alternative 5 proposes 425 new fish stream crossings (Table 30). Minor adverse effects to aquatic resources may occur from bursts of sediment during implementation, but these effects are expected to be short term and localized. All new fish stream crossings would be constructed to provide for fish passage at all flows.

Trails

The direct and indirect effects of trails to water quality, fish habitat, and aquatic organisms are the same in this alternative as what was described in Alternative 2.

Timber

For Alternative 5, an estimated 36,670 acres of young-growth and 6,365 acres of old-growth timber could be harvested for a total of 43,035 acres (Table 28). These acres could be selected from a suitable timber land base that includes areas “North of 20 Road”; however, no old-growth timber will be harvested North of the 20 Road in Alternative 5. The timber harvest proposed in this alternative could have minor adverse effects on water quality, fish habitat, and aquatic organisms. While timber harvest can have adverse effects on water quality, fish habitat and fish by altering the amount and timing of runoff, sediment transport/deposition regimes (Sullivan *et al.* 1987), average substrate size (Ross 2013), and stream temperature (Beschta *et al.* 1987), mandatory no-harvest riparian management areas (RMA) and other protections outlined in the Activity Cards (Appendix A) would minimize these adverse effects.

Restoration

The direct and indirect effects of stream restoration to water quality, fish habitat, and aquatic organisms are the same in this alternative as what was described in Alternative 2.

Fish Habitat Improvement

Fish Habitat Improvement activities proposed in Alternative 5 include barrier modification and lake fertilization activities.

Barrier modification activities could be used to improve/provide Pacific salmon access to spawning and rearing habitat. Where wild sockeye salmon runs had historically been larger, lake fertilization activities could be used for lakes that are exhibiting low levels of fertility and high potential for sockeye salmon production.

The adverse and positive effects from barrier modification and lake fertilization are discussed for Alternative 2.

Road and Recreation Related Activities

Approximately 125 miles of road maintenance is proposed in Alternative 5 (Table 87), which would have negligible adverse effects to aquatic resources in the short term, but proper road maintenance has long term benefits to aquatic resources. Adverse effects would be minimized by following direction in the Road Maintenance Activity Card (Appendix A).

Quarry development is anticipated to have minor to moderate impacts to aquatic resources. With an estimated 0.45 acres of disturbance for every mile of road construction, there are anticipated to be 103 new quarry acres in Alternative 5. Adverse effects would be minimized by siting quarries outside of RMAs, and following direction in the Quarry Development Activity Card (Appendix A).

Up to eight winter sport access points and areas would be developed in Alternative 5, as well as Alternative 2. Trail clearing and development activities could have minor effects to aquatic resources during implementation, but those effects would be minimized by following direction in the Winter Sport Access Improvements for Over-the-snow Vehicle Use Activity Card (Appendix A).

Cumulative Effects

Roads

Project road building brings the total up to 4,385 miles of road in the project area (Table 29). Cumulatively, 907 miles of road will be located along fish streams. An additional 432 fish stream crossings are proposed, bringing the total to 1,802 fish stream crossings in the project area (Table 30). Roads can cause moderate adverse cumulative effects on aquatic resources by increased sedimentation, and these effects can be minimized by following Activity Card direction.

Trails

Five additional trails, as well as trail maintenance and improvements to regularly used trails and spur trails built to access recreational facilities will likely lead to negligible cumulative effects to water quality when considered in conjunction with the existing trails in the project area.

Peak Flow Rates

In Alternative 5, POW LLA Project timber harvest and road building would be planned to avoid peak flow rate increases in all project area watersheds. By minimizing peak flow rates during implementation planning, minor adverse effects to aquatic resources from cumulative timber harvest and road building would be anticipated. Previous restoration efforts and drinking water systems do not have the potential to be affected by peak flow rate changes.

Restoration

Cumulative adverse effects to aquatic resources would decrease with restoration activities in this alternative.

Previous land management practices, like timber harvest in riparian areas or yarding within fish stream corridors, have impaired stream reaches by removing sources for LWD recruitment, degrading stream banks, and in some cases causing down-cutting which incises stream channels, prevents streams from accessing the floodplains, and causes continuous sources of sedimentation. While stream restoration activities in this alternative cause short-terms bursts of sediment, these activities correct long-term adverse effects to water quality, fish habitat, and aquatic organisms.

Fish Habitat Improvement

Cumulative adverse effects to aquatic resources would slightly decrease as a result of barrier modification activities in Alternative 5. While barrier modification would provide access to additional habitat and lake fertilization activities could improve fertility levels in sockeye salmon lakes, several other factors can limit salmon production including water quality, ocean conditions, competition, predation, and fishing pressure. While Fish Habitat Improvement Activities may mitigate some of losses to salmon production, greater improvements could be realized by working with partner entities to identify and address the key sources of production loss.

Conclusion – Alternative 5

Alternative 5 would have minor to moderate adverse effects to aquatic resources. Timber harvest and road building would be timed to avoid peak flow rate increases in all project area watersheds, and no old-growth timber harvest activities would occur “North of the 20 Road”. Up to 200 miles of stream restoration activities help restore the function of streams across the project area. Fish habitat improvement activities like barrier modification and lake fertilization may help improve the productivity of salmon systems where productivity had historically been higher.

Along with the other action alternatives, karst restoration, thinning, road decommissioning, and fixing fish passage issues at road crossings would have positive effects to aquatic resources.

Essential Fish Habitat Assessment

The Magnusson-Stevens Fishery Conservation and Management Act requires consultation with the National Marine Fisheries Service (NMFS) for any activities that could affect the essential fish habitat (EFH) of federally managed fish species identified in a fishery management plan (FMP) by the North Pacific Fishery Management Council (NPFMC). EFH includes all waters and substrate necessary for fish spawning, breeding, feeding, or growth to maturity.

The Forest Service has determined that activities in the POW LLA Project may adversely affect both freshwater and marine essential fish habitat for federally managed fish species, and provided the DEIS on April 27, 2018 to initiate consultation with the NMFS. NMFS requested a hard copy during a phone conversation with the Forest Service October 9, 2018. We responded to this request and consultation will be documented in the Final ROD.

Freshwater EFH

The five Pacific salmon species (Chinook, chum, coho, pink, and sockeye) are included in a Fishery Management Plan (North Pacific Fishery Management Council 2012), and POW LLA Project activities may adversely affect their freshwater EFH. These potential effects include increased stream flows, increased sediment delivery, altered riparian vegetation, and disturbed channel integrity.

Project activities like culvert work, instream restoration, and fish barrier modification can cause bursts of sediment in streams, but the adverse effects to water quality would be minor because the increased turbidity would be short-term and localized.

Timber harvest and road construction remove tree canopy cover in a watershed, which reduces the amount of forest transpiration, or the amount of water released by trees and evaporated into the atmosphere, and can affect snow accumulation and melt. When enough forest canopy cover is removed in a watershed (see Peak Flow Rate discussion above), the amount of water flowing through a stream at peak flow rate can increase and cause detrimental effects to water quality and fish habitat like channel and stream bank erosion, sediment transport, and the scouring of salmon redds. Alternatives 3 and 5 both require timing activities and planning locations of harvest to avoid peak flow rate increases in all project area watersheds. Alternative 2 could result in peak flow rate increases in 36 project area watersheds, and those increases could have adverse effects to water quality, fish habitat, and aquatic organisms.

The use of herbicides (aminopyralid, imazapyr, and glyphosate) is proposed in Alternative 3 for treating invasive plant infestations. Aminopyralid is expected to have minimal effects on aquatic resources because of its low toxicity. Glyphosate (aquatic, less toxic formula) may cause sub-lethal effects to fish, and there could be some localized effects to aquatic macrophytes with the use of imazapyr. However, the adverse effects to aquatic organisms using hand or spot spraying methods are expected to be short term and minor because of the low number of infestations within riparian management areas, in, along, or near Class I and II streams, and along lake/pond shorelines. In addition, application rates will be at or lower than the label recommendations, all of which are lower than the levels required to generate effects to aquatic organisms. Broadcast applications for all three herbicides will require a 100-foot buffer around water to protect riparian vegetation. Given this, it is expected that applications of the herbicides will rarely, if ever, result in concentrations that exceed a level of concern for aquatic organisms.

The Forest Service will minimize the effects on freshwater EFH by following the Implementation Plan (Appendix B) and direction in the Activity Cards (Appendix A) which include BMPs, Forest Plan direction, applicable laws and regulations, and site-specific protections. Protections include:

- All Class I and II streams would be protected by a minimum 100-foot no-harvest buffer. No-harvest buffers may be larger than 100 feet depending on stream process groups, the extent of riparian soils and vegetation, elevated windthrow concerns, and other site-specific resource concerns. The Forest Plan authorizes young-growth harvest in riparian management areas but the harvest must be outside 100-foot no-harvest buffers and would need to meet the objectives of the stream process group.
- Class III streams would be protected by a no-harvest buffer to the top of the side slope (v-notch).

- Reasonable Assurance of Windfirmness (RAW) buffers would be prescribed around no-harvest stream buffers that have a high risk of windthrow.
- All new fish crossing structures on roads will provide for fish passage. All crossings will be removed from temporary roads 3 to 5 years after timber sale activities are completed.
- Any instream work would occur during species specific timing windows which are designed to avoid spawning adults, eggs and alevins in the gravel, and autumn high water.
- Careful consideration of potential changes to peak flow rates will be made during the implementation phase. Given the geographic location of specific activities, professional judgement based on the analysis method provided in the FEIS will be followed to ensure that no adverse effects to EFH will occur.

Marine EFH

Several marine species listed in a Fishery Management Plan use the nearshore waters of Prince of Wales Island including arrowtooth flounder, Pacific cod, walleye Pollock, dusky rockfish, shortraker/rougheye rockfish, yelloweye rockfish, sablefish, sculpin, and skates (North Pacific Fishery Management Council 2017). The nearshore waters are also used by adult and juvenile salmon.

POW LLA Project activities like the development and improvement of LTF and other MAF sites, and temporary barge beach access may adversely affect the marine EFH of these species. These potential effects include injury or mortality of federally managed fish species and their prey from reduced oxygen levels, anaerobic conditions, and the presence of toxic sulfide compounds from log-rafting bark accumulations; increased turbidity and blast-induced pressures and vibrations from in-water MAF construction, blasting, and/or filling activities; and fuel spills from barge loading equipment. Additionally, shade caused by barges and equipment floats can reduce primary production and prey abundance in the water column. Anchoring and moorage could destroy submerged vegetation. Log landings and access trails located within the 1,000-foot beach fringe could increase surface water runoff which can carry sediments, woody debris, and hydrocarbons.

The Forest Service will minimize those potential effects on marine EFH by following direction in the Activity Cards (Appendix A) which include BMPs, Forest Plan direction, applicable laws and regulations, and site-specific protections. Protections include:

- Prohibit siting LTFs and log rafts within 300 feet of the mouth of an anadromous fish stream or in any area known to be important for fish spawning or rearing
- Site LTFs along straits, channels, or deep bays where currents may be strong enough to disperse sunken or floating wood debris.
- Site log rafts along steep shorelines where there is little substrate for plant or animal growth. Areas with a minimum amount of bottom substrate in the euphotic (or sunlight) zone are preferred.
- Site log rafts in a minimum depth of 40 feet at mean lower low water to avoid grounding of log bundles, and to avoid rooted aquatic macrophytes and algaes which generally begin to decrease in density below 40 feet.
- Time in-water construction to limit adverse impacts to marine and estuarine fishery resources. Generally, avoid in-water construction from mid-March to mid-June to protect juvenile salmon and spawning herring, but the actual timing windows will depend on specific locations.

- Following the 2013 Blasting Standard (Timothy 2013) to minimize and mitigate the impacts of blasting on fish:
    - ♦ Hydrophones used to monitor pressures and geophones used to monitor vibrations will be placed in the appropriate habitats as close to the point of detonation as possible without damaging the equipment. The instantaneous pressure rise in the water column in rearing habitat and migration corridors is limited to no more than 7.3 psi (pounds per square inch) where fish are present. Peak particle velocities in spawning gravels are limited to no more than 2.0 inches per second during the early stages of embryo incubation before epiboly is complete.
- Design, construct, and operate facilities to minimize the risk to marine fish habitat from surface water runoff which can carry sediments, woody debris, and hydrocarbons. This can be accomplished by keeping overland flow from entering the LTF or adjacent facilities, collecting runoff from the facility in settling basins, or retaining vegetative buffer strips.
- Prohibit equipment storage, maintenance, and re-fueling within riparian areas. For marine facilities outside riparian areas, maintain equipment and facilities to ensure lubricants and hydraulic fluids do not enter receiving waters.
- The Thorne Bay LTF is Category 4a listed (impaired water with a final/approved Total Maximum Daily Load) because of bark accumulations from previous log rafting activities, and no Alaska Pollutant Discharge Elimination System (APDES) permit will be authorized at this site until bark accumulation meets State standards. While the LTF is in operation, the Alaska Department of Environmental Conservation requires annual dive surveys to monitor bark accumulation.

Essential Fish Habitat Conclusion

Based on the known effects of timber harvest, road building, and other project activities, the Forest Service believes the POW LLA Project may adversely affect Freshwater EFH and Marine EFH. However, the Forest Service has determined that by following the Implementation Plan (Appendix B) and implementing the direction in project Activity Cards (Appendix A), which includes Forest Plan direction, Best Management Practices, and site-specific protections, effects to essential fish habitat would be minimized under all action alternatives.

Issue 5: Wildlife Habitat

Issue 5 includes discussion of Region 10 Forest Service sensitive species (Queen Charlotte goshawk), and other selected wildlife species including Sitka black-tailed deer, Alexander Archipelago wolf, black bear, American marten, marbled murrelet, brown creeper, and endemic species including the Prince of Wales flying squirrel, Prince of Wales spruce grouse, and Keen's myotis.

Issue statement: Proposed actions, particularly timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest would affect the amount of remaining productive old growth (POG), high volume POG (HPOG), and large tree POG (SD67) wildlife habitat. Past actions have also impacted wildlife habitat by converting old-growth forest into young-growth forests. Proposed actions in young-growth stands should improve wildlife habitat. These same activities would affect current wildlife habitat connectivity provided by productive old-growth as well as older young-growth stands (generally greater than 50 years old) across the landscape. Past activities have also impacted the connectivity of the landscape.

Background: Changes in forested conditions and the presence of roads have altered wildlife habitats. Vegetation management can affect wildlife habitat through modification of vegetation characteristics or habitat composition. Primary concerns in the project area include the maintenance of lower elevation, productive old growth (POG) forested habitats and the improvement of wildlife habitat in young-growth stands, especially in lower-elevation stands. Road densities are also a concern in the project area. The amount, location, and diversity of forested habitats need to be considered in order to properly address wildlife needs.

Units of Measure

- Acres harvested of non-winter deer habitat, POG, HPOG, and SD67 habitat by Wildlife Analysis Area (WAA) and Game Management Unit (GMU) 2;
- Literature habitat thresholds for remaining habitat acres by WAA;
- Acres harvested of POG habitat below 1,500 feet in elevation (average snow habitat);
- Acres harvested of HPOG habitat in south-facing stands below 800 feet in elevation (deep snow habitat);
- Total road density below 1,200 feet in elevation on NFS lands by WAA; and
- Qualitative discussion of Deer Habitat Capability (DHC) by biogeographic province and GMU 2.

Methodology

The scales of analysis used include GMU 2 (which is equal to the project area), biogeographic province, and the individual WAA.

Sources of information used in this analysis include field reconnaissance, aerial photo interpretation, Forest Service GIS data, peer-reviewed literature (cited as appropriate), previous NEPA analyses in the vicinity of the project, and information from knowledgeable individuals.

Only the effects of old- and young-growth harvest and treatments are discussed in detail in Issue 5. The effects of other proposed activities found in the Activity Cards, such as recreation structures, and slash treatment would have negligible effects. It is anticipated that effects to wildlife resources from salvage sales would be minor. In rare instances salvage areas could be larger if they are the result of a catastrophic wind event or an insect outbreak. Salvage sales are as defined in the Forest Plan.

For purposes of analysis, assumptions include that all harvest stands from the LSTA would be harvested and the only harvest method would be clearcut. This assumption results in little or no difference between alternatives at the project-area scale. It was assumed that areas with more old-growth harvest would result in a greater effect. Young-growth harvest, depending on the prescription, size, and placement, could result in a positive effect since it was assumed that all young-growth acres treated are in the stem exclusion stage and would result in a younger stand with more available forage. However, no alternative would harvest all LSTA acres (see Table 12 through Table 15) nor would they all be clearcut, and all potential roads needed for timber harvest would not be constructed.

There are no threatened or endangered terrestrial birds or mammals or critical habitat within the project area. A Biological Assessment/Biological Evaluation (BA/BE) for the POW LLA Project was completed. A determination of "Not likely to adversely affect" was found for listed marine mammal species. The BA/BE is included in the project record.

Interagency Wolf Habitat Management Program

Incorporation of recommendations made by the *Interagency Wolf Habitat Management Program* in Alternatives 3 and 5 could mitigate habitat concerns. Alternative 2 does not include recommendations in the *Interagency Wolf Habitat Management Program* per se but there is overlap between recommendations in the *Interagency Wolf Habitat Management Program* with recommendations in the Forest Plan, such as thinning younger-aged young-growth stands.

Alternative 3 incorporates portions of the *Interagency Wolf Habitat Management Program* including the following.

Deer Habitat

<u>Younger Young Growth (0 to 25 years)</u>:

- Aim to thin all young growth prior to about 25 years post-harvest in medium to high productivity stands.
- Leave untreated or unthinned strips (leave strips) to provide elevational movement corridors for wildlife. Promote/maintain redcedar and yellow-cedar through thinning and planting if needed.

<u>Young Growth (26 to 60 years)</u>:

- Incorporate leave strips that provide elevational movement corridors for deer to maintain or enhance connectivity between higher and lower elevations. Use 400 feet as a guide to space travel corridors within thinning treatments in the absence of existing routes, terrain features, or other habitat connectivity drivers.
- Consider a variety of thinning treatment combinations to create deer forage and movement corridors.
- Reduce or abate effects of slash on deer mobility in treated stands.

<u>Older Young Growth (Commercial age, greater than 60 years)</u>:

- Without compromising continued succession towards old-growth conditions, design treatments and harvest that provide understory deer forage and reduce effects of stem exclusion and slash to support long-term deer habitat. Treatments could include variable-density thinning, thinning favoring dominant trees, creating small gaps and narrow openings, and pruning.

- Incorporate leave strips of intact canopy, especially along ridgelines, to promote elevational movements during severe winters and minimize distance between deer and foraging opportunities across the landscape.
- Consider vulnerability to predation when designing sizes and shapes of multi-age class rotational configurations, decreasing deer vulnerability on flatter slopes by creating smaller and more dispersed treatments and harvest.

Wolf

Den:

- Protect the integrity of known wolf dens (active and inactive) with noncircular polygons (buffers) generally centered on the den with consultation with Alaska Department of Fish and Game (ADF&G) and the United States Fish and Wildlife Service (USFWS).
- Retain roadless, gently sloping (less than 14 degrees) old-growth forest within 330 feet of major lakes and streams to preserve denning habitat and den site options for wolves.
- In Legacy VCUs, retain acres to create large buffers along major lakes and streams. See Legacy Standard and Guideline in Forest Plan.
- Use an average buffer of 2,400 feet in radius (about 0.5 mile) for reproductive wolves at den sites as suggested in Preliminary Wolf Buffer Analysis (ADF&G 18 Oct 2017).

Road Density:

- During implementation, prioritize roads for closure based on wolf harvest vulnerabilities. Focus road closures in areas to benefit wolves.

Alternative 5 incorporates the Wolf Plan in its entirety (see project record).

The level of effects to wildlife resources from project activities are further estimated using the following qualitative descriptors.

Analysis Based on Habitat

The analysis for the POW LLA Project focuses on the effects to different habitat types and the species associated with those habitat types. This analysis will include the effects to overall POG, HPOG, and SD67 (large tree habitat); as well as some of these habitats in specific areas on the landscape. Productive old-growth (POG) forest is defined as being 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. The size density model (SDM) divides the POG forest into seven different habitat type categories, including high volume POG (HPOG) and large tree POG (SD67). These are further defined in the Forest Plan FEIS (p. 3-190). The analysis presented compares the habitat thought to be present in 1954 (prior to large scale logging), the existing condition, and the effects of the POW LLA Project. The effects to these habitat types are discussed at different scales depending on species. The scales include the GMU 2, Prince of Wales Island, biogeographic provinces, WAA, and VCU.

The Legacy Standard and Guideline is applied at the VCU scale but only in VCUs that are already over 33 percent POG harvest or will be over as a result of project harvest.

Tolerance to Changes in Habitat

The concept of limits in the amount of habitat arises in part from the idea that animals have minimum requirements for habitat and that if changes decrease the amount of suitable habitat that could drive population numbers down rapidly (Carlson 2000) creating small, unviable populations. This is being used in this analysis to be able to show changes in the available habitat. Literature on tolerance to changes in habitat suggests that the effects of habitat loss are the primary cause of species decline and that different species have different requirements for minimum habitat; hence, species loss occurs along a gradient of habitat loss (Gibbs 1998).

There have been many studies on the level of tolerance of species to changes in habitat with a variety of results and conclusions. Empirical studies at the landscape level are few. Several studies to date suggest that habitat loss has consistently negative effects on biodiversity, and that habitat fragmentation per se has much weaker effects on biodiversity that are at least as likely to be positive as negative (Fahrig 2003). The influence of the spatial features of habitat loss on limits in habitat loss in forested ecosystems is unclear. Dykstra (2004) determined that there is little to indicate universal limits in habitat; there is no general consistency as to when these limits occur across species and ecosystems, and that limits are relevant primarily within ecosystems with similar disturbance regimes and ecologies. Retention of sufficient habitat and habitat components is one way to maintain species above habitat tolerance levels.

Habitat specialists (*e.g.*, POW flying squirrel) will have less tolerance to habitat loss than habitat generalists (*e.g.*, wolf, deer and marten). Retaining sufficient habitat and habitat structures at the stand and landscape level is the best strategy to mitigate declines in populations and species.

Additionally, for some species, the abundance of habitat appears to be more important than the configuration of habitat (With and Crist 1995). Measures of habitat area may be insufficient to predict the effects of habitat loss, because habitat loss has different effects on populations, depending on where the habitat loss occurs (Ney-Niefle and Mangel 2000). Species interactions also influence responses to habitat loss. Models assume that species that disperse poorly, but that are superior competitors, exhibit responses at earlier stages of habitat loss (Tilman *et al.* 1997; Neuhauser 1998). It appears that high quality matrix habitat can mitigate some of the negative factors associated with limits in habitat loss. Spatial features of habitat loss appear to primarily affect poor dispersers and rare species at low levels of habitat loss.

Various species respond differently to different habitat thresholds. If a habitat threshold has been identified for the species chosen for this analysis, those thresholds are used in the analysis; however, sometimes no thresholds have been identified for a specific species and in those cases, a threshold was used for a similar species. These thresholds are discussed under the habitats the species are associated with.

NFMA requires forest plans to “provide for the diversity of plant and animal communities based on the suitability and capability of the specific land area.” This is achieved through implementation of the Conservation Strategy and Forest Plan direction.

Spatial and Temporal Context for Analysis

The analysis for the POW LLA Project focuses on the effects to different habitat types and to the species associated with those habitat types. This analysis will include the effects to overall POG, HPOG, and SD67; as well as some of these habitats in specific areas on the landscape. The analysis presented here is the habitat thought to be present in 1954 prior to large-scale logging, the existing condition and the effects of the POW LLA Project. The effects to these habitat types are discussed at different scales depending on species. The scales include the Game Management Unit 2 (GMU 2; equivalent to the project area), Prince of Wales Island, biogeographic province (BP), Wildlife Analysis Areas (WAA), and Value Comparison Units (VCU). The project area includes four biogeographic provinces: North Central Prince of Wales Province (#14), Southern Outer Islands Province (#16), the Dall Island and Vicinity Province (#17), and the South Prince of Wales Province

(#18). Almost the entirety of GMU 2 is within the project area. GMU 2 includes 32 WAAs, however, WAA 1104 (Forrester Island) is a National Wildlife Refuge managed by the USFWS and was excluded from the project area. WAA 5150 (Coronation Island), which is in GMU 3, was included in the project area because it is on the Thorne Bay Ranger District.

The temporal scale is about 25 years of the project for short-term effects and through 150 years for long-term effects as this analysis focuses on the old-growth ecosystem.

Old Growth Reserves and Connectivity

Tongass Old-growth Habitat Conservation Strategy

The Forest Plan Conservation Strategy was designed to address effects to species through the network of OGRs and other non-development LUDs, combined with Forest-wide standards and guidelines intended to maintain important habitat components, and functional connectivity across the landscape, including through development LUDs (matrix). The conservation strategy is expected to maintain viable, well-distributed populations across the Forest, even with full implementation of the Forest Plan's expected harvest levels. For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the old growth reserve (OGR) system, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan FEIS.

The Conservation Strategy was designed prior to the 2001 Roadless Rule, and these additional non-development roadless area contributions are more protective than the original design and therefore help ensure continued old-growth habitat and connectivity within the project area. See also the 2016 Forest Plan ROD "Wildlife Habitat and the Tongass Old-growth Habitat Conservation Strategy" pp. 19-23 (USDA Forest Service. 2016b).

The 2016 Forest Plan ROD (pp. 19-23) states that within OGRs and other non-development LUDs, young-growth forest stands have ecological values which contribute to the functioning of the OGR system. Openings created by even-aged timber harvest would provide forage for deer as sunlight reaches the forest floor enhancing the growth of forage (Chapter 3 of the Forest Plan FEIS). The Forest Plan ROD also indicates that thinning of young-growth stands in the stem exclusion stage will also improve the forage for deer for 15 to 25 years (Chapter 3 of the Forest Plan FEIS). When it was developed in 1997, the Conservation Strategy was based on the assumption that it would maintain a functional and interconnected old-growth forest ecosystem without the additional habitat quality contribution of previously harvested areas, either as young growth or over time as these stands matured to old-growth condition (2016 Forest Plan Amendment FEIS, Appendix D). For this reason, harvest of young growth in these areas will pose a very low risk to the function and integrity of the Conservation Strategy. The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). Therefore, there will be no change to the functioning of this contributing element of the Conservation Strategy (2016 Forest Plan Amendment FEIS, Appendix D).

Considering both NFS and non-NFS lands, all of the biogeographic provinces on the Tongass are projected to maintain at least 56 percent of the original (1954) POG after 100 years of Forest Plan implementation, and 19 of the 21 biogeographic provinces are projected to maintain at least 80 percent (Forest Plan FEIS. Chapter 3). All of the Forest Plan alternatives should maintain a functional and interconnected old-growth ecosystem, capable of supporting well-distributed, viable wildlife populations across the planning area; therefore, none of them are expected to increase the likelihood of species listing under the ESA (Forest Plan FEIS, Appendix D).

Old Growth Reserves (OGR) – Connectivity, Distance, and Acre Requirements

Landscape level connectivity on Prince of Wales Island was addressed at an Interagency OGR Review on February 2, 2018. Discussion on OGR concerns including connectivity, distance, and acre requirements can be found in the 2018 Interagency OGR Review Document for the POW LLA Project that is part of the project record. OGR concerns expressed at this meeting were either: 1) addressed and fixed in the 2018 Interagency OGR review document, or 2) in some situations, the 2018 interagency review team (IRT) acknowledged that a situation existed but could not be rectified given the situation on the landscape, usually due to land in other ownership.

The Forest Plan allows for the commercial harvest of young growth in OGRs. The Forest Plan includes the option to either retain the young-growth acres within the OGR or treat those acres to meet the old-growth habitat goals and objectives while removing a timber by-product, or the young-growth acres can be removed from the OGR boundary and be replaced with POG acres. The 2018 IRT came to the consensus that it would rather young-growth acres currently in OGRs be retained within the OGR boundary and be treated according to that LUD designation. Documentation of the Interagency OGR review for the POW LLA Project is included in the project record.

Connectivity

The connectivity in the area between Port Protection and Calder Bay is an area of concern for local residents. Much of the NFS land in this is in non-development LUDs, including congressionally designated LUD II which is managed as non-development. The area between Port Protection and Calder Bay is connected to the large Mt. Calder/Mt. Holbrook LUD II area via the 1,000-foot beach fringe and other non-development LUD acres. There is one small area, Hole-in-the-Wall, of non-National Forest System (NFS) land along the beach to the south of Lab Bay. This 675 acre area of non-NFS land is owned by the State of Alaska and is managed for unique recreation opportunities and fish and wildlife harvest values (Prince of Wales Area Plan Revised 1998, Alaska Department of Natural Resources). The 2015 Sealaska Land conveyance included some upland roadless acres in VCUs 5280 and 5310; however, connectivity is still provided on the landscape via the LUD II acres.

Wildlife Habitat

This section provides an assessment of the current condition of the project area.

This section focuses on the past effects associated with old-growth and young-growth timber management (precommercial thinning and commercial harvest), and road construction/reconstruction. Sources of information used to support the analysis include existing information from field surveys, GIS data, scientific literature, and other sources.

This section discusses the effect of old-growth harvest to POG, HPOG, and SD67 habitat types as well as these habitat types in specific locations on the landscape: average snow habitat (POG below 1,500 feet in elevation) and deep snow habitat (HPOG below 800 feet in elevation in south facing stands). The analysis presented compares the habitat thought to be present in 1954 (prior to large scale logging), the existing condition and the effects of the POW LLA Project. The size density model divides the POG forest into several different habitat type categories that are defined in the Forest Plan FEIS (starting on p. 3-189).

Issue 5 includes discussion of Region 10 Forest Service sensitive species (Queen Charlotte goshawk), and other selected wildlife species including Sitka black-tailed deer, Alexander Archipelago wolf, black bear, American marten, marbled murrelet, brown creeper, and endemic species including the Prince of Wales flying squirrel, Prince of Wales spruce grouse, and Keen's myotis.

Harvest prescriptions include even-aged (clearcut), two-aged, and uneven-aged. Wildlife centric prescriptions could include: 1) two-aged harvest retains at least 30 percent of the stand unharvested and can occur in a patchwork of up to 20 acres openings, and timing of the next entry is stand dependent, and 2) uneven-aged harvest in old-growth stands can be by single tree selection (STS) or group selection. Group selection removes less than 33 percent of a stand area during any entry. In young-growth stands harvest tree selection can vary between basal area removal, diameter as breast height (DBH), or by designing removal in strips or groups (see Forest Vegetation section).

The effects of the POW LLA Project are similar between all alternatives because all alternatives assume that all acres proposed for timber harvest will be harvested. The analysis also assumes that all acres will be harvested by even-aged harvest methods. The total acres estimated to be needed to meet timber needs are likely over-estimated and therefore the effects are likely over-estimated as well.

Alternative 2 proposes to harvest the most overall old-growth acres compared to Alternatives 3 and 5. Of the total old-growth acres proposed for harvest under Alternative 2, over half, about 57 percent, would have uneven-aged harvest prescriptions. Uneven-aged harvest should have less effect to old-growth habitat and its associated species than clearcut harvest. Alternative 3 proposes to harvest about 56 percent of the total number of old-growth acres proposed for harvest under Alternative 2; however about 75 percent would use uneven-aged harvest prescriptions. Alternative 5 proposes to harvest about 27 percent of the total number of old-growth acres proposed for harvest under Alternative 2 (see Table 38). Of the old-growth harvest acres in Alternative 5, about 33 percent would have uneven-aged harvest prescriptions. Overall, Alternative 5 would have the least impact to old-growth habitat, since fewer acres are proposed for harvest and a third of the acres that are proposed for harvest would include uneven-aged prescriptions. Alternative 2 proposes to treat the fewest young-growth acres (19,366 acres); this amount is about 57 percent of the total young-growth acres proposed for treatment or harvest under Alternatives 3 and 5 (36,670 acres); see Table 38. Under Alternative 2, about 22 percent of the total young-growth acres would be treated with uneven-aged prescriptions. Alternatives 3 and 5 include uneven-aged prescriptions for about 57 percent of the proposed young-growth acres. Overall Alternatives 3 and 5 would likely have a more long-term beneficial effect than Alternative 2, because Alternatives 3 and 5 result in more young-growth acres being treated with uneven-aged prescriptions, which should increase the understory forage.

Table 38. Overall Comparison of actual proposed Harvest by Alternative

	Alt 2	Alt 3	Alt 5
Old Growth			
Volume	235 MMBF	115 MMBF	75 MMBF
Total acres of harvest	23,269	13,014	6,365
Acres even-aged	9,972	3,253	4,244
Acres uneven-aged	13,297	9,760	2,122
% uneven-aged	57%	75%	33%
Young Growth			
Volume	421 MMBF	529 MMBF	529 MMBF
Total acres of harvest	19,366	36,670	36,670
Acres even-aged	15,156	15,630	15,630
Acres uneven-aged	4,210	21,040	21,040
% uneven-aged	22%	57%	57%

Non-Winter Deer Habitat

Non-winter habitat is important for deer reproduction and recovery following severe winters, and for building up pre-winter body reserves. These habitats include all vegetation types, except young growth, at all elevations.

Southeast Alaska includes both migratory and resident deer. Migratory deer tend to overwinter in forested habitat at higher elevations than resident deer and benefit from abundant forage in alpine areas during snow-free months (McNay and Vollner 1995). Migratory deer may be at lower risk of predation than resident deer. Populations of migratory deer should rebound more quickly than resident deer during mild years because they have access to high-quality range in summer and have lower risk of predation. Consequently, the ratio of migratory deer to resident deer within logged watersheds adjacent to alpine terrain should increase over time (Person and Brinkman 2013). Severe winters may force migratory deer to move down into valley bottoms where they compete with resident deer for winter forage and experience the same risk of predation endured by resident deer (Brinkman 2013). Migratory deer may be less affected by loss of carrying capacity within logged stands, which tend to be concentrated at low elevations (Brinkman 2013).

Mortality of deer in extensively logged watersheds is high during severe winters, but their numbers rebound quickly during mild years despite effects of predation and hunting, indicating that population regulation is strongly influenced by bottom–up processes (Brinkmann 2013).

Resident deer do not migrate to alpine habitat during summer but remain within the same home ranges throughout the year. On Prince of Wales Island, resident deer generally select clearcuts less than 20 years old and open-canopy forest stands during summer and mild winters (Yeo and Peek 1992; Farmer 2002; Doerr *et al.* 2005; Person 2009).

Populations of migratory deer may rebound more quickly than resident deer during mild years because they have access to high-quality range in summer (non-winter habitat). The ratio of migratory deer to resident deer within managed landscapes adjacent to alpine (non-winter) could increase over time (Person and Brinkman 2013).

Deer, especially migratory, have the ability to disperse between habitats. On Admiralty Island, Schoen *et al.* 1985 reported a spring dispersal mean distance of 7.7 kilometers (4.7 miles). The shortest dispersal distance for a resident deer was 0.3 kilometer (0.6 mile) and the greatest for migratory deer was 45 kilometers (28 miles).

Affected Environment

The current estimated acres of non-winter deer habitat in the project area in 1954 was about 1,776,889 acres. On NFS lands the project area currently has about 1,625,718 acres of non-winter deer habitat. This is about 91 percent of the 1954 habitat.

When considering NFS lands only, all WAAs in the project area currently have at least 50 percent or more of the estimated original POG remaining.

No habitat thresholds have been determined for deer.

Environmental Effects

For this analysis it is assumed all old-growth harvest is POG and all acres will be clearcut. Proposed young-growth treatment or harvest acres were not included in the calculations.

Direct and Indirect Effects

Alternative 2 will result in about a 2 percent decline in non-winter habitat at the project area scale, followed by Alternatives 3 and 5, both with a 1 percent decline or less. At the project area scale, this results in about a 10 percent reduction since 1954 for Alternative 2 (90 percent remaining), and a 9 percent reduction in Alternatives 3 and 5 (91 percent remaining).

Assuming all POG harvest acres are also non-winter habitat acres, the effects post-project result in one WAA, 1525 (46 percent remaining), retaining less than 50 percent of the estimated 1954 non-winter habitat.

Proposed activities that could result in less than 50 percent remaining by WAA would have greater effects if these WAAs were adjacent to each other or on islands. WAA 1525 is on Kosciusko Island; however, the other half of Kosciusko Island is WAA 1526, which has an estimated 96 percent non-winter habitat remaining, somewhat mitigating the effects in WAA 1525 relative to WAAs that are isolated or surrounded by other WAAs with less habitat remaining.

Cumulative Effects

Currently there are about 2,058,170 acres of non-winter deer habitat on lands in all ownerships in the POW LLA project area. This is about an 8 percent reduction from the estimated acres (2,248,209) present in 1954.

When considering lands in all ownership all WAAs in the POW LLA Project currently exceed 50 percent non-winter habitat remaining.

Cumulative effects result in six WAAs retaining less than the estimated original non-winter habitat: WAA 1003 (43 percent), WAA 1106 (23 percent), WAA 1315 (32 percent), WAA 1318 (42 percent), WAA 1525 (28 percent), and WAA 1531 (35 percent). Cumulatively, six WAAs or 19 percent of the total WAAs are expected to retain less than 50 percent of the estimated original non-winter habitat.

The effects in these WAAs would be greater relative to the WAAs that retain more than 50 percent of the estimated original POG habitat. Some these WAAs are islands: WAA 1003 is Heceta Island, WAA 1106 is Long Island, WAA 1525 is one of two WAAs on Kosciusko Island, and WAA 1531 includes Tuxekan Island and other smaller islands. Long and Tuxekan Island are almost entirely non-NFS land. Island effects would be similar to those discussed above under POG.

The effects in WAA 1525 may be mitigated to some extent due to the fact the other WAA on Kosciusko Island, WAA 1526, is almost all LUD II and retains 95 of the estimated original non-winter habitat. Adjacency concerns for WAA 1315 are discussed in POG section above. WAA 1318 is surrounded by WAAs retaining between 61 and 98 percent of the estimated original non-winter habitat.

Conclusion

On NFS lands there is one WAAs that may drop below 50 percent of the original non-winter habitat remaining: WAA 1525. Cumulatively six WAAs drop to less than 50 percent non-winter habitat remaining or about 19 percent of the project area.

Based this analysis of non-winter habitat, it is expected that overall the project area on NFS lands should be able to continue to support populations over time since non-winter habitat is not the limiting habitat type for deer (see discussion below on effects to deep snow deer habitat); however, there may be concerns when considering effects on all lands. Effects may be greater in WAAs on islands (WAAs 1003, 1525, and 1531), or WAAs with a greater effects that are adjacent to each other: WAAs 1315 and 1420.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservations strategy in place even with full implementation of the Forest Plan it would be expected to have a moderate to very high likelihood maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, as well as Appendix N of the 1997 Forest Plan and Appendix D of the 2008 Forest Plan.

POG

Productive old-growth (POG) forest is defined as being 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.

This discussion includes the effects to POG and associated species (black bear, insular dusky shrew, and ermine). All POG at all elevations is considered habitat for black bears (USDA Forest Service, 2008b), the endemic insular dusky shrew, and Prince of Wales ermine.

Black bears appear to prefer estuarine, riparian, and forested coastal habitats (USDA Forest Service, 2016c) which are all provided some degree of protection in the Forest Plan. Research by Mikusinski and Angelstram (2000) indicated a habitat threshold for bears (brown) of about 50 percent habitat remaining.

Clearcut logging may actually increase shrew habitat. This species is more often found in deadwood debris areas and in clearcuts that have 85 to 90 percent herbaceous ground cover than in heavily forested areas with less herbaceous cover (Thomas 1979). However, a study in British Columbia found dusky shrew abundance to be lower in clearcuts and riparian buffer strips compared to control plots (Cockle and Richardson 2003). Timber harvest and road construction lead to habitat fragmentation (ADF&G 2005a Alaska Species Ranking System Summary Report – Dusky shrew, Queen Charlotte Islands). Thomas (1979) indicated that suitable habitat of at least 5 acres is required to support a population of shrews. While no habitat thresholds have been identified for shrews specifically, research has been conducted on other small rodents with a range of habitat thresholds indicated; Research by Heinen (1998) in southern Ontario, Canada indicated that mice did not show a habitat threshold while this same research showed that chipmunks had a habitat threshold of about 30 percent habitat remaining. The Estavillo *et al.* (2013) study in Brazil proposed a threshold amount in small mammals was 30 percent of remaining forest.

Management actions could enhance shrew habitat. When considering ermine management, activities could attempt to enhance prey abundance, such as breeding bird and deer mouse populations in riparian areas, and availability, where possible. In general this would include enhancing heterogeneity of canopy, understory, and ground cover species composition and structure (Reid *et al.* 2000).

Research by Mikusinski and Angelstram (2000) indicated a habitat threshold for bears (brown) of about 50 percent habitat remaining. Research by Heinen (1998) indicated that mice did not show a habitat threshold; however, this same research showed that chipmunks had a habitat threshold of about 30 percent habitat remaining. Since there were habitat thresholds defined specifically for shrews the 30 percent defined for chipmunks was used. Therefore a threshold of 50 percent was used for the analysis of effects to bear habitat and 30 percent for shrews. No thresholds were determined for ermine.

Ermine are adapted to a wide variety of habitats but seem to prefer wooded areas with thick understory near water. They rarely occur in heavily forested regions but often occupy early-successional or forest-edge habitats, wet meadows, marshes, ditches, riparian woodlands, or river banks with high densities of small mammals and adequate under-canopy foraging space (Simms

1979a, Simms 1979b). Results of a study on coastal ermine suggest no particular reliance on old-growth forest, but do indicate a use of riparian and marine foreshore (beach buffer) habitats (Reid *et al.* 2000), The Suemez Island subspecies of ermine (*M. e. seclusa)* has been documented in varied habitat including POG and young growth forest, brush, alpine meadows, marshes, and riparian areas (Hall 1951). Because ermine were live trapped in young-growth forest and in the beach buffers, effects to ermine habitat are also discussed under Young Growth (Reid *et al.* 2000). No thresholds have been identified for the ermine; however, the 1997 Forest Plan included the Suemez Island ermine within the group of endemic species. The 1997 population panel identified that the greatest concern for endemic species was their restricted ranges, which naturally increased their risk of extinction, and that being an endemic species equated to increased risk. Thus the panel predicted that all of the proposed 1997 Forest Plan alternatives had some likelihood of causing extirpation within the endemic group (2008 Forest Plan FEIS Appendix D p. D-67). Currently there is an incomplete understanding of the ermine distribution and habitat needs.

The levels of tolerance to habitat change determined by research of 30 (Heinen 1998 and Estavillo *et al.* 2013) and 50 percent (Mikusinski and Angelstram 2000) of the original habitat remaining are dependent in part on the dispersal capabilities of the species associated with that habitat type. Species with greater dispersal capabilities such as the bear may be less affected by WAAs with less habitat if these areas are adjacent to areas that have more habitat. Both reduction in habitat and distance between habitats would likely have a greater impact to species with more limited dispersal capabilities such as the shrew and ermine. Species such as the shrew and ermine may be impacted even more when areas of past effects are concentrated or on islands.

The analysis below is based on these literature identified thresholds for these species. The change in percent habitat remaining between DEIS and FEIS is due to comments received on the DEIS.

Affected Environment

This POG analysis includes both species with high dispersal capabilities (black bear) and ones with more limited dispersal capabilities (insular dusky shrew and ermine).

A threshold of 50 percent was used for the analysis of effects to bear habitat and 30 percent for shrews. No thresholds were determined for ermine. The amount of habitat change determined by research of 30 and 50 percent of the original habitat remaining are dependent in part on the dispersal capabilities of the species associated with that habitat type.

It is assumed that areas that have more POG harvest would have greater effects to these species than areas with less POG harvest. It is also assumed that effects to habitat could have less impact to those species with greater dispersal ability (black bear) than to those species with more restricted dispersal capabilities (insular dusky shrew and ermine). The amount of past harvest may also have a greater impact to species with more limited dispersal capabilities, such as the shrew, in areas of concentrated harvest, such as WAAs with greater past impact in proximity to each other, or on islands.

Currently, on NFS land, the project area is estimated to have about 814,912 acres of POG. This is about 82 percent remaining of the 1954 habitat (996,395 acres). Currently all WAAs have at least 50 percent of the original POG estimated to be present in 1954.

There are four WAAs that have percentages of POG remaining that are in the range of 50 percent of the 1954 habitat: WAA 1003 (59 percent remaining), WAA 1315 (56 percent remaining), WAA 1420 (56 percent POG remaining), and WAA 1525 (59 percent remaining).

The amount of habitat change determined by research of 30 and 50 percent of the original habitat remaining are dependent in part on the dispersal capabilities of the species associated with that habitat type. It is assumed that bears would have greater dispersal capabilities than either the ermine or the shrew.

Environmental Effects

Direct and Indirect Effects

For this analysis it is assumed that all potential harvest acres are POG acres and all would be clearcut. The assumption of all clearcut harvest likely over estimates the effects because the timber analysis indicates more helicopter logging (assumed harvest other than clearcut) than tradition harvest (assumed clearcut). The assumption that all harvest acres were clearcut was done to display maximum effects.

The direct and indirect effects analysis includes NFS land acres only. At the project area scale, Alternative 2 harvests about 23,269 acres (3 percent of current) of POG, Alternative 3 harvests about 13,014 acres (2 percent of current), and Alternative 5 about 6,365 acres (1 percent of current). At the project area scale, this results in about a total reduction since 1954 of about 21 percent for Alternative 2, a 20 percent reduction since 1954 in Alternative 3, and about a 19 percent reduction since 1954 for Alternative 5. The specific location and amount of harvest in each WAA would be determined during implementation and vary by alternative.

Post-project, four WAAs 1003 (40 percent remaining), 1317 (48 percent remaining), 1422 (47 percent remaining) and 1525 (33 percent remaining) drop from having more than 50 percent original POG to less than 50 percent due to the activities proposed in the POW LLA Project. Two WAAs, WAA 1315 (28 percent remaining) and WAA 1420 (30 percent remaining), drop from more than 50 percent POG remaining to 30 percent or less. WAAs 1315 and 1420 are adjacent to each other. WAA 1315 is also adjacent to WAA 1319 (65 percent POG remaining) and WAA 1316 (99 percent POG remaining). WAA 1420 is also adjacent to WAA 1421 (67 percent POG remaining) and WAA 1319 (65 percent POG remaining).

WAA 1003 includes VCUs that would have legacy structure retention as well as peak flow rate mitigation measures. WAAs 1315 and 1420 would receive limited harvest in all alternatives due to mitigation measures in Alternative 2 that includes wildlife centric prescriptions within 5 miles of subsistence communities, Alternative 3 that includes only 25 percent removal by STS in south-facing stands below 800 feet in elevation, and Alternative 5 that does not allow old-growth harvest in south-facing stands below 800 feet in elevation as well as legacy forest structure retention and peak flow mitigation measures. WAA 1317 includes measures included in Alternatives 3 and 5 as well as both legacy structure retention and peak flow rate measures. WAA 1422 includes measures included in Alternative 2 as well as legacy and peak flow rate measures. WAA 1525 includes the measures in place in Alternative 2, legacy structure retention, and peak flow rate measures.

The levels of tolerance to habitat change determined by research (see Affected Environment above) of 30 and 50 percent of the original habitat remaining are dependent in part on the dispersal capabilities of the species associated with that habitat type. Species with greater dispersal capabilities such as the bear may be less affected by WAAs with less habitat if these areas are adjacent to areas that have more habitat. Both reduction in habitat and distance between habitats would likely have a greater impact to species with more limited dispersal capabilities such as the shrew and ermine. Species such as the shrew and ermine may be impacted even more when areas of past effects are concentrated or on islands. The fact that WAAs 1315 and 1420 are both effected by habitat loss and are adjacent to each may exacerbate the local effects to species like the shrew and ermine.

Cumulative Effects

Post-project on all lands, WAAs with less than 50 percent of the estimated 1954 POG habitat remaining post-project include: WAA 1003 (37 percent), WAA 1106 (48 percent), WAA 1315 (20 percent), WAA 1317 (42 percent), WAA 1420 (27 percent), WAA 1422 (45 percent), WAA 1525 (21 percent), WAA 1530 (36 percent), and WAA 1531 (29 percent). These WAAs would have a greater effect to POG habitat and associated species such as the black bear relative to WAAs that retain more than 50 percent of the estimated original POG habitat.

For WAAs separated by saltwater, even species with higher dispersal capabilities, such as black bear, may have a more difficult time dispersing from areas with greater impacts to habitats to areas with less impacts. These include WAA 1003, Heceta Island and WAA 1525, southern part of Kosciusko Island. WAA 1003 is surrounded by WAAs that retain between 21 and 100 percent of the estimated original POG habitat, and WAA 1525 by WAAs that retain between 20 and 100 percent of the estimated original POG habitat.

Kosciusko Island consists of two WAAs, WAAs 1525 and 1526. There may be less concern associated with the effects in WAA 1525 to both bear and shrew because WAA 1526 is on the same island and has 99 percent of estimated original POG remaining. WAA 1106 (48 percent) is Long Island but this WAA is surrounded by WAAs retaining between 75 and 99 percent POG habitat.

WAAs 1003, 1317, and 1530 are discussed above in Direct and Indirect effects.

The following WAAs have less than 30 percent of the estimated POG habitat remaining: WAA 1315 (20 percent); WAA 1420 (27 percent); WAA 1525 (21 percent); and WAA 1531 (29 percent). WAA 1315 is surrounded by other WAAs that retain between 27 and 99 of the estimated original POG habitat; WAA 1420 by WAAs that retain between 20 and 64 percent; and WAA 1525 by other WAAs that retain between 29 and 100 percent. WAA 1531 is Tuxekan Island and is surrounded by WAAs with between 21 and 97 percent.

WAAs with less than 30 percent of the estimated original POG habitat remaining will have the greatest impact on species compared to WAAs that retain 30 percent or more POG habitat. These WAAs would have a greater negative effect to species associated with this habitat type than WAAs that retain more than 30 percent of the original POG habitat.

WAAs 1106 and 1531 do not include any proposed LSTA harvest.

Conclusion

Areas of potential concern, especially for species with more limited dispersal capabilities such as the shrew and ermine, would be in areas where POG harvest has been concentrated or on islands. The WAAs on islands include WAA 1003, Heceta Island and WAA 1525 on Kosciusko Island. WAA 1003 includes all of Heceta Island where WAA 1525 is only about half of Kosciusko Island. The other portion of Kosciusko Island is WAA 1526 that is designated as LUD II and therefore protected from most management activities. Other areas of potential concern may be WAAs 1315, 1317, 1420, and 1422 on Prince of Wales Island. These WAAs are expected to have less than 50 percent of the original POG habitat. WAAs 1315, 1420, 1525, and 1531 are expected to have 30 percent or less of the original POG habitat. The effect may be compounded because many of these WAAs are adjacent to each other (see WAA map in deep snow habitat section Figure 5).

Bears would be a greatest risk in those WAAs that retain less than 50 percent of estimated original POG habitat; on NFS land this would be in WAAs 1003, 1315, 1317, 1420, 1422, 1525, and 1530. Cumulatively, the effect to bears would be greatest in the WAAs listed for NFS lands as well as WAAs 1106 and 1531. There are 31 WAAs in the project area and cumulatively there would be 9

WAAs (29 percent of the total number of WAAs) that retain less than the 50 percent threshold for bears. Bears are not likely to be limited by their dispersal capabilities and may be more likely to be able to move between habitats of lower value to those of higher value.

Shrews would be a greatest risk in those WAAs that retain less than 30 percent of estimated original POG habitat; on NFS land this would be in WAA 1315. Cumulatively, the effect to shrew would be greatest in the WAA listed for NFS lands as well as WAAs 1420, 1525, and 1531. There are 31 WAAs in the project area and cumulatively there would be 4 WAAs (13 percent of the total number of WAAs) with less than the 30 percent threshold for shrew. The shrew has more limited dispersal capabilities and therefore the reduction in habitat could have a greater impact on this species, especially as WAAs 1525 and 1531 are islands and WAAs 1315 and 1420 are adjacent to each other.

WAAs that fall below literature thresholds for habitat may not be capable of supporting species that depend on that habitat type, and this could lead to local extirpation of species from some areas.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservations strategy in place even with full implementation of the Forest Plan it would be expected to have a moderate to very high likelihood to maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan.

POG on the Landscape – Average Snow Deer and Year-round Marten Habitat

Both average snow deer winter habitat and year-round marten habitat are defined as all POG below 1,500 feet elevation (referred to as average snow habitat). No literary habitat thresholds have been identified for deer; 50 percent was used in this analysis.

Coastal habitats and riparian areas, including beach fringe, have the highest habitat value for marten, followed by upland forested habitats (all POG) below 1,500 feet in elevation (USDA Forest Service 2008b, p. 3-234).

DeGayner 1997 states that the marten panel (convened for the 1997 Forest Plan) indicated that the system of well distributed old-growth reserves was only minimally acceptable for marten. The approach was judged to be minimal primarily because the spatial distribution of reserves could allow for “gaps” in marten distribution, they defined the spatial scale of a gap to be one vacant marten territory. A marten territory was considered to be from one to three square miles. Maintaining POG within beach and riparian habitat zones was considered to be important by panel evaluators. A “no-cut” 1,000-foot beach fringe was specifically considered to be important because of the highly dissected and naturally fragmented nature of forest habitat on islands in Southeast Alaska. Beach habitat was generally considered to be more important than altitudinal riparian corridors. Panel evaluators indicated that a population can accommodate a certain, but unknown, level of gaps and still remain viable. The panel could not, however, identify the threshold of POG remaining at which a landscape or a territory would not be suitable for marten reproduction (DeGayner 1997).

In the 1930s, introductions of martens were made by the Alaska Game Commission on Prince of Wales Island. This transplantation was made without knowledge of the underlying morphological and genetic variation that exists across the region (Elkins and Nelson 1954; Burris and McKnight 1973; MacDonald and Cook 1996). Marten populations were thought to not exist on Prince of Wales before introductions, but this presumption was questioned due to the rapid increase in numbers on Prince of Wales Island following the transplant (Elkins and Nelson 1954). Stone *et al.* 2002 provided no indication that martens existed on Prince of Wales Island prior to the introduction, but this conclusion may be premature because it was derived from a mitochondrial gene that may not effectively detect genetic swamping.

Marten are absent from stands with less than 30 percent cover, and prefer stands with 50 to 70 percent cover (see references in Thompson and Harestad 1994).

The removal of POG features, such as decadent live trees and snags, 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).

Thompson and Harestad (1994) used the response of American marten to changes in forest cover at the stand level to predict a limit in habitat. Marten are absent from stands with less than 30 percent cover, and prefer stands with 50 to 70 percent cover (see references in Thompson and Harestad 1994).

Marten, as a species have a wider dispersal capability compared to other species. The mean minimum travel distance for marten is about 8 miles (13 kilometers) (Flynn 1991 as cited in Flynn and Schumacher 2001). This research noted that the mean maximum travel distance reported in this study was 12 miles (20 kilometers) and that travel distances of up to 39 miles (65 kilometers) has been documented. The effects to connectivity and how it relates to marten are addressed in the OGR portion of this document.

Deer, especially migratory deer, have the ability to disperse between habitats. On Admiralty Island, Schoen *et al.* 1985 reported a spring dispersal mean distance of 7.7 kilometers (4.7 miles). The shortest dispersal distance for a resident deer was 0.3 kilometer (0.6 mile) and the greatest for migratory deer was 45 kilometers (28 miles).

Affected Environment

Currently, there are about 750,618 acres of average snow habitat on NFS lands within the project area. This is about a 19 percent reduction (81 percent remaining) from 1954.

Currently on NFS lands, all WAAs have at least 50 percent of the original average snow habitat remaining.

Environmental Effects

For this analysis it is assumed all old-growth harvest below 1,500 feet is POG and all will be clearcut. There are slivers of polygons that are above 1,500 feet but the acreage amount is negligible and likely some of the acres are not POG.

Direct and Indirect Effects

At the project area scale, Alternative 2 would have the greatest impact to average snow deer and year round marten habitat and would result in about a 3 percent reduction. Alternative 3 would result in about a 2 percent reduction, and Alternative 5 about a 1 percent reduction. When compared to 1954 Alternative 2 would still have about 78 percent of this habitat type remaining; Alternatives 3 and 5 would have about 79 and 80 percent remaining, respectively.

The WAAs with the greatest impact to average snow habitat are: WAA 1003 (about 39 percent remaining), WAA 1315 (about 26 percent remaining), WAA 1317 (about 40 percent remaining), WAA 1420 (about 23 percent remaining), WAA 1422 (44 percent), WAA 1525 (about 32 percent remaining), and WAA 1530 (about 40 percent remaining) compared to amount of average snow habitat estimated to be present in 1954. WAA 1003 includes VCUs that would have legacy structure retention as well as peak flow rate mitigation measures. WAAs 1315 and 1420 would receive limited harvest in all alternatives due to mitigation measures in Alternative 2 that includes wildlife centric prescriptions for both old and young growth within 5 miles of subsistence communities; Alternative 3 that includes only 25 percent removal by STS in south-facing stands below 800 feet in elevation; and Alternative 5 that does not allow old-growth harvest in south-facing stands below 800 feet in elevation, as well as legacy forest structure retention and peak flow rate mitigation measures. WAA 1317 includes the mitigation measures in Alternatives 3 and 5, the legacy structure retention and peak flow rate mitigation measures. WAA 1525 includes the measures in place in Alternative 2, legacy structure retention and peak flow rate measures. WAA 1530 includes the measures in Alternative 2 as well as both legacy and peak flow rate measures. WAA 1531 includes both legacy retention and peak flow rate measures.

Implementation of the Legacy Standard and Guideline in many VCUs within WAAs 1315 and 1420 would also reduce the impacts to average snow habitat. Both WAAs also include peak flow rate mitigation measures. WAA 1315 would include no timber harvest on slopes above 800 feet in elevation and 29 percent basin area removal below 800 feet in elevation. WAA 1420 could include 45 percent basin area removal below 800 feet in elevation and 20 percent basin area removal above 800 feet in elevation.

WAAs with effects to average snow habitat that drop below 50 percent habitat remaining that are adjacent to each other could result in a greater effect relative to WAAs with less effect or WAAs with a similar effect but that are surrounded by WAAs with less effect. Both deer (especially migratory) and marten have greater dispersal capabilities relative to many other species and therefore may be more capable of moving between habitats.

Effects to marten that rely on average snow habitat would be greatest in those WAAs with less than 30 percent of the estimated original habitat remaining; on NFS lands only WAAs 1315 and 1420 are estimated to drop below 30 percent habitat remaining. According to research by Thompson and Harestad (1994) marten may become absent from these areas.

Overall there are 7 WAAs that are estimated to retain less than 50 percent habitat or 22 percent of the total WAAs in the project area; two of these seven WAAs are expected to drop to less than 30 percent average winter habitat remaining, or about 6 percent of the total WAAs in the project area.

The mitigation measures, such as the Legacy Standard and Guideline, peak flow rate measures, and harvest restrictions, implemented in the WAAs with average snow habitat concerns help to offset concerns for the species associated with this habitat.

Cumulative Effects

Currently on lands in all ownership the POW LLA Project has about 874,594 acres of average snow habitat, about 80 percent of the estimated 1954 acres.

WAAs where the percentage of remaining estimated average snow habitat is likely a concern includes WAA 1003 (35 percent remaining), WAA 1106 (48 percent remaining), WAA 1214 (49 percent remaining), WAA 1315 (19 percent remaining), WAA 1317 (34 percent remaining), WAA 1318 (33 percent remaining), WAA 1420 (20 percent remaining), WAA 1422 (42 percent remaining), WAA 1525 (21 percent remaining), WAA 1527 (40 percent remaining), WAA 1530 (36 percent remaining), and WAA 1531 (29 percent remaining). This analysis assumed that the effect to species could be greater if impacted WAAs are adjacent to each other or on islands; both would be assumed to limit dispersal. Cumulatively 12 WAAs in the project area, or about 38 percent of all the WAAs in the project area, are expected to drop to below 50 percent of the original average snow habitat remaining.

See discussion above for effects in WAAs on islands (1003, 1106, 1525, and 1531) and WAAs that are adjacent to other WAAs. WAAs 1315 and 1317 are separated by the Karta Wilderness (WAA 1316) with 99 percent of the POG remaining. WAA 1315 is also adjacent to WAA 1319 with 74 percent of the estimated original habitat remaining and WAA 1316.

WAAs with less than 30 percent of original average snow habitat remaining are: WAA 1315 (19 percent remaining), WAA 1420 (20 percent remaining), WAA 1525 (21 percent remaining), and WAA 1531 (29 percent remaining). WAAs 1315 and 1420 are adjacent to each other but both WAAs have additional mitigation on old-growth harvest (average snow habitat) on NFS lands in Alternatives 2, 3, and 5, as well as both the legacy structure retention and peak flow rate mitigation measures. WAA 1525 includes harvest restrictions in Alternative 2, and both the legacy retention guideline and peak flow rate measures. WAA 1531 includes both the legacy retention guideline and the peak flow rate measures.

See direct and indirect effects for discussion on WAAs 1315 and 1420. Even though the Forest Service has no control over the harvest on non-NFS lands, harvest mitigation measures on adjacent NFS lands could help to offset some of the effects on non-NFS lands. WAA 1003 includes VCUs that on NFS lands would require the Forest Plan Legacy Standard and Guideline be applied as well as peak flow rate mitigation measures. WAA 1317 includes the Legacy Standard and Guideline mitigation (all alternatives) as well as for peak flow rate (Alternatives 3 and 5). In WAA 1422 harvest on NFS lands includes harvest limitation measures included in Alternative 2 and both the legacy retention and peak flow rate mitigation measures. WAA 1525 includes measures included in Alternative 2, legacy retention and peak flow rate measures. WAAs 1106, 1211, 1214, 1318, 1332, and 1527 all include measures covered in Alternatives 3 and 5; however, on NFS lands these WAAs are retain at least 56 percent of the estimated original average snow habitat.

Activities on non-NFS lands that would contribute to the cumulative effects include the State of Alaska proposal to harvest about 530 acres, the University of Alaska proposal to harvest about 23 MMBF over the next 5 years, the Alaska Mental Health harvest, and the ANCSA Admiralty Island Land Exchange Finalization Act of 2017 and the Alaska Native Claims Settlement Improvement Act of 2017. This proposes a land exchange between the Sealaska Corporation and the Forest Service. The lands in the proposed legislation to be acquired by or exchanged to Sealaska is about 14,017 acres and located in Cholmondeley Sound between Lancaster Cove and Kitkun Bay. It can be assumed that most of these activities would include the harvest of POG acres. See Appendix C for present and reasonably foreseeable future activities.

Conclusion

Overall effects to average snow habitat and associated species on NFS lands lead to concerns in WAAs 1003, 1315, 1317, 1420, 1422, 1525, and 1530 due to habitat loss compared to other WAAs that retain more than 50 percent of estimated 1954 average snow habitat. Of the WAAs with less than 50 percent habitat remaining, WAAs 1315 and 1420 (6 percent of project area WAAs) have less than 30 percent average snow habitat remaining. WAAs with less than 30 percent average snow habitat may not be capable of providing habitat for marten.

Cumulatively, 12 WAAs in the project area, or about 38 percent of all the WAAs in the project area, are expected to drop to below 50 percent of the original average snow habitat remaining. Cumulatively, 4 of the 12 WAAs, or 13 percent of the total WAAs, drop below 30 percent average snow habitat remaining and may not be capable of providing habitat for marten.

Overall effects to average snow habitat and associated species would likely be mitigated due to the fact that marten and deer habitat is supported by the conservation strategy to maintain mature forest cover and coarse woody debris to provide structure important to marten for resting, denning, escape from predators, trapping refugia, and facilitate marten dispersal. In addition to the functional connectivity across the landscape provided by the reserve system and old-growth forest in the matrix, connectivity between reserves for marten is also provided by structural elements of the Forest Plan conservation strategy, including the stream, estuary, lake and beach buffers.

The mitigation measures implemented on NFS lands in the WAAs that with less than 30 or 50 percent habitat remaining increase the likelihood that these WAAs would continue to support deer and marten, both species with greater than dispersal capabilities. Mitigation measures for all WAAs with concern here are discussed above in effects to other habitat.

The mean minimum travel distance documented for marten was about 8 miles (13 kilometers) reported by Flynn (1991 as cited in Flynn and Schumacher 2001); therefore, the effects to average snow habitat may have less of an impact to marten because they could travel between areas of greater impact to those with less impact. Marten populations are supported by the conservation strategy to maintain mature 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 Forest Plan conservation strategy as a whole will continue to be critical in maintaining a sustainable marten population. In addition to the functional connectivity across the landscape provided by the reserve system and old-growth forest in the matrix, connectivity between reserves for marten is also provided by structural elements of the Forest Plan conservation strategy, including the stream, estuary, lake, and beach buffers.

Deer, especially migratory deer, have the ability to disperse between habitats. Schoen *et al.* 1985 reported a spring dispersal mean distance of 7.7 kilometers (4.7 miles) for deer; therefore, the effects to average snow habitat may have less of an impact to deer, especially migratory, because they could travel between areas of greater impact to those with less impact.

The mitigation measures implemented in the WAAs with habitat concerns increase the likelihood that these WAAs would continue to support deer and marten, both species with less limited dispersal capabilities; but it is acknowledged that cumulatively, 4 of the 12 WAAs, or 13 percent of the total WAAs, drop below 30 percent average snow habitat remaining and may not be capable of providing habitat for marten.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservations strategy in place even with full implementation of the Forest Plan it would be expected to have a moderate to very high likelihood maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan.

Percentage of POG by VCU – Forest Plan Legacy Standard and Guideline

The Forest Plan Legacy Standard and Guideline evolved from considerations presented at the Interagency Conservation Strategy Review workshop (USDA Forest Service 2007a) and replaced species-specific goshawk foraging and marten standards and guidelines. It applies to those Value Comparison Units (VCU) that have had or are anticipated to have high levels of old-growth harvest timber harvest with openings greater than 20 acres in size.

VCUs are generally representative of the size of smaller scales of habitat selection within a goshawk home range. Goshawks are discussed in more detail in the Biological Evaluation. Marten are discussed in the average snow habitat section (above) and in the deep snow habitat section (below).

An interagency assessment (*The Conservation Assessment for the Northern Goshawk in Southeast Alaska*, Iverson *et al.* 1996) defined three categories related to the likelihood of the VCU continuing to support goshawks. These categories are: 1) less than 33 percent POG harvest (high likelihood that the VCUs will continue to support goshawks); 2) 33 to 47 percent POG harvest (there is a slightly increased risk that these VCUs will not support goshawks); and 3) greater than 47 percent (there is an increased risk that these VCUs will not support goshawks). Exceeding the 33 percent harvest does not necessarily mean that these VCUs are incapable of supporting goshawks, only that there is an increased risk in these areas.

The Forest Plan lists the following VCUs as having more than 33 percent of the POG harvested: 5320, 5350, 5371, 5380, 5390, 5440, 5450, 5460, 5500, 5542, 5550, 5560, 5570, 5580, 5590, 5600, 5610, 5620, 5700, 5710, 5720, 5790, 5810, 5830, 5840, 5850, 5860, 5871, 5872, 5880, 5900, 5972, 6100, 6200, 6210, and 6240. The Legacy Standard and Guideline will be applied in these VCUs in all alternatives.

All VCUs with proposed activities would be verified during project-specific implementation to determine if the Legacy Standard and Guideline applies based on the Forest Plan criteria. During project implementation, if proposed activities would cause a VCU to exceed the legacy limit, then the Legacy Standard and Guideline will be applied in that VCU. A project could also be modified so that proposed activities do not cause the VCU to exceed the 33 percent original POG harvest limit. The Legacy Standard and Guideline only applies to old-growth harvest on NFS land.

Affected Environment

Implementation of the Legacy Standard and Guideline is intended to provide for the habitat needs of marten and goshawk. Although the Legacy Standard and Guideline is applied at the VCU scale for this analysis, the percent POG harvested was also calculated at the WAA scale. VCUs are a subset of WAAs and a single WAA usually contains multiple VCUs. For this analysis, the percent POG was also calculated at the WAA scale. WAAs with habitat concerns were then tied to legacy VCUs. Most WAAs with concerns, subsistence and habitat, include legacy VCUs and legacy structure retention can be used as a mitigation measure in these WAAs.

Calculations were done by VCU to determine the acreage remaining that could be harvested before implementation of the Legacy Standard and Guideline would be required (see project record for spreadsheet). That spreadsheet also includes the current percent harvest of POG by VCU. This recalculation showed three VCUs, 6770, 5980 and 6130, not listed in the Forest Plan as currently having more than 33 percent POG harvest and thus requiring the Legacy Standard and Guideline.

See Table 39: VCUs that currently have more than 33 percent POG harvest. There is a slightly increased risk that these VCUs will not support goshawks. Included in this table are the VCUs that currently have more than 47 percent POG harvest where there is an increased risk that these VCUs will not support goshawks.

Proposed POG harvest in the POW LLA Project could result in VCUs that currently have less than 33 percent POG harvest and therefore have a high likelihood to continue to support goshawks, moving into the category with more than 33 percent POG harvest which has a slightly increased risk of not being able to support goshawks. As a result of the POW LLA Project, it is also possible that VCUs that currently have more than 33 percent POG harvest but less than 47 percent POG harvest could move into the greater than 33 percent POG harvest category. These VCUs would be at an increased risk for not being able to support goshawks.

Table 39. VCUs that currently have had more than 33 percent POG harvest

VCU	% POG harvested	Location	Comments
5320	53	Red Bay	Not adjacent
5350	37	Salmon Bay	Adjacent to 5380 and 5390
5371	46	Twin Island lake	Adjacent to 5380 and 5500
5380	68	Twin Island lake	Adjacent to 5371 and 5500
5390	38	Salmon Bay	Adjacent to 5350 and 5380
5440	43	Kosciusko	Not adjacent
5460	37	Kosciusko	Adjacent to 5450
5500	51	Neck Lake	Adjacent to 5371 and 5380
5550	37	Marble	Not adjacent
5580	45	Heceta	Adjacent to other VCUs on Heceta
5590	41	Heceta	Adjacent to other VCUs on Heceta
5610	39	Heceta	Adjacent to other VCUs on Heceta
5620	41	Heceta	Adjacent to other VCUs on Heceta
5700	75	Heceta	Adjacent to other VCUs on Heceta
5710	44	Naukati	Adjacent to 5871, 5880 and 5900
5770	39	Logjam	Adjacent to 5710 and 5880
5790	62	N. Thorne	Adjacent to 5810, 5830, 5840, 5850 and 5860
5810	51	Luck Lake	See 5790; Adjacent to 5720
5830	45	Big Lake	See 5790
5840	43	Ratz	See 5790
5850	62	Sandy Beach	See 5790
5860	59	Thorne Bay	See 5790
5871	41	Staney	Adjacent to 5710, 5872, 5880 and 5900
5880	53	Staney	See 5871
5900	41	Election Creek	See 5871
5972	36	Rio Roberts	Adjacent to 5980
5980	40	Salt Chuck	Adjacent to 5860 and 5972
6100	43	Maybeso	Experimental Forest
6130	36	Little Coal Bay	Adjacent to 6210
6210	37	Twelvemile	Adjacent to 6130
6240	36	Trocadero	Adjacent to 6210

Note: VCUs 5450, 5542, 5600, 5720, 5872, and 6200 are not included in this table because the POW LLA does not include proposed timber activities in these VCUs.

VCUs 5450, 5542, 5560, 5570, 5600, 5672, 5872, and 6200 are all VCUs with more than 33 percent POG harvest but the POW LLA Project does not propose any activities in these VCUs.

Although the Legacy Standard and Guideline is applied at the VCU scale for this analysis, the percent POG harvested was also calculated at the WAA scale. VCUs are a subset of WAAs and a single WAA usually contains multiple VCUs. For this analysis, the percent POG was also calculated at the WAA scale. WAAs with habitat concerns were then tied to legacy VCUs. Most WAAs with concerns, subsistence and habitat, include legacy VCUs and legacy structure retention can be used as a mitigation measure in these WAAs.

At the WAA scale, currently eight WAAs have had more than 33 percent of the estimated original POG harvested and one WAA (1531) is very close at minus 33 percent. WAA 1003 (-39 percent), WAA 1315 (-43 percent), WAA 1317 (-33 percent), WAA 1420 (-44 percent), 1422 (-37 percent), WAA 1525 (-38 percent) and 1530 (-38 percent). All WAAs with more than 33 percent POG harvest contain VCUs where the Legacy Standard and Guideline would be applied. There are five additional WAAs that contain legacy VCUs, even though the overall WAA does not exceed 33 percent harvest: WAAs 1214, 1319, 1332, 1527, and 1529.

At the WAA scale in all WAAs where a potential concern may exist for marten (see average and deep snow habitat discussions), the Legacy Standard and Guideline would be applied within at least some of the VCUs within that WAA. The application of the Legacy Standard and Guideline will help to mitigate further habitat loss that could locally reduce the capacity of the area to support marten over the long-term (Flynn and Schumacher 1997).

Tolerance to Habitat Changes at Stand Level

The Legacy Standard and Guideline evolved from considerations presented at the Interagency Conservation Strategy Review workshop (USDA Forest Service 2007) and replaced species-specific goshawk foraging standards and guidelines (Forest Plan FEIS Appendix D p. D-16).

Penteriani and Faivre (2001) examined goshawk (*Accipiter gentiles*) nesting patterns at the stand level in two European areas, focusing on the effects of harvesting activity and reduction in forest cover on occupancy rate, productivity, and number of young per breeding pair. The authors were interested in whether limits in nesting patterns would occur as a result of progressive thinning of the forest (removal of 10 percent, 20 percent, 20 percent, 20 percent in four passes) and clearcutting activities (removing the final 30 percent of stand) spaced over 10 to 15 years. In this study, site fidelity remained strong if the harvest level does not exceed 30 percent; however, after removal of 50 percent of the stand no nesting pairs remained. The authors therefore conclude that goshawks in these habitats can tolerate some degree of timber harvesting within nesting stands, up to 30 percent removal (the level of removal at which nesting pairs are last observed) (Penteriani and Faivre 2001).

Research in British Columbia suggests that landscapes should be managed to retain at least 40 to 50 percent mature old-growth forest (POG) to provide adequate nesting and foraging habitat for Queen Charlotte goshawks (Doyle 2005, Northern Goshawk Recovery Team 2008). The least amount of remaining productive old-growth within any goshawk use area (home range of 10,000 acres) reported in the Goshawk Assessment (Iverson *et al*. 1996) was 23 percent. Iverson 1997 states that while the 1995 panel identified 20 percent of the productive old growth harvested as a threshold level where excessive amounts of the least valuable early seral forest created local persistence and viability concerns, the 1997 panel did not make any conclusions regarding harvest thresholds due to the lack of information and other uncertainty. The panel also stated that “allowable” thresholds of the amount of early seral forests in the landscape, although unspecified, were relatively low. The panel also found that the value of mature stand structure than can develop between 100 and 200 years, some panel evaluators suggested that these stands might even be superior to old growth relative to goshawk habitat use, or at least the difference between the two stand ages was insignificant. The 1995 panel the earlier panel indicated that a system of large and medium reserves and a 100-year rotation in the matrix was likely to result in some gaps between reserves, but they did not specifically address whether or not this habitat situation represented a well distributed, viable goshawk population (Iverson 1997). The 1997 evaluators concluded that there was virtually no chance of extirpation of the goshawk from the Tongass National Forest as a result of implementation of any of the 1997 Forest Plan alternatives.

Iverson (1997) also states that the 1995 panel found that at the VCU scale, a single gap, even if permanent, might exist in goshawk distribution and it may not be well distributed, but it was unlikely to be significant since the population would continue to be able to interact, and thus remain viable. Gaps to preclude population interaction would have to be very large (*e.g.*, province scale) to be significant given the large movement capabilities of goshawks. Some panel evaluators suggested that goshawks might no longer occur on the northern half of Prince of Wales Island and thus the population would no longer be well distributed – but this may not affect population viability throughout Southeast Alaska. As in the 1995 panel, evaluators generally concluded that the Southeast Alaska population was not a sink population. Panel evaluators strongly indicated their belief that goshawks in Southeast Alaska were likely food-limited. This conclusion emphasized the need to maintain habitat to support prey production and goshawk foraging. Nesting habitat was not considered limiting by panel evaluators (Iverson 1997).

Timber harvest, and subsequent lack of habitat, could increase competition by other raptors, increase predation, reduce life expectancy, and reduce nesting success. Research in British Columbia suggests that landscapes should be managed to retain at least 40 to 50 percent mature old-growth forest (POG) to provide adequate nesting and foraging habitat for Queen Charlotte goshawks (Doyle 2005, Northern Goshawk Recovery Team 2008). This is not a requirement nor a recommendation included in the 2016 Forest Plan. The least amount of remaining productive old-growth (general POG not nesting or foraging habitat) within any goshawk use area (home range of 10,000 acres) reported in the Goshawk Assessment (Iverson *et al*. 1996) was 23 percent.

Effects to goshawk habitat are covered in more detail in the BA/BE.

Environmental Effects

Direct and Indirect Effects: Alternative 1

Alternative 1 would have no direct or indirect effects.

Direct and Indirect Effects: Alternatives 2, 3, and 5

All action alternatives depending on the location of old-growth harvest could result in VCUs exceeding the 33 percent POG harvest value and thereby require the implementation of the Legacy Standard and Guideline in those VCUs. The project record contains a list of VCUs and the acreage available for harvest by VCU before the Legacy Standard and Guideline would be implemented.

The Forest Plan Legacy Standard and Guideline evolved from considerations presented at the Interagency Conservation Strategy Review workshop (USDA Forest Service 2007a) and replaced species-specific goshawk foraging and marten standards and guidelines. It applies to those Value Comparison Units (VCU) that have had or are anticipated to have high levels of old-growth harvest timber harvest with openings greater than 20 acres in size.

VCUs are generally representative of the size of smaller scales of habitat selection within a goshawk home range. Goshawks are discussed in more detail in the Biological Evaluation. Marten are discussed in the average snow habitat section (above) and in the deep snow habitat section (below).

All VCUs with proposed activities would be verified during project-specific implementation to determine if the Legacy Standard and Guideline applies based on the Forest Plan criteria. During project implementation, if proposed activities would cause a VCU to exceed the legacy limit, then the Legacy Standard and Guideline will be applied in that VCU. A project could also be modified so that proposed activities do not cause the VCU to exceed the 33 percent original POG harvest limit. The Legacy Standard and Guideline only applies to old-growth harvest on NFS land.

Cumulative Effects

The Legacy Standard and Guideline does not apply on non-NFS lands. Therefor it is assumed that no legacy structure will be maintained on non-NFS lands. This could result in these areas not being able to support goshawks.

Conclusion

The amount of past POG harvest by VCU would be recalculated at project implementation to see if proposed activities would result in the VCU exceeding 33 percent POG harvest; if so, the Legacy Standard and Guideline would be applied.

In VCUs with more than 33 percent POG harvest on NFS lands, there would be an increased risk of not being able to support goshawks.

Both marten (see average snow habitat discussion) and goshawk are species with relatively high dispersal capabilities. These species are more likely to be able to move between habitats of greater impact to those of lesser impacts. At the WAA scale, all WAAs with more than 33 percent POG harvest include legacy VCUs. Three WAAs (not VCUs) with more than 33 percent original POG harvest, WAAs 1315, 1317 and 1420, are also WAAs where additional mitigation measures would be implemented to address subsistence concerns. Both the Legacy Standard and Guideline and the harvest limitations proposed in all alternatives should help to mitigate impacts to goshawks and marten by retaining forest structure within the matrix. See discussion above (average snow habitat) and below (deep snow habitat) for more on effects to marten habitat and the BA/BE for more on effects to goshawk habitat.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservations strategy in place even with full implementation of the Forest Plan it would be expected to have a moderate to very high likelihood maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan.

High Volume POG (HPOG)

Several wildlife species are associated with HPOG habitat including the goshawk (Reynolds *et al.* 2006, Boyce *et al.* 2006), marbled murrelet (DeGange 1996; Kuletz *et al.* 1995; Ralph and Miller 1995), the endemic Prince of Wales flying squirrel (Pyare *et al.* 2010), and Prince of Wales spruce grouse (Russell 1999). Deer and marten use HPOG habitat tied to specific locations on the landscape. This habitat is defined as deep snow deer and marten habitat, HPOG below 800 feet elevation in south facing stands (2016 Forest Plan Amendment FEIS p. 3-270).

Appendix B (pp. B-25 and B-26) of the Forest Plan FEIS explains how HPOG and SD67 are calculated for 1954 on both NFS and non-NFS lands. To estimate original high volume and large-tree POG, an estimate was first made of the percentage of past harvest in these categories using the SizeDensity1954 layer, which was based on timber type mapping from the mid-1980s and other GIS layers. The following compositions of harvest were conservatively determined for NFS and non-NFS lands:

- For NFS lands, prior harvest was estimated to have been 30 percent large-tree POG and 75 percent high-volume POG.
- For non-NFS lands, prior harvest was estimated to have been 37 percent large-tree POG and 65 percent high-volume POG.

Goshawk

Goshawk is also discussed above under legacy and in more detail in the Biological Evaluation included in the project record.

Conservation measures for the goshawk include nest buffer and Legacy Forest Structure Standard and Guideline under the Forest Plan. The system of OGRs and other non-development LUDs also maintain habitat for goshawks. Smith (2013) expressed some uncertainty 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. The conservation strategy is expected to maintain viable, well-distributed populations across the Forest, even with full implementation of the Forest Plan's expected harvest levels. For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the old growth reserve (OGR) system, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan FEIS.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). Therefore, there will be no change to the functioning of this contributing element of the Conservation Strategy (2016 Forest Plan FEIS, Appendix D).

Individual activities 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.

Marbled Murrelets

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). 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).

Prince of Wales Flying Squirrel

The Prince of Wales flying squirrel (*G. s. griseifrons*) is an endemic of Prince of Wales Island (POW) and nearby islands off POW's western coast (Dall, Long, Kosciusko, Tuxekan; MacDonald and Cook 1999). The entire geographic range of this unique subspecies is limited to POW and these associated islands. This subspecies has the lowest genetic diversity of all northern flying squirrels in North America (Bidlack and Cook 2001). Consequently, it is especially vulnerable to inbreeding with significant additional negative demographic consequences for isolated populations that currently exist (Smith *et al.* 2011) and become isolated as a result of further habitat loss and fragmentation across its range.

Smith (2013) determined that to sustain isolated breeding populations for an extended period (50 years) with a high probability (0.95), old-growth reserves need to be over 5,000 hectares (12,500 acres) in size and be 100 percent POG; the existing small OGRs (designed for flying squirrels; USDA Forest Service 1997) have about an 80 percent probability of supporting flying squirrel populations for 50 years (Smith and Person 2007). Smith 2013 also determined that there are few (if any) OGRs or any POG habitat patches (except Honker Divide) in the project area that likely can support POW flying squirrel populations in isolation (Smith *et al.* 2011).

Prince of Wales flying squirrels are limited by their habitat requirements and dispersal capabilities. An experimental study demonstrated that it takes POW flying squirrels 10 times more time to move through clearcuts than POG (Smith *et al.* 2011),

Smith *et al.* (2011) suggests spacing small OGRs at a maximum distance of about 0.6 mile (1 kilometer). 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 of approximately 250 feet (Flaherty *et al.* 2008).

Fragmentation resulting from 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). The duration of reduced habitat suitability following timber harvest depends in part on the time required for harvested stands to regenerate. Habitat suitability for flying squirrels would be expected to return more quickly under uneven-aged management (about 10 to 20 years), where some forest cover and structure are retained in the stand, than under even-aged management (in 60 or more years; Smith and Holloway 2011). Mikusinski and Angelstram 2000 found, at the scale of about 19 by 19 miles, a habitat threshold of about 15 percent habitat remaining for squirrels while Angelstram 2001b found, at a smaller scale of about 2 by 2 miles, a habitat threshold of 70 percent remaining.

Prince of Wales Spruce Grouse

Prince of Wales spruce grouse are associated with microhabitats within POG forests. Spruce grouse have a dispersal distance of about 1 mile (Russell 1999). The Forest Plan conservation strategy maintains connectivity within matrix lands that will help facilitate dispersal and interchange between isolated spruce grouse populations.

Prince of Wales spruce grouse avoid young (less than 5 years) clearcuts due to large amounts of debris that inhibit movement, increased exposure to predators, and lack of food; however, as the understory vegetation peaks after 15 to 25 years, grouse likely benefit from increased berry production and cover for chicks (Russell 1999).

Research on grouse (Angelstam 2001b) indicated a habitat threshold of about 70 percent while Angelstam 2001 showed a habitat threshold of about 16 percent for black grouse and 30 percent for Capercaillie (*Tetrao urogallus*).

Affected Environment

National Forest System lands in the POW LLA project area were estimated to have about 560,671 acres of HPOG in 1954. Currently NFS lands in the project area is estimated to have about 379,176 acres of HPOG, about 68 percent remaining.

Six WAAs in the POW LLA project area are currently at 50 percent or less of the original HPOG habitat remaining: WAA 1003 (47 percent remaining), 1315 (35 percent remaining), 1420 (39 percent remaining), 1421 (50 percent remaining), 1422 (43 percent remaining), and 1530 (32 percent remaining). Three additional WAAs are nearing the 50 percent trigger point: 1317 (52 percent remaining), 1525 (54 percent remaining), and 1531 (52 percent remaining).

All of the WAAs in the POW LLA project area currently have at least 20 percent or more of the estimated original HPOG habitat remaining.

All WAAs with current HPOG habitat concerns are adjacent to at least one other WAA with HPOG concerns or are on islands thereby potentially having a greater effect to species with more limited dispersal capabilities.

Environmental Effects

Direct and Indirect Effects

HPOG habitat is assumed for analysis to be proportional to the total POG harvest; HPOG currently makes up about 47 percent of the POG on NFS lands in the project area. Therefore, if 100 acres of harvest is projected, it is assumed that 47 acres of that will be HPOG habitat.

As a result of the proposed activities the POG acres may be reduced to about 317, 658 acres. At the project area scale this is about 90 percent of the current amount and about 60 percent of the HPOG estimated in the project area in 1954.

Research from the Queen Charlotte Islands and elsewhere in western North America suggests that landscapes consisting of 40 to 60 percent mature or old forest (POG and mature second-growth) are favored by goshawks for foraging and nesting (Reynolds *et al.* 1992, Finn *et al.* 2002, Doyle 2005). If timber harvest reduces the proportion of the landbase consisting of POG and mature second-growth forest to below 50 percent this could result in portions of the landscape becoming marginal or unsuitable for goshawks. Therefore, alternatives that harvest the most POG, and reduce the proportion of the landscape consisting of mature and old-growth forest to below 50 percent, would be expected to have the greatest effect on goshawks.

For the species listed under HPOG the effects would be expected to be less as a result of uneven-aged harvest (squirrels- Smith and Holloway 2011) rather than even-aged harvest. The uneven-aged harvest of old-growth stands could be especially beneficial in WAAs that have a high percentage of past harvest, such as WAAs that currently have less than 50 percent of the estimated original HPOG habitat remaining.

Post activities nine WAAs are projected to retain 50 percent or less of the estimated original HPOG habitat: WAA 1003 (34 percent), WAA 1315 (14 percent), WAA 1317 (40 percent), WAA 1420 (22 percent), WAA 1421 (44 percent), WAA 1422 (32 percent), WAA 1524 (37 percent), WAA 1530 (13 percent), and WAA 1531 (41 percent). This is about 28 percent of the total WAAs in the project area.

Literature has identified a range of thresholds for squirrels from 15 to 30 percent; and for grouse a range of 15, 30, or 70 percent remaining habitat.

WAAs with at least 70 percent HPOG habitat remaining on NFS lands after implementation of the POW LLA Project include WAAs 901 (83 percent), 902 (100 percent), 1105 (99 percent), 1106 (100 percent), 1107 (96 percent), 1108 (99 percent), 1209 (100 percent), 1210 (99 percent), 1211 (81 percent), 1212 (99 percent), 1213 (97 percent), 1316 (99 percent), 1318 (74 percent), 1323 (86 percent), 1524 (100 percent), 1526 (86 percent), and 5015 (100 percent). This is 17 WAAs or 53 percent of the WAAs in the project area.

WAAs with between 30 and 70 percent HPOG habitat remaining on NFS lands after implementation of the POW LLA Project include WAAs 1003 (34 percent remaining), 1214 (56 percent), 1317 (40 percent remaining), 1319 (52 percent), 1332 (61 percent), 1421 (50 percent remaining), 1422 (32 percent remaining), 1525 (37 percent remaining), 1528 (67 percent), 1529 (64 percent) and 1531 (41 percent remaining). This is about 34 percent of the WAAs in the project area.

As a result of the proposed activities, one WAA is estimated to have between 20 and 30 percent of the original HPOG habitat remaining: 1420 (22 percent remaining), or about 3 percent of the WAAs in the project area.

WAAs with less than 15 percent HPOG habitat remaining include WAAs 1315 (14 percent remaining) and 1530 (13 percent remaining), which is about 6 percent of the WAAs in the project area.

Alternative 2 is estimated to harvest about 57 percent of the total acres by uneven-aged harvest prescriptions, Alternative 3 about 75 percent, and Alternative 5 about 33 percent; see Table 38 for Overall Comparison of Harvest by Alternative.

Table 40. Estimated effects to HPOG on NFS lands by for all Alternatives by WAA*

	Current			Post Project			
WAA	HPOG 1954	HPOG Existing	% remaining	Estimated POW LLA HPOG ac harvested	Estimated POW LLA HPOG ac post-harvest	% remaining from current	% remaining of 1954 post project
1003	24,215	11,396	47	3,142	8,254	72	34
1315	23,354	8,181	35	4,837	3,344	41	14
1317	21,037	10,988	52	2,615	8,373	76	40
1420	20,403	8,032	39	3,467	4,565	57	22
1421	31,937	15,832	50	1,652	14,180	90	44
1422	54,172	23,413	43	5,931	17,482	75	32
1525	18,949	10,311	54	3,217	7,094	68	37
1530	19,662	6,279	32	3,758	2,521	40	13
1531	10,497	5,415	52	1,079	4,336	80	41

*WAAs not included in the Table have 55 percent or more of the original habitat remaining

Alternative 1

Alternative 1 will have no direct effect to HPOG habitat at any scale.

Alternative 2, 3, and 5

All alternatives would result in about a 3 percent reduction in HPOG at the project area scale.

WAAs with HPOG habitat concerns include 1003, 1315, 1317, 1420, 1421, 1422, 1525, 1530, and 1531.

Alternative 2 includes uneven-aged harvest prescriptions for harvest activities within 5 miles of subsistence communities (WAAs 1315, 1317, 1318, 1420, 1421, 1422, 1525, 1529, and 1530); so this would occur in all WAAs with HPOG concerns except WAAs 1003 and 1531.

Under Alternatives 3 and 5, all WAAs with HPOG concerns would receive at least one form of mitigation.

In Alternative 3, WAAs with 10 percent or more deer harvested of the of the estimated DHC would only have 25 percent removal by single-tree selection (STS) for old-growth harvest on south-facing stands below 800 feet in elevation. This would occur in WAAs 1214, 1315, 1317, 1318, and 1420. All of these WAAs except 1318 are also on the list of areas where more than 50 percent of the original HPOG has been harvested. Alternative 3 also includes the portions of the *Interagency Wolf Habitat Management Program* recommendations (see the beginning of Issue 5).

Alternative 3 includes Legacy Standard and Guideline in VCUs within WAAs 1214, 1315, 1317, 1420, 1422, 1525, and 1530. Alternative 3 also includes peak flow rate mitigation measures in WAAs 1003, 1214, 1315, 1317, 1318, 1420, 1421, 1422, 1525, 1530, and 1531.

Alternative 5 proposes no harvest on south-facing stands below 800 feet in elevation in WAAs 1214, 1315, 1317, 1318, and 1420. All of these WAAs except 1318 are also on the list of areas where more than 50 percent of the original HPOG has been harvested. Alternative 5 incorporates the Wolf Plan in its entirety (see project record).

Alternatives 3 and 5 propose about four times the amount of uneven-aged harvest compared clearcut harvest acres. Uneven-aged harvest acres are assumed to have less of an effect to HPOG habitat and the species associated than clearcut harvest acres.

Under Alternatives 3 and 5 WAAs that also include peak flow rate mitigations that are implemented when more than 20 percent of watershed in roads. The peak flow rate mitigation measures would be included in WAAs 1003, 1214, 1315, 1317, 1318, 1422, 1525, 1529, and 1530. The peak flow rate mitigation measures include would no timber harvest on slopes above 800 feet in elevation and 29 percent basin area removal below 800 feet in elevation. WAAs with watersheds that have less than 2 percent of the watershed in roads include WAAs 1420 and 1421. Peak flow rate mitigation in these WAAs includes 45 percent basin area removal below 800 feet in elevation and 20 percent basin area removal above 800 feet in elevation.

The Legacy Standard and Guideline would also be applied to VCUs within WAAs with HPOG concerns in all alternatives. WAAs with VCUs in which the Legacy Standard and Guideline would be applied include 1003, 1214, 1315, 1317, 1420, 1422, 1525, 1529, and 1530.

Table 41 shows the estimated HPOG habitat remaining by WAA on NFS lands currently and post project for all alternatives.

WAAs would be at greater risk for not being able to support species that depend on HPOG habitat. See discussion above under average snow for adjacency concerns. Most WAAs with HPOG concerns are adjacent to at least one other WAA that has more than 50 percent HPOG remaining, somewhat mitigating the adjacency issue for species with more limited dispersal.

Estimated HPOG harvest for the POW LLA Project results in nine WAAs, three more than currently (1317, 1525, and 1531), in the project area having 50 percent or less of the estimated 1954 HPOG habitat remaining. In WAA 1530, the estimated remaining HPOG acres drops to 20 percent of the estimated 1954 HPOG. As a result these WAAs could be at greater risk for not being able to support species that depend on HPOG habitat, especially WAA 1530. See discussion above under average snow for adjacency concerns. Most WAAs with HPOG concerns are adjacent to at least one other WAA that has more than 50 percent HPOG remaining; somewhat mitigating the adjacency issue for species with more limited dispersal capabilities (POW flying squirrel and spruce grouse).

Table 41. Percent HPOG habitat remaining by WAA on NFS lands Current and Post project All Alternatives

WAA	Current					Post Project				
	>70%	50-70%	30-50%	15-30%	<15%	>70%	50-70%	30-50%	15-30%	<15%
901	X					X				
902	X					X				
1003			X					X		
1105	X					X				
1106	X					X				
1107	X					X				
1108	X					X				
1210	X					X				
1211	X					X				
1212	X					X				
1213	X					X				
1214		X						X		
1315			X							X
1316	X					X				
1317			X					X		
1318	X					X				
1319		X					X			
1323	X					X				
1332		X					X			
1420			X						X	
1421			X					X		
1422			X					X		
1524	X					X				
1525		X						X		
1526	X					X				
1527		X					X			
1528	X						X			
1529		X					X			
1530			X							X
1531		X						X		
5015	X					X				

Cumulative Effects

The POW LLA Project was estimated to have 678,586 acres of HPOG in 1954. Currently the project area is estimated to have about 451,990 acres of HPOG. This is a reduction of about 33 percent since 1954.

Currently on all lands WAAs that retain at least 70 percent of the estimated HPOG habitat include WAA 901 (83 percent), WAA 902 (100 percent), WAA 1105 (99 percent), WAA 1106 (100 percent). WAA 1107 (94 percent), WAA 1108 (99 percent), WAA 1209 (100 percent), WAA 1210 (99 percent), WAA 1211 (88 percent), WAA 1212 (98 percent), WAA 1213 (98 percent), WAA 1316 (99 percent), WAA 1323 (78 percent), WAA 1524 (100 percent), WAA 1526 (87 percent), WAA 1528 (70 percent), and WAA 5015 (100 percent).

WAAs with between 50 and 70 percent HPOG remaining include WAAs 1214 (63 percent), WAA 1318 (66 percent), WAA 1319 (60 percent), WAA 1332 (65 percent), WAA 1527 (63 percent), and WAA 1529 (65 percent).

Currently on all lands eight WAAs have between 30 and 50 percent remaining, the threshold identified by some literature for goshawks, of the estimated 1954 HPOG: WAA 1003 (46 percent), WAA 1315 (36 percent), WAA 1317 (48 percent), WAA 1420 (37 percent), WAA 1421 (50 percent), WAA 1422 (43 percent), WAA 1525 (45 percent), WAA 1530 (30 percent), and WAA 1531 (47 percent).

There are currently no WAAs on all lands with less than 30 percent of the estimated original HPOG habitat remaining.

Alternative 2, 3, and 5

See discussion under direct and indirect effects for mitigation measures by WAA.

Activities on both NFS and non-NFS lands would contribute to the cumulative effects; see Appendix C. About 93,979 acres of harvest is estimated for non-NFS lands in the project area. Approximately 62 percent of current POG on non-NFS lands is HPOG; using that percentage, about 52,628 acres of HPOG could be harvested on non-NFS lands. When combined with POW LLA Project, this could result in the project area having about 56 percent of the estimated 1954 HPOG habitat remaining.

As a result of the proposed activities on NFS lands as well as non-NFS lands, several WAAs will retain at least 70 percent of the estimated 1954 HPOG habitat, including: WAA 901 (81 percent), WAA 902 (96 percent), WAA 1105 (87 percent), WAA 1108 (99 percent), WAA 1209 (97 percent), WAA 1210 (94 percent), WAA 1212 (89 percent), WAA 1316 (100 percent), WAA 1323 (76 percent), WAA 1524 (100 percent), and WAA 1526 (86 percent).

WAAs with an estimated 50 to 70 percent of the 1954 HPOG habitat remaining include: WAA 1107 (66 percent), WAA 1211 (51 percent), WAA 1213 (68 percent), WAA 1319 (51 percent), WAA 1528 (66 percent), and WAA 1529 (61 percent).

WAAs with between 30 and 50 percent HPOG habitat remaining include: WAA 1003 (31 percent), WAA 1106 (30 percent), WAA 1214 (38 percent), WAA 1214 (38 percent), WAA 1317 (34 percent), WAA 1332 (41 percent), WAA 1421 (43 percent), WAA 1422 (30 percent), and WAA 1527 (38 percent).

As a result of the proposed activities on NFS lands as well as non-NFS lands, the following WAAs could have between 15 and 30 percent of the 1954 HPOG habitat: WAA 1318 (28 percent), WAA 1420 (20 percent), WAA 1525 (24 percent), and WAA 1531 (19 percent); and two WAAs, WAA 1315 (10 percent) and WAA 1530 (12 percent), would have less than 15 percent remaining.

In WAAs with less than 70 percent of original HPOG habitat remaining mat be less likely to support species such as the grouse. In WAAs with less than 50 percent of the HPOG habitat remaining may be less likely to support species such as the goshawk. WAAs with less than 30 percent HPOG habitat remaining may be less likely to support species such as the Prince of Wales flying squirrel and grouse; however, at some scales squirrels and grouse may occur in WAAs with at least 15 percent habitat remaining.

Conclusion

Species tied to HPOG habitat include the goshawk, marbled murrelet, and the endemic Prince of Wales flying squirrel and spruce grouse. The goshawk and marbled murrelet are less likely to be impacted by the reduction in HPOG than species such as the flying squirrel and grouse because they have a greater ability to disperse. Species such as the Prince of Wales flying squirrel and spruce grouse may be more impacted than other species by the loss of HPOG habitat due to their more limited dispersal capabilities.

All WAAs with HPOG concerns would have at least one form of mitigation measures applied depending on the alternative. These measures should help to mitigate the effects to HPOG associated species.

All action alternatives include some type of timber harvest mitigation measures. Alternative 2 includes wildlife centric prescriptions for harvest activities within 5 miles of subsistence communities (WAAs 1315, 1317, 1318, 1420, 1421, 1422, 1525, 1529, and 1530). In Alternative 3, WAAs 1214, 1315, 1317, 1318, and 1420 include only 25 percent removal by single tree selection (STS) for old-growth harvest on south-facing stands below 800 feet in elevation. Alternative 5 proposes no harvest on south-facing stands below 800 feet in elevation in WAAs 1214, 1315, 1317, 1318, and 1420.

Alternatives 3 and 5 analyze about four times the amount of helicopter harvest (assume harvest other than clearcut) over conventional harvest acres (assume clearcut). Uneven-aged harvest acres are assumed to have less of an effect to HPOG habitat and the species associated than clearcut harvest acres.

Under Alternatives 3 and 5 WAAs that also include peak flow rate concerns for watersheds with the potential for more than 2 percent of their area covered by roads are WAAs 1003, 1214, 1315, 1317, 1318, 1319, 1422, 1525, 1529, and 1530. These areas may exclude timber harvest on slopes above 800 feet in elevation and 29 percent basin area removal below 800 feet in elevation depending on site specific characteristics. WAAs with watersheds that have the potential for less than 2 percent of the watershed covered by roads are WAAs 1420 and 1421. These areas could include 45 percent basin area removal below 800 feet in elevation and 20 percent basin area removal above 800 feet in elevation.

In all action alternatives, the Legacy Standard and Guideline would also be applied to VCUs within WAAs with HPOG concerns. WAAs with VCUs in which the Legacy Standard and Guideline would be applied include 1003, 1214, 1315, 1317, 1420, 1422, 1525, 1529, and 1530.

WAAs with the greatest habitat reduction that are adjacent to each other or on islands would be expected to have a greater impact to those species with more limited dispersal capabilities such as flying squirrel and grouse; see discussion under previous habitat types for adjacency and Figure 5 and Figure 6.

The Forest Plan FEIS concluded that full implementation of the Forest Plan (in 100 or more years) is expected to have a moderate to very high likelihood of maintaining habitat to support viable and well-distributed populations of wildlife. The conservation strategy is expected to maintain viable, well-distributed populations across the Forest, even with full implementation of the Forest Plan's expected harvest levels. For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the old growth reserve (OGR) system, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan FEIS.

Cumulatively, 11 WAAs retain more than 70 percent of the estimated HPOG habitat and therefore are likely capable of providing habitat for species dependent on the HPOG habitat type. Six WAAs are expected to retain between 50 and 70 percent of the estimated 1954 HPOG habitat. Nine WAAs may retain between 30 and 50 percent of the estimated 1954 HPOG habitat, four WAAs with between 15 and 30 percent HPOG, and two WAAs may have less than 15 percent remaining.

WAAs with more than 70 percent of the estimated 1954 HPOG habitat are likely capable of providing habitat for the species associated with this habitat type, goshawk, murrelet, spruce grouse and flying squirrel. Literature thresholds identified for goshawks include a range of down to about 23 percent to between 40 and 60 percent.

WAAs with more than 20 percent HPOG habitat should be capable of providing habitat for goshawks according to Iverson *et al.* 1996 while those above 50 percent should be capable of providing habitat for goshawks according to Doyle 2005. WAAs with less than 20 percent habitat remaining may not be capable of providing habitat for goshawks.

WAAs with more than 20 percent HPOG habitat should be capable of providing habitat for the Prince of Wales flying squirrel (Mikusinski and Angelstram 2000) and spruce grouse (Angelstam 2001). WAAs with less than 20 percent habitat remaining may not be capable of providing habitat for these species.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservation strategy in place even with full implementation of the Forest Plan it would be expected to have a moderate to very high likelihood maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan.

HPOG on the Landscape – Deep Snow Deer and Marten Habitat

Deer and marten have been tied to use of HPOG in specific locations on the landscape. Both deep snow deer and marten habitat is defined as HPOG below 800 feet elevation in south-facing stands (USDA Forest Service 2016c, pp. 3-266 and 3-270). Low-elevation HPOG on south-facing stands receive the highest relative value when looking at habitat capability for deer. This analysis uses these south-facing stands to represent a worst-case scenario.

Research on deer conducted in Southeast Alaska, and elsewhere, indicates that low-elevation, high-volume old-growth habitats are particularly important to deer, especially during severe winters (Hanley and Rose 1987; Schoen and Kirchhoff 1990; Yeo and Peek 1992; B.C. Ministry of Forests 1996c).

No habitat thresholds have been identified for deer; some research on marten indicate habitat thresholds for marten is 30 to 50 percent but prefer more than 70 percent (see discussion under average snow habitat).

On NFS lands, the project area currently is estimated to have about 49,449 acres of deep snow habitat about 67 percent of the estimated 1954 (73,729 acres) habitat.

WAAs with 70 percent or more of the estimated original 1954 deep snow habitat include WAA 901 (87 percent), WAA 902 (100 percent), WAA 1105 (100 percent), WAA 1106 (100 percent), WAA 1107 (96 percent), WAA 1008 (99 percent), WAA 1209 (100 percent), WAA 1210 (99 percent), WAA 1211 (99 percent), WAA 1212 (100 percent), WAA 1213 (100 percent), WAA 1316 (100 percent), WAA

1318 (75 percent), WAA 1323 (98 percent), WAA 1332 (79 percent), WAA 1524 (100 percent), WAA 1526 (83 percent), WAA 1528 (84 percent), and WAA 5015 (100 percent).

WAAs between 50 and 70 include WAA 1003 (59 percent), WAA 1214 (51 percent), WAA 1319 (62 percent), WAA 1527 (67 percent), and WAA 1529 (66 percent).

The WAAs that either are between 30 and 50 percent of the deep snow habitat remaining include WAAs 1421 (44 percent remaining), WAA 1422 (35 percent remaining), WAA 1525 (47 percent remaining), and WAA 1530 (50 percent remaining).

WAAs with less than 30 percent are WAA 1315 (28 percent remaining), WAA 1317 (26 percent remaining), and WAA 1420 (29 percent remaining).

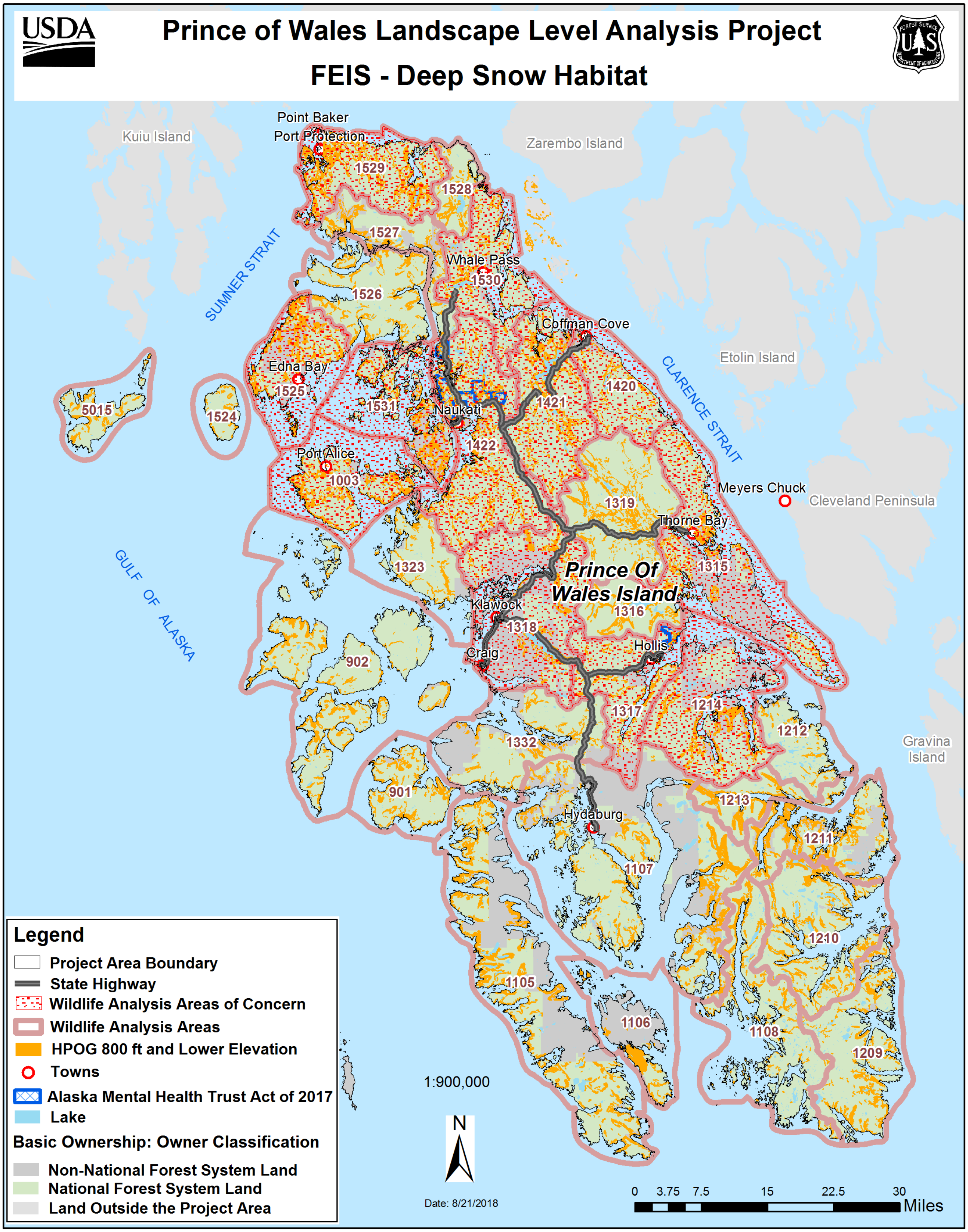

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Figure 5. Deep Snow Habitat

Environmental Effects

Direct and Indirect Effects

Currently on NFS lands in the project area, about 6 percent of POG is HPOG on south-facing stands at or below 800 feet elevation. This analysis assumes the same percentage of proposed harvest to be in this habitat type. This assumption results in about 46,561 acres of deep snow and marten original habitat remaining on the project area, a reduction of about 6 percent from current for an overall 63 percent remaining on NFS lands.

Young-growth treatments or harvest proposed in all action alternatives could help mitigate effects to deep snow habitat, especially young-growth treatments or harvest on south-facing low-elevation stands that are treated with wildlife centric prescriptions and slash treatments.

No habitat thresholds have been identified for deer, however research has shown that deep snow winter range is likely the most limiting habitat for deer. Literature habitat thresholds for marten have identified 30 percent habitat remaining but that marten prefer 50 to 70 percent habitat remaining,

Alternative 1

Will have no direct effect to deep habitat at any scale. Indirectly, Alternative 1 could result in negative effects to deep snow habitat because of the fewer young-growth acres treated. It is assumed that all young-growth treatments or harvest would result in a benefit to wildlife, especially deer at least in the short term. Young-growth thinning treatments would continue to occur under Alternative 1 but on fewer acres than proposed under the action alternatives.

Alternative 2, 3 and 5

WAAs that retain more than 70 percent of the estimated deep snow habitat after proposed activities include WAAs 901 (87 percent), 902 (100 percent), 1105 (100 percent), 1106 (100 percent), 1107 (96 percent), 1108 (99 percent), 1209 (100 percent), 1210 (99 percent), 1211 (83 percent), 1212 (100 percent), 1213 (99 percent), 1316 (100 percent), 1318 (74 percent), 1323 (97 percent), 1332 (74 percent), 1524 (100 percent), 1526 (82 percent), 1528 (79 percent), and 5015 (100 percent).

WAAs that retain between 50 and 70 percent of the estimated 1954 deep snow habitat include WAAs 1319 (54 percent), 1527 (62 percent), and 1531 (52 percent).

WAAs with between 30 and 50 percent include WAAs 1003 (49 percent), 1214 (48 percent), 1421 (38 percent), 1525 (33 percent), and 1530 (32 percent).

WAAs with less than 30 percent of the estimated 1954 deep snow habitat include WAAs 1315 (26 percent), 1317 (15 percent), and 1422 (24 percent).

The GIS calculations for WAA 1420 for deep snow habitat show that all the deep snow habitat in this WAA could be lost.

Alternative 2 includes timber harvest mitigation in the form of wildlife centric prescriptions for harvest activities within 5 miles of subsistence communities (WAAs 1315, 1317, 1318, 1420, 1421, 1422, 1525, 1529, and 1530).

In all action alternatives the Legacy Standard and Guideline would also be applied to VCUs within WAAs with deep snow habitat concerns. WAAs with VCUs in which the Legacy Standard and Guideline would be applied include 1003, 1214, 1315, 1317, 1420, 1422, 1525, 1529, and 1530. The Legacy Standard and Guideline requires that even-aged old-growth harvest in these VCUs where openings exceed 20 acres in size must retain 30 percent of old-growth structure. The structure retention of the Legacy Standard and Guideline and the mitigation measures in WAAs near subsistence communities could both help to mitigate the effects to deep snow habitat.

In WAAs with 10 percent or more deer harvested of the estimated DHC, Alternative 3 allows only 25 percent removal by single tree selection (STS) for old-growth harvest on south-facing stands below 800 feet in elevation. This would occur in WAAs 1214, 1315, 1317, 1318, and 1420.

Table 42. Percent of Deep Snow habitat remaining by WAA – NFS Land All Alternatives

WAA	Current					Post Project				
	>70%	50-70%	30-50%	15-30%	<15%	>70%	50-70%	30-50%	15-30%	<15%
901	X					X				
902	X					X				
1003			X					X		
1105	X					X				
1106	X					X				
1107	X					X				
1108	X					X				
1210	X					X				
1211	X					X				
1212	X					X				
1213	X					X				
1214		X						X		
1315			X						X	
1316	X					X				
1317			X							X
1318	X					X				
1319		X					X			
1323	X					X				
1332		X					X			
1420			X							X
1421			X					X		
1422			X						X	
1524	X					X				
1525		X						X		
1526	X					X				
1527		X					X			
1528	X						X			
1529		X					X			
1530			X							X
1531		X						X		
5015	X					X				

Alternative 5 proposes no harvest on south-facing stands below 800 feet in elevation in WAAs with 10 percent or more of the estimated deer habitat capability (WAAs 1214, 1315, 1317, 1318, and

1420). In Alternative 5, effects to deep snow habitat in these WAAs would be mitigated by these restrictions in these five WAAs.

Alternatives 3 and 5 include WAAs with peak flow rate concerns of more than 2 percent of watershed in roads in WAAs 1003, 1214, 1315, 1317, 1318, 1319, 1422, 1525, 1529, and 1530 and would include no timber harvest on slopes above 800 feet in elevation and up to 29 percent basin area removal below 800 feet in elevation. WAAs with watersheds that have less than 2 percent of the watershed in roads include WAAs 1420 and 1421. These areas could include 45 percent basin area removal below 800 feet in elevation and 20 percent basin area removal above 800 feet in elevation.

Alternative 3 also incorporates portions of the Wolf Plan (see above) and Alternative 5 incorporates the Wolf Plan in its entirety.

WAAs 1003 (Heceta) and 1525 (Kosciusko) are on islands. See discussion above under general POG above for adjacency discussion in relation to dispersal capabilities. All other WAAs, except one, with less than 50 percent of the estimated deep snow habitat remaining on NFS lands are adjacent to at least one other WAA that also has less than 50 percent deep snow habitat remaining. WAA 1529 is the one exception and it is only separated from other heavily impacted WAAs by narrow strips of WAAs with more than 50 percent of the deep snow habitat remaining.

WAAs 1315, 1317, and 1422 are all estimated to have less than 30 percent of the estimated original deep snow habitat remaining. This is the threshold below which where research (Thompson and Harestad 1994) has said marten are absent.

The panel for the 1997 Forest Plan determined that a gap in habitat could be as small as the territory of a single marten. A marten territory was considered to be from one to three square miles. The consequence of a gap is some measure of reduced gene flow within the population. Panel evaluators indicated that a population can accommodate a certain, but unknown, level of gaps and still remain viable but the greater the size and number of gaps, however, the higher the risk of reducing gene flow. To avoid creation of gaps by forest management practices the panel recommended uneven-aged harvest. The panel could not identify the threshold of POG remaining at which a landscape or a territory would not be suitable for marten reproduction (DeGayner 1997). The panel projected no likelihood that marten would be extirpated from the entire forest under the preferred alternative for the 1997 Forest Plan. The Forest Plan was strengthened after this evaluation primarily due to the level of concern about the likelihood of marten populations remaining well-distributed across the Tongass for at least 100 years (1997 Forest Plan FEIS Appendix D pp. D-32 and 33). WAAs 1315, 1317, and 1422 are not adjacent to each other.

Cumulative Effects

For the project area as a whole, about 8 percent of POG is low elevation HPOG on south-facing stands. Using that percentage for estimated harvest on non-NFS lands, about 7,518 acres of this habitat type could be harvested in addition to the POW LLA Project; this would result in the project area having about 54 percent remaining of the original estimated HPOG below 800 feet elevation on south-facing stands.

WAAs that remain above the 70 percent of the original deep snow habitat level include WAAs in Wilderness, LUD II and other non-development LUDs, and some WAAs that have less proposed harvest. These WAAs include 901 (86 percent), 902 (97 percent), 1105 (82 percent), 1108 (99 percent), 1209 (92 percent), 1210 (91 percent), 1212 (97 percent), 1316 (100 percent), 1323 (75 percent), 1524 (100 percent), 1526 (82 percent), 1528 (78 percent), and 5015 (100 percent).

WAAs with between 50 and 70 percent of the estimated 1954 deep snow habitat include WAAs 1107 (61 percent), 1211 (59 percent), 1213 (65 percent), 1319 (53 percent), 1332 (64 percent), and 1529 (61 percent).

WAAs with between 30 and 50 percent of the estimated 1954 deep snow habitat include WAAs 1003 (43 percent), 1214 (31 percent), 1421 (36 percent), and 1527 (40 percent).

WAAs with less than 30 percent of the estimated 1954 deep snow habitat include WAAs 1106 (29 percent), 1315 (20 percent), 1317 (13 percent), 1318 (15 percent), 1422 (21 percent), 1525 (19 percent), 1530 (28 percent), and 1531 (26 percent). These WAAs are all estimated to have less than 30 percent of the estimated original deep snow habitat remaining. This is the threshold below which where Thompson and Harestad 1994 has said marten are absent.

The GIS calculations for WAA 1420 for deep snow habitat show that all the deep snow habitat in this WAA could be lost.

Timber harvest mitigation measures would be applied on NFS lands (Alternatives 3 and 5) (see direct and indirect effects above). WAAs 1315, 1317, 1318, 1420, 1422, 1525, 1529, and 1530 all would have wildlife centric prescriptions applied within 5 miles of subsistence communities in Alternative 2. On NFS lands, WAAs 1003, 1214, 1315, 1317, 1420, 1422, 1525, 1529, and 1530 are WAAs that include VCUs where the Legacy Standard and Guideline will be applied, requiring the retention of structure in harvested stands over 20 acres in size. Peak flow rate restrictions would occur in Alternatives 3 and 5 in WAAs 1003, 1214, 1315, 1317, 1318, 1420, 1421, 1422, 1525, 1530, and 1531.

The proposed young-growth treatments and harvest on both NFS land and non-NFS lands as well as the timber harvest mitigation measures in some WAAs on NFS lands could help to offset some of these effects.

Activities on both NFS and non-NFS lands would contribute to the cumulative effects; see Appendix C.

Table 43. Comparison of effects to deep snow habitat post project between NFS and all lands all alternatives

WAA	NFS lands Post project					Cumulative effects post project				
	>70%	50-70%	30-50%	15-30%	<15%	>70%	50-70%	30-50%	15-30%	<15%
901	X					X				
902	X					X				
1003			X					X		
1105	X					X				
1106	X								X	
1107	X						X			
1108	X					X				
1210	X					X				
1211	X						X			
1212	X					X				
1213	X						X			
1214			X					X		
1315				X					X	

WAA	NFS lands Post project					Cumulative effects post project				
	>70%	50-70%	30-50%	15-30%	<15%	>70%	50-70%	30-50%	15-30%	<15%
1316	X					X				
1317					X					X
1318	X									X
1319		X					X			
1323	X					X				
1332		X					X			
1420				X						X
1421			X					X		
1422				X					X	
1524	X					X				
1525			X							X
1526	X					X				
1527		X						X		
1528		X							X	
1529		X					X			
1530				X					X	
1531			X						X	
5015	X					X				

Conclusion

Between NFS lands and non-NFS lands there are or will be several WAAs with less than 30 percent of the estimated 1954 deep snow habitat. According to some research these WAAs may be at greater risk for not being able to support populations of species dependent on this habitat over the long term; however in Alternatives 3 and 5, WAAs 1214, 1315, 1317, 1318, and 1420 all have the additional timber harvest mitigation measures which should help to reduce the negative effects to deep snow habitat. Alternative 2 includes mitigation measures in WAAs around subsistence communities (1420, 1421, and 1530) that could also help to lessen the effects to deep snow habitat. WAAs 1525 and 1531 includes peak flow rate restrictions in Alternatives 3 and 5.

Young-growth thinning treatments and harvest proposed in the WAAs with deep snow habitat concerns under all action alternatives would help mitigate the effects to deep snow habitat. All young-growth treatments and harvest are assumed to improve habitat over the current condition, at least in the short term, especially if slash treatment is included in the prescription.

Young-growth treatments or harvest on the low elevation south-facing stands in WAAs with deep snow habitat concerns may include a more wildlife-centric prescription and slash treatment. These mitigations measures should be implemented to try to prevent WAAs that currently have more than 50 percent deep snow habitat remaining from dropping to less than 50 percent. In WAAs that already below 50 percent value, these mitigation measures should be implemented to try to prevent the habitat decreasing any further.

Marten and migratory deer both have dispersal capabilities that should enable them to move between habitats that have been more heavily impacted to those with less impact. Resident deer have more limited dispersal capabilities and would likely be more impacted by effects to deep snow habitat than either migratory deer or marten. Deep snow habitat has been identified as the limiting factor for deer and this is the habitat that has seen the greatest impact, along with large tree POG, since 1954. This should be of greater concern in areas where WAAs of greatest impact are adjacent to each other or where WAAs with habitat remaining on NFS lands are adjacent to WAAs with a high percentage of non-NFS lands (see Figure 5. Deep Snow Habitat).

While no thresholds have been identified for deer, deep snow habitat is likely the limiting factor for deer and WAAs with the greatest impact to this habitat type would have the greatest effect to deer. As a result of the proposed activities none of the WAAs may be expected to retain less than 50 percent of the 1954 deep snow habitat and one of these WAAs may not retain any of the 1954 deep snow habitat. Cumulatively thirteen WAAs (42 percent of the project area WAAs) may retain less than 50 percent of the estimated 1954 deep snow habitat.

Literature thresholds for marten include 30 percent and a range between 50 and 70 percent. On NFS lands it is estimated that four WAAs could retain less than 30 percent of the estimated 1954 deep snow habitat and therefore may not be capable of providing habitat for marten. Cumulatively none WAAs may retain less than 30 percent of the 1954 habitat. See discussion above for 50 percent habitat. On NFS lands 19 WAAs are estimated to retain 70 percent of more of the estimated 1954 deep snow habitat and cumulatively 13 WAAs are estimated to retain at least 70 percent of the 1954 original deep snow habitat.

The Forest Plan FEIS concluded that full implementation of the Forest Plan (in 100 or more years) is expected to have a moderate to very high likelihood of maintaining habitat to support viable and well-distributed populations of wildlife. The conservation strategy is expected to maintain viable, well-distributed populations across the Forest, even with full implementation of the Forest Plan's expected harvest levels. For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the old growth reserve (OGR) system, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan FEIS.

Large Tree POG (SD67)

Brown creepers (Kissling, *et al.*, Forest Bird Presentation, Conservation Strategy Meeting, 2006) and the endemic bat Keen's myotis are both associated with large-tree POG (Boland *et al.* 2009).

Large-tree POG is defined as the SD67 type, representing the most productive of the POG types, and typically containing the highest density of large trees. SD67 is defined as highly productive forests associated with riparian areas, alluvial fans, karst geology, and wind-protected uplands.

Forest Plan Appendix B (pp. 25 and 26) explains how original HPOG and SD67 are calculated for 1954 on both NFS and non-NFS lands. To estimate original high volume and large-tree POG, an estimate was first made of the percentage of past harvest in these categories using the SizeDensity1954 layer, which was based on timber type mapping from the mid-1980s and other GIS layers. The following compositions of harvest were conservatively determined for NFS and non-NFS lands:

- For NFS lands, prior harvest was estimated to have been 30 percent large-tree POG and 75 percent high-volume POG.
- For non-NFS lands, prior harvest was estimated to have been 37 percent large-tree POG and 65 percent high-volume POG.

Affected Environment

The current estimated acres of SD67 on NFS lands is 158,805 acres and the historical estimate is 217,322 acres; this is about 73 percent of the estimated 1954 SD67 habitat. There are no habitat thresholds specific to the brown creeper or Keen's myotis.

Blewett and Marzluff (2005) about a 27 percent forest cover contained all nine species of birds, including brown creepers, which suggests that this amount of forest can maintain cavity-nesting bird following urban development. Blewett and Marzluff (2005) suggested that urban planners in the Pacific Northwest design developments have 27 percent to 60 percent. Blewett and Marzluff (2005) found that brown creeper density was similar between managed forests sites and forested urban sites included in the study. Martensen *et al.* 2012 indicated a threshold of between 30 percent and 50 percent for understory birds in Atlantic Forest. For this analysis, these percentages of 30, 50, and 60 were used for habitat thresholds for brown creeper.

Muylaert *et al.* 2016 indicated that the threshold value for richness, below which bat diversity declines precipitously, was estimated at 47 percent of remaining forest. Muylaert *et al.* 2016 found a precipitous decline in species number and abundance in more degraded landscape due to forest loss. Different habitat types did not seem to affect richness when considered separately; instead, what seems matters for increased bat richness is greater amount of forest within the landscape. Recommendation for bats in Ávila-Gómez *et al.* 2015 included a tree cover between 50 and 80 percent in heterogeneous landscapes and to promote the conservation of tree and riparian corridors. Muylaert *et al.* 2016 also suggested a drop in biodiversity, and species richness in particular, when less than 30 percent of the original amount of habitat in the landscape remains. For this analysis the percentages of 30, 50, and 80 were used for the Keen's myotis.

Currently all WAAs have at least 30 percent SD67 habitat.

WAAs with greater than 80 percent of the estimated 1954 SD67 habitat include WAAs 902, 1105, 1106, 1107, 1108, 1209, 1210, 1211, 1212, 1213, 1316, 1323, 1524, 1526, and 5015 (48 percent of WAAs in project area).

WAAs with about 60 to 80 percent of the estimated 1954 SD67 habitat include WAAs 901, 1214, 1318, 1319, 1421, 1525, 1528, 1529, and 1531 (29 percent of project area WAAs)

WAAs with about 50 to 60 percent of the estimated 1954 SD67 habitat include: 1003, 1332, 1420, and 1527 (13 percent of project area WAAs).

WAAs with about 30 to 50 percent of the estimated 1954 SD67 habitat include WAAs 1315, 1317, and 1530 (about 10 percent of project area WAAs).

According to literature thresholds all WAAs have SD67 habitat to support brown creepers and Keen's myotis.

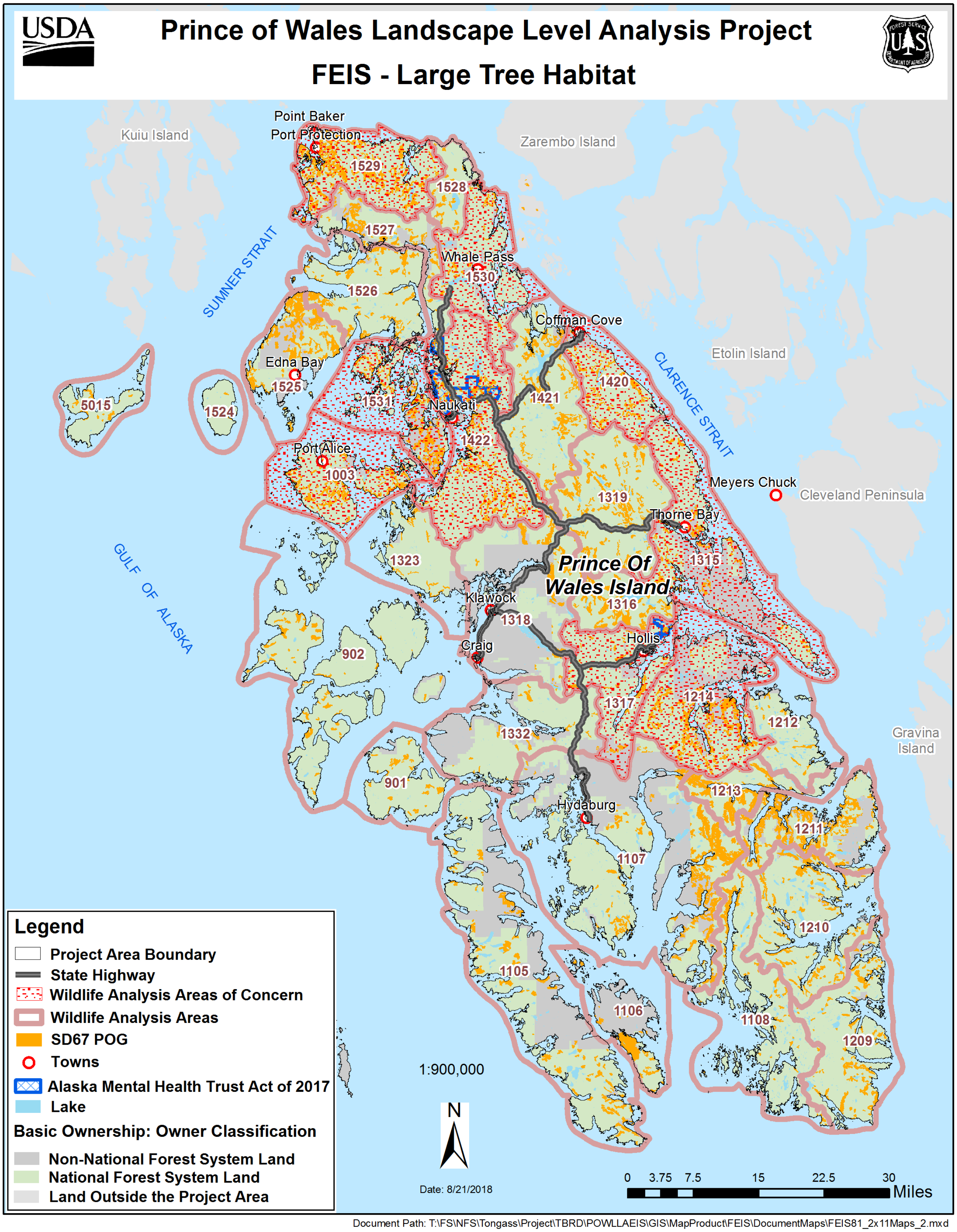

Figure 6. Large Tree Habitat

Environmental Effects

Direct and Indirect Effects

The current estimated acres of SD67 on NFS lands is 158,805 acres and the historical estimate is 217,322 acres; this is about 73 percent of the estimated 1954 SD67 habitat. The POW LLA Project could harvest an about 4,421 acres of SD67 habitat across the entire project area resulting in about 1154,384 acres remaining. This is about 97 percent of the current SD67 and about 71 percent of the estimated 1954 SD67 habitat.

Alternative 1

Alternative 1 will have no direct or indirect effect to SD67 habitat.

Alternatives 2, 3, and 5

Alternative 2 could harvest about 4,421 acres of SD67 resulting in about a retention of about 97 percent of the current SD67 habitat and about 71 percent of the estimated 1954 SD67 habitat. Alternative 3 could harvest about 1,162 acres of SD67 habitat and Alternative 5 about 568 acres both resulting in about a 99 percent retention of current SD67 habitat and 73 percent of the estimated 1954 SD67 habitat.

Table 44 shows the effects of timber harvest proposed in the POW LLA Project on the current estimated SD67 habitat.

As a result of the proposed activities in the POW LLA Project, WAAs 902, 1105, 1106, 1107, 1108, 1209, 1210, 1211, 1212, 1213, 1316, 1323, 1524, 1526, and 5015 all retain more than 80 percent of the estimated 1954 SD67 habitat (48 percent of project area WAAs). Of these WAAs, only two retain less than 90 percent of the estimated 1954 SD67 habitat.

Post-project WAAs with between 60 to 80 percent of the estimated 1954 SD67 habitat include 901, 1214, 1318, 1319, 1525, 1528, and 1529 (23 percent of project area WAAs).

Post-project WAAs with between 50 to 60 percent of the estimated 1954 SD67 habitat include 1421, 1527, and 1531 (10 percent of project area WAAs).

Post-project WAAs with between 30 to 50 percent of the estimated 1954 SD67 habitat include 1003, 1332, 1420, and 1422 (13 percent of project area WAAs).

Post-project WAAs with less than 30 percent of the estimated 1954 SD67 habitat include WAA 1315, 1317, and 1530 (about 10 percent of the project area WAAs).

Alternative 2 includes wildlife centric prescriptions for harvest activities within 5 miles of subsistence communities within the project area (WAAs 1315, 1317, 1318, 1420, 1421, 1422, 1525, 1529, and 1530).

Alternative 3 allows for 25 percent removal by single tree selection (STS) for old-growth harvest on south-facing stands below 800 feet in elevation in WAAs with 10 percent or more deer harvested of the estimated DHC: 1214, 1315, 1317, 1318 and 1420. Alternative 5 allows no harvest of old-growth harvest in south-facing stands below 800 feet in elevation. The proposed timber harvest mitigation in Alternatives 2, 3, and 5 will help to offset the effects of harvest of SD67 habitat.

Table 44. Categories of SD67 habitat remaining by WAA – NFS Land All Alternatives

WAA	Current % of 1954					Post Project				
	>80	60-80	50-60	30-50	<30	>80	60-80	50-60	30-50	<30
901		X					X			
902	X					X				
1003			X						X	
1105	X					X				
1106	X					X				
1107	X					X				
1108	X					X				
1209	X					X				
1210	X					X				
1211	X					X				
1212	X					X				
1213	X					X				
1214		X					X			
1315				X						X
1316	X					X				
1317				X						X
1318		X					X			
1319		X					X			
1323	X					X				
1332			X						X	
1420			X						X	
1421		X						X		
1422				X					X	
1524	X					X				
1525		X					X			
1526	X					X				
1527			X					X		
1528		X					X			
1529		X					X			
1530				X						X
1531		X						X		
5015	X					X				

Shaded rows indicate the WAAs that changed category of percent habitat remaining.

Under Alternatives 3 and 5, WAAs that also include peak flow rate concerns for watersheds with the potential for more than 2 percent of their area covered by roads are WAAs 1003, 1214, 1315, 1317, 1318, 1319, 1422, 1525, 1529, and 1530. These areas may exclude timber harvest on slopes above 800 feet in elevation and 29 percent basin area removal below 800 feet in elevation depending on site specific characteristics. WAAs with watersheds that have the potential for less than 2 percent of the watershed covered by roads are WAAs 1420 and 1421. These areas could include 45 percent basin area removal below 800 feet in elevation and 20 percent basin area removal above 800 feet in elevation.

The Legacy Standard and Guideline would also be applied to VCUs within WAAs. WAAs with VCUs in which the Legacy Standard and Guideline would be applied include 1003, 1214, 1315, 1317, 1420, 1422, 1525, 1529, and 1530.

All WAAs with SD67 habitat concerns include at least one form of mitigation depending on the alternative.

Figure 6 Large Tree Habitat shows WAAs with SD67 concerns and if they are adjacent to each other.

Cumulative Effects

Lands in other ownerships are estimated to have about 45,671 acres of SD67 currently and about 114,810 acres in 1954. The project area as a whole has about 62 percent of the original large tree SD67 habitat remaining; this is slightly higher than the estimated percent of deep snow habitat remaining. This is because deep snow habitat is a more restrictive habitat type. For this analysis it is assumed that all SD67 on non-NFS lands would be harvested.

As a result of the proposed activities on all lands, WAAs 902, 1108, 1209, 1210, 1212, 1316, 1524 and 5015 all retain more than 80 percent of the estimated 1954 SD67 habitat (23 percent of project area WAAs).

As a result of the proposed activities on all lands, WAAs with between 60 and 80 percent of the estimated 1954 SD67 habitat include 901, 1105, 1213, 1319, 1323, 1528, and 1529 (23 percent of project area WAAs).

As a result of the proposed activities on all lands, WAAs with between 50 and 60 percent of the estimated 1954 SD67 habitat include 1107, and 1421 (6 percent of project area WAAs).

As a result of the proposed activities on all lands, WAAs with between 30 and 50 percent of the estimated 1954 SD67 habitat include 1003, 1211, 1214, 1420, 1525, 1526, and 1527 (23 percent of project area WAAs.

As a result of the proposed activities on all lands, WAAs with between 20 and 30 percent of the estimated 1954 SD67 habitat include WAAs 1332 and 1422 (6 percent of project area WAAs).

As a result of the proposed activities on all lands, WAAs with less than 20 percent of the estimated 1954 SD67 habitat include WAAs 1106, 1315, 1317, 1318, 1530, and 1531 (19 percent of the project area WAAs).

Table 45. Comparison of effects to deep snow habitat post project between NFS and all lands all alternatives

WAA	Post project NFS					Post Project All lands				
	>80	60-80	50-60	30-50	<30	>80	60-80	50-60	30-50	<30
901		X					X			
902	X					X				
1003				X					X	
1105	X						X			
1106	X									X
1107	X							X		
1108	X					X				
1209	X					X				
1210	X					X				
1211		X							X	
1212	X					X				
1213	X						X			
1214			X						X	
1315				X						X
1316	X					X				
1317				X						X
1318		X								X
1319		X					X			
1323	X						X			
1332			X							X
1420			X						X	
1421			X					X		
1422				X						X
1524	X					X				
1525		X							X	
1526	X								X	
1527			X						X	
1528		X					X			
1529			X					X		
1530					X					X
1531			X							X
5015	X					X				

Shaded rows indicate the WAAs that changed category of percent habitat remaining.

Conclusion

On NFS lands, WAAs with greater than 80 percent (45 percent of the project area WAAs post project) of the original estimated of SD67 habitat remaining are likely to be able to continue to provide habitat capable to support both brown creepers and Keen's myotis and WAAs with greater than 60 percent (65 percent of the project area WAAs post project) are likely to be able to continue to provide habitat capable to support brown creepers. Bat diversity decline was estimated at 47 percent of remaining forest, and post-project there are four WAAs or about 13 percent of the project area that have between 30 and 50 percent habitat remaining and one WAA is projected to have less than 30 percent of the estimated 1954 SD67 habitat. The loss of habitat in these WAAs may result in a lower diversity of bats. One study on birds, Blewett and Marzluff (2005), found that about a 27 percent forest cover contained all nine species of birds, including brown creepers. As a result of the proposed activities on NFS lands, all WAAs except one are projected to retain more than 30 percent of the estimated 1954 SD67 habitat and therefore should be capable of providing habitat for brown creepers.

As a result of activities on all lands, about 23 percent of project area WAAs are likely to be able to continue to provide habitat capable to support both brown creepers and Keen's myotis and WAAs with greater than 60 percent (23 percent of the project area WAAs post project) are likely to be able to continue to provide habitat capable to support brown creepers. Bat diversity decline was estimated at 47 percent of remaining forest and post project there are seven WAAs or about 23 percent of the project area WAAs have between 30 and 50 percent habitat remaining, two WAAs (about 6 percent of the project area WAAs) that are projected to have between 20 and 30 percent of the estimated 1954 SD67 habitat, and six WAAs (23 percent of project area WAAs) may have less than 20 percent of the estimated 1954 SD67 habitat. Combined about 46 percent of the project area on all lands could retain less than 50 percent of the estimated 1954 SD67 habitat resulting in these areas not being capable of providing habitat for bats. One study on birds, Blewett and Marzluff (2005), found that about a 27 percent forest cover contained all nine species of birds, including brown creepers. As a result of the proposed activities on all lands, seven WAAs or about 23 percent of the project area WAAs are projected to retain less than 30 percent of the estimated 1954 SD67 habitat and therefore may not be capable of providing habitat for brown creepers; or, 70 percent of the WAAs would be expected to retain at least 70 percent of the 1954 SD67 habitat.

WAAs 1214, 1315, 1317, 1318, and 1420 have harvest mitigation measures in Alternatives 2, 3, and 5. WAAs 1003, 1214, 1315, 1317, 1420, 1422, 1525, 1529, and 1530 all include VCUs that would have the Legacy Standard and Guideline implemented in all alternatives.

The amount of past harvest may also have a greater impact to species with more limited dispersal capabilities in areas of concentrated harvest, such as WAAs with greater past impact in proximity to each other, or on islands. WAA 1003 is Heceta Island so all adjacent WAAs are separated by saltwater. Adjacent to WAA 1003 are WAAs with varying amounts of original SD67 habitat WAA (see Figure 6 for adjacency). The fact that some of these WAAs are separated by saltwater means that even species with higher dispersal capabilities may have a more difficult time dispersing from areas with greater impacts to habitat to areas with less impacts.

WAAs 1003 (Heceta) and 1531 (Tuxekan) have concerns because they are islands and adjacent WAAs are separated by saltwater. This may increase the risk for species with more limited dispersal capabilities. Clusters of impacted WAAs may increase the risk to species with limited dispersal capabilities (see Figure 6). There may also be an increased risk to species with limited dispersal capabilities in the areas of overlap between the heavily impacted WAAs on Prince of Wales (see Figure 6).

Based on the limited information on dispersal patterns for the brown creeper and the Keen's myotis, it appears that Keen's myotis may be more likely to be negatively impacted by the loss of habitat than the brown creeper due to the more limited dispersal capabilities of the Keen's myotis; however, both species do have the ability to fly and disperse between habitats. The brown creeper may be more limited by the decrease in the size of forest patches. Habitat for the brown creeper and Keen's myotis would be maintained in the project area under the Forest Plan conservation strategy.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservations strategy in place even with full implementation of the Forest Plan it would be expected to have a moderate to very high likelihood maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan.

Overall Comparison

Table 46. Percent of the 1954 habitat type remaining by WAA NFS lands only – post project

WAA	POG	Avg. snow	HPOG	Deep snow	SD67	Wolf Ranking *	Deep snow habitat mitigation Alts 3 & 5	Sub. Alt 2	Legacy* (WAA)	Peak Flow
901	91	91	83	87	75	#1				
1003	40	39	34	49	43	#2			X	X
1214	74	71	56	48	66	#2	X		X	X
1315	28	26	14	26	15	#2	X	X	X	X
1317	48	40	40	15	23	#1	X		X	X
1318	87	85	74	74	77	#1	X	X		X
1420	30	23	22	0	34	#2	X	X	X	X
1421	67	66	44	38	57	#2		X		X
1422	47	44	32	24	33	#3		X	X	X
1525	33	32	37	33	62	#4		X	X	X
1530	40	40	13	32	5	#3		X	X	X
1531	54	54	41	51	52	#4			X	X

*Wolf Ranking is defined in the Wolf Mortality section
Differences in SD67 values due to GIS data

The Forest Plan FEIS concluded that full implementation of the Forest Plan (in 100 or more years) is expected to have a moderate to very high likelihood of maintaining habitat to support viable and well-distributed populations of wildlife. The conservation strategy is expected to maintain viable, well-distributed populations across the Forest, even with full implementation of the Forest Plan's expected harvest levels. For a complete review of the Forest Plan Conservation Strategy, including assumptions underlying the design of the old growth reserve (OGR) system, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan FEIS.

Harvest of young growth will pose a very low risk to the function and integrity of the Conservation Strategy. Therefore, there will be no change to the functioning of this contributing element of the Conservation Strategy (Forest Plan FEIS, Appendix D). The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels).

Table 47. Overall percent of the 1954 habitat type remaining by WAA Lands in all ownerships – post project

WAA	POG	Non-winter	Average snow	HPOG	Deep snow	SD67	Subsistence Alt 3 & 5	Subsistence Alt 2	Legacy (WAA)	Peak Flow
1003	37	43	35	31	43	38			X	X
1106	48	23	48	30	29	14				
1214	55	60	49	38	31	36	X		X	X
1315	20	32	19	10	20	10	X	X	X	X
1317	42	61	34	34	13	14	X	X	X	X
1318	57	42	33	28	15	19	X	X	X	X
1332	72	64	54	41	64	24				
1420	27	52	20	20	0	30	X	X	X	X
1421	65	80	64	43	36	53		X	X	X
1422	45	63	42	30	21	24		X	X	X
1525	21	28	21	24	19	41			X	
1526	93	95	92	86	82	39				
1527	47	61	40	38	40	36			X	
1530	36	60	36	12	28	5		x	X	X
1531	29	35	29	19	26	20			X	X

*WAAs 1005, 1106 and 1107 all have between 20 and 50 percent of the original SD67 remaining but include either little NFS land or NFS lands that have not been harvested; percent reductions are due to Non –NFS lands
Legacy values in table are WAAs with legacy VCUs.
Blank cells indicate values greater than 50 percent
Differences in SD67 values due to GIS data

Young Growth

Despite the localized effects of POG harvest, the transition to young-growth proposed under the action alternatives is likely to minimize effects to species such as goshawks, flying squirrels, murrelets, and spruce grouse 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, all of the action alternatives would be expected maintain the long-term viability of goshawk. The Legacy Forest Structure Standard and Guideline protects habitat features that are important for goshawks on a stand level (see Appendix D for a detailed discussion of effects to the Conservation Strategy). 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 several species than what was 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 Alternative 2 (the 1,000-foot inland buffer) and Alternative 5 (the 200-foot no-harvest shoreline buffer) would further reduce effects.

It is generally assumed that the acres currently in the stem exclusion stage of development provide little habitat for most wildlife species. The conversion of the stands in the stem exclusion stage back to an early seral stage may provide better habitat for a short time for some species. Clearcut harvesting does produce an immediate flush of high quality understory biomass, though it typically only lasts 10 to 25 years, and is not available to deer during periods of heavy snow (Alaback 2010).

Species, such as deer and bear, may benefit from the increase in forage availability that the early seral stands provide in comparison to the stem excluded stands.

Species that could be affected by the proposed treatments or harvest in the beach buffer include the ermine and marten. Ermine are adapted to a wide variety of habitats but seem to prefer wooded areas with thick understory near water. They rarely occur in heavily forested regions but often occupy early-successional or forest-edge habitats, wet meadows, marshes, ditches, riparian woodlands, or river banks with high densities of small mammals and adequate undercanopy foraging space (Simms 1979a, Simms 1979b, King 1983). Coastal ermine may exhibit a preference for low elevation riparian and marine shoreline and estuarine habitats (Reid *et al.* 2000). Subspecies *M. e. seclusa* has been documented in varied habitat including old-growth and successional forest, brush, alpine meadows, marshes, and riparian areas (Hall 1951).

Returning stands to an early seral stage can have a short-term benefit for some wildlife species such as deer. Cole 2010 states that, when compared to unthinned stands, the thinned stands had greater understory cover. According to Cole 2010, summer food resources were increased for deer and winter food values were increased by thinning for a snow-free condition. Cole also found that in the first 7 years, thinning had a major effect but the differences in the spacing of the thinning was not significant. According to Cole (2010), thinning released all vegetation similarly. Evergreen forbs are especially important due to their high digestibility (Parker et al 1999). Blueberry, another important winter food source, responded inconsistently. Other food species that respond to thinning are either non-existent in winter (fireweed) or have poor winter nutritional value (salmonberry twigs). Cole (2010) also discusses that slash may reduce the value of the thinning treatments. Stands that are thinned at younger ages should produce more forbs while those stands thinned at older age may produce more shrubs. Overall, the increase in forage was short lived (less than 10 years), but thinned stands provide higher forage values than unthinned stands (Cole 2010).

Coastal habitats and riparian areas, including beach fringe, have the highest habitat value for marten (USDA Forest Service 2008b, p. 3-234) and, therefore, marten habitat could be impacted by the proposed activities in this area. Because ermine were live trapped in young-growth forest and in the beach buffers, effects to ermine habitat are also discussed here under Young Growth (Reid *et al.* 2000).

Young-growth treatments within non-development LUDs, such as beach buffer and OGRs, that have to meet the goals and objectives of the LUD while providing for a commercial timber by-product, provide the opportunity to treat areas to attain more old-growth characteristics more rapidly than with no treatments. Impacts to beach and estuary habitats differ among the alternatives based on young-growth and road management within and near habitats and in riparian habitats for downstream influences. Actions that could result from the alternatives include tree harvesting, transport of logs, floating or shoreline accumulation of loose logs, personnel presence along shorelines, and development and operation of log transfer facilities. The application in all alternatives of Forest-wide Standards and Guidelines as well as BMPs developed to meet soil protection, fish-habitat protection, and water-quality standards (USDA 2012) will help minimize impacts of contaminants to riparian habitat and downstream beach, estuary, and marine habitats. The 200-foot buffer along the beach and estuary fringe will minimize disturbance and adjacency impacts to TES species using beach, estuary, and marine habitats as will 15-year and single-entry restrictions.

Among the alternatives, the number of acres of commercial young-growth harvest by all prescriptions within beach and estuary fringe habitat within 100 years will vary. Forest Plan objectives include the dual intent of facilitating recovery of late-seral (more old-growth-like) forest characteristics, while also producing commercial timber byproducts in these areas.

The scale of young-growth harvest and road building within the beach fringe is relatively small. There are about 460,705 acres within 1,000 feet of the shoreline in the project area. About 3,194 acres of beach fringe (0.7 percent of the project area beach fringe) were identified for potential young-growth commercial harvest, and only about 1,118 acres (35 percent of the identified young growth between 200 feet and 1,000 feet of the shoreline, and 0.24 percent of the beach fringe within the project area) could be harvested, per Forest Plan standards. Most of the beach fringe harvest will occur by road and helicopter, which reduces potential nearshore disturbance. About 36 miles of roads could be constructed or reconstructed within 1,000 feet of the mean high tide line, of which about 2 miles could be within the 200-foot no harvest buffer. Forest Plan standards for commercial young-growth harvest within the 1,000-foot beach buffer (Forest Plan p. 5-5) limit the amount of harvest to 35 percent of the original stand acreage, limit the size of the opening to 10 acres or less, allow one-time only entry and include a minimum 200-foot no commercial harvest buffer from the mean high tide line. Protective measures in Forest-wide Standards and Guidelines and BMPs developed to meet soil protection, fish habitat protection, and water-quality standards (USDA 2012) will be applied.

All action alternatives analyze more young-growth stands by even-aged harvest than by uneven-aged harvest. Alternatives 3 and 5 propose about twice as much young growth by even-aged harvest over uneven-aged harvest and Alternative 2 about four times as much.

The interagency approved deer model assigns different relative values to different habitat types. The stem exclusion stage gets one of the lowest values while early seral stage acres get a higher value. The conversion of the stem exclusion acres back into early seral stage acres may improve habitat for deer.

Young-growth treatments and restoration activities on NFS lands may provide additional foraging opportunities for species such as cavity nesters through the increase in downed wood and decaying slash. These treatments could collectively improve habitat conditions for old-growth associated species.

Many older young-growth stands in biogeographic provinces with high levels of past old-growth activities would begin to recover back into the understory reinitiation stage over the next 40 to 50 years. However, the POW LLA Project proposed harvest activities would delay this recovery process so that clearcut second-growth forests would require 50 to 60 years to reach the same stand conditions present today, and another 40 to 50 years to recover into understory re-initiation structure. This may be inconsistent with the need to provide long-term understory forage production and habitat quality for wildlife. Under the current Forest Plan, all of the alternatives in the POW LLA Project, over the long term, would result in some NFS land remaining at the stem exclusion stage or lower. Although clearcut harvesting does produce an immediate flush of high quality understory biomass, it typically lasts only 10 to 25 years, and is not available to deer during periods of heavy snow. The stem exclusion phase lasts for as much as 150 to 200 years and can create a long-lasting deficit of wildlife habitat for a given watershed or region (Alaback 2010). Short rotations are "insufficient for development of forest stand attributes approximating the composition, structure, and function of old-growth forests" (Iverson 1996).

There are risk/benefit tradeoffs between allowing a stand in the stem exclusion stage to continue to mature on a natural trajectory versus manually resetting it back to the stand initiation stage. In the short term, there are benefits to some species by resetting the stands back to the stand initiation stage and increasing the forage availability, at least in the summer. Overall, however, the long-term effects are unknown.

Precommercial Thinning (PCT)

In young-growth stands, generally less than 25 years old, the most common intermediate treatment is PCT. PCT removes excessive trees through the cutting of less desirable trees while leaving the most desirable trees in a more free-to-grow condition. PCT can be performed to various residual stand densities depending on overall resource objectives.

Commercial Young-Growth Harvest

Commercial harvest (such as commercial thinning and even-aged and uneven-aged management prescriptions) of young-growth stands may have potential beneficial effects to biodiversity associated with promoting stand development in previously harvested stands such as opening the tree canopy and promoting understory development.

Commercial harvest could result in habitat improvements in young growth, potentially benefiting deer, and thus wolves, over the long term. Commercial harvest could improve deer habitat quality by increasing forage availability (Hanley 2005). The harvest of older young-growth stands without slash removal may create unacceptable levels of slash, which can persist for about 10 years or longer. The slash levels may inhibit forage maintenance or reestablishment. Various methods of reducing slash depth or amounts have proven to be expensive.

The use of open areas by deer may increase the risk of predation. Important factors in influencing predation included slope, flat terrain, and a north aspect. These factors combined with an increase in predation in open areas means managers should avoid creating large openings on flat or gently rolling terrain.

The Kosciusko DEIS (June 2002) indicated that limited surveys conducted on Kosciusko Island (included in the project area), showed that previously thinned stands were producing substantial amounts of forage that should be available for deer and other wildlife.

The structure in commercial-aged young-growth stands is predominantly stem exclusion, but is trending toward understory re-initiation. Many of these stands were precommercially thinned in the past. PCT has positively influenced stand development moving them toward understory re-initiation sooner. Understory re-initiation is the stage where the stand overstory begins to open up allowing for new understory plants to develop due to the increase in light. The process of under story re-initiation would continue without any stand treatments, though, over a longer time frame. Over time, the base of the overstory crown moves upward and more sunlight reaches the forest floor from side lighting. As these stands age, increasingly larger trees succumb to mortality from various causes, resulting in the potential for opening to form in the canopy creating greater vertical and horizontal diversity. Eventually these stands naturally develop old-growth structural characteristics. The time it takes for these stands to move through this process is contingent on a number of factors like species composition, site index, natural events, and past treatments. On average it is expected that commercial sized stands would be in transition between stem exclusion and understory re-initiation until about age 100. After age 100 they would likely be more fully into the understory re-initiation stage.

The benefits of letting a stand return to old-growth habitat on its own compared to either returning it to the stand initiation stage and having the stand have to go through the all the successional stages again before returning to old growth has been debated. At this time on the Tongass, there is no research that indicates the that the value of returning a stand back to the stand initiation stage is better than letting it return on a more natural trajectory to old growth; however, in the short term, returning a stand the stand initiation stage should provide more forage especially when uneven-aged harvest methods are used.

Environmental Effects

Direct and Indirect Effects

One effect of the proposed treatments or harvest to the young-growth acres would be the increase in light to the forest floor thereby increasing forage. Many wildlife species, including deer and bears, would benefit from the increased forage. Proposed riparian treatments would likely result in long-term improvements to the habitat around Class I streams. Young-growth treatments or harvest may provide additional foraging opportunities for cavity nesters due to the increase of downed wood and decaying slash.

All action alternatives would result in a positive direct effect to deer by converting stem excluded stands with little to forage into stands with more forage available, thereby benefiting deer (and indirectly wolves) and bear. Indirectly, the proposed activities in the young growth may result in improved connectivity in the long term by leaving some acres untreated or unthinned.

Alternative 1

Alternative 1 will have no direct effect to young-growth habitat. There will be indirect effects as acres currently providing some deer habitat move from the early seral stage into the stem exclusion stage. WAA 901 will decrease DHC by about 5 percent, WAA 1003 about 2 percent, WAA 1211 about 3 percent, WAA 1214 about 5 percent, WAA 1315 about 8 percent, WAA 1317 about 2 percent, WAA 1318 about 3 percent, WAA 1319 about 2 percent, WAA 1420 about 5 percent, WAA 1421 about 3 percent, WAA 1422 about 4 percent, and WAA 1527 about 3 percent. The DHC in all the other WAAs in the project area would decrease by 1 percent or less under the No-Action Alternative.

Effects Common to All Action Alternatives

It is assumed that the direct effect of young-growth treatments or harvest could result in a positive effect to wildlife over the current condition, either by increasing the amount of forage available or by maintaining corridors. The indirect effects would occur as acres currently providing deer habitat move from the early seral stage into the stem exclusion stage, resulting in a more negative effect.

Alternative 2

Alternative 2 proposes to treat about 3 MMBF of young growth in the first 1 to 7 years of the POW LLA Project. In years 8 to 15 it would treat about 50 MMBF.

Alternatives 3 and 5

These alternatives propose to treat about 7 MMBF of young growth in the first 1 to 7 years of the POW LLA Project. In years 8 to 15 they would treat about 60 MMBF.

Alternative 3

Alternative 3 incorporates parts of the *Interagency Wolf Habitat Management Program*. Alternative 3 includes retaining un-treated leave strips in young-growth stands with the intent to provide corridors and travelways for wildlife. The Wolf Plan recommends that these strips be about 400 feet apart from each other. Alternative 3 also includes the recommendation to consider a variety of treatment and harvest combinations to include forage production, corridors, and reduce slash. Vulnerability of deer to predation can be reduced on flatter slopes by creating smaller and more dispersed treatments or harvest. All of these recommendations benefit deer but also other wildlife species by increasing forage availability and reducing slash.

Alternative 5

The *Interagency Wolf Habitat Management Program* (available in the project record) recommendations would be implemented fully.

Cumulative Effects

It is assumed that while some acres of young-growth on non-NFS land would continue to move from early seral stage stands into stem exclusion stands, other acres would likely be treated in some way that would improve wildlife habitat over the current condition. The amount of acres that would be treated are unknown, but any acres converted from stem exclusion back into the early seral stage would be assumed to provide a beneficial effect to deer and thus wolves.

Conclusion

Since Alternatives 3 and 5 could result in more acres of young-growth being converted from stem exclusion back to stand initiation or being treated using an uneven-aged harvest prescription, these alternatives would result in a greater benefit to habitat overall than Alternative 2. All actions alternatives would result in a benefit to wildlife greater than Alternative 1.

The treatment and harvest of young-growth acres would affect different species differently. Some species, such as deer (and indirectly wolves), bear, and grouse, could be expected to benefit in the short term from the even-aged harvest of young-growth stands. The beneficial effect to deer may also benefit subsistence hunters if the deer population increases. Most species could be expected to benefit in the long term from the uneven-aged harvest treatments or harvest of young-growth stands because these treatments and harvest would be expected to provide more old-growth-like characteristics quicker over the long term. If these treatments or harvest also include slash treatments, then these stands could provide less dispersal restrictions to some species. The uneven-aged harvest treatments could also mean that there would be some structural retention remaining in these stands which could be beneficial to species such as the squirrel.

Alexander Archipelago Wolf

In 2016, the U.S. Fish and Wildlife Service (USFWS) concluded there was reasonable risk that wolves could be significantly reduced, or perhaps even extirpated, from Prince of Wales Island and the smaller surrounding islands as a result of declining prey abundance and increasing density of roads and subsequent human-induced mortality risk to wolves. The GMU 2 wolf population relies solely on deer as an ungulate prey species. Although other non-ungulate species are also food sources, it is more vulnerable to declines in deer numbers compared to all other populations. Logging has occurred disproportionately in GMU 2 and deer are projected to decline by approximately 21 to 33 percent over the next 30 years, and, correspondingly, the wolf population is predicted to decline by an average of 8 to 14 percent (Gilbert *et al.* 2015, pp. 19, 43).

The USFWS in their response to the petition to list the wolf determined that the Conservation Strategy provided adequate habitat for wolves and that listing the wolf was not warranted (Federal Register /Vol. 81, No. 3 /Wednesday, January 6, 2016 / Proposed Rules).

The USFWS response to the petition to list the wolf in the Federal Register states that the wolf population in GMU 2 is about 6 percent of the overall population (also citing Person *et al.* 1996 p. 13 and ADF&G 2015a p. 2). The Federal Register also states that the gene flow was most restricted to and from the GMU 2 wolf population (Weckworth *et al.* 2005, p. 923; Cronin *et al.* 2015, Supplemental Table 3), although this population does not appear to be completely isolated. the frequency of private alleles (based on nuclear DNA) in the GMU 2 wolf population is low relative to other Alexander Archipelago wolves (Weckworth *et al.* 2005, p. 921), and the population does not harbor unique haplotypes (based on mitochondrial DNA), both of which suggest that complete isolation has not occurred. Thus, although some genetic discontinuities of Alexander Archipelago wolves is evident, likely due to geographical disruptions to dispersal and gene flow, genetic connectivity among populations seems to be intact, albeit at low levels for some populations (*e.g.*, GMU 2). The USFWS determined that the subspecific identity, if any, of wolves in southeastern Alaska and coastal British Columbia remains unresolved (Federal Register /Vol. 81, No. 3 /Wednesday, January 6, 2016 / Proposed Rules). Other literature finds that wolves inhabiting Prince of Wales Island are genetically isolated from other populations in Southeast Alaska (Person 2001; Weckworth *et al.* 2005, 2010, 2011). Research presented at the Tongass Conservation Strategy Review Workshop 2006 indicated that the population on Prince of Wales Island is genetically isolated from other Tongass populations. This presents implications for maintaining well-distributed wolf populations in light of local declines, given that these populations may be more sensitive to human activity and habitat disturbance than wolf populations elsewhere in the state (Schoen and Person 2007).

The USFWS acknowledges in the Federal Register response on the petition to list the wolf indications that gaps in wolf population may occur but that these gaps did not warrant the listing of the wolf. The USFWS determined that the loss of the GMU 2 population of the Alexander Archipelago wolf, when considered in relation to the taxon as a whole, would not result in a significant gap in the range of the taxon. The GMU 2 population constitutes only 6 percent of the current rangewide population, only 4 percent of the range, and only 9 percent of the range below 1,312 feet in elevation where the Alexander Archipelago wolf selectively occurs (Federal Register /Vol. 81, No. 3 /Wednesday, January 6, 2016 / Proposed Rules). In the Federal Register response to list the wolf, the USFWS found that even though deer and wolf populations are expected to decline in GMU 2, in part as a result of timber harvest, these declines would not result in a rangewide impact to the Alexander Archipelago wolf population. The USFWS goes on to state that the GMU 2 population contributes little to the viability of the taxon as a whole given that it composes a small percentage of the current rangewide population and it occupies a small percentage of the range of the Alexander Archipelago wolf. Given the insularity and peripheral geographic position compared to the rest of the range, the GMU 2 population contributes even less demographically and genetically than it does numerically. Due the fact that it is insular and geographically peripheral, and that it appears to be functioning as a sink population, the GMU 2 population represents a small percentage of the range and rangewide population of the Alexander Archipelago wolf. The USFWS concluded that, although there are potential threats in GMU 2, the GMU 2 contribution to the viability of the taxon as a whole is not so important that, without the members of GMU 2, the Alexander Archipelago wolf would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range (Federal Register /Vol. 81, No. 3 /Wednesday, January 6, 2016 / Proposed Rules).

Deer Habitat

Affected Environment

The Tongass Conservation Strategy provides habitat for wolves and their prey (deer). The Conservation Strategy was determined to maintain viable and well-distributed populations.

Habitat suitability/capability modeling is a useful method for identifying habitat that is potentially suitable for a species. During modeling, the suitability or capability of habitat types is rated based on known habitat associations of the species. Differences in carrying capacity of winter habitat for deer is referred to as habitat capability. Good habitat capability may not equate to a good deer population due to other environmental factors such as disease, over-predation or overhunting.

Table 48. Deer Habitat Capability by Biogeographic Province – 2016 Forest Plan

Province	Existing DHC	Percent maintained with full implementation of 2016 Forest Plan
14	31,134	95 percent or more depending on Forest Plan alternative
16	9,043	100
17	5,272	100
18	11,358	100

Numbers from Table 3.10-10 2016 Forest Plan FEIS p. 3-264

The Forest Plan estimated that with full implementation of the plan for biogeographic provinces within the POW LLA Project, that only Province 14, the North Central Prince of Wales Biogeographic Province, would experience a reduction in DHC and that even this Province would maintain at least 95 percent of the current DHC. All other provinces in the POW LLA Project area were estimated to maintain 100 percent of the current estimated DHC. All effects discussed below would be assumed to be in Province 14.

Environmental Effects

Direct and Indirect Effects

It is assumed that all LSTA proposed harvest acres would be harvested and the harvest method would be clearcut.

Alternative 1

Alternative 1 would have no direct effect to wolves. There will be indirect effects as acres currently providing deer habitat move from the early seral stage into the stem exclusion stage. WAA 901 will decrease DHC by about 5 percent, WAA 1003 about 2 percent, WAA 1211 about 3 percent, WAA 1214 about 5 percent, WAA 1315 about 8 percent, WAA 1317 about 2 percent, WAA 1318 about 3 percent, WAA 1319 about 2 percent, WAA 1420 about 5 percent, WAA 1421 about 3 percent, WAA 1422 about 4 percent, and WAA 1527 about 3 percent. All the other WAAs in the project area would decrease by less than 1 percent under the No-Action Alternative.

Alternative 2

Alternative 2 includes timber harvest mitigation in timber harvest polygons within 5 miles of a subsistence community in WAAs with 10 percent or more deer harvested of the estimated DHC. This would occur in WAAs 1214, 1315, 1317, 1318, and 1420. See discussion on deer habitat above. See discussion above for impacts to non-winter, average snow, and deep snow deer habitat and the effects of young-growth treatments and harvest.

Alternative 3

In WAAs with 10 percent or more deer harvested of the estimated DHC, allow only 25 percent removal by single tree selection (STS) for old-growth harvest on south-facing stands below 800 feet in elevation. This would occur in WAAs 1214, 1315, 1317, 1318, and 1420. WAAs 1315, 1317, and 1420 are also areas where more than 50 percent of the original deep snow deer habitat has been harvested. In Alternative 3, effects to DHC in these three WAAs (1315, 1317, and 1420) would be mitigated by the restrictions in these three WAAs. These WAAs may also include other mitigation measures such as the Legacy Standard and Guideline or peak flow rate measures (See Issue 5). See discussion above for impacts to non-winter, average snow, and deep snow deer habitat and the effects of young-growth treatments and harvest.

Alternative 3 incorporates portions of the Wolf Plan.

Alternative 5

Alternative 5 we would propose no harvest in south-facing stands below 800 feet in elevation in WAAs with 10 percent or more deer harvested of the estimated DHC (WAAs 1214, 1315, 1317, 1318, and 1420). WAAs 1315, 1317, and 1420 are also areas where more than 50 percent of the original deep snow deer habitat has been harvested. This mitigation will help to offset the effects to deer habitat capability. These WAAs may also include other mitigation measures such as the Legacy Standard and Guideline or peak flow rate measures (see Issue 5). See discussion above for impacts to non-winter, average snow, and deep snow deer habitat and the effects of young-growth treatments and harvest.

Alternative 5 incorporates the Wolf Plan in its entirety.

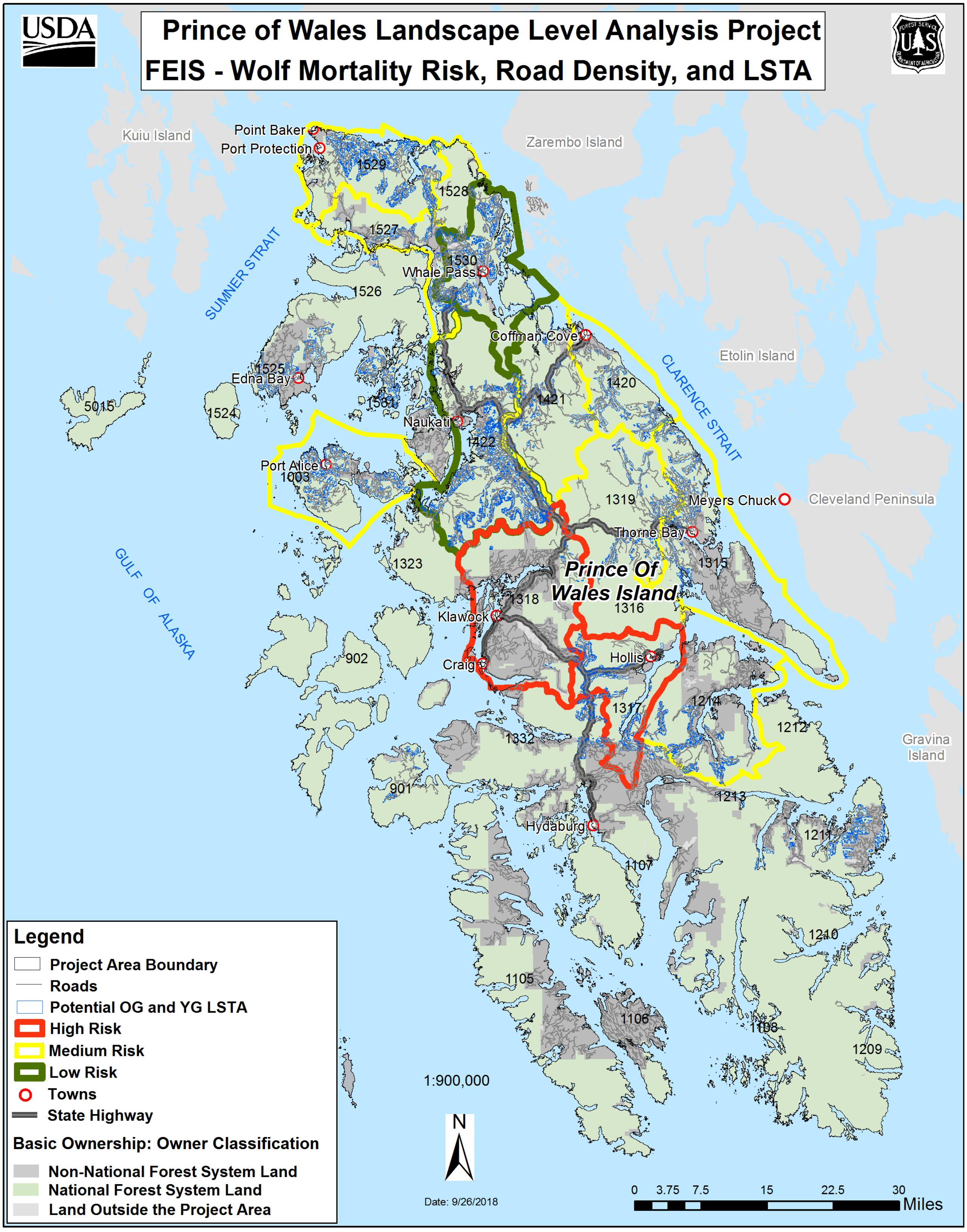

Figure 7. Wolf Mortality and Road Density with LSTA displayed

Cumulative Effects on Lands in All Ownerships

Harvest on non-NFS lands would move both young-growth acres and old-growth into the early seral stage, assuming clearcut harvest would be used. It is assumed that while some acres of young-growth on non-NFS land would continue to move from early seral stage stands into stem exclusion stands, other acres would likely be treated in some way that would improve wildlife habitat over the current condition. The amount of acres that would be treated is unknown, but any acres converted from stem exclusion back into the early seral stage would be assumed to provide a beneficial effect to deer and thus wolves.

Conclusion

Overall effects to wolves are due to effects to deep snow habitat (deer); see discussion above under deep snow habitat. However, the POW LLA Project does focus on maintaining the limiting habitat for deer (deep snow habitat) in Alternatives 3 and 5 which should help to mitigate the effects to wolves.

The Forest Plan Conservation Strategy is intended to maintain the persistence of the old-growth ecosystem (and the predator-prey dynamic of wolves and deer which it supports) (USDA Forest Service 2008b, p. 3-232).

Wolf Mortality

Affected Environment

A study, Person and Logan 2012, was done to attempt to quantify which WAAs may have unsustainable or greater wolf mortality on Prince of Wales Island. In 1999 the season was temporarily closed by emergency order which Person and Logan felt may have affected the reliability of reported take. Person and Logan (2012) stated that the occurrence of both unsustainable and pack depletion harvests peaked prior to 1999.

This report suggested that some WAAs on Prince of Wales Island may have periodically experienced unsustainable wolf harvest, which is annual harvest rates greater than or equal to 3 wolves per 300 square kilometers with some WAAs experiencing chronic unsustainable wolf harvest, which is unsustainable harvest at least 5 times between 1985 and 2009.

The risk criteria used to rank the WAAs were defined in Person and Logan 2012. The wolf harvest in the highest risk WAAs may benefit the most from road management. Risk category #1 is defined as greater than or equal to seven wolves per 300 square kilometers for at least 2 years at least 5 times from 1985 to 2009. The WAAs included in risk category #1 are WAAs 1317 and 1318. Risk category #2 is defined as greater than or equal to 7 wolves per 300 square kilometers at least once from 1985 to 2009 and includes WAAs 1003, 1214, 1315, 1420, 1421, 1527, 1528, and 1529. Risk category #3 is defined as WAAs that have experienced chronic unsustainable harvest (greater than or equal to three wolves per 300 square kilometers) for greater than or equal to 5 years from 1985 to 2009. Risk category #3 includes WAAs 1422 and 1530. The least risky category, #4, is defined as unsustainable harvest (greater than or equal to 3 wolves per 300 square kilometers at least one time from 1985 to 2009) and includes WAAs 1525 and 1531. The rest of the WAAs in GMU 2 either do not have a wolf mortality concern or a high road density.

Road Density

Although most wolves (about 59 percent) are harvested by hunters and trappers working from boats, harvest-related wolf mortality is correlated with road density and type of habitat, which influence their vulnerability to harvest (Person and Russell 2008; Person and Logan 2012). Person and Russell 2008 found that the rate of harvest of wolves increased with density of roads, which provide access to hunters and trappers; however, road densities of about 1.5 miles per square mile or greater had little additional effect on harvest rates. Road building in WAAs that does not result in road densities that exceed 0.7 mile per square mile would have the least negative effect to wolf mortality.

The 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. Person *et al.* (1996) reported that wolf harvest increased twofold when total road density below 1,200 feet elevation exceeded 0.7 miles per square mile. 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).

New roads constructed in drainages with existing roads would be expected to have less of an effect on harvest-related mortality risk than new roads entering undisturbed areas. Such effects could be mitigated to some extent through road closures. Open roads would be expected to have a greater effect than roads that are closed (either through storage or decommissioning) following their use (Person and Russell 2008). However, Person and Logan (2012) modeled the effects of such closures and found them to have little influence on mortality risk.

Currently, total road density below 1,200 feet elevation for National Forest System roads only on Prince of Wales Island is about 0.99 mile per square mile. The road densities in some WAAs exceed both the Forest Plan recommendation (0.7 to 1.0 mile per square mile) as well as the 1.5 miles per square mile suggested by Person and Russell (2008). There are five WAAs (1315, 1429, 1422, 1529, and 1530) that exceed the 1.5 miles per square mile and have higher mortality concerns. There are also WAAs 1003, 1525, and 1531 that exceed this road density, but where only the least level of wolf mortality concern (unsustainable harvest greater than or equal to three wolves per 300 square kilometers at least once) has been identified (WAAs 1003, 1525, and 1531).

There can be a high rate of illegal harvest on wolves. Person and Russell 2008 found that illegal take can approach about 46 percent of the total wolf mortality. The 46 percent was rounded up to 50 percent to estimate illegal take. The reported take was doubled because Person and Russell 2008 concluded that the illegal take may at times equal the legal harvest on Prince of Wales.

The project area is about 2.3 million acres (all lands) which equals to about 31 packs (300 square kilometers). When this value is multiplied by 3 for unsustainable harvest it equals about 93 wolves harvested and when multiplied by 7 this is about 217 wolves harvested. Reported harvest did not exceed the defined unsustainable harvest.

Double the legal harvest only exceeded unsustainable harvest once in 2004. When reported harvest was doubled, it exceeded unsustainable harvest in 2004, 2005, and 2013. No levels harvest exceeded the chronic unsustainable harvest levels.

Table 49. Reported Legal and Estimated Illegal Wolf Take in GMU 2 WAAs*

GMU 2			
Year	**Reported**	**+50%**	**2X**
2003	33	50	66
2004	77	116	154
2005	60	90	120
2006	38	57	76
2007	36	54	72
2008	38	57	76
2009	36	54	72
2010	24	36	48
2011	23	35	46
2012	20	30	40
2013	52	78	104
2014	30	45	60
2015**	7	11	14
2016	30	45	60
TOTAL	504	756	1008
Avg. take per year	36	54	72

*Harvests pulled from sealing data from ADF&G; J. Reeves; numbers rounded
**Season closed by ADF&G emergency closure

Environmental Effects

Road Density

Table 50 is a compilation of information from Person and Logan 2012. This table shows that there are several WAAs that have wolf mortality concerns but have low road densities (below 0.7 mile per square mile): WAAs 901, 1106, 1107, 1211, 1215, 1316, 1332, and 1526. All of these WAAs provide beach access for potential wolf harvest. This table also shows the following:

- WAAs, 1319, 1525, and 1531 have road densities above 0.7 mile per square mile, but have only the least level of wolf mortality concern, which is unsustainable harvest greater than or equal to three wolves per 300 square kilometers at least once.
- WAAs 902, 1105, 1108, 1209, 1210, 1213, 1323, and 1524 all have low road densities and low wolf mortality concerns.
- The remaining WAAs, 1003, 1214, 1315, 1317, 1318, 1420, 1421, 1422, 1527, 1528, 1529, and 1530, all have both high road densities and high wolf mortality concerns.
- WAAs 1104 (Forrester Island) and 1524 (Coronation Island) are not included, as neither WAA has any roads, though both provide beach access.

Adverse effects due to increased road density may occur in other WAAs that currently have less than 0.7 mile per square mile of road, but is less likely because of the current lower road densities in these WAAs. However, WAAs that would not have increased road density due to either being in Wilderness, LUD II or roadless are: 902, 1105, 1106, 1107, 1108, 1209, 1210, 1212, 1213, 1316, 1323, and 1524. WAAs 901, 1211, 1318, 1332, and 1528 are all near the 0.7 mile per square mile value, but less than 1.0.

Table 50. Wolf Mortality Risk 1985 to 2009 and Road densities by WAA

WAA	Unsustainable harvest1/	Chronic unsustainable harvest2/	unsustainable rates ≥10 years	pack turnover or pack depletion possible3/	high risk of pack depletion4/	risked pack depletion ≥5 times	Total Rd density5/ mi/mi^2	Area
901	X	X	X	X	X	X	0.6	Suemez
902	X	X	X	X	X		0	Outer Is.
1003	X	X		X	X		2.3	Heceta
1105	X						0	Dall
1106	X	X		X	X		0	Long Is.
1107	X			X	X		0.1	Nutkwa
1108	X						0	South POW Wilderness
1209	X						0	Bokan
1210							0	Moira
1211	X	X		X	X	X	0.5	Chasina
1212	X				X		0	Dr. Point
1213	X	X		X			0	Cholmondeley
1214	X	X		X	X		1.1	Polk
1315	X	X		X	X		1.9	Kasaan
1316	X	X		X	X	X		Maybeso*
1317	X	X	X	X		X	1.0	12 mile
1318	X	X		X	X	X	0.8	Craig
1319	X						1.1	N. Thorne
1323	X						0.2	Shinaku
1332	X	X	X	X	X	X	0.5	Trocadero
1420	X	X	X	X	X		2.0	Coffman
1421	X	X		X	X		1.4	Logjam
1422	X	X		X			1.9	Naukati
1524							0	Warren Is
1525	X						2.1	South Kosciusko
1526	X	X		X	X		0.2	North Kosciusko
1527	X	X		X	X		1.3	Calder
1528	X	X		X	X		0.7	Salmon Bay
1529	X	X		X	X		1.6	Lab Bay
1530	X	X		X			1.8	Whale Pass
1531	X						1.8	Tuxekan

1/ ≥3 wolves per 300 km^2 harvested at least once between 1985 and 2009
2/≥3 wolves per 300 km^2 harvested for ≥5 years
3/≥7 wolves per 300 km^2 harvested at least once between 1985 and 2009
4/ ≥7 wolves per 300 km^2 harvested for ≥2 years
5/ NFS roads only
*WAA 1316 Maybeso is missing information

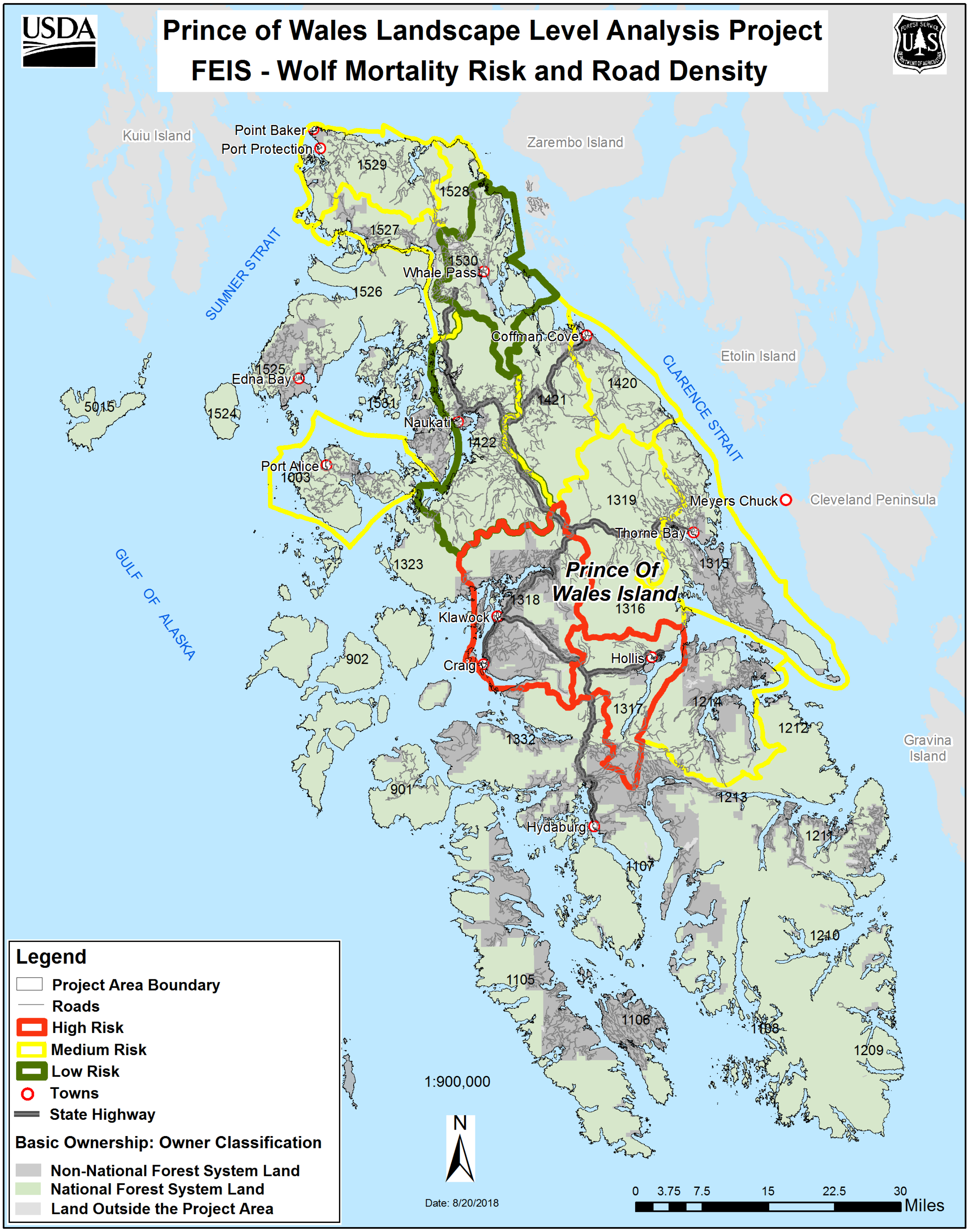

Figure 8. Wolf Mortality and Roads

WAAs Ranked by Wolf Mortality Concerns and Road Density

The following table only includes the WAAs that were identified as having a high risk of wolf mortality or high road densities, as defined in Person and Logan 2012. Not all WAAs are included in the following discussion because they either did not rate out as having a mortality concern or high

Table 51. Ranking of WAAs by Concern as Defined in Person and Logan 2012

Concern #1 – WAAs that have risked pack depletion (greater than or equal to seven wolves per 300 square kilometers for at least 2 years) at least five times from 1985 and 2009			
WAA	**Name /Location**	**Road Density mi/mi^2**	**Comments**
901	Suemez Island	0.6	Lower road density may indicate that most of the harvest is occurring from the beach.
1211		0.5	Chasina
1316	Maybeso Experimental Forest	No information	
1317	Twelvemile Arm	1.0	WAA may benefit from road management
1318	Craig	0.8	WAA may benefit from road management. Much of the land in this WAA is non NFS.
1332	Trocadero	0.5	
Concern #2 – WAAs that have experienced high risk of pack depletion (greater than or equal to seven wolves per 300 square kilometers) at least once from 1985 to 2009			
WAA	**Name /Location**	**Road Density mi/mi^2**	**Comments**
902	Outer Islands	0	No NFS roads
1003	Heceta	2.3	WAA may benefit from road management
1106	Long Island	0	No NFS roads
1107	Nutkwa	0	No NFS roads
1212	Dr. Point	0	No NFS roads
1214	Polk Inlet	1.1	WAA may benefit from road management
1315	Thorne Bay/Kasaan	1.9	WAA may benefit from road management
1420	Coffman Cove	2.0	WAA may benefit from road management
1421	Logjam	1.4	WAA may benefit from road management
1526	N. Kosciusko	0.2	Low NFS road density
1527	Calder	1.3	WAA may benefit from road management
1528	Salmon Bay	0.7	WAA may benefit from road management
1529	Lab Bay	1.6	WAA may benefit from road management
Concern #3 – WAAs that have experienced chronic unsustainable harvest (greater than or equal to three wolves per 300 square kilometers) for greater than or equal to 5 years from 1985 to 2009			
WAA	**Name /Location**	**Road Density mi/mi^2**	**Comments**
1422	Naukati	1.8	WAA may benefit from road management.
1530	Whale Pass	1.9	WAA may benefit from road management.
Concern #4 – WAAs that have experienced unsustainable harvest (greater than or equal to three wolves per 300 square kilometers) at least once from 1985 to 2009			
WAA	**Name /Location**	**Road Density mi/mi^2**	**Comments**
1525	Kosciusko Island (southern half)	2.1	Most of the land in this WAA is non NFS.
1531	Tuxekan Island	1.8	Almost all of the land in this WAA is non NFS.

road densities. See Table 51 for a relative ranking of the WAAs in the project area by the different levels of mortality concern, as defined by Person and Logan 2012.

Direct and Indirect Effects

The POW LLA Project proposes to harvest timber and build roads under all action alternatives, but it is unknown at this time where on the landscape this would occur; maps showing WAAs with wolf mortality concerns and potential road building and timber harvest are shown in Figure 7 and Figure 8. It is likely that timber harvest and road building would continue to occur on lands in other ownership.

Alternative 1

Alternative 1 would have no direct effects on wolves related to access; however, roads would be continued to be closed under the POW ATM. Closing roads would benefit wolves by reducing access for hunting and trapping.

Alternative 1 does not result in the loss of any old-growth habitat and, therefore, there is no reduction in the amount of currently available deep snow deer winter range, which is the most limiting factor for deer. The POW LLA Project Alternative 1 would not build any roads but would continue to close roads under the POW ATM, resulting in an overall decrease in road density at least on NFS lands. No old-growth harvest would occur under Alternative 1 resulting in no direct change to deer habitat capability; however, indirectly deer habitat capability would continue to decrease as acres in the stand initiation stage move into the stem exclusion stage. Some young-growth treatments would continue to occur under Alternative 1.

Alternative 2

Alternative 2 proposes to build about 35 miles of NFS road and 129 miles of temporary road at the project area scale. It is unknown where on the landscape the road building would occur.

Alternative 3

Alternative 3 proposes to build about 48 miles of NFS road and about 175 miles of temporary road at the project area scale. It is unknown where on the landscape the road building would occur.

Alternative 5

Alternative 5 proposes to build about 49 miles of NFS road and about 180 miles of temporary road at the project area scale. It is unknown where on the landscape the road building would occur.

Cumulative Effects

About 566 miles of road could be built on non-NFS lands. The effects of road building on non-NFS lands would increase the effects of road access on NFS lands.

WAAs 901, 1211, 1318, 1332, and 1528 are all near the 0.7 mile per square mile value, but less than 1.0 mile per square mile. All these WAAs have non-NFS lands within them as well. Road building in these WAAs would result in an increased negative effect to wolves due to the increased access that roads provide to hunters and trappers.

It is likely that road building would continue to occur on non-NFS lands. The road closures that would occur on NFS lands under the POW ATM could offset some the road building on non-NFS lands. Road building on non-NFS lands in WAAs that already exceed the 1.5 miles per square mile, the value suggested by Person and Russell 2008 to have little additional effect to wolf harvest rates, would be in WAAs 1003, 1315, 1420, 1421, 1422, 1525, 1529, 1530, and 1531.

Conclusion

Effects to wolves from reductions in deer habitat capability would occur under all alternatives. However, taking only NFS lands into account, long-term (stem exclusion) deer habitat capability would be similar under all action alternatives. When taking both NFS and non-NFS lands into account, deer habitat capability would be comparable under any of the alternatives. Project-related effects to deer habitat capability under the action alternatives, and reductions due to forest succession in previously harvested stands, have the potential to reduce the prey base for wolves. Accordingly, there would be some reduction in the ability of project area WAAs to maintain a sustainable wolf population, based on deer habitat capability alone.

Benefits to wolves in the project area would be provided indirectly (by improving habitat for deer) through young-growth management. Alternatives 2, 3, and 5 could also result in the commercial harvest of young-growth acres which could improve deer habitat quality.

Cumulatively, road densities may increase under all action alternatives and be similar under all alternatives. Road densities in many project area WAAs (below 1,200 feet elevation) currently exceed the Forest Plan recommended level of 0.7 to 1.0 mile per square mile for managing harvest-related morality risk, both when considering only NFS lands and all landownerships. Further increases in road density have the potential to increase wolf harvest mortality risk; however, Person and Russell (2008) concluded that road densities above 1.5 miles per square mile (0.9 kilometer per square kilometer) had little additional effect on harvest rates. Therefore, minor increases in road density under any of the alternatives would not be expected to substantially increase harvest risk because of existing road densities in the project area WAAs that are above this number. If wolf harvest levels appear unsustainable, ADF&G has the ability to implement a wolf harvest cap in GMU 2.

The proposed activities under the POW LLA Project would have no direct effect to wolves. The proposed activities would result in an indirect effect to wolves through the direct effects to deer habitat and increased access due to increased access for hunters and trappers.

Overall, indirect effects to wolves in WAAs where the estimated percentage of deep snow habitat remains above 50 percent and the road densities do not exceed 0.7 mile per square mile, could be the least of all WAAs impacted, due to level of habitat retention and low road densities.

In WAAs where the deep snow habitat drops below 20 percent habitat remaining and have a road density currently below 0.7 mile per square mile, and the POW LLA Project results in the road density exceeding this value, the effects to wolves would be greatest relative to WAAs with more deep snow habitat and lower road densities.

Of the WAAs in the project area, six are calculated to be in the ranking of greatest concern (#1) according to Person and Logan 2012. These are WAAs that have risked pack depletion (greater than or equal to seven wolves per 300 square kilometers for at least 2 years) at least five times from 1985 and 2009. Eight WAAs are included in Concern Level #2 for WAAs that have experienced high risk of pack depletion (greater than or equal to seven wolves per 300 square kilometers) from 1985 to 2009. The WAAs in Concern Level #1 is equal to 19 percent of the WAAs in the project area, and the WAAs in Concern Level #2 is equal to 58 percent of the project area. Two WAAs, about 6 percent of project area WAAs, are included in Concern Level #3; these are WAAs that have experienced harvest that could have resulted in pack turnover or pack depletion (greater than or equal to seven wolves per 300 square kilometers). Two WAAs (about 6 percent of project area WAAs) are in Concern Level #4, WAAs that have experienced unsustainable harvest (greater than or equal to three wolves per 300 square kilometers) at least once from 1985 to 2009. Overall, about 89 percent of the project area WAAs have some level of wolf mortality concern as defined by Person and Logan 2012.

The Conservation Strategy maintains old-growth associated species (marten, goshawks, flying squirrels). The Forest Plan determined that with the conservation strategy in place, even with full implementation of the Forest Plan, it would be expected to have a moderate to very high likelihood to maintain viable, well-distributed populations. For a complete review of the Forest Plan Conservation Strategy, refer to Appendix D of the 2016 Forest Plan Amendment FEIS, Appendix D of the 2008 Forest Plan FEIS, and Appendix N of the 1997 Forest Plan.

See conclusion discussion above under deep snow deer winter range for effects to deer.

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 Migratory Bird Treaty Act (MBTA), the Bald and Golden Eagle Protection Act, and other pertinent statutes. Agencies are required to avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions (Forest Plan FEIS pp. 3-242 to 3-245).

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 below. 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.

The main management issue for some migratory birds 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). Of these species, 14 use hemlock/spruce/cedar forest (both old-growth and young-growth) as primary habitat (Forest Plan FEIS pp. 3-242 to 3-245).

Migratory and Resident Birds Identified as Species of Concern in Southeast Alaska

The 2016 Forest Plan Amendment FEIS, Table 3.10-6 pp. 3-244-245 lists migratory birds for the Tongass from the Boreal Partners in Flight Landbird Conservation Plan for Alaska Biogeographic Regions (1999). The species that may occur in POW LLA project area include the following: western screech-owl (*Megascops kennicottii*), black swift (*Cypseloides niger borealis*), Vaux's swift (*Chaetura vauxi*), rufous hummingbird (*Selasphorus rufu*s), red-breasted sapsucker (*Sphyrapicus ruber*), olive-sided flycatcher (*Contopus cooperi*), western wood-peewee (*Contopus sordidulus*), Hammond's flycatcher (*Empidonax hammondii*), Pacific-slope flycatcher (*Empidonax difficilis*), Steller's jay (*Cyanocitta stelleri*), northwestern crow (*Corvus caurinus*), chestnut-backed chickadee (*Poecile rufescens*), American dipper (*Cinclus mexicanus*), varied thrush (*Ixoreus naevius*), Townsend's warbler (*Dendroica townsendi*), blackpoll warbler (*Dendroica striata*), McGillivray's warbler (*Oporornis tolmiei*), golden-crowned sparrow (*Regulus satrapa*), and golden-crowned kinglet (*Zonotrichia atricapilla*).

Conclusion

All of the action alternatives would result in a reduction of perching, foraging, and potential nesting habitat and an 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. However, reductions in this 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. Species associated with early successional habitat, such as the McGillivray's warbler, golden-crowned sparrow, and golden-crowned kinglet, may benefit through increases in suitable habitat over the short term from timber harvest. All migratory bird species would benefit from the transition to young-growth harvest proposed under the Forest Plan due to the reduced POG harvest.

See discussion above under the various habitat types: POG, HPOG, and SD67.

Under all alternatives, migratory bird habitat would be maintained by the Forest Plan Conservation Strategy, and the Legacy Forest Structure Standard and Guideline.

Environment and Effects for Other Resources

The following sections describe the environmental effects of each of the alternatives as they relate to other resources for this project. Concerns, suggestions, and design recommendations are discussed as they relate to the project's affected environment and potential effects of the alternatives on resources.

Botany

This section provides a summary of existing conditions for sensitive and rare plants in the POW LLA project area. No proposed or federally listed plant species are known on the Tongass National Forest.

Methodology

Geographic Information Systems (GIS) information, Alaska Natural Heritage Program (ANHP) rare plant list, and on-line herbaria searches all were used to determine the present locations of sensitive and rare plants in the project area. Prior to implementation a qualified Botanist/Ecologist must conduct a site-specific review to determine if the activity location has the potential to support any Region 10 sensitive plants or Tongass National Forest rare plants.

Spatial and Temporal Context for Analysis

The spatial boundaries for analyzing the direct, indirect, and cumulative effects to sensitive and rare plants is Prince of Wales Island and the neighboring islands that make up the Thorne Bay and Craig Ranger districts. Forests and other habitats of the southwestern Tongass contain similar dominant tree species and the various non-forested plant communities. Additionally, a sizable proportion of the documented sensitive and rare plant populations from the Tongass National Forest occur in the southwestern region of the Alexander Archipelago.

The temporal boundary for direct effects to sensitive and rare plants is short term, such as immediately after project implementation. The indirect and cumulative effects temporal boundary is short and long term, such as within a few days after disturbance, but also can be up to several years after project implementation before deleterious effects are evident in relation to sensitive and rare plant populations. To measure effects of management activities on sensitive and rare plants, a qualitative evaluation is used to assess how much natural vegetation has grown back at a site that has been disturbed, if invasive or native plants have become established or not, and if soil or other substrates for vegetation remain unchanged or are restored to pre-activity conditions.

Incomplete or Unavailable Information

The documented occurrences of sensitive and rare plants are associated with surveys from past project activities including two recent rare plant studies that focused on potential habitat on the northern portion of Prince of Wales Island (Meridian Environmental 2011, 2014). Comprehensive habitat surveys have not been conducted for sensitive and rare plants within the entirety of the project area and it is likely that additional populations occur in un-surveyed areas.

Affected Environment

Sensitive Plants

There are 17 plant species and 1 lichen designated as sensitive on the Alaska Regional Forester's list; 16 of these are known or suspected to occur on the Tongass National Forest. Six of these species have been documented within the project area. The project area is within the potential range of an additional 5 species, which are suspected to occur within the project area. Table 52 summarizes the general habitat requirements of the 11 sensitive species that are either known or suspected to occur within the project area.

Table 52. 2009 Alaska Region Sensitive Plants Known or Suspected to Occur Within the Project Area[1]

Common Name (*Scientific Name*)	**Range and Habitat[2]**
Spatulate moonwort (*Botrychium spathulatum*)	Habitat includes coastal forests, stabilized coastal dunes, upper beach meadows, well-drained open areas, alpine habitats, and riparian forests. **Suspected** in project area.
Moosewort fern (*Botrychium tunux*)	Moosewort fern grows on upper beach meadows, coastal dunes, stream terraces, river bars and subalpine and alpine slopes. **Suspected** in project area.
Large yellow lady's slipper (*Cypripedium parviflorum* var. *pubescens*)	On the Tongass, this orchid grows in peatlands on calcareous substrates (USDA Forest Service 2015a). There are five **known** populations of large yellow lady's slipper on the Tongass, all within the project area on northern Prince of Wales Island (Carlson & Fulkerson 2017a).
Calder's lovage (*Ligusticum calderi*)	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 (*Ricasolia amplissima* ssp. *sheiyi*)	There are 10 **known** populations on National Forest System lands on Prince of Wales and the surrounding islands. This lichen grows on trunks and main branches of Sitka spruce, Pacific crab apple (*Malus fusca*), and western hemlock in old-growth beach buffer forest (K. Dillman *et al.* 2017).
Alaska rein orchid (*Platanthera unalascensis*)	This plant is **known** from 17 populations on the Tongass, with 9 on the Thorne Bay Ranger District. 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 (Nawrocki *et al.* 2017).
Lesser round-leaved orchid (*Platanthera orbiculata*)	In Alaska, it grows in low elevation forested wetlands, medium to high volume old-growth hemlock forests with high bryophyte cover and a redcedar component, forest edges or near gaps in shady forests, and near muskegs, open water, or boggy areas (Fulkerson *et al.* 2017). There 22 populations **known** in the project area (Fulkerson *et al.* 2017).
Kruckeberg's swordfern (*Polystichum kruckebergii*)	Habitat includes open ultramafic rock outcrops. **Suspected** in project area.
Unalaska mist-maid (*Romanzoffia unalaschcensis*)	This plant grows on ledges and crevices in rock outcrops and in gravelly areas along stream banks, often along coasts. There are two **known** populations on the Tongass, both on the Thorne Bay Ranger District.
Henderson's checkermallow (*Sidalcea hendersonii*)	On the Tongass, the one documented population grows at the upper edge of an upper beach meadow near the edge of a hemlock and spruce forest (USDA Forest Service 2015a). **Suspected** in project area.
Dune tansy (*Tanacetum camphoratum*)	Habitat for this species includes upper beaches, sand dunes, and well drained and calcareous soils. **Suspected** in project area.(Carlson & Fulkerson 2017b)

[1] Sensitive Plant list updated February 2009. Currently being updated in 2018.
[2] Range, habitat, and occurrence information, unless otherwise noted, based on USDA Forest Service 2009; Carlson & Fulkerson 2017 a&b, K. Dillman *et al.* 2017, Fulkerson *et al.* 2017, and Nawrocki *et al*. 2017

Rare Plants

Rare plants have similar protection in the Forest Plan as sensitive plants. Rare plant species known or suspected to occur on the Tongass National Forest are evaluated based on a list derived from the

Alaska Natural Heritage Program (ANHP; USDA Forest Service 2009). Included are species with a State Ranking of S1 (critically imperiled in the state), S2 (imperiled in the state), or occasionally S3 (rare within the state), excluding species that are already listed as Sensitive on the Tongass National Forest. The list may change with plants added or dropped as additional information on plant distribution and taxonomy is learned. The following rare plants have been documented within the project area and are included as examples of species that may be encountered during Implementation Plan surveys: subalpine fir (*Abies lasiocarpa*), silver bur ragweed (*Ambrosia chamissonis*), maidenhair spleenwort (*Asplenium trichomanes*), moonwort (*Botrychium* spp.), watershield (*Brasenia schreberi*), northern golden saxifrage (*Chrysosplenium tetrandrum*), fragile rock brake (*Cryptogramma stelleri*), mountain bladderfern (*Cystopteris montanum*), boreal bedstraw (*Galium kamtschaticum*), slender-spiked mannagrass (*Glyceria leptostachya*), sickle leaf rush (*Juncus falcatus* var. *sitchensis*), broadlipped twayblade (*Listera convallarioides*), twinberry honeysuckle (*Lonicera involucrata*), inundated clubmoss (*Lycopodiella inundata*), tree groundpine (*Lycopodium dendroideum*), adder's tongue orchid (*Malaxis* spp.), Alaska oniongrass (*Melica subulata*), cleftleaf ragwort (*Senecio moresbiensis*), Pacific ninebark (*Physocarpus capitatus*), white piperia (*Piperia candida*), looseflower bluegrass (*Poa laxiflora*), straightbeak buttercup (*Ranunculus orthorhynchus* var. *alaschensis*), rannoch-rush (*Scheuchzeria palustris*), swaying bulrush (*Scirpus subterminalis*), and Pacific yew (*Taxus brevifolia*).

Environmental Effects

Alternative 1 – No-Action

Direct and Indirect Effects

No new activities are proposed under Alternative 1. Therefore, Alternative 1 would result in the least direct and indirect effects to sensitive and rare plants for this project. Under Alternative 1, none of the specific management activities proposed in the FEIS would be implemented to accomplish project goals and objectives. However, natural disturbances and current management of the project area would continue as before. Ongoing activities such as recreation, firewood gathering, road and trail maintenance, and other routine forest management activities not associated with this decision would continue at current levels. This alternative does not meet the purpose and need for this project.

Under the No-Action Alternative 1, invasive plant infestations would continue to be treated by manual and mechanical methods under an integrated pest management approach, as provided in the Forest Plan for invasive species. Treatment of infestations by chemical methods would also occur at current levels in areas authorized under an existing Categorical Exclusion (CE) for five administrative and recreation sites within the project area (36 CFR 220.6 (d) (3) and (6)).

Cumulative Effects

The Forest Plan direction for invasive plant management (USDA Forest Service 2016a) includes a provision for reviewing the implementation and effectiveness of conservation actions for sensitive and rare plants. This review provides information to improve conservation efforts and reduce the likelihood of adverse effects to sensitive and rare plant species due to management actions. Under Alternative 1, the effects to previously documented sensitive and rare plant populations or their habitats have been analyzed under past NEPA decisions. No additional cumulative effects to sensitive and rare plants on NFS lands are anticipated.

Conclusion

There are no significant direct and indirect effects to sensitive and rare plants. No additional cumulative effects are anticipated.

Alternatives 2, 3, and 5

A review of the habitat and a possible site visit to survey for sensitive and rare plants will be conducted as part of the Implementation Plan for all activities for all proposed actions. The process of a pre-field review will include sufficient detail to determine if sensitive and rare plant species are present or their habitat. The intensity and scope of inventories selected to provide information are required to be commensurate with the potential risk of a proposed project to sensitive and rare plant species. The review is used to evaluate project-level impacts to sensitive and rare 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 Planning Area (the Tongass National Forest). In addition, existing Forest Plan direction will be applied to avoid or minimize impacts to sensitive and rare plants and their habitat. If sensitive plants are found, the botanist will evaluate the survey results for consistency with the determination of effects in the EIS for any sensitive taxa found in the project area and document. Mitigation actions may be required to be consistent with the May Affect or No Effect determination for sensitive plants found in a project area (USDA Forest Service 2016a, p. 4-39, PLA1.II).

Direct and Indirect Effects

Direct and indirect effects are not expected to occur on the known populations of sensitive and rare plants in the project area on NFS lands (K. Dillman 2018b). Botanical review of the proposed activity including field surveys and assignment of appropriate mitigation measures will occur before activities begin in all the alternatives. The direct and indirect effects for those populations not yet discovered, or undocumented sensitive and rare plant populations within other landownerships include possible changes in species abundance and/or distribution as a result of disturbance, light change, and/or moisture changes that may be caused by proposed activities.

Cumulative Effects

For this analysis, past, present, and reasonably foreseeable future timber harvest and road construction for forestry and other uses and development on all land ownerships within the project area boundary were considered to qualitatively compare the risk that the action alternatives would add to cumulative effects to sensitive and rare plants. Considering present and reasonably foreseeable future actions in the project area on NFS lands, as well as on and state and private lands, cumulative effects may occur to the species that inhabit old-growth forests such as *Platanthera orbiculata* and *Platanthera unalascensis*. Old-growth habitat will have the most direct and indirect disturbance over the life of this project compared to other sensitive and rare plant habitats in the project area. The effects of land exchanges will compound these effects with the assumption that old-growth habitat would likely be harvested over the short and long term. Therefore, Alternative 3 has the most potential for cumulative effects with the most proposed timber harvest acreage, followed in decreasing potential by Alternatives 5 and 2. Proposed road building has the potential to affect sensitive and rare plant habitat as well. The greatest cumulative effects to sensitive and rare plants due to proposed road construction are possible in Alternative 5 followed by Alternatives 3, and 2.

Present and future non-timber activities within the project area have not had or are not expected to have cumulative effects to sensitive and rare plant populations. Lack of cumulative effects is due to the small footprint size of many of these types of activities (trails, restoration, etc.), along with implementation of appropriate mitigation measures as needed through future botanical surveys for sensitive plants before project initiation.

Impacts to sensitive and rare plant habitat cannot be completely avoided since most proposed actions include some ground-disturbing activities. Therefore, the Forest Service acknowledges the importance of maintaining habitat through a network of old-growth reserves and conservation areas within the Planning Area. Please see the Biodiversity section of Chapter 3 of the Forest Plan (USDA Forest Service, 2016c), which describes the Conservation Strategy for the Tongass National Forest. In addition to certain old-growth forest ecosystems, this reserve system embodies the full spectrum of habitat types where sensitive and rare plants are known or suspected to occur within non-development LUDs (*e.g.*, wilderness areas). In addition, other areas that are protected either through legislation or by Forest Plan direction, including TTRA stream buffers, Riparian Management Areas and beach and estuary buffer, also represent high value habitat for some sensitive and rare plant species. The full suite of conservation areas embodied in the Tongass Conservation Strategy contains areas of potential habitat for all 10 sensitive plants and one lichen on the Regional Forester's list and those rare plants known to occur in the project area.

Additionally, timber harvesting on state, municipal, and private land is governed by the Alaska Forest Resources and Practices Act (Alaska Statute 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 in these habitats.

Conclusion

Based on the rationale described above, the relative impacts from the alternatives and determinations for sensitive plant species are summarized in Table 53 by plant taxon and alternative. The 11 sensitive species in the project area have a low to moderate risk[5] to be affected in all the alternatives; no alternative would result in a trend toward federal listing. See Biological Evaluation for Sensitive Plants (K. Dillman 2018b) in the project record for risk assessment of each sensitive plant taxon.

Table 53. Summary of the relative impacts of the alternatives and determinations for sensitive plant species in the project area.

Species	Relative Impacts of the Alternatives	Alternative 1	Alternative 2, 3, and 5
Spatulate moonwort	1<3<5<2	No Effect	May Affect
Moosewort fern	1<3<5<2	No Effect	May Affect
Large yellow lady's slipper	1<3<5<2	No Effect	May Affect
Calder's lovage	1<3<5<2	No Effect	May Affect
Ricasolia amplissima ssp. *sheiyi* lichen	1<3<5<2	No Effect	May Affect
Alaska rein orchid	1<3<5<2	No Effect	May Affect
Lesser round-leaved orchid	1<3<5<2	No Effect	May Affect
Kruckeberg's swordfern	1<3<5<2	No Effect	May Affect
Unalaska mist-maid	1<3<5<2	No Effect	May Affect
Henderson's checkermallow	1<3<5<2	No Effect	May Affect
Dune tansy	1<3<5<2	No Effect	May Affect

[5] Risk is determined using Region 10 Sensitive Plant Risk Assessment Process for Plant Biological Evaluations

Cultural Resources

This section provides a summary of existing conditions and an analysis of environmental effects for cultural resources in the POW LLA project area.

The National Historic Preservation Act (NHPA) and implementing regulations (36 CFR 800) define “historic properties” as districts, sites, buildings, structures, and objects included in, or eligible for, the National Register of Historic Places (NRHP). The NRHP is the Nation’s inventory of significant historic places. Section 106 of the NHPA is used to inform the NEPA process and requires federal agencies to consider the effects of their actions on historic properties. Section 106 also requires consultation with tribes, the State Historic Preservation Officer (SHPO), and in some instances the Advisory Council on Historic Preservation (ACHP) to ensure that historic properties are not adversely affected by federal undertakings, and if they are, that appropriate mitigation is completed.

The NEPA definition of “cultural resources,” by contrast, encompasses both eligible and non-eligible cultural resources, including districts, sites, buildings, structures, and objects. The definition of cultural resources may also include sacred sites, traditional cultural properties, and other areas that are culturally important to stakeholders, including tribes. This FEIS evaluates effects to eligible and non-eligible cultural resources within the POW LLA project area.

Methodology

The preparation of the POW LLA Project FEIS is considered an undertaking within Section 106 (and implementing regulations at 36 CFR 800) of the National Historic Preservation Act. As a planning document, it has been determined to have no potential to affect historic properties in accordance with the *2017 Programmatic Agreement Among the USDA Forest Service, Alaska Region, the Advisory Council On Historic Preservation, and the Alaska State Historic Preservation Officer Regarding Heritage Program Management On National Forests in the State Of Alaska* (PA; USDA Forest Service, 2017) Appendix B.I. Administrative Actions.

However, activities (referred to in this section as “undertakings”) implemented based on this FEIS may have potential effects to cultural resources. Undertakings are defined under 36 CFR 800.16(y) as being a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring Federal permit, license or approval.

Undertaking-specific details are presently lacking for Section 106 analysis and a finding of effect cannot be made at this time. Once specific undertakings are identified, Section 106 procedures shall be followed in order to determine whether historic properties exist, and whether they will be affected. The Forest Service shall review each future proposed undertaking within the POW LLA project area on a case-by-case basis. The Record of Decision (ROD) shall document that Section 106 procedures are not concluded with the signing of the ROD and that no new activities (undertakings) would be authorized without Section 106 procedures being completed.

As undertakings are developed the Forest Service may use either the PA or standard Section 106 procedures, whichever is applicable. The PA utilizes an alternative approach to the standard Section 106 procedures. It is authorized for use in undertakings with findings of “no historic properties affected” or “no adverse effects.” Standard Section 106 procedures apply to undertakings with findings of “adverse effects.”

As discrete undertakings are identified, the Heritage Professional will identify the Area of Potential Effects (APE), and then will determine whether the area has been adequately investigated for historic properties.

Heritage Professionals use probability zones during an undertaking's implementation phase to determine what level of identification effort is required. Probability zones are defined as areas of land where the probability that a cultural resource will be discovered is either "high" or "low" based on models that take into account geology and history of those areas. The basic premise is that areas with suitable habitat or resources, both currently and in the past, are more likely to have cultural resources than areas without suitable habitat or resources.

Survey strategies are defined in the PA (USDA Forest Service, 2017: Appendix D). If the probability of encountering cultural resources is low (low probability area/zone), the Heritage Professional may rely on literature reviews and other non-field research, and shall use their best professional judgement in deciding what, if any, level of field survey is deemed necessary. The need for intensive survey within the low probability zone shall be determined on a case-by-case basis. If the probability of encountering cultural resources is high (high probability zone), the Heritage Professional may conduct an appropriately designed survey of all locations of direct, indirect, and cumulative impact in the undertaking's APE. Cultural resource surveys performed specifically for compliance with NHPA or NEPA shall be designed and executed in such a manner as to demonstrate that a reasonable and good faith effort has been made to locate historic properties in the APE. Tribal consultation shall take place, when appropriate, to determine whether scared sites or traditional cultural properties exist within an undertaking's APE.

If a cultural resource is identified within an undertaking's APE, the Heritage Professional shall follow provisions within the PA (USDA Forest Service 2017) for treating the resource as eligible or apply the "Criteria for Evaluation" (36 CFR 60.4), in consultation with the SHPO to determine eligibility. Cultural resources found to retain integrity and meet eligibility Criteria are considered *historic properties.* It is the Forest Service's policy to protect and/or mitigate adverse effects to historic properties (USDA Forest Service 2016a p. 4-17, HSS1.IV; FSM 2360.3). If a cultural resource is determined not eligible to the NRHP, it may still warrant protective measures (such as sacred sites, or ethnographically important sites that are generally not eligible). Such determinations shall be made by the Heritage Professional on a case-by-case basis in consultation with the SHPO and Tribal representatives.

As undertakings are developed, should a determination be made that an undertaking will have an adverse effect on historic properties, Standard 106 procedures at 36 CFR 800.5 shall be followed including consultation with the SHPO, and potentially the ACHP. A Memorandum of Agreement or a Programmatic Agreement may be prepared to mitigate adverse effects. At every step in the Section 106 process there shall be ongoing consultation with federally recognized tribes, non-federally recognized tribes, ANCSA corporations, certified local governments, and other interested parties.

Spatial and Temporal Context for Analysis

The POW LLA project area includes all NFS lands within the Thorne Bay and Craig Ranger Districts on Prince of Wales Island and the surrounding islands, and non-NFS lands between Township 64 South and Township 83 South, and between Range 71 East and Range 90 East, Copper River Meridian, North American Datum 1983. Cultural resources within the POW LLA project area shall be analyzed for the purposes of this FEIS.

For cultural resources, historic context is of paramount importance in evaluating a cultural resource for eligibility to the NRHP. The historic context is equated with the POW LLA project area's affected environment for the purpose of analyzing the potential effects to cultural resources.

The Alexander Archipelago, Queen Charlotte Islands, and the narrow mainland coast of Southeast Alaska and northern British Columbia are the ancestral homeland of the Tlingit, Haida, Tsimshian, Eyak, and Tsetsaut peoples. The POW LLA project area lies within the traditional territory of the Klawock and Stikine Tlingits, and the Kasaan and Hydaburg Haida (Goldschmidt and Haas 1998). The Tlingit and Haida settlement system consisted of occupying at least one main village during the winter and moving to the outer islands as seasons progressed. This settlement pattern is reflected in the site types that include, but are not limited to, petroglyphs and fish traps, shell middens, winter/summer village sites, seasonal habitation sites, food processing sites, petroglyphs and pictographs, lithic manufacture area, culturally modified trees (CMT), and human burials.

Significant Euro-American impact on the Tlingit and Haida people's subsistence activities were not experienced until the late 1870s. In Klawock the first cannery was established in 1878, and a school with a teacher in 1886.

Site types that represent the fishing industry today include canneries, salteries, smokehouses, moorage locations, and subsistence fishing camps.

Trapping and fox fur farming is represented throughout the project area by historic cabins and ruins, fox farm remains, and trapping lines.

In 1907, President Roosevelt established the Tongass National Forest and consolidated it with the Alexander Archipelago Forest Reserve, which had been previously established in 1902.

The early timber industry is represented by two types of lumber mills: town-based lumber mills, which produced hewn wood for local use, and mills associated with building salmon canneries and mines.

Growth in Southeast Alaska's industries and communities spurred a need for specialty services such as U.S. Coast Guard rescue response infrastructure and navigational features, as well as increased radio-communication facilities near ports and remote camps.

Prospecting and mining activities began in 1867 and are represented in the historic record at the mines at Jumbo Mountain and on the Kasaan Peninsula, a local smelter at Hadley, Prince of Wales Island, at the Salt Chuck Mine, and at Tokeen, Calder, and El Capitan where marble deposits were quarried. During the Cold War the initial development and implementation of nuclear power was begun. To spur the discovery and development of new uranium deposits, the United States Atomic Energy Commission offered incentives to the mining industry. A direct result of this was the establishment of the Ross-Adams Mine in 1955 on the southeast tip of Prince of Wales Island (Dean and Marshall 2010).

Affected Environment

There are 866 cultural resources recorded within the POW LLA project area. These sites are predominantly prehistoric in nature with some dating to over 10,000 years before present (YBP). These sites are typically identified between the beach fringe and 120 feet above mean lower low water (MLLW).

Historic site types (sites dating from 50 years of age to European contact), can generally be found in predictable locations. For example, historic sites such as canneries, salteries, fur farms, marine access facilities, fur and fish processing stations, older Forest Service infrastructure, U.S. Coast Guard infrastructure, and logging camps are typically observed between the beach fringe and 100 feet of shore, and along the mouth of larger freshwater creeks and large-body lakes. Archaeologists commonly find logging equipment near logging camps, marine access facilities, and at the end of roadways at all elevations. Radio-communication infrastructure has been identified between the coastline and mountain tops. Rare earth element mines such as gold, copper and uranium are identified between the beach fringes and the alpine, and are most commonly found at the southern and northwestern ends of Prince of Wales Island.

Many cultural resources identified within the project area have been impacted to some degree by natural disturbances or anthropogenic activities. Cultural resources in the project area range from being relatively intact (good condition) to heavily disturbed (poor condition). Cultural resources in good condition are potentially eligible for the NRHP, provided they retain certain elements of integrity (36 CFR part 63).

Environmental Effects

For the purposes of this section all culturally significant features and items, regardless of NRHP-eligibility, shall be called cultural resources.

Alternative 1 – No-Action

Direct and Indirect Effects

The No-Action Alternative would not result in direct or indirect effects to cultural resources because no new activities would occur and existing conditions would remain unaffected. Natural disturbances and current management of the project area would continue as before.

Cumulative Effects

Implementation of the No-Action Alternative would not contribute to cumulative effects to cultural resources because no new activities would occur.

Alternatives 2, 3, and 5 – Action Alternatives

Effects Common to all Action Alternatives

Because the effects analysis covers a large area and the exact location and nature of the activity for proposed projects are undeveloped, specific effects cannot be analyzed except under general terms and policy. All alternatives that include ground-disturbing activities have the potential to adversely affect cultural resources if they are carried out in locations of cultural resources. Some activities, such as dispersed camping in undeveloped areas using Leave No Trace principles, may have no adverse effect to cultural resources even if carried out in the vicinity of cultural resources. Additionally, some activities, such as manual or herbicidal invasive plant treatments, may be considered an authorized undertaking under the terms of the PA (USFS 2017: Appendix B). Proposed activities under all action alternatives and a summary of potential effects to cultural resources can be found in the project record.

Direct and Indirect Effects

The direct and indirect effects an activity has on cultural resources is determined largely by the location and nature of the activity, the characteristics of the soils, and the degree of use the area will receive. Large-scale changes to the landscape affect the integrity of a cultural resource, including its historic setting and feeling of association, which in turn affects its NRHP-eligibility.

Ground-disturbing activities have the most potential to directly affect cultural resources. Timber harvesting, mining, stream restoration, and road construction have the potential to affect cultural resources or sacred sites through alteration of environmental settings, which affects the integrity of location and setting, or direct damage or destruction as projects are implemented. Movement of material over the ground surface and excavating stream banks can negatively affect buried cultural resources by disturbing the context of the deposit. Some trees are considered cultural resources, namely those that have been modified by humans. Examples include bark stripping for textile manufacture or cutting a notch in the trunk for a trap set. Recreation and public use may destroy cultural sites or sacred sites inadvertently or by intent. Inadvertent damage primarily results from site access and consists of compaction and other ground disturbing activities. Intentional damage is defined by looting and vandalism activities and includes relic collecting, theft, and defacement, which result in the loss of information and destruction of the resource.

Indirect effects include those that are initiated by, and may be unintended consequences of, the activity. For example, along the margins of timber harvest units, trees are more likely to blow down in windstorms, potentially upending and damaging prehistoric sites. The installation of new public facilities and/or access into the Forest may increase visitor use to nearby cultural resources resulting in looting or damage. Indirect effects cannot always be anticipated, particularly for as yet identified cultural resources.

Cumulative Effects

Cumulative impacts to cultural resources may result from ongoing and increasing encroachment on cultural resources. Increasing access to formerly remote and relatively protected cultural resources increases the chance that adverse impacts will occur without direct intervention and preservation. Congressionally legislated land exchanges may, or may not, have an adverse effect on historic properties. For NFS land exchanges to the State, state historic preservation laws will govern the transfer of any historic properties out of NFS ownership, thereby mitigating any potential effects. A review of a catalog of events showing present and reasonably foreseeable future activities indicates type of projects that may occur in the project area that have a ground disturbing or reconstruction component. Past activities have generally been modified to avoid impact to cultural resources. If discovered unintentionally, practices have focused on mitigating adverse effects to the best foreseeable outcome.

Invasive Plants

This section provides a summary of existing conditions and effects of proposed activities on the introduction or spread of invasive plants in the POW LLA project area as a result of proposed activities, such as timber harvest, road construction, watershed restoration activities, and/or recreation activities or other ground disturbing actions. The specific analysis of invasive plant treatment methods (manual, mechanical and chemical) are discussed further in Issue 1: Invasive Plant Management because it was specifically identified a project issue. 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 [EO] 13112).

Methodology

Geographic Information Systems (GIS) information, Alaska Exotic Plants Information Clearinghouse (AKEPIC) invasive plant list, and online herbaria searches all were used to determine the present locations of invasive plants in the project area. Prior to any specific project implementation a qualified Botanist/Ecologist must conduct a site-specific review and risk assessment to determine if the activity location has the potential to spread existing invasive plants.

Spatial and Temporal Context for Analysis

The spatial boundaries for analyzing the direct, indirect and cumulative effects is Prince of Wales Island and the neighboring islands that make up the Thorne Bay and Craig Ranger Districts. The spatial boundary for effects of proposed road construction are increased with a buffer within the road corridor by 12 feet on either side of road bed where invasive plants occur, for a total of 50 foot wide linear feature that is converted to acres. The invasive plant treatment activity of this project also includes non-National Forest System lands in the analysis area to allow a comprehensive approach to weed management, and enable future partnerships with other landowners if funding becomes available to local communities through federal grants or other initiatives.

The temporal boundary for direct effects is short term (days), such as immediately after project implementation. The indirect and cumulative effects temporal boundary is short and long term, such as within a few days after disturbance, but also can be up to several years after project implementation before deleterious effects are evident in relation to invasive plant introduction and spread. Units of measure are how much natural vegetation has grown back at a site that has been disturbed, if invasive plants have become established, re-established, or have spread, or if soil or other substrates for vegetation remain unchanged or are restored to pre-activity conditions.

Because of the difficulty in estimating the amount of disturbance that will be caused by each alternative, a relative estimate of total acres is used to compare each alternative’s potential for establishment and spread of invasive plants. However, it should be noted that the acres of actual disturbance is many times greater than the soil disturbance that would result from these activities. Road construction is a direct source of soil disturbance; therefore, total miles or acres of road construction may be interpreted as a relatively accurate account of the level of soil disturbance created as a result of this activity.

Affected Environment

Undeveloped lands in the project area have relatively few invasive plant infestations. Known infestations are primarily in areas that have experienced previous disturbance, such as along roads, rock pits, and log transfer facilities, at recreation sites and within some riparian areas. Alaska has been relatively insulated from the introduction and subsequent problems that invasive plants have caused other states. However, existing infestations of weeds are spreading and new introductions are increasingly being discovered.

Current Inventory of Non-native Plants

The main sources of invasive plant data in the project area are the USFS Natural Resource Manager (NRM-INVP) and the State of Alaska's Exotic Plants Information Clearinghouse (AKEPIC). The inventory data is primarily based on a 2005 roadside inventory with a limited amount of detailed surveys that occurred during clearances for other program activities, namely timber sale projects, wilderness monitoring, recreation facilities inspections, and special use permit applications. Field inventories have identified 92 different non-native plant species infesting approximately 2,288 acres within the boundaries of the project area (Krosse 2018d).

Invasive Plant Transportation Vectors

Roads are conduits for the spread of weeds, facilitating their rapid transport and dispersal (*e.g.*, by seeds and vegetative reproductive parts attached to vehicles), and providing disturbed ground and altered habitat for easy colonization and establishment of invasive plants. Roads and trails may also serve to introduce weeds into areas with intact native plant communities and where ecological integrity are highly valued. The road system across the project area is concentrated around communities and in areas where extensive timber harvest has previously occurred, such as the northern and central portions of Prince of Wales Island as well as Kosciusko, Heceta, and Suemez Islands.

Timber harvest, road building, and other ground-disturbing activities contribute to the spread of weeds, as the habitat conditions that facilitate colonization are created, such as changes in sunlight from forested conditions to open sun and/or soil disturbance that result from these activities. Recreation activities (*e.g.*, hiking, camping) can spread weeds along trail systems and at both remote and developed recreation sites. In addition, weeds are spread through the movement of water in creeks and across wetlands. Floods move weed seeds and materials into adjacent riparian areas. Wind and sea wave action may also move lightweight and/or buoyant seeds long distances to infest new areas.

Intentional and accidental introductions have primarily occurred over the past century, but major introductions have occurred most rapidly over the past 50 to 60 years. Intentional introductions of weeds for erosion control have contributed to a number of infestations that are now targets for control. Commercial landscape nurseries or other vendors (such as grocery and hardware stores in local communities) sell, or once sold, exotic species for domestic landscaping that have later been found to be invasive. While most ornamental plants have not yet spread to federal lands, the potential for them to do so exists.

Invasive Plant Management Activities

Invasive plant infestations have been treated via manual methods (hand pulling, digging, or tarping) in previous years, with a very minor amount of herbicide treatment at selected administrative and recreation sites (36 CFR 220.6 (d) (3) and (6)). The total acreage of treatments since 2010 is 337 acres with the annual accomplishments varying based on available funding and project workload. Annual targets mainly prioritize re-treating existing infestations. While some treatments have been effective at reducing or eradicating infestations, many treatments have been repeated at the same location over multiple years. This has occurred due to ineffective treatment methods and the appearance of new plants from a persistent seed bank at some infestation sites.

Environmental Effects

Alternative 1 – No-Action

Direct and Indirect Effects

No new activities are proposed under Alternative 1. Therefore, Alternative 1 would result in the least direct and indirect effects from invasive plants for this project. Under Alternative 1, none of the specific management activities proposed in the FEIS would be implemented to accomplish project goals and objectives. However, natural disturbances and current management of the project area would continue as before. Ongoing activities such as recreation, firewood gathering, road and trail maintenance, and other routine forest management activities not associated with this decision would continue at current levels. This alternative does not meet the purpose and need for this project.

In all alternatives, the continued use of categorical exclusions (CE) (36 CFR 220.6 (d) (3) and (6)) is anticipated to continue to allow limited treatment of invasive plants using manual, mechanical, and chemical methods at designated Forest Service administrative and recreation sites. These two categories applicable for this project are listed in 36 CFR 220.6(d) (3) and (6):

- Repair and maintenance of administrative sites, including applying registered pesticides for rodent or vegetation control.
- Repair and maintenance of recreation sites and facilities, including applying registered pesticides for rodent or vegetation control.

For this project, designated administrative sites and recreation sites and facilities include the following locations: Forest Service offices, visitor centers, employee housing, warehouse compounds, developed campgrounds, day use areas, parking areas, boat launches, and public use cabins. Infestations of invasive plants located outside these areas are not currently treated with herbicides. See Issue 1 Invasive Plant Management for an analysis of effects from manual and mechanical treatment methods to control the spread of invasive plants in the project area.

Conclusion

There are no significant direct and indirect impacts to the spread of invasive plants. However, ongoing and continuous spread of invasive plants will continue through time given the relatively low level of control. Cumulative effects are anticipated. Highly invasive plants that can only be successfully treated with herbicides that are outside administrative and recreation areas or other areas that can be treated under the CE (see above) will remain untreated. Since we do not have complete information on the infestations of invasive plants on non-NFS lands, we can only assume that non-Forest Service projects may continue to introduce and spread invasive plants.

Alternative 2, 3, and 5 – Action Alternatives

Direct and Indirect Effects

Direct and indirect effects of proposed activities on the spread of invasive plants are moderate to high and may occur within known populations of invasive plants in the project area on NFS lands. However, an invasive plant risk assessment of the proposed activity and invasive plant surveys will occur before activities begin in all the action alternatives. For invasive plant populations not yet documented, direct and indirect effects are uncertain but are expected.

Table 54. Comparison of activities, site types, level of risk and recommended Weed Best Management Practices (WBMP).

Proposed Activity	Proposed acres[1] or action by Alternative (includes old-growth and young-growth)	Site types and vulnerability level: high moderate or low	Level of Risk for Direct and Indirect compared by Action Alternative	Level of Risk for Cumulative effects compared by Action Alternative	WBMP recommended to reduce risk (Krosse 2017)
Young- and old-growth harvest, thinning, tree planting, slash treatments, pruning etc.	Alt 1: 0 Alt 2: 42,635 Alt 3: 49,683 Alt 5: 43,034	Forested areas: low to moderate depending on disturbance	Alt 3 > Alt 5 > Alt 2	Alt 3>Alt 2> Alt 5	WBMPs 1-6 and 17-18 for forest management
Road construction, Quarry development, maintenance, decommissioning, storage, reconstruction	Alt 1: 0 Alt 2: 212 Alt 3: 290 Alt 5: 297	Disturbed areas: High, wetlands: low to moderate, forested areas: low to moderate	Alt 5 >3 > Alt 2	Alt 5 >3 > Alt 2	WBMPs 1-6 and 7-13 for roads
Watershed restoration, Riparian enhancement, fish pass improvement, stream restoration, harvesting root wad trees	Expand restoration opportunities	Disturbed areas: High; wetlands: low to moderate, forested areas: low to moderate	All action Alts same level of risk	All action Alts same level of risk	WBMPs 1-6, 22 and 7-13 if road equipment is used
Campground, outhouses, parking, trails kayak and canoe access route development	Expand rec opportunities	Campgrounds, outhouses, parking, trails kayak and canoe access routes	Disturbed areas: High, wetlands, low to moderate, forested areas: low to moderate, alpine areas: low to moderate, estuaries and beach meadows: moderate to high	All action Alts same level of risk	WBMPs 1-6, 7-13 if road equipment is used in a project, and 14-15 for all recreation projects

Calculated acres of timber harvest are for 15 years, including old and young-growth forests. Calculated acres for roads was determined with a 50 foot wide area of disturbance by the number of miles proposed by alternative, converted to square feet and then converted to acres.

Cumulative Effects

Considering the present and reasonably foreseeable future actions on NFS lands, as well as on and state and private lands in the project area, cumulative effects may occur to the invasive plant species that inhabit previously disturbed areas such roads and timber harvest units, mines, restoration areas, and recreation sites. Old-growth and young-growth forest habitats will have the most disturbance over the life of this project compared to other habitats in the project area. However, invasive plants generally do not occur within the old-growth forest, but rather on the edges of this habitat. Disturbance of the old-growth and young-growth forest habitats can introduce invasive plants into the bare mineral soil exposed during logging operations. Young-growth forested areas between ages 0 to 15 years have higher potential for weeds to spread due to the higher likelihood of weeds present along existing road systems adjacent to young-growth stands coupled with the open sunlight created by timber harvest.

Alternative 3 has the greatest potential for cumulative effects because it has the most amount of proposed timber harvest acreage, followed in order of decreasing risk for Alternatives 5 and 2. As mentioned above because of the difficulty in estimating the amount of disturbance that will be caused by each alternative, a relative estimate of total acres is used to compare each alternative's potential for establishment and spread of invasive plants. Proposed road building has the highest potential to affect the spread or introduction of invasive plants if a road goes through their habitat. Road construction is a direct source of soil disturbance; therefore, total miles or acres of road construction may be interpreted as a relatively accurate account of the level of soil disturbance created as a result of this activity. Therefore, the greatest cumulative effects from the introduction of invasive plants due to proposed road construction would occur in Alternative 5, followed by Alternatives 3 and 2.

Mitigation Measures

Weed Best Management Practices (WBMP) (Krosse 2017) put into action measures that prevent spread within the project area and from the project area to surrounding non-project lands. Some examples of WBMPs include but are not limited to use of weed-free gravel sources, and use of non-invasive weed-free seed materials for erosion control measure and other restoration activities. These practices will help project managers assist in the prevention of invasive plants in their project implementation.

Control measures of the known invasive plants or new infestations of invasive plants within or adjacent to the project area will continue to be prioritized before treatment. Invasive plant treatments proposed for this project are more fully discussed within Issue 1: Invasive Plant Management. As part of any treatment activity, a specific treatment plan for all sites will be prepared prior to treatment. The plan will include the location, target species, treatment method, and herbicide, application method and rate (if applicable). A Pesticide Use Proposal (PUP) will be prepared for all proposed herbicide use. Future control measures may not necessarily be implemented in association with other proposed activities. Control measures for some high priority species are currently being implemented based on the site type where the infestation is growing, the size of the populations, the invasiveness ranking of the plant, and the threat it may pose to sensitive features of the landscape such as sensitive plant populations, or other wildlife and fish habitats.

Conclusion

In summary, Alternative 3 has the most acres proposed for disturbance and therefore has an expected greater risk to the spread or introduction of invasive plants. For road building, Alternative 5 has the greatest risk to weed spread due to this alternative having the most road building planned in the project area. Most vulnerable habitats include all disturbed areas from current and future activities in the project area. Weed Best Management Practices and Forest Plan direction used in project implementation will help in the prevention and spread and to lower the risk of the proposed actions on invasive plant movement and introduction for all alternatives.

Karst and Cave Resources

Applicable federal, state, and municipal laws, regulations, policies which govern the management of karst include: The Federal Cave Resources Protection Act (FCRPA) of 1988 (16 U.S.C. 4301-4309; 102 Stat. 4546), 36 CFR Part 290, 36 CFR part 261, Forest Service Manuals 2356 and 2880, and the Forest Plan, Karst and Cave Resources, Forest-wide Standards and Guidelines pp. 4-23 to 4-25, Standard S-YG-KC-02 p. 5-6, and Appendix H.

The FCRPA requires the Secretary of Agriculture to issue such regulations as he deems necessary to achieve the purposes of the Act on National Forest System lands. FSM 2880.5 states that, "associated ecosystems shall be inventoried and classified based on resource value and sensitivity to disturbance. Cave inventories should include information about the geology, hydrology, biology, paleontology, archaeology, cave climate, abundance and quality of cave formations, recreation potential, educational and scientific values, and be considered in the preparation of land management plans. Inventory and management guidelines for associated resources, such as ground water, shall be followed where appropriate."

To meet the direction from the above, the Tongass National Forest strives to maintain, to the extent practical, the natural karst processes and the productivity of the karst landscape while providing for other land uses, where appropriate. This strategy is designed to assess a karst resources vulnerability or sensitivity to a proposed land use, and recognize the differences in degree of karst development and glacial history across the karst landscape.

Units of Measure

To compare the effects to karst and cave resources between the four different alternatives the following measures will be used:

- estimated acres of past management,
- miles of existing road,
- acres of proposed management, and
- miles of proposed roads, either NFS or temporary.

These measures align with the Forest Plan Karst and Cave Resource direction and direction in Appendix H.

Methodology

A karst resource vulnerability assessment is conducted for each project regardless of its scale.

A Karst Vulnerability Assessment is a four-step process. It includes:

1. Identify Potential Karst Lands. Identify those lands underlain by carbonate rocks. As a practical matter, all lands underlain by carbonate rocks within the project area should be considered a karst landscape. These include outcrops of limestone, marble, and dolomite.
2. Inventory Karst Resources. At the beginning of any land-disturbing project planning effort, determine the project's proximity to or position on a karst landscape. If it is determined that karst occurs in the project area, require an inventory adequate to characterize the resources. Assess the degree and location of karst development.
3. Delineate Karst Hydrologic System and Catchment Area. Define, to the extent feasible, the karst hydrologic system and the recharge area watershed or catchment area for each karst system. The

character of the catchment area (*i.e.*, the area, slope gradient, vegetation, water quality, soils, etc.) controls the nature of the receiving karst system and defines the volume of runoff available for infiltration into the system. Recharge area delineation is a crucial component of vulnerability mapping; it is important to know where the water comes from and resurges to credibly assess and characterize possible impacts.

4. Assess Vulnerability of Karst Terrain to Management Activity. The final step is to delineate the land under investigation into various vulnerability categories. An area's vulnerability rating must be sensitive to potential surface management practices based on the extent to which epikarst has developed and the openness of the karst system. Where recharge is diffused through deep soils, the underlying karst is less vulnerable to increased sediment inputs and other pollutants than in areas where recharge is discrete and soils are thin or nearly absent. Where soils are thin or nearly absent, surface disturbances will almost always result in exposure of the epikarst, providing an easy pathway for sediment and other pollutants to enter the subsurface drainage network. Discrete recharge areas are especially vulnerable to ground-disturbing activities because the flowing surface water can carry sediment and other pollutants directly to the subsurface drainage network. Karst vulnerability mapping recognizes the variability in karst terrain and uses the vulnerability concepts described here to assign a high, medium, or low vulnerability rating to an area of karst terrain. The proposed ground disturbing activity is considered when determining mitigation or applying karst management guidelines.

Spatial and Temporal Context for Analysis

The boundary selected for the following analysis of karst and cave resources is the same as the POW LLA Project boundary. According to the karst and cave resources inventory, the project area is approximately 2,300,436 acres and includes federal, state, and private lands. Of this, 298,297 acres (13 percent of the project area) are underlain by karst. Also of concern are the adjacent land whose waters flow to the karst, sinking along its margins. This number may be inconsistent from other resources due to the number of different variable combinations used in the GI tool but the differences are negligible.

Analysis Areas for Direct, Indirect, and Cumulative Effects to Karst and Cave Resource

Direct, indirect, and cumulative effects to karst and cave resources are assessed at the stand or harvest unit scale and by karst watershed or catchment area when defined.

The time frame for the effects analysis looks at all past disturbance, *i.e.*, past harvest, road construction, and quarry development on karst and within the karst watershed catchment areas, and proposed activities, in this case for the next 15 years. Recovery rates for impaired karst systems have not been established. For purposes of this analysis we rely on the vulnerability assessment to protect karst features and the discrete and diffuse recharge to those systems.

Data Limitations

Though focused geologic mapping has been completed for much of the project area, some boundaries of the karst polygons have not been field verified. These boundaries will be verified during field reconnaissance.

Past karst resource inventory has been focused on proposed timber harvest units and the lands immediately adjacent to those units in proposed timber sale projects since 1990. Approximately 72 percent of the NFS karst lands within the project area have not been assessed as to their vulnerability. Many of these acres underlie young growth. Much of the karst lands that were assessed have recently been transferred to Sealaska Corporation and Alaska Mental Health Trust Authority. There are 37,764 acres of karst lands that have not been assessed in the LSTA, 10,271 old growth acres and 27,493 young growth acres. One of the benefits of this project may be completing a vulnerability assessment for these acres.

Affected Environment

Karst lands impose land management challenges not encountered in non-karst areas because this three-dimensional landform functions differently than other landforms. Karst resources must be evaluated according to their vulnerability to land uses affecting karst systems. Vulnerability mapping recognizes that some parts of the karst landscape are more sensitive than others to surface activities and groundwater contamination. These differences in vulnerability may be a function of the extent of karst development, the openness of the karst systems, and the sensitivity of other resources that benefit from karst groundwater systems. The vulnerability categories and their criteria are discussed below:

Low Vulnerability Karst Lands

Low vulnerability karst lands are those areas where resource damage threats associated with land management activities in the areas are not likely to be appreciably greater than those posed by similar activities on non-carbonate substrate.

A generalized characterization of these lands would be that they are underlain by carbonate bedrock that is moderately well to well drained, most commonly internally drained, but surface streams may be present. Generally, these areas have been greatly modified by glaciation, and a deep (greater than 40 inches deep) covering of glacial till or mineral soil, and little or no epikarst showing at the surface. The epikarst may be buried and/or ground off, depending on the intensity of glaciation. These lands pose little or no threat to organic, sediment, debris, or pollutant introduction into the karst hydrologic systems beneath through diffuse recharge. Often these are areas of little or no slope (less than 20 percent).

Moderate Vulnerability Karst Lands

The moderate vulnerability karst lands are those areas where resource damage threats associated with land management activities in the areas are appreciably greater than those posed by similar activities on low vulnerability karst lands.

A generalized characterization of these areas would be areas underlain by carbonate bedrock that are well drained internally. Surface streams are rare. The soils of moderate vulnerability areas are a mosaic of shallow organic (20 to 40 percent, McGilvery Soils) and mineral (80 to 60 percent, Sarkar [less than 20-inch depth] and Ulloa [greater than 20-inch depth] Soils) with minor amounts of glacial till. The epikarst is moderate- to well-developed and is visible at the surface. These areas tend to be at higher elevations (*i.e.*, greater than 500 feet, and on knobs, ridges, and on the dip-slope of carbonate bedding planes when near the surface). The surface of these areas tends to be irregular and undulating, following the epikarst development, which is the result of solution of the bedrock surface rather than solution and/or collapse features such as sinkholes.

High Vulnerability Karst Lands

The high vulnerability karst lands are those areas where resource damage threats associated with land management activities are appreciably greater than those posed by similar activities on low or moderate vulnerability karst lands. These are the areas contributing to or overlying significant caves and areas containing a high density of karst features.

These are areas underlain by carbonate bedrock that are well drained internally. Surface streams are rare. Karst systems and epikarst are extremely well-developed and collapse karst features may be numerous. These include all collapse karst features, caves, sinking or losing streams, insurgences, open resurgences, and open grikelands (*i.e.*, those without soil or moss infilling and with open connections to the subsurface). The highest vulnerability features are those that could produce and transport the greatest amount of sediment, debris, and/or organics if disturbed. These include till-lined sinkholes and cave entrances accepting a sinking stream, whether intermittent or not. Also considered high vulnerability are karst lands in which the epikarst is well- or extremely well-developed and the soils are predominately (greater than 50 percent) very shallow organic (less than 10 inches deep, McGilvery) and (less than 50 percent) mineral (less than 20 inches deep, Sarkar). The subsurface drainage network is highly vulnerable to sediment, organic matter, logging debris, and other pollutants generated as the result of surface activities.

Within areas labeled as high or moderate vulnerability there are features that require buffering under current Forest Plan direction. These buffers were drawn as the “minimum” 100-foot radius buffer. However, these buffers will need to be designed and laid out by a karst specialist during unit layout taking into account factors such as aspect, slope, wind throw potential, soils, etc., at which point certain buffers may need to be enlarged or modified in response to these concerns.

Since 1991, within the project area karst and cave resources have been inventoried and karst features buffered and protected. Tracer Dye Studies have been conducted to determine karst ground water flow paths. This has been accomplished through efforts in support of numerous timber sale and road building projects. The current karst resource data base has evolved from those efforts. The table below summarizes the acres of karst within the project area and the acres of karst disturbed by various management activities.

Analysis of GIS data shows that 298,297 acres of karst exist in the project area, 197,003 acres on National Forest System (NFS) lands. Of these, 45,548 acres are designated as Geologic Special Areas or LUDII/Geologic Areas. Of the 154,455 acres remaining, 141,732 acres are known to be karst but their vulnerability has not been assessed. 65,859 acres of the karst lands mapped on NFS lands have had timber harvest, 33 percent of the karst lands (Table 55).

Table 55. Existing Karst Resource Condition in the POW LLA project area

POW LLA Project Karst Resource Acres		
Total Karst Acres	**Acres**	**Percent**
Karst within Project Boundary	298,297	100
USFS Karst within Project Boundary	197,003	66
Karst by LUD and Vulnerability	**Acres**	**Percent**
Karst within Project Boundary but not Assessed	141,732	72
USFS Karst within Project Boundary within Geologic Special Interest Area LUD	28,856	15
USFS Karst within Project Boundary within LUDII/Geologic Area	13,692	7
USFS Karst within Project Boundary High Vulnerability	4,852	2
USFS Karst within Project Boundary Moderate Vulnerability	6,830	3
USFS Karst within Project Boundary Low Vulnerability	1,041	1
Sum	197,003	100
Harvested Karst Acres in the Project Area	**Acres**	**Percent**
POW LLA USFS Karst Harvested but not Assessed	54,513	83

POW LLA USFS Karst Harvested High Vulnerability	1,773	3
POW LLA USFS Karst Harvested Moderate Vulnerability	5,098	7
POW LLA USFS Karst Harvested Low Vulnerability	564	1
POW LLA USFS Karst Harvested GSA and LUD II/Geological Area	3,941	6
Total POW LLA USFS Karst Harvested (33% of USFS karst in project area)	65,859	100
LSTA Karst Acres	**Acres**	**Percent**
Acres of karst in the LSTA potential units	42,934	100
Acres of karst in the LSTA Old-growth potential units	11,875	28
Acres of karst in the LSTA Young Growth 55 years or Older	31,059	72
Old-growth, On NFS Lands in the POW LLA LSTA by Vulnerability	**Acres**	**Percent**
POW LLA USFS Karst Harvested Karst but not Assessed	10,271	87
POW LLA USFS Karst Harvested High Vulnerability	274	2
POW LLA USFS Karst Harvested Moderate Vulnerability	1,103	9
POW LLA USFS Karst Harvested Low Vulnerability	227	2
Total USFS Young Growth on Karst in the LSTA	11,875	100
Young Growth 55 years or Older, On NFS Lands in the POW LLA LSTA by Vulnerability	**Acres**	**Percent**
POW LLA USFS Karst Harvested Karst but not Assessed	27,493	89
POW LLA USFS Karst Harvested High Vulnerability	800	3
POW LLA USFS Karst Harvested Moderate Vulnerability	2,603	8
POW LLA USFS Karst Harvested Low Vulnerability	163	0
Total USFS Young Growth on Karst in the LSTA	31,059	100
Roads	**Miles**	
Miles of Existing Roads on Karst on all Ownership	638	
Miles of NFS Roads on USFS Karst	388	
Miles of New NFS Roads on USFS karst Projected to Access volume for Alts 2, 3, and 5***	33	
Miles of New Temporary Roads Projected to Access volume for Alts 2, 3, and 5***	74	

*NFS, State and Private Lands all Harvest.
**It was assumed that all previous harvest on karst was POG. This value equals existing and past POG on karst of all land ownerships.
*** Road miles vary by Alternative

Environmental Effects

Effects Common to All Action Alternatives

All action alternatives propose similar activities but the amount of each activity varies between alternatives. Activity Cards include specific karst and cave resource mitigation. One Activity Card was developed specifically to “Restore Altered Karst Surface Water Flow Paths”. The alternatives are described in Chapter 2 and that information will not be repeated here.

All alternatives will have differing effects both possibly adverse and/or desirable. Assuming all Forest Plan karst and cave management direction and Activity Cards are fully implemented there should be no detrimental effects to those resources.

It is projected that for the LSTA acres, 352 miles of road will be maintained, 138 miles of NFS road will be constructed and 505 miles of temporary road will be constructed. Not all these miles will be or are on karst. Any new road construction on karst will follow the Forest Plan Karst and Cave Resources Standards and Guidelines for road construction and quarry development (Forest Plan pp. 4-23 to 4-25 and Appendix H pp. H-5 to H-7).

Karst Watersheds

Karst watersheds where defined do not follow the USGS Hydrologic Unit Code (HUC) boundaries. Karst watershed boundaries are controlled for the most part by groundwater flow intensity, hydrologic head, and geologic structure (Prussian and Baichtal, 2007). Many karst watersheds have been intensely managed, *i.e.*, greater than 60 percent harvested with associated roads. The Forest is working to develop a Karst Disturbance Index (KDI) for the karst watersheds and their catchment areas. Some of the index indicators of the KDI will be the geomorphic, surface karst development, soils, caves, past management, roads and quarries, windthrow, and young-growth management. These indicators will be scored and a rating developed for each karst watershed. The KDI is not an alternative defining process, it would be a method to drive future harvest prescriptions and harvest spacing on the landscape. It is believed that carefully planned commercial thinning of second growth stands would be a positive attribute within the KDI. Though not statistically proven (Prussian, 2011), it is believed that some of the harvest treatments would return the stand to closer-to-pre-harvest tree

Table 56. Past Harvest and Possible Proposed harvest within select Karst Watersheds

	Karst Watershed											
	Cataract Cave	West Neck Lake	North Central Neck Lake	Coastal East	Honkin' Spring	Snoose Creek	Coastal NW	Beaver Falls Cave	Cavern Lake South	South Neck Lake	Exchange Cove	
Element	1	2	3	4	5	6	7	8	9	10	11	Total
Karst Watershed Acres	869	501	833	545	913	1,305	223	1,202	992	3,101	3,735	14,218
Karst Watershed Historical Harvest Acres	522	282	351	335	483	715	106	849	796	2,235	2,040	6,674
% Historical Harvest	60	56	42	61	53	55	48	71	80	72	55	47
LSTA POG Acres	29	6	119	31	107	170	13	8	21	430	761	934
Total Past and LSTA Harvest Acres	551	288	470	366	590	885	119	857	816	2,665	2,801	7,608
% Watershed Harvest with LSTA	63	57	56	67	65	68	53	71	82	86	75	54
% Change	3	1	14	6	12	13	6	1	2	14	20	7

spacing, thus hastening the hydrologic recovery of the site. Reducing the canopy cover could restore the 'health' of second growth forests on karst lands by increasing the volume of throughfall, flushing sedimentation out of diffuse and discrete karst openings, and reconnecting surface to subsurface flow pathways.

Not all karst watersheds have been delineated by tracer dye studies. We have enough tracer dye studies to tentatively define some of the karst watersheds within the project area. As an example, we have selected 11 of the known karst watersheds to illustrate the past harvest disturbance in these watersheds. Table 56 above shows the percentage of historic harvest within these defined karst watersheds and the total possible cumulative harvest per watershed within the LSTA.

Alternative 3 would have the highest percentage of disturbance, mostly in young-growth harvest acres. Alternative 2 would harvest the most acres of old growth (Table 57 below). All action alternatives effects could initially increase in flow through karst systems after initial harvest in low and moderate vulnerability karst areas and subsequent (approximately 15 years post-harvest) decrease to flow through these karst systems due to dense forest regeneration (Aley *et al.* 1993). An increase of turbidity and changes in water chemistry through the karst system could also occur due to these changes in flow (Aley *et al.* 1993). Tracer dye studies have shown that some downstream effects may be as much as a mile away within a 24-hour period, often at spring-fed anadromous streams (Prussian and Baichtal, 2007). Karst resource mitigation and prescription development will strive to minimize these effects.

34.2 percent of the LSTA is on karst, some 42,934 acres. These include 11,875 acres of old-growth and 31,059 acres of young-growth harvested prior to 1978. For analysis we assume that harvest of old-growth will be spread evenly across the landscape (Table 57).

Table 57. Potential Acres of Harvest and Miles of Road Construction on Karst by Alternative and percent change from existing.

		Total Acres	% LSTA Acres on Karst	Estimated Acres of Harvest on Karst?	Estimated Miles of NFS and Temp Road	% Karst Acres/miles Change
Alt 2	Total Old Growth	23,269	25	5,818	33	8
	Total Young Growth	19,366	40	7,746	41	1
	Total			13,564	73	9
Alt 3	Total Old Growth	13,014	25	3,254	18	5
	Total Young Growth	33,670	40	13,468	74	6
	Total			16,722	92	11
Alt 5	Total Old Growth	6,365	25	1,592	9	2
	Total Young Growth	33,670	40	13,468	74	8
	Total			15,443	83	10

All action alternatives will likely consider a portion 31,059 acres of young growth 55 years or older in the LSTA on karst. Of these acres, 27,493 acres of karst have not been assessed. Based on previous inventory within the project area, Table 55 predicts the vulnerability classifications expected.

Because of the requirements of Standard S-YG-KC-02 (Forest Plan p. 5-6), the maximum size of any created opening for commercial timber harvest must not exceed 10 acres with a maximum removal of 35 percent of the acres of the original harvested stand. That would mean that of the 19,245 acres of modeled moderate vulnerability karst on young growth 55 years or older, only 6,735 acres would be available to manage.

Alternative 1 – No-Action

Direct and Indirect Effects

Under the No-Action Alternative, none of the specific management activities proposed in the FEIS would be implemented to accomplish project goals and objectives. Natural disturbances and current management of the project area would continue as before.

Cumulative Effects

Cumulative effects to karst and cave resources occur at a stand or harvest unit scale and by karst watershed or catchment area when defined. Since no areas are proposed for harvest and no new roads will be constructed, no cumulative effects will occur in those stands or areas on karst.

According to Forest Service GIS, on karst there are 31,059 acres of young growth 55 years or older in the LSTA. Under this alternative, these acres would not be commercially thinned. By commercial thinning of older young-growth stands on karst, the stand will have closer-to-pre-harvest tree spacing, thus hastening the hydrologic recovery of the site. The canopy of these stands are closed to varying degrees. Reducing the canopy cover could restore the ‘health’ of young-growth forests on karst lands by increasing the volume of throughfall precipitation which flushes the sedimentation out of diffuse and discrete karst openings, and reconnects surface to subsurface flow pathways. The management of older young-growth stands can also hasten the return to more natural stand characteristics and conditions. Considering the above discussion, a commercial thinning prescription that minimizes ground disturbance and treats the whole stand, decreasing the canopy closure to increase throughfall would be best for the karst systems and the streams and creeks which the karst systems contribute to (Karst Review Panel, 2002; Prussian, 2011). By not commercial thinning these stands possible benefits to the karst systems will not be realized.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Karst disturbance would increase by a modeled 13,564 acres (5,818 acres of old-growth harvest and 7,746 acres of young-growth harvest) and 73.47 miles of road. This equates to an 8.9 percent increase in harvest of old-growth on karst and an 8.8 percent increase in miles of road on karst (Table 57).

Approximately 5,422 acres of young-growth management would be on moderate vulnerability karst. The maximum size of any created opening for commercial timber harvest must not exceed 10 acres with a maximum removal of 35 percent of the acres of the original harvested stand (S-YG-KC-02). This would allow for management of 1,898 acres of the expected moderate vulnerability karst. A commercial thinning prescription that minimizes ground disturbance and treats the whole stand, decreasing the canopy closure to increase throughfall would be best for the karst systems and the streams and creeks which the karst systems contribute to.

Effects from harvest could initially increase flow through karst systems after initial harvest in low and moderate vulnerability karst areas and subsequently (approximately 15 years post-harvest) decrease flow through these karst systems due to dense forest regeneration (Aley *et al.* 1993). Increase to turbidity and changes in water chemistry through the karst system could also occur due to these changes in flow (Aley *et al.* 1993). Karst resource mitigation and unit prescription development will strive to minimize these effects.

Cumulative Effects

All action alternatives will have differing effects both possibly adverse and/or desirable. Until the exact extent and location of any proposed action it determined, a determination of specific effects cannot be made. Assuming Forest Plan karst and cave management direction and Activity Cards are fully implemented there should be no detrimental effects to those resources. The karst vulnerability assessment will be used to approximate the disturbance index of specific karst watersheds and catchment areas.

Disturbance in the karst watersheds will continue to change through time, with stands aging and canopy closing in younger stands. Active management of the older stands appropriate for commercial thinning could help lessen the hydrologic effects of throughfall and canopy closure.

Alternative 3

Direct and Indirect Effects

Karst disturbance would increase by a modeled 16,722 acres (3,254 acres of old growth and 13,468 acres of young growth) and 92 miles of road. This equates to a 5 percent increase in harvest of old-growth on karst and an 11 percent increase in miles of road on karst (Table 57).

Approximately 9,428 acres of young-growth management would be on moderate vulnerability karst. The maximum size of any created opening for commercial timber harvest must not exceed 10 acres with a maximum removal of 35 percent of the acres of the original harvested stand (S-YG-KC-02). This would allow for management of 3,300 acres of the expected moderate vulnerability karst. A commercial thinning prescription that minimizes ground disturbance and treats the whole stand, decreasing the canopy closure to increase throughfall would be best for the karst systems and the streams and creeks which the karst systems contribute to.

Effects could initially increase in flow through karst systems after initial harvest in low and moderate vulnerability karst areas and subsequent (approximately 15 years post-harvest) decrease to flow through these karst systems due to dense forest regeneration (Aley *et al.* 1993). Increase to turbidity and changes in water chemistry through the karst system could also occur due to these changes in flow (Aley *et al.* 1993). Karst resource mitigation and unit prescription development will strive to minimize these effects.

Cumulative Effects

All action alternatives will have differing effects both possibly adverse and/or desirable. Until the exact extent and location of any proposed action it determined, a determination of specific effects cannot be made. Assuming Forest Plan karst and cave management direction and Activity Cards are fully implemented there should be no detrimental effects to those resources. As an interim measure, the karst vulnerability assessment procedures will be used to approximate the disturbance index of specific karst watersheds and catchment areas.

Disturbance in the karst watersheds will continue to change through time, with stands aging and canopy closing in younger stands. Active management of the older stands appropriate for commercial thinning could help lessen the hydrologic effects of throughfall and canopy closure.

Management on non-NFS lands in the project area, such as timber management and road construction, could change the percentage of disturbance within a karst watershed, thus affecting our management of that watershed.

Alternative 5

Direct and Indirect Effects

Karst disturbance would increase by a modeled 15,443 acres (1,592 acres of old growth and 13,468 acres of young growth) and 83 miles of road. This equates to a 2 percent increase in harvest of old-growth on karst and a 10 percent increase in miles of road on karst (Table 57).

There is a potential for approximately 9,428 acres of young-growth management on moderate vulnerability karst. The maximum size of any created opening for commercial timber harvest must not exceed 10 acres with a maximum removal of 35 percent of the acres of the original harvested stand (S-YG-KC-02). This would allow for management of 3,300 acres of the expected moderate vulnerability karst. A commercial thinning prescription that minimizes ground disturbance and treats the whole stand, decreasing the canopy closure to increase throughfall would be best for the karst systems and the streams and creeks which the karst systems contribute to.

Effects could initially increase in flow through karst systems after initial harvest in low and moderate vulnerability karst areas and subsequent (approximately 15 years post-harvest) decrease to flow through these karst systems due to dense forest regeneration (Aley *et al.* 1993). Increase to turbidity and changes in water chemistry through the karst system could also occur due to these changes in flow (Aley *et al.* 1993). Karst resource mitigation and unit prescription development will strive to minimize these effects.

Cumulative Effects

All action alternatives will have differing effects both possibly adverse and/or desirable. Until the exact extent and location of any proposed action it determined, a determination of specific effects cannot be made. Assuming Forest Plan karst and cave management direction and Activity Cards are fully implemented there should be no detrimental effects to those resources. As an interim measure, the karst vulnerability assessment procedures will be used to approximate the disturbance index of specific karst watersheds and catchment areas.

Disturbance in the karst watersheds will continue to change through time, old-growth stands aging and canopy closing in younger stands. Active management of the older stands appropriate for commercial thinning could help lessen the hydrologic effects of throughfall and canopy closure.

Management on non-NFS lands adjacent to the project, such as timber management and road construction could change the percentage of disturbance within a karst watershed affecting our management of that watershed.

Conclusions

The karst management analysis shows similar direct and indirect effects between Alternatives 2, 3, and 5. Alternatives 3 and 5 involve fewer acres of old-growth timber harvest than Alternative 2, but have the same young-growth component. Alternative 2 involves more acres of old-growth harvest and fewer acres of young-growth. Cumulative acres of karst disturbance are very similar between the action alternatives. Assuming Activity Cards and Forest Plan karst and cave management direction are fully implemented there should be no adverse effects to those resources.

Recreation

Methodology

Geographic Information Systems (GIS) and infrastructure data were used to identify current locations and extent of recreation assets in the project area. Input from the public regarding potential recreation activities were used to provide measurable effects and comparisons between alternatives. Potential activities would be vetted during the biannual workshops and proposed for implementation based on public input and available agency resources.

Spatial and Temporal Context for Analysis

The recreation analysis considers Forest Service recreation assets in the project area. The current inventory of approximately 77 assets, includes cabins, shelters, campgrounds, trails, and day-use sites. The El Capitan interpretive site, cabins, and campgrounds are the only sites with visitor use information.

Existing recreation assets are widely distributed across the project area. See Figure 9. Most assets are found within the northern two-thirds of the project area. Recreation assets are typically discrete sites with limited footprints; that is, these are sites located in single, well defined areas on the landscape. Trails traverse broader areas of landscape, but are limited to their trail corridors and may be defined as linear sites. Enhanced recreation opportunities may combine multiple types of recreation assets, such as trails associated with discrete sites.

The effects analysis of proposed recreation activities would consider lands and resources directly modified by, and adjacent to, planned activities. An example of concerns to adjacent lands could include firewood gathering in proximity to a shelter that may lead to user created trails and timber felling. Recreation specialists would consider the effects of proposed activities by other resources on adjacent recreation assets, and their consequences to the recreation experience. Views from recreation assets is considered in this effects analysis and the results of activities on the landscape.

The temporal scale of this analysis encompasses the present through the 15 years of this project.

Affected Environment

Recreation use on Prince of Wales Island (POW) includes activities such as fresh- and saltwater fishing access, big game and waterfowl hunting, OHV use, kayaking and canoeing, hiking and wildlife viewing, picnicking, and camping. The following section is divided into three parts that present an overview of forest visitation and use, describes Recreation Opportunity Spectrum (ROS) settings, and provides a snapshot of current recreation resources in the project area.

Visitation and Use

Prince of Wales Island offers world class fishing and one of the highest populations of black bear in the country, and more than 1,500 miles of roads, most of which are gravel. The Alaska Marine Highway does not stop at any ports on POW and large cruise ships, which account for the majority of visitors to Southeast Alaska, do not visit the island either. There are a few small cruise line companies making intermittent stops on POW, with visitation occurring at El Capitan for cave tours up until 2017. Most visitors to POW Island arrive by float plane from Ketchikan or via the Inter-Island Ferry between Ketchikan and Hollis. Generally recreation users can be broken down into three categories: resident, regional, and non-resident. The Recreation section of Chapter 3 in the Forest Plan discusses resident and non-resident use at the Forest level; based on local knowledge, this information may be loosely applied to POW recreation use.

Our analysis assumes that outdoor recreation opportunities and activities provided by the Tongass National Forest are important to local residents, and that the proportion of Alaskan residents who participate in outdoor activities is generally much higher than elsewhere in the United States; however, limited data restricts us from accurately quantifying resident recreation use on POW.

Non-resident visitors, or users, can be generally divided into package and independent visitors. Package visitors are typically cruise ship clients, though some arrive by ferry and airplane, and most often visit on set itineraries. Independent visitors, a large segment of visitors to POW, tend to arrive by air or ferry 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. Independent visitors compete directly with residents for recreation opportunities on the Forest. There is limited data to accurately quantify non-resident recreation use on POW.

The third group of visitors/users are the regional recreationists that come to POW. This segment of users are primarily Alaskan residents who travel to POW for fishing and hunting opportunities and compete directly with local users. There is limited data that accurately quantifies regional recreation use on POW.

An estimated 15,000 non-residents visited POW in summer 2006, about 1.5 percent of the total visitors to Southeast Alaska (McDowell Group 2007). A study by the University of Alaska Institute of Social and Economic Research (ISER) estimated that 12,326 visitors participated in nature-based tourism on POW in 2007, bringing in more than $30 million in gross revenues, with most of this revenue related to sport fishing (Dugan *et al.* 2009). The majority of this revenue (over 80 percent) comes from the lodges on Prince of Wales Island and its outer islands. The community of Craig has large lodges with this type of clientele. All of these lodges have direct waterfront access and focus on saltwater fishing. These operations are accessed by float plane from the communities with jet service (*i.e.*, Ketchikan, Wrangell, and Petersburg). The lodge experience is self-contained; that is, clients typically do not visit any of the recreation sites in the project area (Dugan *et al.* 2009) nor contribute to the local economy through the purchases of goods and services.

Most sport fish visitors stay in one of the islands' lodges, with a smaller number staying in cabins or other local accommodations. Fishing lodges are located in Craig, Klawock, Thorne Bay, and Coffman Cove, as well as in remote locations scattered around the islands. Sport fish visitors to Craig, Klawock, and the remote lodges focus on saltwater fishing. Lodges and day charter operators in Thorne Bay and Coffman Cove offer a combination of saltwater and freshwater fishing (Dugan *et al.* 2009).

Bear hunting is popular on the island, with guided hunting and transporter services available from outfitters. Visitor numbers and revenue associated with bear hunting are lower than those associated with sport fishing (Dugan *et al.* 2009). More than 80 percent of all guided hunts are conducted by motorized boat in shoreline areas. Hunting guide numbers on POW are allocated, or distributed, based on the *Prince of Wales Outfitter and Guide Management Plan Decision Notice* (USDA Forest Service 2012).

The existing road system on Prince of Wales Island provides opportunities for sightseeing and exploring, and provides access for hunters, fishing opportunities, and OHV enthusiasts. Roads designated as open under the POW Access and Travel Management process have been identified as important to resident users for recreation, subsistence hunting, and gathering of firewood. Visitors are able to travel to POW with their vehicles via the Inter-Island Ferry between Ketchikan and Hollis.

Recreation Opportunity Spectrum (ROS)

The ROS system, an inventory developed by the Forest Service, aids in identifying and describing possible combinations of recreation activities, settings, and experiences for management purposes (Appendix I, Forest Plan). The ROS system defines appropriate combinations of activities, settings, and experiences along a continuum, which ranges from primitive to highly modified environments. Seven classifications are identified along this continuum: Primitive (P); Semi-Primitive Non-Motorized (SPNM); Semi-Primitive Motorized (SPM); Roaded Natural (RN); Roaded Modified (RM); Rural (R); Urban (U).

ROS classes represent a spectrum of possible experiences, from those with a high probability of self-reliance, solitude, challenge, and risk, to those with a relatively high degree of interaction with other people. The settings, activities, and probable recreation experience opportunities associated with each ROS setting are described in Appendix I of the Forest Plan.

The ROS does not specify or prescribe what types of activities are allowed in an area. Land Use Designations (LUD) defined in the Forest Plan (Chapter 3) prescribe allowable management activities, in conjunction with federal, state, and local laws and regulations. If a LUD allows for increased development, timber harvest, or increased recreation use, the ROS character associated with the LUD typically aligns with the designation. If expanded development occurs within a project area based on an area's LUD, the Forest Plan allows a change in ROS setting. Changes to existing ROS allocations were anticipated as part of Forest Plan Implementation and direction on how to make changes was incorporated in the Forest Plan (USDA Forest Service 2016a).

The project area encompasses approximately 1.8 million acres of NFS lands, within approximately 2.3 million acres of Prince of Wales Island and its surrounding islands. Both NFS and non-NFS lands are considered in the ROS table below; however, only NFS lands are considered in the ROS analysis. Over one-third (36.3 percent) of NFS lands have been classified as Primitive (P) (Table 58). This setting is situated primarily within the southern extent of the island, on the western outer islands, and in more remote sections of the central and northern portions of POW. These areas are typified by their remoteness and lack of road connectivity, and in most cases are associated with Wilderness and LUD II management areas. Roaded Modified (RM) settings account for approximately 32 percent of NFS lands. Over 50 percent of NFS recreation assets on POW are located within, or accessed through, RM settings. Semi-Primitive Non-Motorized (SPNM) setting accounts for approximately 21 percent of NFS lands, and Semi-Primitive Motorized (SPM), Roaded Natural (RN), Rural (R), and Urban (U) settings account collectively for the remaining 11 percent.

Table 58. ROS Acreages within the Project Area and on NFS Lands

ROS	Project Area GIS Acres (All)	Percent	NFS Land GIS Acres	Percent
P	713,318	31.0	661,622	36.3
SPNM	411,790	17.9	380,163	20.9
SPM	235,816	10.3	178,982	9.8
RN	14,770	0.6	9,834	0.5
RM	910,824	39.6	590,931	32.4
R	10,751	0.5	1,461	0.1
U	1,111	0.0	161	0.0
Total	**2,298,380**		**1,823,154**	

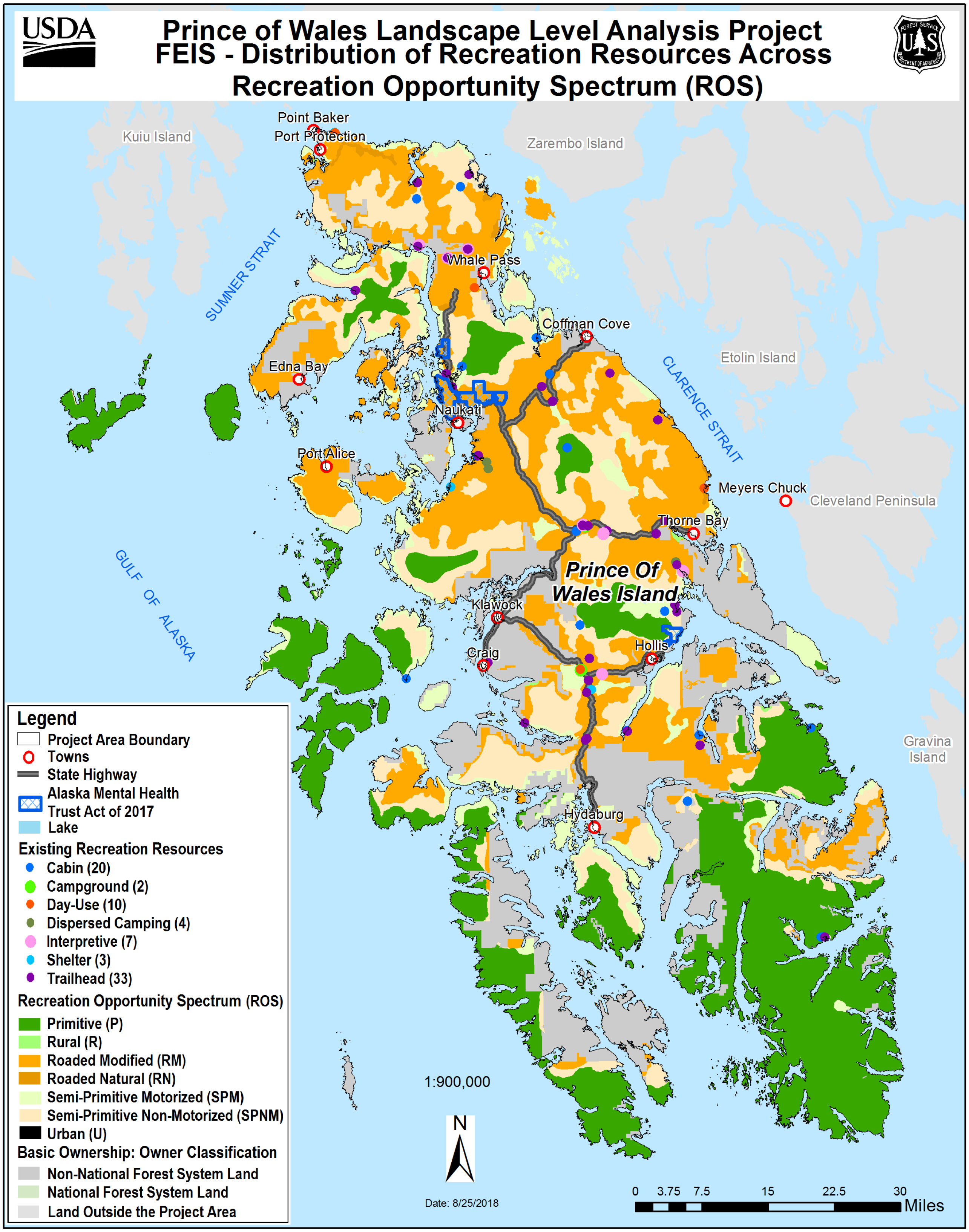

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Figure 9. ROS Settings and Resources on NFS Lands

Recreation Places and Sites

Forest Service recreation assets within the project area are sites and/or facilities where users can engage in recreation activities. These locations are generally accessible via road, boat, or float plane (see discussion below). These assets include developed recreation sites, such as trails, picnic/day-use sites, campsites, interpretive sites, and Forest Service cabins and shelters. Undeveloped sites with unique natural features such as waterfalls, geological features, and other natural formations are recognized opportunities, but are not considered in the asset inventory.

The majority of the project area is undeveloped and primarily used for dispersed recreation activities. Dispersed recreation activities include scenery and wildlife viewing, boating, fishing, beachcombing, hiking, and hunting. Patterns of use tend to be associated with the existing road system, protected boat anchorages/moorings, boat access points, and float plane landing areas. Points for boat access may be on or close to NFS land; their use is not monitored. Boat access points often include, but are not limited to, launches and docks that are managed and maintained by the Forest Service, and are often in proximity to a recreation site. Anchorages and moorings may also be managed and maintained by the Forest Service and are typically associated with recreation sites, such as cabins. Salt- and freshwater recreation areas may be accessed by floatplanes and may use the same docks as boaters; however, in many cases floatplanes will taxi directly onto shorelines in proximity to recreation sites and areas. Modes of access to recreation assets may influence visitation levels to remote recreation resources (*e.g.*, cabins); however, quantitative measures providing data on modes of access to these sites is lacking.

Current recreation assets are discussed in the following sections.

Developed Recreation Sites

There are approximately 77 recognized recreation assets on Prince of Wales Island and its outer islands. These resources are monitored and maintained by the Forest Service at different levels based on need, use, and capacity or people/funding availability (*i.e.*, program resources).

The Forest Service charges fees for the 20 cabins and at the two developed campgrounds on Prince of Wales Island. The balance of recreation assets are fee-free; therefore, a means to quantify use levels is not in place for most assets, with the exception of periodic visitor use monitoring that occurs on a 5-year cycle. Cabins are rented through a centralized reservation system, providing a relatively accurate means for quantifying use of those assets. Fees are collected at campgrounds on the honor system. The payment system does provide a level of measure for campground use; however, these numbers may be under-represented because some users may not fill out and deposit fee envelopes. Use of fee-free assets can only be subjectively measured based on program and district staff knowledge, and input from the public. National Visitor Use Monitoring (NVUM) data is available for the Tongass National Forest for 2014; however, the data set that covers POW includes the Ketchikan-Misty Fjords Ranger District (KMRD). It is assumed these data would be skewed toward KMRD due to greater accessibility and infrastructure on that district. With the lack of comprehensive visitor use data for POW, beyond anecdotal information, quantitative analysis of asset use will be limited to cabins and campgrounds.

The following sections provide an overview and brief description of the available recreation assets in the project area broken down by structures (cabins and 3-sided shelters), trails, day-use sites, interpretive sites, campgrounds, and dispersed camping. Most of these sites are identified on the 2007 POW Visitor Map. Detailed descriptions of assets and their existing conditions are available in the Existing Condition Reports (available in the project record).

Table 59. Distribution of Forest Service Recreation Sites across ROS Settings

Recreation Sites							
ROS	**Overall**	**Structures**	**Trailhead**	**Day-Use**	**Interpretive**	**Campgrounds**	**Dispersed**
P	3	2	1	0	0	0	0
R	0	0	0	0	0	0	0
RM	51	6	26	7	7	2	3
RN	4	1	1	2	0	0	0
SPM	11	9	2	0	0	0	0
SPNM	7	5	2	0	0	0	0
U	1	0	1	0	0	0	0
NON-FS	1	0	0	1	0	0	0
Total	78	23	33	10	7	2	3

Recreation Structures

Within the project area there are twenty cabins available to users through a centralized reservation system. Cabins have an associated outhouse and often have a wood shelter that is occasionally stocked with firewood. These sites are maintained regularly by Forest Service staff. Cabin maintenance typically involves small repairs and cleaning, toilet maintenance and cleaning, and stocking of firewood. Cabin use varies based on location and ease of access. Many cabins are accessible only by boat or float plane. Recent efforts have been made to locate newer cabins on road-accessible sites. Road accessible cabins often involve hikes less than 0.5 mile from parking areas and some entail the use of a skiff provided by the Forest Service at shoreline access points. Remote cabins may experience limited use because access requires the use of boats or float planes; weather variables and costs associated with flight times may be prohibitive to users. However, cabins located in preferred hunting/fishing areas often experience increased use during seasons for these activities. See Table 60 for a list of existing cabins. Use data for these cabins are available in the project record.

Table 60. Forest Service Cabins on POW

Forest Service Cabins: Prince of Wales Island				
Barnes Lake	Black Bear	Control Lake	Honker Lake	Josephine Lake
Karta Lake	Karta River	Kegan Cove	Kegan Creek	Point Amargura
Polk Inlet	Red Bay	Sarkar Cabin	Salmon Bay	Salmon Lake
Shipley Bay	Staney Creek	Sweetwater Lake	Trollers Cove	Twelvemile Arm

Cabins are distributed across the project area and can be found in a variety of ROS settings; two cabins in Primitive (P), eight in Semi-Primitive Motorized (SPM), five in Semi-Primitive Non-Motorized (SPNM), and five in Roaded Modified (RM) settings.

Descriptions of cabins can be found on the Recreation page of the Tongass National Forest public website (https://www.fs.usda.gov/activity/tongass/recreation/) and in the project record.

Three-sided shelters are located at Memorial Beach, Winter Harbor, and the end of One Duck Trail. With the exception of the One Duck shelter these sites have a toilet. Shelters are first-come first-served assets and are fee-free. There are no recent records of shelter use; however, from program staff experience it is known that these sites are popular and relatively well used. Recreation staff visit these sites at least monthly, if not twice a month, and perform small repairs, pick-up trash, stock firewood, and clean the outhouses. Based on staff input, Memorial Beach is the most popular of the three shelters. The shelters are located in the following ROS settings: Memorial Beach - Roaded Natural (RN); Winter Harbor - Roaded Modified (RM); and One Duck - Semi-Primitive Modified (SPM).

Trails

There are approximately 33 National Forest Service trails within the project area, totaling approximately 70 miles. Most trails are less than 2 miles long and are typically associated with a particular site or feature. Examples include interpretive trails within day-use areas or starting on the roadside and terminating at land features or fish passes. Most trails are barrier free, but may not be fully accessible for users with disabilities. Dependent on length, trails often cross multiple ROS settings.

The longest trails are canoe trails with portages: Honker Divide and Sarkar. Honker Divide Trail reaches approximately 30 miles from the put-in on Hatchery Creek on the Coffman Cove Road, following creeks and along lakes crossing the Honker Divide, before terminating close to Thorne Bay near the outlet of the Thorne River. The Sarkar Canoe Trail starts and ends at the day-use area on Road 20 north of Naukati. This trail travels approximately 15 miles, starts and ends across Sarkar Lake, and follows a loop consisting of portages, streams, and lakes. Both canoe trails have cabins associated with them, on Honker (Galea Lake) and Sakar Lakes.

The longest "traditional" trails, used for hiking are the Karta River and Balls Lake Trails. The Karta Trail is accessed from the shoreline of Kasaan Bay and extends over 8 miles into the Karta River Wilderness. The upper end of the trail skirts the north side of Salmon Lake. Based on cabin rentals (Karta River, Karta Lake, and Salmon Lake) and local information, this trail is relatively well used. Balls Lake Trail loops approximately 2 ¾ miles around the lake and ties in with Eagles Nest Campground. Access to Balls Lake is from the Thorne Bay Road near Control Lake Junction, at the trailhead or from Eagles Nest Campground. The trail head for Balls Lake is well established with parking, a day-use pavilion, and an outhouse.

Day-Use Sites

There are ten day-use sites within the project area. These sites are fee-free and typically include a toilet facility and one or more picnic tables, some also have pavilions and fire rings. Based on local knowledge, Sandy Beach is likely the site with the highest level of use, due to its proximity to Thorne Bay and its location on the shores of Clarence Strait along Road 3000 (Sandy Beach Road). Gravelly Creek sits along the Thorne River, provides good fishing access, and also receives consistent use based on its proximity to Thorne Bay. Coffman Cove has a Forest Service day-use site in town that receives primarily local use. Luck Lake day-use site is a recently upgraded asset with improved infrastructure sitting on the lake's north shore at its discharge into Eagle Creek. Luck Lake is easily accessible from both Coffman Cove and Thorne Bay and is a popular location for fishing and family recreation. The Sarkar day-use site is a recently improved site and serves as the gateway to the Sarkar Trail, located north of Naukati on Road 2000 (2007 Forest Visitor Map). Based on local knowledge the Sarkar site receives relatively consistent use from locals and island visitors.

Other day-use sites include Memorial Beach, Balls Lake, Harris River, Canoe Point, and Neck Lake. The Harris River site is accessible via a bridge crossing from the campground entrance situated along the road between Hollis and Klawock (Road 925). The site consists of a pavilion with two picnic tables and an additional two picnic sites. Use of this site is unknown, but occasional use from campground users and transient island visitors is probable. The Balls Lake site is at the trail head for the Balls Lake Trail along the Thorne Bay Road near Control Lake junction, its use is most likely associated with trail users. The site includes a pavilion, picnic tables, and a fire ring. Memorial Beach, on the north end of the island, is a popular site for island visitors and residents due to its remoteness and location on Sumner Strait. The day-use area consists of two picnic tables, and it provides an opportunity for beachcombing and whale watching. Canoe Point is a relative remote day-use site located on Trocadero Bay. This site is only accessible from the bay and is associated with a short trail to a waterfall. The Neck Lake site is an undeveloped site with a boat launch approximately 4 miles west of Whale Pass.

Seven day-use sites are located within Roaded Modified (RM) ROS settings. Coffman Cove is in an Urban (U) setting, and the last two sites are within Roaded Natural (RN) settings.

Interpretive Sites

There are seven Forest Service interpretive sites within the project area. Fish passes with overlooks may be loosely defined as interpretive sites; however, in most cases they are solely viewing platforms with limited interpretive information. With the exception of El Capitan Cave, none of these sites are staffed and all of them are fee-free. All of the interpretive sites are within Roaded Modified (RM) ROS settings.

The El Capitan Cave site is managed for tours and staffed with seasonal Forest Service personnel. El Capitan is recognized nationally and is likely the most popular interpretive site on Prince of Wales Island. The cave serves as one of three sites on the north end that gives an overview of the island's karst geology and geomorphology. Beaver Falls Trail is the second karst site, located approximately 6 miles by road east southeast of El Capitan. The trail is a developed boardwalk with an observation platform at the falls and interpretive signs at several karst formations along the loop. The third karst site is Cavern Lake Trail, a short trail to a viewing platform with a view of an emerging subterranean stream and a set of downstream falls.

The Eagles Nest interpretive site is located in the campground on a boardwalk spur trail off of the Balls Lake Trail. The interpretive signs discuss hydrologic and riparian systems and their benefits to fish and their lifecycles.

Salt Chuck Trail leads to an interpretive site at Salt Chuck Mine located off of tidal flats that flow to Kasaan Bay. Visitation to this site is unknown, but it is located in relative proximity to Kasaan and Thorne Bay. The site affords the opportunity to explore the remnants of an old mining facility and has several interpretive signs providing visitors with a history of the area.

The Harris River interpretive area affords visitors an opportunity to learn about forest management. This site is located approximately 2 miles east of the junction with Hydaburg Road on Road 924 (Klawock–Hollis Highway). The interpretive area is not developed beyond a parking area and trail, but does have signage explaining the management of young-growth forests. Visitation to this site is unknown, but it does tie in with the Gándlaay Háanaa (translation: in the beautiful creek) Trail that follows a portion of the Harris River.

Fish passes on Prince of Wales may be identified as interpretive sites, but as mentioned above they may not include informative signs or provide anything else to visitors beyond a viewing platform. Examples of fish passes include the Dog Salmon site near Polk Inlet and Big Lake near Ratz Harbor, about a mile off Sandy Beach Road (National Forest System road 3000).

Campgrounds

Harris River and Eagles Nest campgrounds are the only developed campgrounds in the project area. These are fee sites (honor system) that see moderate, but consistent, use throughout the season between May and October. Both campgrounds are within Roaded Modified (RM) ROS settings.

Harris River Campground is located off of Road 924 between Klawock and Hollis. The campground has 14 camp sites, two vault toilet units, and a short boardwalk crossing muskeg inside the campground loop. In 2017, for the period between May 24th and August 8th (78 days), the Harris River Campground recorded 183 user days (*i.e.*, number of days x number of users in party). Based on its proximity to the Hollis ferry terminal, use of the campground is likely from visitors arriving on or departing the island; however, it is known that the site is often simply used as a rest stop for people transiting to or from the ferry.

Eagles Nest Campground is located approximately 2 miles east of the Control Lake Junction on the Thorne Bay Road. This campground has ten pull-in campsites, two walk in tent pads, and a double vault toilet. Features of the campground are the tie in with the Balls Lake Trail via the lakeshore boardwalk and Eagles Nest interpretive trail, as well as lake paddling and fishing. In 2017, the campground recorded 211 user days from April 21st to August 14th. The campgrounds location between Klawock and Thorne Bay on the primary road system provides a central location for visitors to explore the island.

Fee collections for the 2017 season, from approximately April through August, were used to calculate user days for both campgrounds. It is assumed that use numbers may be slightly higher because it is known that some people do not record, or pay for, their stay. Neither of these campgrounds had a Campground Host, nor did the Forest Service have enough staff, to monitor campground use during the 2017 season.

Dispersed Camping

There are three inventoried dispersed campsites within the project area. These sites are on the 2007 Forest Service visitor map and have at least a picnic table and a clearing for setting up camp. This does not preclude other sites on the islands that may be favored for camping by users. The three sites are associated with fishing and hunting opportunities and their use is probably limited to seasonal activity. Levels of use are unknown; however, recreation staff make at least annual visits to the sites and report evidence of recent use; indicators include fire-ring use, trash, and site alterations. The dispersed sites are Horseshoe Hole, Staney Bridge, and Lake No. 3; all are in Roaded Modified (RM) ROS settings.

Horseshoe Hole and Staney Bridge are located in proximity to Staney Creek on the west side of POW off of NFS roads 2054 and 2050, respectively. Lake No. 3 is located on the east side of the island near Thorne Bay and Kasaan, off NFS road 2030 near the Salt Chuck trail head.

Undeveloped Recreation Sites

Undeveloped recreation sites are used for undeveloped recreation opportunities, including hunting and fishing, these sites are not managed or maintained by the Forest Service. Examples include: the old Colby Cabin (a.k.a. Trapper’s Cabin) that is popular with Honker Divide Trail users; and Ratz Harbor, used as a resident day-use site and for small boats to access Clarence Strait.

Boat Docks, Landings, and Launches

Docks, launches, and landings are affiliated with recreation sites and activities, and are discussed in the Transportation section.

Environmental Effects

This analysis looks at the potential effects of developing recreation assets on National Forest System lands based on the maximum implementation of proposed activities (Alternatives 2 and 5) and the restriction placed in Alternative 3. The data for this analysis are available in the project record. If the No-Action Alternative were to be implemented there would be no change to current levels of recreation infrastructure.

Implementation and operation are terms used frequently in this analysis. Implementation is defined as the phase of development when construction of a discrete or linear site is put into effect, after a decision is in place and site plans have been approved. Implementation activities for recreation infrastructure can be found in the Activity Cards (36 through 40 and 43 through 46). Operation is defined as the post-implementation phase, for a site's lifetime, when it is available as a recreation opportunity to users. During operation Forest Service staff would, at a minimum, perform regular seasonal maintenance. Improvements and repairs would also be performed during the operation phase.

Proposed and existing recreation sites can be found on a variety of land types; in the case of trails, across multiple types. Due to the analysis scale, generalizations are made on land types that recreation infrastructure could be located; *e.g.*, coastal, upland, and alpine. For this analysis the coastal zone is defined as the 0.2 mile (approximately 1,000 feet) belt of land adjacent to saltwater above the mean high water line. Uplands cover the area adjacent to the coastal zone and terminate at tree line. Alpine is considered above tree line. To account for landscape variability, uplands have been sub-divided to account for lake shores, riparian zones, muskeg, timber, and sub-alpine areas. These sub-divisions recognize that development of recreation infrastructure could affect these upland land types in different ways.

Access to and connectivity between recreation sites within the project area have historically been via float plane or boat, and more recently, with improvements to the island's transportation infrastructure, by vehicle. Forest Service recreation cabin data shows that sites only accessible by floatplane see the lowest levels of annual use. This could be attributed to increased costs of chartering flights (flights originate from Ketchikan) and a lack of local flight services on Prince of Wales Island. Based on the maritime culture of Southeast Alaska, boating will remain a viable means of recreation access into the future. Therefore, future development of recreation infrastructure would concentrate on creating recreation opportunities that are road or boat accessible.

For this analysis, recreation infrastructure is divided into two types: discrete and linear. Campgrounds/campsites, cabins and shelters, day-use/picnic sites, interpretative sites, and winter recreation areas are considered discrete. Discrete sites are defined as sites contained within a defined area at a specific location. Depending on site type, and a site's ancillary infrastructure, the extent of a discrete site can range from a couple of hundred square feet to a few acres. Trails are defined as linear sites. Linear sites are comprised of a series of segments covering a linear distance, across varying landscapes, and are defined by trail length and tread width.

Discrete sites may be subdivided into three types based on the extent of ground coverage that may result in potential ground disturbances. We do not have site specific designs for proposed sites; therefore, for this analysis an allowance of 80 percent of a site's base structure(s) area has been added to account for design variables such as boardwalks, trails, and accessibility considerations, as well as to account for user activities (exploring, firewood gathering, etc.) adjacent to the site. The extent of campgrounds, camp sites, day-use/picnic areas, and interpretative areas are based on conceptual perimeters that would contain all of a site's features; therefore, the 80 percent allowance is not added.

Types of proposed discrete sites and their ground coverage:

- Single structure (shelter) with no ancillary buildings or infrastructure: less than 300 square feet.
- Structures (cabins and shelters) with ancillary buildings and infrastructure: typically less than 1,000 square feet.
- Campgrounds, campsites, day-use/picnic areas, and interpretative sites: variable acreage.

Ground coverage for trails (linear sites) is measured by the length of the route and the width of the trail plus immediately adjacent ground. For this analysis trail coverage is 2.4 acres per mile. This measure accounts for variability of trail widths, potential activity within 10 feet of tread centerline, and other features such as trail head parking and viewpoints.

There are 33 existing Forest Service trails on Prince of Wales Island and its outer islands. These 33 trails cover approximately 72 miles (approximately 172.8 acres); however, two of these are canoe trails. If only the canoe trail portages (ground disturbing sections) are accounted for, existing trail miles drops to approximately 32 miles or 76.8 acres. Existing trails include cabin and skiff spur trails, loop and out and back trails, interpretive and day-use trails, and canoe portages. These trails come in a variety of tread styles and widths, which are dependent on variables such as land type and slope.

Alternatives 2 and 5 propose up to 50 miles with a coverage of 120 acres of trail activities, and Alternative 3 proposes no new trails, but focuses improvements to popular and high use trails. For Alternatives 2 and 5, these additions could increase the existing trail network by approximately 155 percent. Trail routes have not been designed or surveyed; therefore, coverage and miles may change through the planning and implementation process. There were seven trails that were suggested by commenters during scoping for the project. Three of the seven trails are identified for outer islands: Noyes, Baker, and Suemez. These trails would provide ocean side beach access from sheltered coves. The balance of suggested trails includes an expansion of the Memorial Beach Trail, establishing a Luck Creek trail south of Luck Lake, re-establishing the east segment of the Deweyville Trail, a new trail at Rio Beaver (8 ½ mile) to the Thorne River, and development of the Hollis-to-Craig Trail. The Hollis-to-Craig Trail could be between 15 and 25 miles and would require agreements with private landowners. Additional trail miles could be included with the development of future infrastructure, such as kayak/canoe access points and spur tails to structures. Trails for kayak/canoe access points have not been identified, but would typically be short spur trails (usually less than 0.3 miles) with road access.

There are approximately 47 existing discrete Forest Service recreation sites on Prince of Wales and its outer islands. These include cabins, shelters, launches/docks, day-use, interpretive, dispersed camp sites, and campgrounds. The breakdown of these sites is as follows: 20 cabins, 3 shelters, 6 launches/docks, 11 day-use, 2 interpretative, 3 dispersed camp sites, and 2 campgrounds. Based on the discussion on the extent of discrete sites, existing sites cover approximately 47 acres of National Forest System lands on Prince of Wales Island and its outer islands.

Alternatives 2 and 5 propose the development of up to three new cabins and up to twelve new shelters that are boat or road accessible, up to eight winter sport access points and areas for over-the-snow vehicle use, up to three new campgrounds, the development of a picnic day-use area near Neck Lake, and boat launches/docks. The proposed sites could affect approximately 75 acres of National Forest System land, resulting in an approximately 160 percent increase of discrete site coverage. Shelter sites could be changed to camp sites in Alternative 3 to meet the intent of increasing recreation opportunities while minimizing the resource commitment required for maintenance. Alternative 3 would not develop new cabin or shelter sites, limit the size of the winter access points, and focus on maintaining the existing high-use sites. Proposed site numbers do not include kayak/canoe access points because these locations have not been specified and the area for ground disturbance would be negligible at the landscape level. Winter recreation access areas are being considered as discrete sites because we do not have plans or definitive locations for implementation. The acreage values for these sites should account for roadside pullouts, trails, and ancillary infrastructure. Thirty-eight sites were suggested during scoping for this project (see Chapter 2).

Some segment or segments of 16 existing trails and 3 suggested trails are within 0.2 miles of a Logging System Transportation Analysis (LSTA) potential timber harvest unit. Fifteen of 47 existing sites, and 9 of 31 suggested discrete sites are within 0.2 mile of LSTA potential harvest units. Consideration would be given to developing measures to preserve the recreation experience at existing and suggested sites in proximity to these units (refer to Activity Cards, Appendix A).

Decommissioning of recreation infrastructure is proposed for all action alternatives and may occur over the life of this project, based on use levels, public safety, and or site conditions. Decommissioning would reduce the number, and acreage, of recreation infrastructure on Prince of Wales. However, for Alternatives 2 and 5, the quantitative value (number or acreage) of decommissioned sites would be held in reserve to provide flexibility for future implementation. This flexibility would provide recreation planners the latitude to implement yet unidentified sites to meet public requests for new sites or facilitate infrastructure realignment.

Signage is not analyzed because the footprint of sign installation is negligible at the landscape level. In most cases signs would be directly associated with discrete and linear site implementation, and would provide public safety to, or educational opportunities for, visitors.

For specifics regarding proposed recreation infrastructure see Activity Cards 36 through 40 and 43 through 46.

Available recreation assets would be considered for proposed and existing infrastructure in all alternatives because an infrastructure inventory that is not manageable with program resources would not be practical. Maintenance and improvements of existing infrastructure keeps recreational opportunities viable, improve the recreation experience and public health and safety.

Direct and Indirect Effects

Alternative 1

No new activities are proposed under Alternative 1. Therefore, Alternative 1 would result in the least direct and indirect effects to recreation for this project. Under Alternative 1, none of the specific management activities proposed would be implemented to accomplish project goals and objectives. This alternative does not meet the purpose and need for this project.

Repair and maintenance of existing recreation infrastructure would continue at present levels based on available program resources and prior approved plans.

Alternatives 2, 3, and 5

Direct and indirect effects on recreation infrastructure of proposed non-recreation activities are low to moderate. There are occurrences where proposed activities could occur in proximity to recreation infrastructure. In these cases an analysis of effects would be made to determine the level of disturbance to recreation activities and assets. In all action alternatives, regardless of the proximity, an assessment of proposed activities on recreation infrastructure and the recreation experience would occur before implementation.

Land Use Designation and Recreation Opportunity Spectrum of Proposed Sites

The effects analysis for this project is applied at the landscape level; however, the analysis can make assumptions on trends on the distribution of potential recreation infrastructure based on the suggested sites from the public. These trends (displayed in the tables below) give an indication of where the public is interested in recreating and the type of recreation experience they are seeking. The land use designation (LUD) table (Table 61) indicates over a third of the suggested sites fall within Modified Landscape and Timber Management LUDs and over half of the suggested sites fall within a Roaded Modified recreation opportunity spectrum (ROS) setting (Table 62). Although consideration must be given to the other designations and classifications, this breakdown shows that most sites fall in areas conducive to recreation development because of less restrictive LUD components and ROS classifications. Existing recreation infrastructure is not included in this LUD and ROS analysis because those sites are already managed under the existing LUD components and ROS classifications.

Table 61. Number of suggested sites per land use designation (trails may cross multiple LUDs).

Land Use Designation (LUD)	Number of Suggested Sites	Percentage of All Suggested Sites
Wilderness	0	0.0
LUD II	7	18.4
Semi-Remote Recreation	5	13.2
Old Growth Habitat	2	5.3
Special Interest Area	3	7.9
Wild, Scenic, or Recreation River	0	0.0
Modified Landscape	10	26.3
Timber Management	6	15.8
Combination of LUDs	3	7.9
non-NFS	2	5.3

Table 62. Number of suggested sites per recreation opportunity spectrum inventory. Combinations of ROS are indicative of trails or winter recreation areas.

Recreation Opportunity Spectrum (ROS)	Number of Suggested Sites	Percentage of All Suggested Sites
Primitive	10	26.3
Semi-primitive Non-motorized	0	0.0
Semi-primitive motorized	2	5.3
Roaded Natural	2	5.3
Roaded Modified	20	52.6
Rural	0	0.0
Urban	0	0.0
Combination of ROS	4	10.5

Site Access

Public use of existing sites and program maintenance efforts are also influenced by access. Table 63 provides an overview of access to all existing and suggested sites (discrete and linear). Most existing sites are accessible via road due to the road network on Prince of Wales Island, and this trend would continue with the implementation of proposed activities. Currently 63 percent of existing Forest Service recreation sites are road accessible, with implementation of proposed infrastructure this percentage could drop to 55 percent. This decrease would be due to the development of more boat accessible sites on the outer islands. The percentage of boat accessible sites would increase from 13 percent to 23 percent if suggested shelters are implemented in the future. Boat accessible sites could see high use levels with their availability due to the maritime centric recreation of the area. Percentage of sites accessible by floatplane would stay relatively static with future development of recreation infrastructure because new fly-in sites are not being proposed.

Table 63. Modes of access to existing and suggested recreation sites (discrete and linear).

Means of Access	Existing Sites (All)	Suggested Sites (All)	Total	Percent of Total
Road	50	14	64	55
Boat	10	17	27	23
Float Plane	3	0	3	2
Road/Boat	8	7	15	13
Road/ Float Plane	2	0	2	2
Boat/ Float Plane	6	0	6	5
Sum	**79**	**38**	**117**	

Land Types

Based on the topography and vegetation of Prince of Wales Island, most existing recreation sites (discrete and linear) are found within the coastal band (0.2 mile) around the islands, or in proximity to lakes or streams. This trend will continue with the proposed activities considered in this analysis. Table 64 shows the number of sites per primary land type; secondary land types are considered for linear sites. Linear sites in many case would cross multiple land types, the project record spreadsheet accounts for secondary and tertiary land types; therefore, there could be additional land types that would need to be accounted for in the implementation process for linear sites.

Table 64. Land types where existing recreation sites (discrete and linear) are located and suggested.

Land Type (Primary)	Existing Sites (All)	Suggested Sites (All)	Total	Percent of Total
Coastal	23	12	35	30
Coastal - Outer Island	4	14	18	15
Upland - Lake Shore	19	2	21	18
Upland - Riparian	18	3	21	18
Upland - Muskeg	2	0	2	2
Upland - Timber	10	0	10	8
Upland - Sub-Alpine	1	7	8	7
Alpine	2	0	2	2
Sum	**79**	**38**	**117**	

Overall Extent

Overall the ground disturbing activity involved with the development of proposed recreation infrastructure would have a negligible impact on the overall landscape. Existing discrete and linear sites total approximately 124 acres, while proposed sites could contribute an additional 195 acres to the recreation infrastructure. Existing recreation infrastructure directly effects 0.007 percent of the acres of National Forest System land on Prince of Wales Island and its outer islands (approximately 1.8 million acres). The addition of all the proposed projects would directly affect 0.011 percent of National Forest System lands. Based on the quantity of proposed recreation sites and their individual footprints their implementation would result in negligible effects at the landscape level of analysis. Implementation of proposed activities would result in localized ground disturbing activities, but these activities would be contained within limited areas and mitigation measures identified on the Activity Cards would be applied, thus reducing effects.

Other Resources

Effects between recreation and other forest resources are considered in the analysis of proposed and existing recreation infrastructure. With increased recreation opportunities on the island, there is the potential for more visitation to POW. Improved recreation infrastructure and newer facilities would provide a safer and more easily accessed recreation experience for the public across the districts; shelters on outer islands may increase recreation opportunities on the district(s) and additionally provide safe havens for boaters on local waters.

Assumptions:

- Timber harvest has the greatest potential to impact the recreation experience of a site. ROS classification and LUD components would be evaluated prior to implementation of an activity. The Forest Plan allows a change in ROS setting if the current setting is not aligned with proposed activities. Implementation and operations of recreation infrastructure would meet the new setting. Measures would be established to mitigate existing and proposed, recreation sites and opportunities to maintain a site's desired recreation experience.
- Development of sites may result in user concentrations, but this would be relative to ongoing island-wide use levels. This may result in some disturbances, but would generally be of short duration and would not result in alterations to the natural state of the landscape.
- Road development and maintenance would provide improved access to some sites, which in turn could lead to improved opportunities.

Overview

The development of proposed recreation infrastructure would have a negligible effect to the overall landscape on Prince of Wales Island and its outer islands. Variations in the distribution and types of recreation infrastructure across the project area would not result in meaningful changes to the discussions regarding LUD, ROS, access, and land types, due to the relatively small impact of recreation infrastructure proposed in this project.

The differences in alternatives for recreation are driven primarily by the capacity of the Forest Service to maintain and improve existing infrastructure, and to develop and maintain proposed sites. This driver may indirectly or directly affect social and economic interests associated with local recreation opportunities.

Outfitters and Guides

Outfitter and guide activities on Prince of Wales Island and its outer islands would continue at current levels. According to a recent report, the number of visitors to Prince of Wales Island and Southeast Alaska is on an upward trend. From 2011 to 2016, Prince of Wales Island visitation increased by 7 percent. During that same time period, visitation across Southeast Alaska increased by 17 percent. Outfitters and guides serve a portion of those visitors and based on the trends, outfitter and guide requests for use in the project area are likely to increase. Currently, outfitter and guide use is set by the allocations in the 2012 Prince of Wales Outfitter and Guide Management Plan. The plan allows for some allocation adjustments through an adaptive management process. The plan may be reevaluated in the future to ensure that it remains relevant to current and projected use trends. Infrastructure development or improvements may result in changes to current activities, but will not affect allocated service days.

Cumulative Effects

Cumulative effects examines the impacts to recreation infrastructure from reasonably foreseeable activities on NFS lands and non-NFS lands, at the landscape level, over the 15 years proposed for this project.

Reasonably Foreseeable Future Activities could affect recreation opportunities and infrastructure. Generally, activities on non-NFS lands would have minimum to no effect on recreation sites and their associated activities; however, some activities (*e.g.*, timber harvests) may change recreation experiences associated with a site because of noise, visible transformations to the landscape, and temporary or permanent loss of access to the recreation asset. Impacts to recreation experiences could result in reduced use levels at sites in proximity to these activities.

Enacted legislation and future land transfers out of federal ownership could reduce recreation infrastructure inventory and limit resource growth, resulting in fewer Forest Service recreation opportunities on Prince of Wales and its outer islands. Loss of opportunities may in turn affect communities by impacting local socio-economic activity. Changes in land ownership could disrupt accessibility to, and connectivity between, recreation opportunities on National Forest System lands, which could result in sites becoming isolated and experiencing reduced or no use. Land ownership changes would also effect outfitter and guide activities on Prince of Wales and its outer islands. Changes could lead to a reduction of service days because of lost recreation use areas, and could lead to greater concentrations of authorized activities on remaining NFS lands.

Wilderness

This section provides a summary of existing conditions and an analysis of environmental effects for wilderness resources in the POW LLA project area. The only activity proposed within designated wilderness is the treatment of invasive plant species.

Wilderness designation is intended to preserve and protect certain lands in their natural state. The Wilderness Act of 1964 identifies wilderness uses and prohibited activities. The Wilderness Act's Statement of Policy, Section 2(c) states that wilderness should be managed "…in such manner as will leave them unimpaired for future use as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character…" The statutory language of the Wilderness Act is used to identify five qualities of wilderness character: Untrammeled, Undeveloped, Natural, Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation, and Other Features of Value, defined below (Landres *et al.* 2015).

- Untrammeled: Area is unhindered and free from intentional actions of modern human control or manipulation.
- Natural: Area appears to have been primarily affected by the forces of nature and are substantially free from the effects of modern civilization.
- Undeveloped: Area is essentially without permanent improvements or the sights and sounds of modern human occupation, and it retains its primeval character.
- Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation: Area provides outstanding opportunities for people to experience solitude or primeval and unrestricted recreation including the values associated with physical and mental inspiration, challenge, self-reliance, self-discovery, and freedom.
- Other Features of Value: Area may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. Though not required of any wilderness, where they are present they are part of that area's wilderness character and must be protected as rigorously as any of the other four required qualities.

Activities prohibited under Section 4(c) of the Wilderness Act must go through a Minimum Requirements Analysis (MRA) before it can be determined whether and how to implement the activity. Accordingly the Forest Service has conducted a MRA in order to determine if the treatment of invasive plant species is necessary for the administration of wilderness, and the minimum activity to accomplish the action. The final MRA determination has been made by the Regional Forester. The MRA allows for site-specific, professional judgment when determining weed treatment options, including: hand-pulling, tarping, and various means of applying herbicides.

Affected Environment

The POW LLA project area includes all NFS lands within the Thorne Bay and Craig Ranger Districts on Prince of Wales Island and the surrounding islands.

There are five wilderness areas designated on Prince of Wales Island and the surrounding islands. The Coronation Island, Maurelle Islands, South Prince of Wales, and Warren Island Wilderness Areas were designated in 1980 through the Alaska National Interest Lands Conservation Act (ANILCA) and the Karta River Wilderness was designated in 1990 through the Tongass Timber Reform Act (TTRA). TTRA amended §703 of ANILCA to include the Karta River Wilderness, among others. The Karta River Wilderness is therefore managed in concurrence with the provisions of ANILCA.

Approximately 166,200 acres (7 percent) of the project area are within designated wilderness.

All five wilderness areas are naturally functioning. Wilderness character monitoring data compiled in 2012 indicates no significant impairments or noted concern with any of the qualities of wilderness character. Subsequent monitoring has not taken place so no trend has been established.

Environmental Effects

Alternative 1 – No-Action

Direct and Indirect Effects

The No-Action Alternative would not result in direct or indirect effects to wilderness resources because no new activities would occur and existing conditions would remain unaffected. Natural disturbances and current management of the project area would continue.

Cumulative Effects

Implementation of the No-Action Alternative would not contribute to cumulative effects to wilderness resources because no new activities would occur.

Alternatives 2, 3, and 5 – Action Alternatives

Activities Proposed within Designated Wilderness by Alternative

Alternatives 2 and 5 propose hand pulling and tarping of invasive plants. Alternative 3 proposes hand pulling and tarping of invasive plants, but also includes herbicide application such as broadcast spraying, spot spraying, and hand/selective treatment.

Direct and Indirect Effects

The direct and indirect effects an activity has on the wilderness resource is determined largely by the location and nature of the activity, and the effect of the activity and its component activities on the five qualities of wilderness character: untrammeled, undeveloped, natural, outstanding opportunities for solitude or primitive and unconfined recreation, and other features of value. All alternatives that include management activities within or adjacent to designated wilderness have the potential to adversely affect one or more of the qualities of wilderness character. However, those same actions may also positively affect another quality, and therefore it is necessary to carefully consider effects and tradeoffs to ensure wilderness character is preserved. In addition to the five qualities of wilderness character defined above, the Wilderness Act mentions societal benefits to wilderness that go beyond recreational use. These “non-use values” are, for the most part, intangible aspects of wilderness character that are difficult or impossible to quantify.

The following terminology is used in describing the degree of effects to the five qualities of wilderness character. These terms are used only to compare the effects across alternatives and not to reach a conclusion about the significance of potential effects.

- **No Effect:** No effect to the quality.
- **Negligible:** Little or no impact to the quality; any change that might occur may be perceptible but difficult to measure.
- **Minor:** Change in the quality would occur, but no substantial impact would result. Change would be perceptible and measurable but not alter the quality’s condition.
- **Moderate:** Noticeable and measurable change would occur and would alter the quality’s condition; integrity of the quality would remain.

- **Major:** Substantial impact to the quality would occur; impact is easily defined, highly noticeable, and would measurably alter the quality's integrity.

The treatment of invasive and non-native plant communities is proposed within all wilderness areas in the project area. Alternatives 2, 3, and 5 would include hand pulling and tarping. Only Alternative 3 proposes the use of herbicide.

Effects on Untrammeled Character

Hand pulling would have a minor effect on the untrammeled quality due to the physical removal of weeds. Because seed banks can remain viable for a number of years before germination, repeated treatment would likely be required over a number of years.

Tarping would have a major effect on untrammeled quality due to the tarp remaining over the entire weed infestation for multiple years depending on the viability of the seed bank.

Effects would be localized to the treatment site and would not measurably impact the untrammeled quality across any one wilderness as a whole.

Broadcast herbicide spraying would have a major effect on the untrammeled quality as it would indiscriminately manipulate all the plants in a treatment area. Drift of herbicide outside the treatment area would have an additional minor to moderate adverse effect on untrammeled character. However, the duration of the effect would be temporary and the need for repeated treatments would be less likely. Effects would be localized to the treatment site and would not measurably impact the untrammeled quality across any one wilderness as a whole.

Spot herbicide spraying would have a moderate effect on the untrammeled quality. The manipulation that occurs with spot spraying would target individual plants and therefore would have less adverse effect on untrammeled character than that associated with broadcast spraying or tarping. However, the duration of the effect would be temporary and the need for repeated treatments would be less likely.

Hand/selective herbicide use would have a minor effect on the untrammeled quality because the manipulation that occurs with selective herbicide use would be a much smaller foot print to either of the other herbicide uses and tarping. However, the duration of the effect would be temporary and the need for repeated treatments would be less likely.

Mulching, seeding, and planting of competitive, desirable native vegetation may occur to restore treated sites, which would have additional long-term moderate effects.

Effects on Undeveloped Character

Hand pulling and crew campsites would leave evidence of soil disturbance and trampling of vegetation in the area for a short duration following treatment resulting in a negligible effect. Because seed banks can remain viable for many years before germination, impacts to the undeveloped quality could occur year after year in the same area.

Tarping is a temporary installation, and could be accompanied by temporary signs and rope to temporarily close severely damaged sites during rehabilitation and restoration. This would have a major effect on the undeveloped quality during the time these developments are in place.

Broadcast and spot spraying herbicide treatments would have no effect on the undeveloped quality. However, while the type of treatment itself would have no effect, the presence of the backpack sprayers themselves would be reminders of modern civilization while they are being used on site, and would have a negligible effect. These effects would occur each time treatments are conducted at the site.

There would be no effect to the undeveloped quality from hand/selective herbicide treatment.

Access to areas by boat or float plane would have a short term minor effect.

Effects on Natural Character

Treatment of invasive and non-native plant species would overall have a long term positive effect on the natural quality regardless of treatment method.

Hand pulling could result in a negligible, localized, adverse effect to natural quality because some native plants and seeds could be removed along with the weed species.

Tarping is indiscriminate and adversely affects any desirable native plants that are under the tarp. Until these areas recover, there is a localized moderate effect to natural character.

Broadcast herbicides would have a localized moderate effect on natural character until the areas recover because they indiscriminately kill desirable and non-desirable plants. Drift of herbicide outside the treatment area would have an additional minor adverse effect on natural character.

Spot spraying may have a negligible short term and localized effect on the natural quality if some desirable native plant species are inadvertently sprayed or effected by drift.

Hand/selective treatment may have a localized negligible short term effect on the natural quality if some desirable native plant species are inadvertently treated.

Effects on Outstanding Opportunities for Solitude

Large crews, their equipment and the presence of more and/or larger temporary structures (*i.e.*, wall tents) for longer durations per visit associated with hand pulling treatments would have a major effect on solitude. Effects would be localized to the treatment site and would not measurably impact opportunities for solitude across any one wilderness as a whole.

The presence of tarps and, if required, temporary signs and rope could have a major effect on the visitors opportunities for solitude for the duration the installations are in place. Effects would be localized to the treatment site and would not measurably impact opportunities for solitude across any one wilderness as a whole.

The ability to use herbicides, regardless of the method, may reduce the amount of time that is spent in treatment areas thus decreasing the potential to have a negative impact on visitor's solitude expectations, resulting in a minor effect. Short-term, the presence of dead plants in the treatment site could adversely affect visitor’s wilderness experiences and feeling of solitude in the local treatment area.

Access to areas by boat or float plane, regardless of treatment method, would also have a short term minor effect to solitude.

Effects on Outstanding Opportunities for Primitive and Unconfined Recreation

Large crews, their equipment and the presence of more and/or larger temporary structures (*i.e.*, wall tents) for longer durations per visit associated with hand pulling treatments would have a major effect on unconfined recreation. Effects would be localized to the treatment site and would not measurably impact unconfined recreation across any one wilderness as a whole.

The presence of tarps and, if required, temporary signs and rope could have a major effect on the visitors unconfined recreation experience for the duration the installations are in place. Effects would be localized to the treatment site and would not measurably impact unconfined recreation across any one wilderness as a whole.

The ability to use herbicides, regardless of the method, may require temporary closure of areas during and directly following spraying and could have a minor effect to the unconfined visitor experience.

There would be no effect to the primitive recreation experience with any treatment method.

Effects on Other Features of Value

Soil disturbance associated with hand pulling would have a localized temporary short term minor effect on scenic value.

The presence of tarps and, if required, temporary signs and rope would have a major, localized effect on scenic value for the duration of time the installations are in place. Effects would be localized to the treatment site and would not measurably impact the scenic value across any one wilderness as a whole.

The presence of large numbers of dead plants following broadcast spraying would have a major effect on the scenic value for a short term until the area recovered and revegetated. Effects would be localized to the treatment site and would not measurably impact the scenic value across any one wilderness as a whole.

The presence of dead plants following spot spraying and hand/selective treatments would have a localized negligible short term effect on the scenic value compared to some of the other treatment methods as the plants would be interspersed with living vegetation and would not be expansive.

Effects on Non-Use Wilderness Values

Some people may be aware that the untrammeled quality of wilderness character would be degraded and the natural quality would be degraded in the short-term but may improve. This realization could have indirect adverse impacts to certain non-use values. Both adverse and beneficial effects on non-use values would be negligible and localized to the affected individuals.

Direct and Indirect Effects of Proposed Activities Adjacent to Wilderness

Marine Access Facilities (MAF)

MAFs are proposed adjacent to or in proximity to the Maurelle Islands Wilderness. As these facilities would not be located within designated wilderness, an MRA is not necessary, or required. However, activities associated with these facilities and the facilities themselves would likely degrade the undeveloped and opportunities for solitude qualities of wilderness character.

Indirect effects include those that are initiated by, and may be unintended consequences of, the activity. The installation of new public facilities and/or access into the Forest may increase or alter visitor use of wilderness areas resulting in further degradation of the undeveloped and opportunities for solitude qualities within the vicinity of the facility.

Winter Sport Access Area

There is a winter sport access area proposed adjacent to the northwest boundary of the Karta River Wilderness. The increased noise associated with snowmobile or over snow vehicle use will likely degrade the undeveloped and opportunities for solitude qualities of wilderness character.

Indirect effects include those that are initiated by, and may be unintended consequences of, the activity. New public access into the Forest may increase or alter visitor use of wilderness areas and snowmobile use within the wilderness will likely increase resulting in degradation of the undeveloped and opportunities for solitude qualities.

Vegetation Management

Various vegetation management projects are proposed either adjacent to or in proximity to the Karta River and South Prince of Wales Wilderness Areas. As these activities would not occur within designated wilderness, an MRA is not necessary, or required. However, activities associated with these projects would likely degrade the undeveloped and opportunities for solitude qualities of wilderness character during implementation. Options to minimize these effects, such as timing restrictions, would be considered during project development.

Indirect effects include those that are initiated by, and may be unintended consequences of, the activity. Examples include: trees along the margins of timber harvest units are more likely to blow down in windstorms. Wind throw along or within the wilderness boundary would adversely affect untrammeled and natural qualities of wilderness character. Vegetation management adjacent to wilderness may also affect animal distribution and patterns of use within wilderness, which would adversely affect the untrammeled quality.

Cumulative Effects

Cumulative effects analyses examine the impacts to wilderness character from the projects proposed within and adjacent to wilderness in conjunction with reasonably foreseeable future activities on both National Forest System (NFS) and non-NFS lands, at the landscape level, over the 15-year proposed span of this project. The *Catalog of Present and Reasonably Foreseeable Future Activities* table (Appendix C) was reviewed for activities that could impact the wilderness resource.

Present and reasonably foreseeable future vegetation management projects including Timber Harvest – Tongass National Forest, Precommercial Thinning: Timber, Wildlife and Riparian Emphasis, Timber Harvest – State Lands (non-NFS), Big Thorne Project EIS, Small Timber Sales (five-year schedule), Microsales, State of Alaska Division of Forestry Projected Future Harvest, Alaska Mental Health Trust Projected Future Harvest, University of Alaska Trust Projected Future Harvest, Sealaska Corporation Projected Future Harvest, Free-use Timber harvest on NFS land, Personal Use Firewood and Commercial Firewood Permits that occur adjacent to or within sight and sound of a wilderness area will continue to effect the undeveloped and opportunities for solitude qualities of wilderness character. The sounds of harvest activities would occur only during implementation while the visual impacts of harvest adjacent to the wilderness would be longer term. Neither, at this point in time, would significantly impact any one wilderness area as a whole.

Present and reasonably foreseeable future road construction projects including Road Construction for Timber Harvest and Road Maintenance that occur adjacent to or within sight and sound of a wilderness area would continue to effect the undeveloped and opportunities for solitude qualities of wilderness character. These effects may be long term if the roads are left open to public travel, increasing the frequency that someone would hear vehicles but would not at this point in time significantly impact any one wilderness area as a whole. Indirectly, roads left open to public travel may create new access points into wilderness and affect the current distribution of wilderness uses which could affect opportunities for solitude.

Outfitter and Guide activities, dispersed recreation, and subsistence gathering would continue as currently allowed and in conjunction with the proposed projects would not significantly impact any one wilderness area as a whole. Indirectly, these activities may create new access points into wilderness and affect the current distribution of wilderness uses which could affect opportunities for solitude.

The Alaska Mental Health Trust Act of 2017 and the State National Forest Management Act of 2017 could disrupt access to wilderness areas, and may lead to greater concentrations of use within wilderness which would have various impacts to the qualities of wilderness character.

Scenery

Spatial and Temporal Context for Analysis

The analysis area for direct and indirect effects are the National Forest System (NFS) lands in the project area.

The temporal boundaries are the timeline of the project implementation.

Methodology

Methodology used to evaluate scenery impacts for this project is the Scenery Management System (SMS) and is described in *Landscape Aesthetics* (USDA Forest Service, 1995).

Under the Forest Plan, all NFS land has a land use designation (LUD), which guides the types and intensity of development actions. The management prescriptions for each LUD define the Scenic Integrity Objectives (SIO) for each area. SIOs define the degree to which the natural landscape can be visibly 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 maintained. A LUD may have different SIOs within it, depending on the distance zone (foreground, middleground, background) in which the development activity is to take place. SIOs are classified using terms for scenic integrity: High, Moderate, Low, and Very Low. For a description of the levels of scenic integrity used for both Existing Scenic Integrity (ESI) and SIO, see the Forest Plan Scenery Forest-wide Standard and Guidelines p. 4-54, and the 2016 Forest Plan FEIS, p. 3-388.

Table 65. Scenic Integrity Objectives for all NFS land within the analysis area

Scenic Integrity Objective	Percentage of Project Area
High	42%
Moderate	19%
Low	11%
Very Low	28%

Assumptions made for this analysis:

- Proposed activities in this project would be designed to be consistent with the Forest Plan Scenery direction.
- Proposed activities other than timber harvest would result in small, localized effects.
- The most visible impacts would be from timber harvest and its corresponding road construction.
- Even-aged management timber harvest would have more visible impacts than partial harvest.
- Acres of timber harvest are used to represent the scale of the visible impacts of each alternative.

Affected Environment

The present condition for scenery is described using Existing Scenic Integrity (ESI).

Existing Scenic Integrity

The scenic resources of the Tongass encompass everything from vast tracts unmodified by human activity to extensive areas of heavily modified landscapes. The Existing Scenic Integrity (ESI) inventory is used by the Forest Service to represent the degree of intactness of the landscape character. This inventory is used to categorize the degree of alteration visible in the landscape on a continuum from a natural setting to a heavily altered landscape. Visible alterations can be a result from any human activity, including but not limited to timber harvest, road construction, recreation and special use developments, building construction and power infrastructure. ESI applies to the broad landscape affected, not just the acres altered. ESI also changes over time because some alterations may revegetate and begin to blend in with the surrounding landscape, or new projects may impact scenic integrity. ESI ranges over six levels of integrity, from Very High to Unacceptably Low. This inventory was last completed on a large scale before 2005, and would be reevaluated on a site-specific scale for each activity.

Table 66. Existing Scenic Integrity by percent of project area

Existing Scenic Integrity	Percentage of Project Area
Very High	67%
High	1%
Moderate	4%
Low	15%
Very Low	14%
Unacceptably Low	<1%

Environmental Effects

With the activities proposed in this project not being specific with regards to location or appearance, the scenic analysis is focused on determining if there is capacity within the analysis area and the logging systems and transportation analysis (LSTA) to support the alternatives. For this analysis, capacity is defined as the ability to reduce the scenic integrity of an area while still meeting the SIOs and applicable Forest Plan direction. The existing condition (ESI) is compared to the desired condition (SIO) for the analysis area, to determine how much of the analysis area has an existing condition that has room to support activities that cause visual impact. In other words, if the ESI is higher than the SIO (*e.g.*, Moderate ESI compared to Very Low SIO), there is capacity to proceed with projects that lower the scenic integrity of an area. If the ESI is currently the same as the SIO for an area, it does not mean that activities cannot take place, but that there is limited capacity, and care would be need to be taken when designing a project to minimize visible impacts to continue to meet the SIO and remain consistent with Forest Plan Scenery direction. Where the ESI is lower than the SIO, a generalized assumption would be that activities may be able to occur but would need to have no visible impact.

There are several LUDs that allow exceptions to the SIO for various developments. It is assumed that any activity developed from this project will be designed to meet the SIO of the area it is located in, and any related exceptions to SIO would be considered and used as needed and applicable (Refer to Implementation Plan, Activity Cards, and Forest Plan for more details).

Table 67. Comparison of ESI and SIO by percent of analysis area

ESI/SIO Comparison	Percentage of Analysis Area
ESI is greater than SIO	75%
ESI is the same as SIO	11%
ESI is lower than SIO	14%

A similar analysis was conducted for the LSTA, looking at young growth and old growth separately.

For all young-growth harvest, the SIO is Very Low (Forest Plan, p. 5-7). 63 percent of the LSTA young growth has an ESI greater than its SIO. For old-growth harvest in the LSTA, 37 percent is in areas where the ESI is greater than the SIO.

Table 68. Comparison of ESI and SIO by percent of young growth and old growth in LSTA

ESI/SIO Comparison	% of LSTA	% of Young Growth in LSTA (SIO = V. Low)		% of Old Growth in LSTA	
ESI is greater than SIO	53%	63%	48,966 acres	37%	17,605 acres
ESI is the same as SIO	39%	37%	28,284 acres	44%	21,079 acres
ESI is lower than SIO	8%	<1%	139 acres	20%	9,457 acres

Alternative 1 – No-Action

Direct and Indirect Effects

For Alternative 1, current management of the project area would continue as before. Any ongoing activities that occur would have scenic analysis on a project by project basis. If no activities occur that impact the scenic integrity, then there would be no direct effects. There would be a continued increase of the Existing Scenic Integrity (ESI) (*e.g.*, from Low to Moderate) because regrowth in previously harvested or disturbed areas would lessen the visual impact of older cuts and they would slowly become less noticeable.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Alternative 2 is consistent with the Forest Plan Scenery direction. There is capacity for the project area to absorb the scenic impacts from the proposed activities. Most activities outside of timber harvest will have negligible large-scale impacts to the scenic integrity. Young-growth harvest of 19,366 acres can occur in the 99.8 percent (77,250 acres) of the LSTA area that has an ESI greater than or equal to Very Low.

Old-growth timber harvest is estimated at 9,972 acres of even-aged management, and 13,297 acres of partial harvest, for a total estimated acreage of 23,269. The total potential old-growth harvest of 23,269 acres is 60 percent of the 38,683 acres of old growth within the LSTA that have an ESI greater than or equal to its SIO. Even-aged management is planned for 25,128 acres in both old-growth and young-growth areas. This is 38 percent of the areas within the LSTA that have an ESI greater than its SIO.

The existing condition of the project area can absorb visible effects of the proposed old-growth and young-growth timber harvest activities. With 25,128 acres of even-aged management in both young growth and old growth, Alternative 2 ranks highest among the action alternatives in terms of having the most impacts to the scenery resource.

Alternative 3

Direct and Indirect Effects

Alternative 3 is consistent with the Forest Plan Scenery direction. There is capacity for the project area to absorb the scenic impacts from the proposed activities. Most activities outside of timber harvest will have negligible large-scale impacts to the scenic integrity. Young-growth harvest of 36,669 acres can occur in the 99.8 percent (77,250 acres) of the LSTA area that has an ESI greater than or equal to Very Low. Old-growth timber harvest is estimated at 2,688 acres of even-aged management, and 8,063 acres of partial harvest, for a total estimated acreage of 10,750. The total potential old-growth harvest of 10,750 acres is 28 percent of the 38,683 acres of old growth within the LSTA that have an ESI greater than or equal to its SIO. Even-aged management is planned for 18,317 acres in both old-growth and young-growth areas. This is 28 percent of the areas within the LSTA that have an ESI greater than its SIO.

The existing condition of the project area can absorb visible effects of the proposed old-growth and young-growth timber harvest activities of this alternative. Alternative 3 ranks lowest among the action alternatives in terms of having the most impacts to the scenery resource, with 18,317 acres of even-aged management in both young growth and old growth.

Alternative 5

Direct and Indirect Effects

Alternative 5 is consistent with the Forest Plan Scenery direction. There is capacity for the project area to absorb the scenic impacts from the proposed activities. Most activities outside of timber harvest will have negligible large-scale impacts to the scenic integrity. Young-growth harvest of 36,669 acres can occur in the 99.8 percent (77,250 acres) of the LSTA area that has an ESI greater or equal to Very Low.

Old-growth timber harvest is estimated at 4,244 acres of even-aged management, and 2,122 acres of partial harvest, for a total estimated acreage of 6,365. The total potential old-growth harvest of 6,365 acres is 16 percent of the 38,683 acres of old growth within the LSTA that have an ESI greater than or equal to its SIO. Even-aged management is planned for 19,873 acres in both old-growth and young-growth areas. This is 30 percent of the areas within the LSTA that have an ESI greater than its SIO.

The existing condition of the project area can absorb visible effects of the proposed old-growth and young-growth timber harvest activities. Alternative 5 ranks second highest among the action alternatives in terms of having the most impacts to the scenery resource, with 19,873 acres of even-aged management in both young growth and old growth.

Cumulative Effects Common to All Alternatives

Past activities outside of this project that have created scenic impacts are considered and accounted for in the Affected Environment section.

It is not possible at this time to predict the impacts to scenic integrity of many of the reasonably foreseeable future projects. Activities planned for National Forest System (NFS) lands will be taken into consideration during the implementation phase of this project. Activities on non-NFS lands, including those due to land conveyances, may have impacts to the scenic integrity if located in areas where both non-NFS and NFS lands are visible simultaneously.

Overall, the cumulative effects of past, present, and reasonably foreseeable future actions on scenery are not expected to be substantially different than the effects addressed under direct and indirect effects.

Socioeconomics

Socioeconomic analysis explores how project activities may affect community social and economic well-being including employment, quality of life, environmental justice, and economic efficiency. Socioeconomic analysis focuses on Prince of Wales Island communities including Coffman Cove, Craig, Edna Bay, Hollis, Hydaburg, Kasaan, Klawock, Naukati Bay, Point Baker, Port Protection, Thorne Bay, and Whale Pass. Socioeconomic effects are discussed across four alternatives including one no-action and three action alternatives.

The purpose of the POW LLA Project is to implement Forest Plan direction and work toward achieving its goals and objectives, including providing a diversity of opportunities for resource uses that contribute to the local and regional economies and supporting a wide range of natural resource employment (USDA Forest Service 2016a, p. 2-3). At this time, a need exists to contribute to the economic viability of Prince of Wales area communities, in part by providing a sustainable level of forest products to help maintain the expertise and infrastructure of the timber industry. This section assesses social and economic conditions and trends in Prince of Wales communities and provides a foundation for considering how proposed project activities may affect community social and economic well-being.

Methodology

Ecosystem Services

National forests provide a suite of goods and services important to public and community needs, livelihoods, and preferences. Many of these goods and services are traditionally viewed as free benefits to society – "public goods" – including wildlife habitat and diversity, watershed services, carbon storage, and scenic landscapes, for example. These natural assets are known as ecosystem services. The concept of ecosystem services has emerged as a way of framing and describing the comprehensive set of benefits people receive from nature – and, more specifically, from public lands.

Lacking a formal economic market, these natural benefits are often absent from traditional market "balance sheets" and their contributions are frequently overlooked in public, corporate, and individual decision-making. Although the full suite of natural benefits associated with the Tongass National Forest are undoubtedly considerable, they are extremely difficult to quantify and accurately measure. The 2016 Forest Plan Amendment Final Environmental Impact Statement (FEIS) does not assign a summative monetary value to all ecosystem services, but recognizes their importance to local communities, economies, and residents (USDA Forest Service 2016c).

Ecosystem services have been described using a variety of typologies and definitions. The 2005 Millennium Ecosystem Assessment presents a popular typology including four ecosystem service categories: provisioning, regulating, cultural, and supporting. Provisioning services include the products or commodities obtained from forest ecosystems including clean air, fresh water, fiber, forage, fuel, minerals, and food. Regulating services are obtained from natural processes including air quality, climate stabilization, water quality, and erosion. Cultural services are nonmaterial benefits, including educational, aesthetic, spiritual, cultural heritage, and recreational experiences. Supporting services are best described as intermediate services that contribute to the production of other ecosystem services, such as pollination, seed dispersal, soil formation, nutrient cycling, biodiversity, and resilience.

The effects of the action alternatives on these services and benefits are assessed in resource sections related to watersheds, fisheries, soils, wildlife and subsistence use, heritage resources, timber, and vegetation. Although monetary values are sometimes not assigned to these services, this does not diminish their importance to decision-making. The Forest Service considers both quantifiable economic benefits of action alternatives as well as qualitative discussion regarding less tangible benefits in environmental decision making (Table 69).

Table 69. Methodology Overview: Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure	Used to Address: Purpose and Need or Key Issue?
Economic Benefit 1 Employment	Economic Efficiency	Total Timber Industry Jobs Supported	Purpose and Need Key Issue 3, Timber Economics
Economic Benefit 2 Direct Income	Economic Efficiency	Total Direct Income	Purpose and Need Key Issue 3, Timber Economics
Ecosystem Service 1 Fish Habitat	See FEIS Chapter 3, Fisheries Resource Section	Qualitative Evaluation	Purpose and Need
Ecosystem Service 2 Recreation	See FEIS Chapter 3, Recreation Section	Qualitative Evaluation	Purpose and Need
Ecosystem Service 3 Non-Timber Forest Products	See FEIS Chapter 3, Multiple Resource Sections	Qualitative Evaluation	Purpose and Need
Ecosystem Service 4 Subsistence Resource Access	See FEIS Chapter 3, Wildlife and Subsistence Resource Section	Qualitative Evaluation	Purpose and Need Key Issue 2, Subsistence
Environmental Justice	Disproportionate and adverse effects to low-income and/or minority populations.	Qualitative Evaluation	Executive Order 12898

Assumptions

Economic analysis assumes full implementation of the alternatives. If market demand does not exist to utilize all available products and opportunities, economic impacts will likely be smaller than initially anticipated. Economic analysis also assumes a static economy with the project area economy remaining unchanged over the project period.

Units of Measure

Economic impacts, including employment and labor income, associated with project activities are estimated based on best available information. Employment and income for some types of jobs have been estimated using the Forest Service's Financial Analysis Spreadsheet Tool – Residual Value (FASTR). This spreadsheet uses cost collection information obtained from the timber industry and other sources for related jobs. Information from other resource related employment such as commercial fishing and tourism cannot be estimated since this information is not collected at the project area scale. Information is analyzed related to a variety of ecosystem services indicators and environmental justice characteristics. Units of measure used to compare alternatives include:

- economic impact (*i.e.*, employment and income),
- ecosystem services (*i.e.*, fish habitat, recreation opportunities, non-timber forest products, subsistence resource access), and
- environmental justice – the potential for project activities to disproportionately impact low-income and minority populations.

Spatial and Temporal Context for Analysis

The project area is within the Prince of Wales – Hyder Census Area which encompasses Prince of Wales Island and adjacent outlying islands. Where possible, community-level data are presented. Prince of Wales communities include: Coffman Cove, Craig, Edna Bay, Hollis, Hydaburg, Kasaan, Klawock, Naukati Bay, Point Baker, Port Protection, Thorne Bay, and Whale Pass. Direct, indirect, and cumulative socioeconomic effects of proposed project activities are expected to occur in these communities.

Proposed project activities are expected to occur over 15 years, from 2019 to 2034. The temporal scale for socioeconomic effects analysis is through 2039, to capture both project implementation and residual effects to local economic activity and quality of life.

Incomplete or Unavailable Information

Socioeconomic data at the state and regional level are fairly abundant. However, in some cases, demographic and economic data at the community-level are unavailable or suppressed due to privacy concerns. In the affected environment section, this is particularly the case for economic data in the smallest communities in the project area.

Generally, economic analyses include indicators that can be quantitatively measured and evaluated – primarily goods and services traded in markets. Social assessments include non-market values, such as social well-being indicators, that lack quantitative values and are therefore evaluated using qualitative methods.

Affected Environment

Prince of Wales Overview

Prince of Wales Island, the United States' fourth largest island, is one of the major islands in Southeast Alaska's Alexander Archipelago. Natural resource extraction and development, National Forest System lands, and indigenous culture are integral pieces of the island's history. The timber industry became a mainstay of Prince of Wales' economy with the opening of two large pulp mills in Ketchikan (1954) and Sitka (1956). Each had a Forest Service contract to provide 50 years of Tongass National Forest timber. The primary sale area for the Ketchikan Contract included large portions of the POW LLA Project area on Prince of Wales Island. The opening of pulp mills and implementation of long-term timber contracts fueled the settlement of Prince of Wales Island with new residents and communities, road and utility infrastructure, and interweaving of indigenous and Western cultures.

Industrial scale logging occurred on Prince of Wales Island from the mid-1950s until the pulp mills closed during the late-1990s. Since that time, the timber industry has declined and many timber-dependent Prince of Wales communities have struggled to maintain population and diversify their economies. Tourism, including whale and other wildlife viewing and sport fishing, has become an important component of Prince of Wales' economy. Commercial fishing (salmon, halibut, and black cod), mariculture (geoducks, sea cucumbers, and sea urchins) and mining activities have helped create and diversify job opportunities for Prince of Wales residents. Developing transportation infrastructure, including improving Forest Service logging roads, transferring some roads to the State of Alaska for reconstruction to paved two-lane state highways, establishing daily ferry service between Ketchikan and Prince of Wales Island via the Inter-Island Ferry Authority in 2002, and adding regularly scheduled flights, has greatly improved island access for both local residents and a growing visitor industry.

Demographic and Economic Summary

Table 70, Table 71, and Table 72 provide an overview of demographic and economic data for communities in the POW LLA project area. The project area is considered rural and encompasses nine incorporated and three unincorporated communities. Table 70 displays community-level population data for 1990, 2000, 2010, and 2015. Data for 2015 show that overall, population ranged from 25 to 1,180 residents, with nearly three-quarters (70 percent) living in Craig (33 percent), Klawock (23 percent), or Thorne Bay (14 percent). The remaining 30 percent of residents are distributed across nine small and largely remote communities. The total population in project area communities declined by 52 people between 1990 and 2015, from 3,641 to 3,589 residents (-1 percent). Overall, island population has remained relatively stable, but individual communities vary significantly. The majority of communities sustained population losses for two consecutive decades (1990 – 2010), followed by a period of stabilization followed by growth from 2010 to 2015.

Table 70. Community Population Change, 1990 – 2015

Community	1990 Population	2000 Population	2010 Population	2015 Population	1990-2010 Percent Change (Long Term)	2000-2010 Percent Change (Mid Term)	2010-2015 Percent Change (Short Term)
Coffman Cove	186	199	176	199	-5%	-12%	13%
Craig	1,260	1,397	1,201	1,180	-5%	-14%	-2%
Edna Bay	86	49	42	47	-51%	-14%	12%
Hollis	111	139	112	113	1%	-19%	1%
Hydaburg	384	382	376	402	-2%	-2%	7%
Kasaan	54	39	49	86	-9%	26%	76%
Klawock	722	854	755	820	5%	-12%	9%
Naukati Bay	93	135	113	107	22%	-16%	-5%
Point Baker	39	35	15	25	-62%	-57%	67%
Port Protection	62	63	48	54	-23%	-24%	13%
Thorne Bay	569	557	471	510	-17%	-15%	8%
Whale Pass	75	58	31	46	-59%	-47%	48%
Project Area Total[1]	**3,641**	**3,907**	**3,389**	**3,589**	**-7%**	**-13%**	**6%**

Source: Alaska Department of Commerce, Community, and Economic Development 2016
[1]Excludes approximately 700 people who live outside of designated places in the Prince of Wales-Hyder Census Area.

Table 71 displays changes in school enrollment (kindergarten through grade 12) in project area communities. Comparisons between community population changes (Table 70) and changes in school enrollments reveal demographic variation across Prince of Wales. For example, between 1990 and 2015, Coffman Cove's population grew slightly, yet school enrollments declined by more than 70 percent. In contrast, school enrollments between 1990 and 2015 increased by approximately 70 percent in Craig, even though population declined slightly. These data reveal movement of families with school-aged children as well as school consolidation trends on the island. In 2015, a number of communities in the project area were near the minimum number of students (10) required to maintain state government funding for schools. These include Coffman Cove, Kasaan, Port Protection, and Whale Pass. These rural schools are at high-risk of closing, which could create significant local instability in rural and remote areas, as schools are also local employers, community gathering places, and part of social identity. Notably, schools in Edna Bay and Whale Pass have closed and re-opened multiple times during the past 25 years, a reflection of population instability.

Table 71. Community School Enrollments, K – 12

Community	1990 Enrollment	2000 Enrollment	2010 Enrollment	2015 Enrollment	1990-2010 Percent Change (Long Term)	2000-2010 Percent Change (Mid Term)	2010-2015 Percent Change (Short Term)
Coffman Cove	47	31	11	14	-77%	-65%	27%
Craig	308	551	630	525	105%	14%	-17%
Edna Bay	15	Closed	9	Closed	-40%	-	-
Hollis	16	14	10	22	-38%	-29%	120%
Hydaburg	109	91	61	81	-44%	-33%	33%
Kasaan	10	11	14	11	40%	27%	-21%
Klawock	203	190	136	114	-33%	-28%	-16%
Naukati Bay	25	36	19	19	-24%	-47%	0%
Point Baker[1]	-	-	-	-	-	-	-
Port Protection	9	27	10	13	11%	-63%	30%
Thorne Bay	168	136	73	77	-57%	-46%	5%
Whale Pass	11	Closed	Closed	10	-	-	-
Project Area	**921**	**1,087**	**973**	**886**	**6%**	**-10%**	**-9%**

Source: Alaska Department of Education and Early Development 2016 (October 1, 2015 School Enrollments)
[1]Children attend school in nearby Port Protection.

Table 72 displays a number of standard economic indicators for Prince of Wales communities, again demonstrating the variation among them. The largest community, Craig, also has the highest median household income. More populous areas typically provide a broader range of employment opportunities. Craig also has the largest number of current business licenses, though Coffman Cove has the most business licenses per capita at approximately one for every four residents. Due to confidentiality issues in very small communities, some data is suppressed for Edna Bay and Point Baker.

Table 72. Community Economic Characteristics, 2016

Community	Residents Employed	Private Sector Employment	Public Sector Employment	Per Capita Income	Median Household Income	Current Business Licenses
Coffman Cove	57%	54%	46%	$27,764	$41,250	55
Craig	65%	74%	26%	$28,038	$61,607	273
Edna Bay	43%	93%	7%	Not Available	Not Available	14
Hollis	59%	59%	41%	$19,986	$34,028	28
Hydaburg	55%	47%	53%	$17,834	$36,042	16
Kasaan	73%	21%	79%	$21,393	$48,438	9
Klawock	60%	72%	28%	$21,693	$38,958	121

Community	Residents Employed	Private Sector Employment	Public Sector Employment	Per Capita Income	Median Household Income	Current Business Licenses
Naukati Bay	45%	75%	25%	$25,226	$23,229	8
Point Baker	Not Available	Not Available	Not Available	$14,140	$18,482	7
Port Protection	43%	73%	27%	$28,221	$41,341	2
Thorne Bay	50%	61%	39%	$31,953	$52,500	90
Whale Pass	46%	75%	25%	$20,262	Not Available	24
Project Area[1]	**58%**	**66%**	**34%**	**$24,929**	**$46,616**	**647**

Source: US Census Bureau 2016, Alaska Department of Commerce, Community, and Economic Development 2016, and Alaska Department of Labor and Workforce Development 2016a

[1]Project area row displays population-weighted average results except for current business licenses, which is a sum.

Prince of Wales Area Communities

Prince of Wales Island, including adjacent outer islands, is comprised of 12 independent communities and approximately 4,300 residents. There is significant variation in community history, culture, and socioeconomics across the island. Some communities have indigenous origins that pre-date written history, while others were established in the late 1950s as company-owned logging camps. Today, several unincorporated settlements exist as “lifestyle” communities where local residents have chosen a subsistence lifestyle in a remote location, with a limited economy, no organized government, few public services, and strong reliance on locally-harvested wild foods.

Two-thirds of communities are incorporated as city governments; one-third remain unincorporated settlements with limited public services. The majority of communities endured two consecutive decades of significant population decline following the closure of pulp mills and subsequent decline of the timber industry (1990 – 2010). Populations have remained relatively stable since then (2010 – 2015). One-quarter of the communities are considered indigenous, including two Haida communities (*i.e.*, Kasaan, Hydaburg) and one Tlingit community (*i.e.*, Klawock). One-third of all communities have a federally-recognized tribe, five where the Alaska Native population exceeds the statewide proportion for Alaska Natives (15 percent). Alaska Native corporations, both regional and village, have been active in the Southeast timber industry – likely also easing the integration of indigenous and Western cultures. Half of all Prince of Wales communities began as company-owned logging camps that transitioned to year-round communities, facilitated by state government land disposals.

Coffman Cove

Coffman Cove is located on the northeast coast of Prince of Wales Island. It was first settled as a logging camp during the 1950s and incorporated as a city government in 1989. Nearby state government land disposal sales facilitated this transition. Residents that remained after closure of the pulp mills have largely transitioned to livelihoods such as value-added niche forest products, tourism, and seafood products. Coffman Cove is accessible by floatplane, boat, and paved road from Hollis, where the ferry terminal is located. Nearby recreational opportunities including camping, hiking, biking, kayaking, and wildlife viewing attract visitors to the community. Coffman Cove has relatively high per capita income and low rates of poverty compared to other Prince of Wales communities. Population has fluctuated over the past two decades, but generally remains around 200 residents. School enrollments have declined by 70 percent over this period, suggesting the population is aging or younger families are leaving Coffman Cove. The median age in the community is 50 years and Coffman Cove has more residents aged 60 or older than 19 or younger (ADLWD 2016a).

Craig

Craig is located on the west coast of Prince of Wales Island. Tlingit and Haida tribes historically utilized the area around Craig for its rich natural resources. With local Haida knowledge, a fish saltery was established on nearby Fish Egg Island during the early 1900s (ADCCED 2017). Cold storage, fish processing, and canneries have remained mainstays of Craig's local economy and identity ever since. A nearby sawmill, Viking Lumber LLC, provides year-round jobs that have helped stabilize Craig's economy during times of low fish prices and stocks. Today, Craig includes a city government, federally-recognized tribe (Craig Tribal Association), and a village corporation established via the 1971 Alaska Native Claims Settlement Act (Shaan-Seet Incorporated).

Craig is the largest community in the project area, with approximately 1,200 residents, and serves as the island's regional hub for medical services, retail goods and services, arts and entertainment, educational opportunities, and gatherings for island residents. Regular off-island transportation links are located in neighboring communities including a paved airport in Klawock and ferry terminal in Hollis. With the decline of the timber industry, Craig has worked to diversify its economy including adding marine infrastructure, encouraging independent tourism, and improving an industrial park.

Craig's population has declined from a peak of nearly 1,400 in 2000 to approximately 1,200 in 2015 (-14 percent). Despite this decline, school enrollments in Craig have remained stable between 2000 and 2015, following a sharp increase between 1990 and 2000 likely from migration of families from smaller island communities. School enrollment suggests Craig remains an attractive place for families with children. Craig also provides a greater variety of employment opportunities, and has one of the highest shares of employed residents (65 percent) and the highest median household income ($61,607) in the project area. About a quarter (22 percent) of Craig residents work in the three sectors closest tied to Tongass National Forest management.

Edna Bay

Edna Bay is a small, remote community on Kosciusko Island, located off Prince of Wales Island's northwest coast. It is one of Alaska's newest city governments, incorporating in 2014. Edna Bay was originally established as a company logging camp for assembling ocean-going log rafts (Edna Bay 2017). The disposal of nearby state government lands facilitated its settlement as a year-round community. Today, Edna Bay is largely a community of commercial fishing families and includes both seasonal and year-round residents. Year-round residents are largely either retired or work in commercial fishing or forest products. Only 43 percent of residents are employed, the majority (57 percent) work in the natural resources and mining or manufacturing sectors. Because of Edna Bay's remote location, household livelihoods are supplemented with subsistence hunting, fishing, and gathering. Edna Bay's population has declined by about half since 1990, from 86 to 47 residents. As of the writing of this document, the Edna Bay School – the only school on Kosciusko Island – is closed from not meeting minimum student enrollment to qualify for state government school funding.

Hollis

Hollis is situated on the east side of Prince of Wales Island on Twelvemile Arm. Hollis was originally a mining town in the early 1900s with nearby gold and silver deposits. During the 1950s, Hollis transitioned to a company logging camp and timber operations base for Ketchikan's pulp mill. State government land disposals paved the way Hollis to transition from logging camp to community. Today, Hollis is considered a community that provides timber industry support services, serves as the island's transportation gateway, and contains a growing number of seasonal residences. Hollis serves as a major transportation hub; the year-round, daily ferry service between Ketchikan and Hollis is a key mode of access to Prince of Wales Island. Hollis has the second-highest share of employment in leisure and hospitality (12 percent) among the project area communities, with services for recreational visitors including car rental, lodging, and developed recreation sites. A small community of 113 residents, Hollis' population has experienced volatility during the past twenty years, ranging from 111 to 139 residents. School enrollment has also varied over time, ranging from 10 to 22 students.

Hydaburg

Hydaburg is located on the southwest coast of Prince of Wales Island. The majority (77 percent) of Hydaburg residents are Alaska Native and the community is Alaska's largest Haida village. Hydaburg was originally populated by Haidas that migrated from Canada during the early 1700s. Current-day Hydaburg was established in the early 1900s by the consolidation of three Haida villages in Cordova Bay – Howkan, Sukkwan, and Klinkwan. Hydaburg was eventually incorporated as a city government during the 1960s. Today, Hydaburg includes a city government, federally-recognized tribe (Hydaburg Cooperative Association), and a village corporation established via the 1971 Alaska Native Claims Settlement Act (Haida Corporation).

Hydaburg is one of the larger communities in the project area with approximately 400 residents. It is one of the few communities to maintain a stable population over the past two decades, growing from 384 to 402 people between 1990 and 2015. Fisheries are important to the community, both for subsistence and employment opportunities. Fishers and related fishing workers is the second most common occupation in Hydaburg (ADLWD 2016a). Hydaburg is home to world-renowned totem carvers, culture bearers, and other artisans practicing Haida art, culture, and tradition. The famed Hydaburg Totem Park, established during the 1930s and later restored, is a well-known collaborative effort between the Forest Service, Civilian Conservation Corps (CCC), local leaders, and Alaska Natives to recognize Haida culture, traditions, and document oral histories (NPS 2017).

Kasaan

Kasaan is located on eastern Prince of Wales Island in Kasaan Bay. Like Hydaburg, Kasaan was populated by Haidas that migrated from Canada during the early 1700s. Kasaan was originally located on Skowl Arm (*i.e.*, "Old Kasaan"), but later relocated to the current village site on Kasaan Bay to be near an operating mine, sawmill, and later a cannery (Organized Village of Kasaan 2017). Kasaan was eventually incorporated as a city government during the 1970s. Today, it includes a city government, federally-recognized tribe (Organized Village of Kasaan), and a village corporation established via the 1971 Alaska Native Claims Settlement Act (Kavilco Incorporated).

Approximately one-third of Kasaan's population is Alaska Native. While Kasaan is commonly-considered a traditional Haida village, today's local population includes Haidas, Tlingits, and non-Natives (ADCCED 2017). Kasaan has the highest labor force participation rate (73 percent) and the greatest share of employment in the public sector (79 percent) among the project area communities. As a result, median household income is relatively high ($48,432) and the poverty rate is low (3 percent). Kasaan's population grew considerably between 1990 and 2015, from 54 to 86, yet school enrollments remained flat over this period, which reflects an aging population.

Similar to Hydaburg, Kasaan maintains a strong Haida cultural tradition with language and culture camps, cultural learning center, recently restored Chief Son-i-Hat Whale House (clan house), and the Kasaan Totem Park (Organized Village of Kasaan 2017). In recent years, Kasaan has been encouraging tourism by marketing its Totems Historic District, newly-built Discovery Cabins, and reopening the Totem Trail Café. Notably, both the Whale House and Totems Historic District were listed in the National Register of Historic Places during 2002 (Organized Village of Kasaan 2017).

Klawock

Klawock is on the west coast of Prince of Wales Island, 7 miles by paved road from Craig. Together, Klawock and Craig form the major population center of Prince of Wales Island. Current-day Klawock was originally used by the Tlingits as a summer fishing camp, later becoming a permanent village site (Klawock Cooperative Association 2017). Similar to Craig, Klawock's history is closely tied to commercial fishing. A stwoalmon saltery and Alaska's first cannery were established during the mid- and late 1800s, respectively, with additional canneries and a fish hatchery built over time. During the 1970s, a sawmill and additional timber-related facilities were built, including a log sort yard and deep-water dock for transporting timber.

Klawock eventually incorporated as a city government, and today is the second largest community in the project area, with more than 800 residents. In addition to the city government, Klawock also includes a federally-recognized tribe (Klawock Cooperative Association), and Alaska Native Claims Settlement Act (1971) village corporation (Klawock Heenya Corporation). Today, Klawock is a mix of Tlingit and non-Native residents and the population has grown by approximately 15 percent since 1990. School enrollment has declined by approximately 45 percent, indicating that growth has not increased the number of households with school-aged children.

Klawock has a relatively diverse economy, with retail and other service professionals as well as Viking Lumber LLC and logging firms in the community (ADLWD 2016a). Klawock airport has the only runway that can accommodate wheeled-aircraft on Prince of Wales Island. The community has been greatly influenced by commercial fishing and timber industries, but most residents continue to pursue a subsistence lifestyle. The community maintains a strong Tlingit cultural tradition with the Klawock Totem Park, which includes 21 restored totem poles, heritage center, and a traditional long house (City of Klawock 2017). Notably, the Alaska Native Brotherhood and Alaska Native Sisterhood, historic nonprofit organizations working for civil rights for Alaska Natives, were founded by Klawock residents during the early 1900s (Klawock Cooperative Association 2017)

Naukati Bay

Naukati Bay, commonly referred to as "Naukati", is located on the northwest coast of Prince of Wales Island. Naukati was originally established as a logging camp to support Ketchikan's pulp mill. The community remained after the pulp mill closed and grew with state government land disposals. Residents are primarily logging, small sawmill, and homesteading families, with growth in emerging tourism enterprises during the past decade. The community remains unincorporated, but residents are represented by two non-profit associations (*i.e.*, Naukati West and Naukati East) organized for planning, addressing local issues, and improving local infrastructure.

Naukati's population grew from 93 to 107 people between 1990 and 2015. Like several other Prince of Wales communities, school enrollment has fallen despite overall population growth. Naukati has one of the lowest labor force participation rates (45 percent) in the project area. Many residents rely on subsistence activities to maintain cultural ties and support economic well-being (Naukati West, Inc. 1998). Naukati is home to Shikat Bay Farm, an oyster nursery that raises oyster spat (seed) for oyster farmers across coastal Alaska. Naukati is also home to well-known community celebrations including the Skunk Cabbage Festival and off-road mud bog races (Naukati Bay 2017).

Point Baker

Point Baker is on the northern tip of Prince of Wales Island and is only accessible via seaplane or boat. It was established in the early 1900s as a fish buying and packing station. The settlement transitioned into a community when the Forest Service opened the area for homesite development (ADCCED 2017). Current-day Point Baker is considered a small fishing community, but neighboring lodges have been established providing sportfishing, wildlife viewing, and other outdoor experiences. Visitors are drawn to Point Baker for its hunting and fishing opportunities. The community's proximity to Sumner Strait, an exceptional fishing site for all five species of Pacific salmon and halibut, makes Point Baker a particularly appealing fishing destination. Point Baker remains an unincorporated community where residents practice a subsistence and homestead lifestyle without city government.

By standard economic measures, Point Baker is the most impoverished community in the project area. According to federal measures, a large majority of residents (81 percent) live in poverty, but local residents have chosen to live remotely and practice a homestead lifestyle instead of pursuing steady income. Furthermore, federal poverty or household income measures for very small communities are often skewed by one or two outliers reporting either very high or low income. Differentiating between actual poverty, lifestyle choice, or skewed federal data is an exercise in professional judgement for many small Southeast Alaska communities, including Point Baker.

Port Protection

Port Protection is on the northern tip of Prince of Wales Island, near Point Baker, and is only accessible via seaplane or boat. Similar to Point Baker, Port Protection was established as a fish buying center that provided safe harbor, fuel, and supplies for commercial fishing vessels. State government land disposal sales enabled the permanent settlement of a year-round community (ADCCED 2017). Port Protection has remained a small fishing community with no roads. All homes and other buildings are located along docks or upland boardwalks.

Port Protection has relatively low median household income and high rates of poverty. It has the lowest labor force participation rate (43 percent) of any community in the project area. Like Point Baker, Port Protection is more akin to a homesteading community where residents practice a rural and subsistence lifestyle. Furthermore, federal poverty or household income measures for very small communities are easily skewed by one or two household outliers reporting either high or low income. The distinction between actual poverty, lifestyle choice, or skewed federal data is an exercise in professional judgement.

Thorne Bay

Thorne Bay is situated on the east coast of Prince of Wales Island. Originally established as a floating logging camp for the Ketchikan pulp mill in 1960, it grew substantially in 1962 when the Hollis logging camp was relocated there. A shop, log sort yard, and camp were built and soon thereafter, roads were constructed connecting Thorne Bay to Hollis, Craig, and Klawock. During the peak of island timber activities, Thorne Bay was considered the largest logging camp in North America, hosting over 1,500 residents (ADCCED 2017). Today, Thorne Bay contains one of the log transfer sites on the Island.

State government land disposal sales encouraged permanent settlement and eventual incorporation as a city government. Thorne Bay evolved into one of the larger communities on Prince of Wales Island, with approximately 500 residents. Employment is primarily in barge and freight services, small sawmills, government, commercial fishing, and tourism as guided sport fishing charter opportunities increasingly attract visitors. To supplement incomes, residents engage in subsistence activities, fish and trap. The population declined by 10 percent between 1990 and 2015, but school enrollment fell by more than 50 percent, mirroring the trend in other communities with aging populations. The median age in Thorne Bay is 45 years (ADLWD 2016a).

Whale Pass

Whale Pass is a small community located on northern Prince of Wales Island. It was originally established as a logging camp during the early 1960s and the camps remained through the early 1980s (ADCCED 2017). Whale Pass is situated at a remote area of the island, but is connected to other island communities via a gravel road. State government land disposal sales facilitated the transition from company-owned logging camp to a year-round community that incorporated in 2016. Population declined considerably between 1990 and 2015, from 75 to 46 residents (-39 percent). Today, residents of Whale Pass consider themselves homesteaders and value a subsistence lifestyle. Commercial fishing, recreational tourism, and subsistence activities are important to residents (Whale Pass Community Action Team 1997). The economy is dependent on natural resources and tourism, with high levels of employment in both the natural resources and mining and leisure and hospitality sectors. However, fewer than 50 percent of residents are employed and nearly two-thirds (62 percent) of residents live in poverty according to standard federal economic measures. Whale Pass had enough students in 2015 to keep the school open, but the school was closed in both 2000 and 2010.

Economic and Infrastructure Trends

Prince of Wales has undergone significant change during the past two decades including timber industry decline, community population volatility, significant transportation improvements, local government incorporations, minerals exploration and early mine development activities, and growth in both tourism and mariculture industries. While economists and planners have varied opinions regarding Prince of Wales' long-term future, there is general consensus regarding past activities and events that have significantly affected the island's present condition.

Prince of Wales has undergone significant change during the past two decades including timber industry decline, community population volatility, significant transportation improvements, local government incorporations, minerals exploration, mine development activities, and growth in both tourism and mariculture industries. While economists and planners have varied opinions regarding Prince of Wales' long-term future, there is general consensus regarding past activities and events that significantly affected the island's present condition.

Economic Transitions

Half of Prince of Wales communities started as company-owned logging camps to harvest and transport Tongass National Forest timber during the pulp-mill and industrial logging era, spanning nearly fifty years from the mid-1950s to late-1990s. Prince of Wales Island, and its communities, were heavily-impacted by the closure of the Ketchikan Pulp Company in 1997. The majority of industrial timber harvest jobs were lost, but Viking Lumber, LLC has survived and additional cottage forest product businesses have been established, notably in the Goose Creek Industrial Subdivision outside of Thorne Bay. The decline and deindustrialization of the timber industry forced the island to diversify its economy, which increasingly relies upon value-added forest products, tourism, seafood, mining, and government jobs.

Prince of Wales' legacy of mineral extraction seen a resurgence in recent years with mine exploration and early development activities at both Bokan Mountain and Niblack mineral projects. Ucore Rare Metals continues exploratory work at Bokan Mountain, which has been described as the "Silicon Valley of Rare Earth Elements" (ADLWD 2012). Heatherdale Resources is similarly exploring Niblack's copper, gold, zinc, and silver deposits, which could potentially rival Juneau's Greens Creek Mine in project scope. These projects have generated employment opportunities, however, it is their long-term potential to fill the employment void left after the pulp-mill era that garners the attention of Prince of Wales local officials, tribes, and residents.

Transportation Improvements

The diversification of Prince of Wales' economy away from timber dependence has been facilitated by improvements to both on- and off-island transportation systems. There are approximately 2,000 miles of Forest Service road that connect the majority of communities – only Edna Bay, Point Baker, and Port Protection are without road access. Modernization of the island road system has transformed some former logging roads to state scenic byways, supporting economic opportunity by facilitating the movement of goods, services, and visitors. For example, upgrading the Coffman Cove Road connecting the City of Coffman Cove to the Thorne Bay cutoff on the Klawock to Thorne Bay Road transformed a remote gravel road to paved highway which improved the economic vitality of Coffman Cove (City of Coffman Cove 2017).

Dependable transportation to and from the island was a long-time challenge for residents and businesses because of sporadic service provided by the Alaska Marine Highway System. The Inter-Island Ferry Authority was created in 1997 to develop a reliable ferry shuttle system to the island. By 2002, the first vessel, the M/V Prince of Wales, began year-round daily service between Hollis and Ketchikan. The introduction of convenient and reliable ferry service supported growth in tourism, including fishing lodges, outfitter/guide services, and a variety of accommodations and hospitality services. An additional ferry from Coffman Cove to the communities of Wrangell and Petersburg began operating in 2006 but was discontinued in 2008 from a lack of consistent ridership.

Industry Sector Highlights

Table 73 displays employment share by industry sector in project area communities. Almost half of all jobs in the project area are in government (34 percent) or trade, transportation and utilities (21 percent). Forest Service management actions contribute to employment in a variety of sectors. Timber harvesting supports employment in the natural resources and mining sector, water and overland transportation, road construction, and manufacturing. Ecosystem restoration activities contribute to employment in the natural resources and mining sector. Ecosystem services from the forest also contribute to natural resources and mining sector employment through the provision of healthy watersheds and fisheries. For example, the commercial fishing and seafood processing have remained foundational components of the local economy, while a growing mariculture industry, including sea cucumbers, sea urchin, geoduck, and oyster farms, has expanded the seafood product portfolio for

Table 73. Selected Industry Employment, 2016

Community	Natural Resources and Mining	Manufacturing	Leisure and Hospitality	Trade, Transportation, and Utilities	Construction	Government	All Other
Coffman Cove	10%	<1%	<1%	19%	17%	46%	8%
Craig	8%	7%	7%	27%	7%	26%	18%
Edna Bay	36%	21%	<1%	<1%	14%	7%	22%
Hollis	7%	4%	12%	20%	6%	41%	10%
Hydaburg	1%	1%	2%	9%	10%	53%	24%
Kasaan	3%	<1%	3%	7%	3%	79%	5%
Klawock	8%	6%	6%	27%	7%	28%	18%
Naukati Bay	10%	<1%	5%	5%	25%	25%	30%
Point Baker	<1%	17%	<1%	67%	<1%	<1%	16%
Port Protection	5%	<1%	5%	14%	<1%	27%	49%
Thorne Bay	7%	4%	10%	20%	9%	39%	11%
Whale Pass	21%	<1%	13%	4%	13%	25%	24%
Project Area[1]	**8%**	**5%**	**6%**	**21%**	**9%**	**34%**	**17%**

Source: Alaska Department of Labor and Workforce Development 2016a
[1]Project area displays population-weighted average.

Prince of Wales Island. Recreational opportunities arising from robust and sustainable fish stocks have fueled jobs in leisure and hospitality through the development of sport fish lodges, outfitter and guide services, accommodations, and related tourism services. Government employment, with well-paying full-time jobs, has likely buoyed communities during tumultuous economic times.

Seafood Industry

Commercial, subsistence, and recreational fishing activities are common across Prince of Wales Island. This section addresses commercial and subsistence fishing. Recreational fishing is described in the next section on tourism. Active fisheries in the project area include all five species of Pacific salmon, halibut, lingcod, herring, sablefish, cutthroat trout, rockfish, Dungeness crab, shrimp, clams, sea cucumber, and sea urchin among others (Himes-Cornell *et al.* 2013). The importance of commercial fishing grew in many project area communities following the decline of the timber industry. Many residents hold commercial fishing permits. For example, about one-third of Edna Bay residents held a commercial fishing permit in 2010 (Himes-Cornell *et al.* 2013). This exceeds the share of residents reported as employed in the natural resources sector, as shown above in Table 73. Due to the seasonal nature of fisheries, many residents participate in commercial fishing operations while also having a non-fisheries job. The primary occupation of these residents may be in another sector, which reflects a limitation of industry employment data in small communities. Additionally, project area communities are eligible to participate in the Community Quota Entity (CQE) program, which enables them to form non-profit organizations to purchase and manage individual fishing quotas for halibut and sablefish (Himes-Cornell *et al.* 2013).

Canneries and other land-based seafood processing facilities in the project area are located in Coffman Cove, Craig, Klawock, and Naukati Bay (ADEC 2012). Fish processing employment spikes during the summer months, with approximately 5,000 people employed in fish harvesting in July and August throughout Southeast Alaska. It is estimated only 10 percent of seafood processing jobs in Southeast Alaska are in the Prince of Wales-Hyder Census Area (ADLWD 2016b). The majority of jobs are related to salmon (ADLWD 2016b). Many of these jobs are filled by people who reside outside the area – only about 30 percent of the seafood processing workforce is local (ADLWD 2016b). In 2015, wages per worker in seafood processing in Southeast Alaska were approximately $13,000 (ADLWD 2016b). Most jobs in this sector are seasonal and average wages do not reflect year-round earnings. In some communities, fisheries-related revenue (*e.g.*, harbor usage fees) is an important source of municipal funding. For example, in both Thorne Bay and Craig, approximately 10 percent of total municipal revenue is attributable to fisheries (Himes-Cornell *et al.* 2013).

Subsistence fishing activities are not captured in the industry data, but certainly contribute to social and economic well-being on the island. Smaller communities, and those with a higher proportion of Alaska Native residents, tend to rely more heavily on subsistence resources. In particular, Hydaburg is known to rely on subsistence activities. A survey of Alaska communities found that Hydaburg residents consumed an estimated 336 pounds of subsistence wild food per capita between 1982 and 1999 (Himes-Cornell *et al.* 2013), but household subsistence data have not been available since. Some subsistence activities occur across all communities in the project area to both supplement income and preserve cultural heritage. In many communities, reported subsistence harvests of fish declined between 2000 and 2010, but community level subsistence data after 2010 are lacking.

Tourism Industry

Alaska is well-known for its natural amenities and draws tourists from around the world. According to the most recent McDowell Group's Alaska Visitor Statistics Program report, in 2016, Southeast Alaska received 67 percent of the total visitors to Alaska, and nearly all (95 percent) were traveling for vacation or pleasure, with a large majority of cruise visitors. Most of these cruise ship visitors arrive via the ports of Ketchikan and Juneau and a lesser extent, Sitka. Prince of Wales Island visitor volume increased from 15,000 to 16,000 people between 2011 and 2016 (McDowell Group 2017). Visitors to Prince of Wales Island are interested in sport fishing, hunting, camping, boating, wildlife viewing, and historical and cultural resources. World-class sport saltwater fishing opportunities, in particular, draw visitors to the island. According to the 2010 Prince of Wales Alaska Department of Fish and Game (ADF&G) Harvest Survey, non-residents in Alaska accounted for approximately 75 percent of saltwater angler days fished and 70 percent of freshwater angler days fished (Himes-Cornell *et al.* 2013). Many of the communities have active sport fish guide businesses (Himes-Cornell *et al.* 2013). Sport fishing, therefore, is critical to the tourism industry on the island. Visitors to Prince of Wales Island for its recreational opportunities spend money in area communities on outfitters, guides, lodging, food, and other goods and services. Tourism-related services provide employment opportunities in many communities on the island. Craig is the largest community and has a number of tourist amenities, however, other communities in the project area also earn income supplying goods and services to tourists.

Timber Industry

Southeast Alaska timber is primarily purchased and harvested from lands managed by the US Department of Agriculture (Forest Service), and to a lesser extent from the State of Alaska (Division of Forestry, Alaska Mental Health Land Trust Authority, and University of Alaska), and Alaska Native Village and Regional corporations. Southeast Alaska timber purchasers are challenged with limited domestic marketing opportunities. Operating costs are higher compared to Lower 48 states, and transportation is particularly costly due to haul and tow distances to available markets. The timber industry supports project area communities that are traditionally dependent on the Tongass National Forest to provide natural resources employment and revenue. Viking Lumber Company, LLC, located in Klawock, and Icy Straits Lumber Company, located in Hoonah, are medium-sized timber sawmills currently operating in Southeast Alaska. Additional sawmills exist, but are substantially smaller as measured by annual volume processed, employment, and industrial capacity.

Table 74. Timber Industry Employment in Southeast Alaska, 2002 – 2014

Year[1]	Tongass Logging[2]	Tongass Sawmill[2]	Tongass-Related Employment	Other Logging	Other Sawmill	Total Other Employment	Total 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	265
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**

Source: Forest Plan Amendment Final EIS 2016, p. 3-485
[1] Reported in calendar years.
[2] Tongass employment estimates based on the ratio of Tongass timber harvest to total timber harvest in Southeast Alaska.

Many challenges have confronted the Southeast Alaska forest products industry during the past two decades. Southeast Alaska's two pulp mills and numerous sawmill facilities have closed. Remaining active sawmills operate at about 15 percent of their estimated production capacity, on average. During 2013, the Tongass National Forest supplied approximately three-quarters of logs for local sawmills followed by one-quarter from state land; less than one percent is from private lands. In recent years, the domestic market has been increasingly attractive with rising housing starts and forest product prices (USDA Forest Service, 2016d, Appendix G, p. G-8). The destination for material sawn in Southeast Alaska is now primarily other US states (Kilborn *et al.* 2004; Brackley *et al.* 2006; Brackley and Crone 2009; Alexander and Parrent 2010, 2012). Yet, demand for Southeast Alaska sawnwood products in export markets continues to be relatively low, while exports of softwood logs have remained strong. Table 74 shows timber industry employment in Southeast Alaska. Between 2002 and 2014 harvest activities on the Tongass National Forest have generated about 40 percent of all timber industry jobs in the region, on average.

Environmental Justice

In 1994, President Clinton issued Executive Order (EO) 12898, which directs federal agencies to identify impacts from federal activities that disproportionately affect the human health or environment of minority and low-income populations and identify alternatives that will avoid or mitigate those impacts (Office of the President 1994). Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. According to USDA DR5600-002 (USDA 1997), environmental justice, minority, minority population, and low-income population are defined as follows:

Environmental Justice: to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered, allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment.

Minority: a person who is a member of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Minority Population: any readily-identifiable group of minority persons who live in geographic proximity to and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons, who will be similarly affected by USDA programs or activities.

Low-Income Population: any readily-identifiable group of low-income persons living in geographic proximity to and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons, who will be similarly affected by USDA programs or activities.

Human health and/or environmental effects as used in this departmental regulation include interrelated social and economic effects. The Council on Environmental Quality (CEQ) has interpreted health effects with a broad definition: "Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities or Indian Tribes …when those impacts are interrelated to impacts on the natural or physical environment" (CEQ 1997).

To assess if the project area contains environmental justice populations, project area communities are compared to a reference area, in this case the state. Forest Service environmental justice guidance recommends using a 5 percentage point threshold relative to the reference area to classify environmental justice communities (Grinspoon *et al.* 2014). Characterizing Prince of Wales communities utilizing traditional socioeconomic indicators is challenging owing to small population sizes, alternative lifestyle choices and values, and the mixing of cash and subsistence economies. What may be perceived as a low-income community by traditional economic metrics may be more akin to a community where residents practice a subsistence lifestyle, value a homestead culture, and earn seasonal or project-based income.

Statewide, Alaska Natives account for 15 percent the population and 10 percent of Alaskans live below the federal poverty line. Table 75 displays the proportion of Alaska Natives in each project area community and residents living below the federal poverty line. Five communities have a higher proportion of Alaska Natives compared to the state – Craig, Hydaburg, Kasaan, Klawock, and Port Protection. Almost all communities on Prince of Wales have a higher percentage of people living in poverty than the statewide average (10 percent), most exceeding the 5 percent threshold. Only Coffman Cove, Edna Bay, and Kasaan have proportionally fewer residents living below the federal poverty line than the statewide average. Because nearly half of all communities exceed the statewide proportion of American Indian or Alaska Native residents and three-quarters of all communities far below the statewide poverty line, the project area satisfies criteria for designation as an environmental justice population. Environmental effects analysis addresses the potential for Forest Service management actions in the project area to disproportionately and adversely affect these populations.

Table 75. Environmental Justice Indicators

Community	American Indian or Alaska Native	Below Federal Poverty Line[1]
Coffman Cove	4%	6%
Craig	20%	15%
Edna Bay	0%	0%
Hollis	5%	18%
Hydaburg	77%	11%
Kasaan	35%	3%
Klawock	48%	20%
Naukati Bay	6%	14%
Point Baker	0%	81%
Port Protection	19%	36%
Thorne Bay	2%	18%
Whale Pass	0%	62%
Alaska	**15%**	**10%**

Source: Alaska Department of Labor and Workforce Development, Research and Analysis Section 2016a
[1]The US Census Bureau annually determines the federal poverty threshold, which varies based on family size.

Environmental Effects

Effects Summary

The three action alternatives contain a range of options to fully implement the purpose and need of the POW LLA Project: improve forest ecosystem health; support community resiliency; and provide long-term economic development opportunity. Alternative 1, the No-Action Alternative, does not respond to the purpose and need. Action Alternatives 2, 3, and 5 provide a range of opportunities in different project activity emphasis areas including timber harvest, invasive plant management, recreational amenities, habitat improvements, and stream restoration. Table 76 provides a summary of socioeconomic effects by management alternative based on a qualitative evaluation. Each alternative was compared against the others with respect to the impact of proposed activities by resource area. For instance, the alternative with maximum investment in tourism and recreation infrastructure was assigned a rating of "major". This qualitative assessment is based on potential outcomes of project activities. The more numerous or larger scope of activities, the greater likelihood of positive outcomes for social or economic opportunity. Number of jobs supported and direct income were calculated by combining the old- and young-growth estimates from Table 19 and Table 20.

Table 76. Environmental Effects Overview, Socioeconomic Comparison by Alternative

Resource Element	Alternative 2	Alternative 3	Alternative 5
Economic Benefit 1 Timber Industry Jobs Supported	2,657	2,524	2,344
Economic Benefit 2 Direct Income	$146,620,933	$144,242,238	$135,364,521
Ecosystem Service 1 Fish Habitat	Major Improvements	Limited Improvements	Moderate Improvements
Ecosystem Service 2 Recreation	Major Improvements	Moderate Improvements	Major Improvements
Ecosystem Service 3 Non-Timber Forest Products	Moderate Improvements	Moderate Improvements	Moderate Improvements
Ecosystem Service 4 Subsistence Resource Access	Major Improvements	Major Improvements	Major Improvements
Environmental Justice	No Disproportionate/ Adverse Impacts	No Disproportionate/ Adverse Impacts	No Disproportionate/ Adverse Impacts

Alternative 2 provides the greatest support for the timber industry through increased timber harvest, more old-growth timber harvest, new log transfer facilities, and new road construction, resulting in more jobs and labor income. Alternative 2 also provides the greatest support for tourism by proposing new campgrounds, cabins, shelters, trails, and other facilities. Alternative 2 also recommends wildlife habitat improvements, invasive weed management, and stream restoration activities. In short, Alternative 2 is the most aggressive of the three action alternatives by proposing the most activity across multiple resource areas including timber, fish and wildlife habitat, and recreation. It is likely to yield the greatest economic opportunity for island residents, thereby supporting the purpose and need for community resiliency.

Alternative 3 provides the greatest emphasis on habitat improvements and addresses public concern regarding past Tongass National Forest management activities and related effects to wildlife habitat. Alternative 3 proposes slightly less overall timber harvest than Alternative 2, but significantly less old-growth timber harvest. This results in fewer jobs, less income, and limited old-growth "bridge timber" as the industry transitions from old- to young-growth timber harvest. Alternative 3 proposes habitat improvements for wildlife and includes watershed improvements. Fewer recreation-related project activities are proposed compared to Alternative 2 and resources largely target recreation facility improvements as justified by overall use or prioritized by the Forest Service. While Alternative 3 yields habitat improvements, which will likely improve subsistence resources, reduction in overall timber harvest will yield fewer jobs and less income. Furthermore, old-growth timber harvest limitations and rapid reduction over time may not provide enough old-growth to allow the industry to transition to predominantly young-growth timber harvest. Moderate investments in recreational amenities will improve overall quality of life, but may not meet the needs of a growing tourism industry.

Alternative 5 was developed to address public comment submitted in response to published Draft Issues and Alternatives (December 2017) – after the public had the time to reflect on written issue statements and draft alternatives. Alternative 5 is largely a combination of Alternative 2 and Alternative 3 with reduction in overall timber harvest and a significant reduction in old-growth timber harvest. Alternative 5, in particular, limits old-growth timber harvest to an average of 5 MMBF per year throughout the project lifetime. This would result in fewer jobs, less income, and limited old-growth timber. Limiting the timber industry to only 5 MMBF of old growth per year will not accommodate industry need for old-growth “bridge timber” as it transitions to predominantly young-growth timber harvest. Alternative 5 fully implements broad protections for both wolves and deer habitat thereby improving subsistence resources and also proposes recreation amenity investments, fully supporting tourism industry growth.

Environmental Justice

None of the alternatives are expected to disproportionately impact low-income or minority populations. POW LLA Project proposed actions, particularly timber harvest and road construction, combined with past and reasonably foreseeable future timber harvest may affect subsistence resources and lifestyle. Subsistence hunting, fishing, trapping, and gathering activities are a major focus of life for many Prince of Wales Island residents, especially Alaska Native communities practicing a subsistence or traditional lifestyle. Frequently cited reasons for participating in subsistence activities include the ability to provide food or supplemental income, the perpetuation of cultural customs and traditions, and the importance of values associated with self-reliance (USDA Forest Service 2008b). POW LLA Project public comments highlighted concerns about timber harvest and road construction impacts to the harvest of fish, deer, berries, mushrooms, and firewood.

Subsistence-related analysis in response to significant issue 2 indicate all action alternatives propose timber harvest prescriptions that improve wildlife habitat, with Alternatives 3 and 5 placing the greatest emphasis on habitat improvements. Alternative 2, in contrast, proposes timber harvest prescriptions that improve or maintain wildlife habitat, but only within a 5 mile radius of communities.

Timber Industry

Effects to the timber industry are assessed in terms of employment and income at the regional scale – Southeast Alaska. Effects to commercial fishing, recreation, tourism, wildlife and subsistence resources, and other resources are not analyzed owing to the difficulty of obtaining data specific to the project area. Ecosystem services are assessed by resource area and throughout the environmental impact statement with analysis areas, measurement units, and methodologies also discussed in those respective resource sections.

Alternative 1 – No-Action

The No-Action Alternative, required by the National Environmental Policy Act (NEPA), represents the existing condition in the project area and provides a baseline to measure and compare impacts of the various action alternatives against. Under Alternative 1, the No-Action Alternative, none of the specific management activities proposed in the Final Environmental Impact Statement (FEIS) would be implemented to accomplish project goals and objectives. Natural disturbances, current management, ongoing activities, and other routine forest management activities would continue at current levels and as authorized by prior decisions. Alternative 1, the No-Action Alternative, does not meet the project's purpose and need to improve forest ecosystem health, support community resiliency, and support economic development opportunities through multiple resource management.

Direct and Indirect Effects

The total cost of project planning and environmental analysis does not differ by alternative. Alternative 1 would not generate revenue. Therefore, the net present value of Alternative 1 is equivalent to the total cost of project planning and environmental analysis. The No-Action Alternative would not affect current quality of life, economic opportunity, or environmental justice because no activities would be implemented across the project area.

Cumulative Effects

The only social and economic consequence of Alternative 1 is the cost of project planning and environmental analysis. No past, present, or reasonably foreseeable future activities affect this cost. Therefore, there are no cumulative effects to social and economic conditions under Alternative 1.

Conclusion

Alternative 1, the No-Action Alternative, does not incorporate any specific management activities across the project area. Therefore, the only social and economic effects of the alternative are the expenses associated with project planning and environmental analysis. Of noteworthy importance, the absence of Tongass National Forest timber sales – as represented by Alternative 1 – could threaten the viability of existing sawmill operators due to limited, inconsistent, or non-existent national forest timber supply. Without ongoing timber sales, additional sawmills would likely close, resulting in lost employment and income for Prince of Wales communities.

Alternative 2 – Proposed Action

Alternative 2, the proposed action, was developed in response to the project's purpose and need to improve forest ecosystem health, support community resiliency, and support economic development opportunity. This alternative was also heavily-influenced by the Prince of Wales Landscape Analysis Team (POW LAT) – an independently-formed collaborative that provided comment, input, and recommendations through a variety of public participation opportunities. Alternative 2 incorporates the majority of POW LAT recommendations. The underlying intent of this alternative is to incorporate a variety of management activities that will support stable and long-term economic development opportunities for local communities while also maintaining important fish and wildlife habitat. Of noteworthy importance, Alternative 2 seeks to provide sufficient old-growth and young-growth commercial timber harvest to support local sawmills to shift to predominantly young-growth timber harvest – as guided by the 2016 amendment of the Forest Plan (USDA Forest Service, 2016a). Alternative 2 includes a variety of additional actions spanning vegetation management, watershed improvement and restoration treatments, sustainable recreation management, and associated actions.

Direct and Indirect Effects

Economic Benefits

Based largely on POW LAT recommendations targeting long-term economic opportunity, Alternative 2 proposes to harvest 656 MMBF of timber over the POW LLA Project lifetime. This includes approximately two-thirds young-growth (64 percent) and one-third old-growth (36 percent) harvest. Total timber harvest volume, including both young- and old-growth over the 15-year project timeframe, is expected to generate 2,657 jobs and $145,620,933 in income (Table 77).

Estimated jobs and direct income are based on the current Alaska Region limited export policy (USDA Forest Service 2016e, Volume II, Appendix H). Current policy allows old-growth western hemlock and Sitka spruce export equal to 50 percent of total sale net saw log volume plus 100 percent of Alaska yellow-cedar. An estimated 208 additional jobs would be generated with 100 percent domestic processing of old-growth Sitka spruce and western hemlock.

Additional Ecosystem Service Benefits

Effects to additional ecosystem services including fisheries, recreation, and non-timber forest products are assessed in their respective resource sections located throughout Chapter 3 – Environment and Effects.

Environmental Justice

Alternative 2 proposed activities are not expected to disproportionately or adversely affect low-income and minority populations.

Table 77. Alternative 2, Proposed Action: Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure	Outcome
Economic Benefit 1: Jobs Supported	Economic Efficiency	Total Timber Jobs Supported	2,657
Economic Benefit 2: Direct Income	Economic Efficiency	Total Direct Income	$146,620,933
Ecosystem Service 1: Fish habitat	See FEIS Chapter 3, Fisheries Resource Section	Qualitative Evaluation	Major Improvements
Ecosystem Service 2: Recreation	See FEIS Chapter 3, Recreation Section	Qualitative Evaluation	Major Improvements
Ecosystem Service 3: Non-Timber Forest Products	See FEIS Chapter 3, Multiple Resource Sections	Qualitative Evaluation	Moderate Improvements
Ecosystem Service 4: Subsistence Resource Access	See FEIS Chapter 3, Wildlife and Subsistence Resource Section	Qualitative Evaluation	Major Improvements
Environmental Justice	Disproportionate and adverse effects to low-income and/or minority populations.	Qualitative Evaluation	No Disproportionate/Adverse Impacts

Conclusion

Alternative 2, incorporates a variety of activities to support long-term economic opportunity across Prince of Wales Island. Specific activities include young- and old-growth timber harvest – with a larger proportion of old-growth timber harvest compared to other action alternatives resulting in improved support for the timber industry to shift to predominantly young-growth timber harvest. Also of benefit to the timber industry, the development of two new log transfer facilities would be considered and 13 log transfer facilities would remain in use. Alternative 2 also proposes 35 miles of new National Forest System roads and 129 miles of temporary roads. Ongoing old-growth harvest, new National Forest System roads, and new log transfer facilities are critical considerations for the overall transition of the timber industry to predominantly young-growth timber harvest.

Alternative 2 incorporates invasive plant management across 2,300 acres using only manual and mechanical means and proposes to restore up to 200 miles of stream across NFS and non-NFS lands. The full spectrum of fish habitat improvements are considered in fresh water streams with known reductions in fish populations. Additional wildlife habitat improvements aim to treat young-growth timber stands prior to stem exclusion. These management activities will support subsistence resources across the landscape thereby supporting Alaska Native and rural community lifestyles.

Alternative 2 proposes a number of recreation-related improvements to improve local quality of life and support a growing tourism industry. New recreation infrastructure would be built, existing infrastructure would be maintained, and some infrastructure may be decommissioned. Interpretative and informational signage would be incorporated where appropriate. Ongoing trail maintenance would continue and new trails and roads-to-trails would be considered. Alternative 2 proposes the development of new facilities including outhouses at some facilities, three campgrounds, three cabins, and twelve shelters. The consideration of new recreational amenities, in particular, creates long-term opportunity for a growing recreation and tourism industry.

Alternative 3

Alternative 3 addresses public concerns regarding past management activities, specifically timber harvest, and its effects to wildlife habitat, watershed function, subsistence opportunities, and the spread of invasive plants. Alternative 3 incorporates mitigation measures beyond Forest Plan requirements, minimizes old-growth timber harvest, emphasizes measures to limit timber harvest effects, and emphasizes habitat improvements on NFS and adjacent non-NFS lands. Alternative 3 emphasizes multiple habitat improvements by implementing partial harvest in Wildlife Analysis Areas (WAA), avoiding increased peak flow rates in all watersheds, incorporating multiple young-growth harvest recommendations from the *Interagency Wolf Habitat Management Program,* and incorporating an integrated weed management approach using manual, mechanical, and herbicide treatments. This alternative also emphasizes improving wildlife habitat by implementing uneven-aged management prescriptions and creating or maintaining wildlife corridors in areas that have been previously harvested or may be subject to future harvest.

Alternative 3 was primarily developed in response to public concerns regarding increasing stream restoration projects or ongoing public interest in developing more recreational sites. Although significantly reduced, sufficient volumes of old-growth timber would be harvested to support small sawmills and provide a limited amount of time for larger sawmills to increase their utilization of young-growth timber or identify a non-federal source of old-growth timber. In short, Alternative 3 minimizes old-growth timber harvest while increasing habitat improvement activities and incorporating limited recreational amenity improvements. Alternative 3 addresses all project issues, to varying degrees, in its design and recommended activities.

Direct and Indirect Effects

Economic Benefits

Alternative 3 proposes to harvest 644 MMBF of timber over the lifetime of the POW LLA Project. This includes 82 percent young-growth and 18 percent old-growth harvest. Total timber harvest volume, including both old- and young-growth over the 15-year project timeframe, is expected to generate 2,005 jobs and $144,242,238 in direct income (Table 78).

Estimated jobs and direct income are based on the current Alaska Region limited export policy (USDA Forest Service 2016e, Volume II, Appendix H). Current policy allows old-growth western hemlock and Sitka spruce export equal to 50 percent of total sale net saw log volume plus 100 percent of Alaska yellow-cedar. An estimated 102 additional jobs would be generated with 100 percent domestic processing of old-growth Sitka spruce and western hemlock.

Additional Ecosystem Service Benefits

Effects to additional ecosystem services – including fisheries, recreation, and non-timber forest products – are assessed in their respective resource sections located throughout Chapter 3 – Environment and Effects.

Environmental Justice

Alternative 3 proposed project activities are not expected to disproportionately or adversely affect low-income and minority populations.

Table 78. Alternative 3, Habitat Focused: Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure	Outcome
Economic Benefit 1 Jobs Supported	Economic Efficiency	Total Timber Jobs Supported	2,524
Economic Benefit 2 Direct Income	Economic Efficiency	Total Direct Income	$144,242,238
Ecosystem Service 1 Fish habitat	See FEIS Chapter 3, Fisheries Resource Section	Qualitative Evaluation	Limited Improvements
Ecosystem Service 2 Recreation	See FEIS Chapter 3, Recreation Section	Qualitative Evaluation	Moderate Improvements
Ecosystem Service 3 Non-Timber Forest Products	See FEIS Chapter 3, Multiple Resource Sections	Qualitative Evaluation	Moderate Improvements
Ecosystem Service 4 Subsistence Resource Access	See FEIS Chapter 3, Wildlife and Subsistence Resource Section	Qualitative Evaluation	Major Improvements
Environmental Justice	Disproportionate and adverse effects to low-income and/or minority populations.	Qualitative Evaluation	No Disproportionate/Adverse Impacts

Conclusion

Alternative 3, proposes a variety of activities to improve the habitat while supporting economic opportunity across the project area. Specific activities include harvest of majority young-growth timber (82 percent) and a limited and decreasing amount of old-growth timber (*e.g.*, 10 MMBF decreasing to 5 MMBF annually). Similar to Alternative 2, two new log transfer facilities would be considered and 13 existing log transfer facilities would remain in use. Approximately 48 miles of National Forest System roads and 175 miles of temporary roads would be constructed – with more roads associated with young-growth timber harvest. Alternative 3 proposes an integrated weed management strategy including mechanical, manual, and herbicide treatments across 2,300 acres. Stream restoration is similar to Alternative 2 except it will occur on only 80 miles of stream as previously prioritized or based on public need. Deer habitat improvements include treatments to young-growth timber stands (precommercial and commercial) and protection of wolf dens.

Recreation-related project activities are generally limited to improving, maintaining, or developing infrastructure that is justified by overall public use, public interest, or other documented support. Some lesser-used recreation sites, where use does not justify maintenance expense, would likely be decommissioned. Development of new and currently-accessible sites may occur, but would not exceed current inventory. No new trails would be developed, only regularly-used trails would be maintained, and road-to-trail conversions would be minimal and limited to routes with public support. Additional outhouse development would be limited to road-accessible locations. Up to 12 semi-developed campsites may be developed, but there would likely be no additional campgrounds, cabins, or shelters. Cabins with limited use would likely be decommissioned. Although this approach to improving recreation infrastructure focuses support on high-use or high-public interest recreational sites, it may not accommodate tourism industry needs or support long-term economic opportunity.

In conclusion, the combination of timber harvest, habitat improvements, and consideration of limited recreational amenity improvements will provide young-growth timber for the timber industry and improve local quality of life – but perhaps not meet the needs of a growing tourism industry. Furthermore, while Alternative 3 is likely to support 2,524 jobs and $144 million in related income over the lifetime of the project. It expedites the shift to young-growth timber harvest but reduces flexibility to the timber industry by proposing a very limited and decreasing amount of old-growth timber harvest. Project activities, considered as a whole, are not expected to disproportionately or adversely impact low-income or minority populations.

Alternative 5

Alternative 5 was developed in response to the December 2017 public comment period collecting feedback targeting Draft Issues and Alternatives. Particularly Alternative 5 components include limiting old-growth timber harvest to an average of 5 MMBF per year for the life of the project and without any harvest “North of 20 Road” – at the north end of Prince of Wales Island between Port Protection and Calder Bay. While annual old-growth harvest would be limited to 5 MMBF for the life of the project, additional young-growth would be offered to encourage local sawmills to shift to predominantly young-growth harvest. Additional components include no fish egg incubation boxes in fish habitat improvement projects and full implementation of the recommendations from the *Interagency Wolf Habitat Management Program*, which includes broader protections for both wolves and deer habitat. This alternative gives greatest priority to subsistence, watershed, and wildlife issues by incorporating no increases in peak flow rates, stream restoration, and maintaining and improving wildlife habitat across the landscape. It also proposes manual and mechanical treatments to eradicate, control, or contain invasive plants.

Direct and Indirect Effects

Economic Benefits

Alternative 5 proposes to harvest 604 MMBF over the lifetime of the POW LLA Project. This includes 88 percent young-growth and 12 percent old-growth harvest. Total timber harvest volume, including old- and young-growth harvest over the 15-year project timeframe, is estimated to generate 2,344 jobs and $135,364,521 in direct income (Table 79).

Estimated jobs and direct income are based on the current Alaska Region limited export policy (USDA Forest Service 2016e, Volume II, Appendix H). Current policy allows old-growth western hemlock and Sitka spruce export equal to 50 percent of total sale net saw log volume plus 100 percent of Alaska yellow-cedar. An estimated 66 additional jobs would be generated with 100 percent domestic processing of old-growth Sitka spruce and western hemlock.

Additional Ecosystem Service Benefits

Effects to additional ecosystem services – including fisheries, recreation, and non-timber forest products – are assessed in their respective resource sections located throughout Chapter 3 – Environment and Effects.

Environmental Justice

Alternative 5 proposed project activities are not expected to disproportionately or adversely affect low-income and minority populations.

Table 79. Alternative 5, Comment Response: Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure	Outcome
Economic Benefit 1 Jobs Supported	Economic Efficiency	Total Timber Jobs Supported	2,344
Economic Benefit 2 Direct Income	Economic Efficiency	Total Direct Income	$135,364,521
Ecosystem Service 1 Fish habitat	See FEIS Chapter 3, Fisheries Resource Section	Qualitative Evaluation	Moderate Improvement
Ecosystem Service 2 Recreation	See FEIS Chapter 3, Recreation Section	Qualitative Evaluation	Moderate Improvement
Ecosystem Service 3 Non-Timber Forest Products	See FEIS Chapter 3, Multiple Resource Sections	Qualitative Evaluation	Moderate Improvement
Ecosystem Service 4 Subsistence Resource Access	See FEIS Chapter 3, Wildlife and Subsistence Resource Section	Qualitative Evaluation	Major Improvement
Environmental Justice	Disproportionate and adverse effects to low-income and/or minority populations.	Qualitative Evaluation	No Disproportionate/Adverse Impacts

Conclusion

Alternative 5 responds directly to the comments submitted by the public to Draft Issues and Alternatives. Alternative 5 project activities are largely a combination of Alternative 2 and 3 with reductions in timber harvest, very limited old-growth harvest, and full implementation of wildlife habitat improvements. Alternative 5 timber harvest is reduced compared to Alternatives 2 and 3 with the large majority as young-growth harvest (88 percent); old-growth timber harvest is limited to 5 MMBF per year. Similar to Alternative 2, two new log transfer facilities would be considered and 13 existing log transfer facilities would remain in use. Similar to Alternative 3, approximately 49 total miles of National Forest System roads and 180 miles of temporary roads would be constructed – with more roads associated with young-growth timber harvest.

Invasive plant management mirrors Alternative 2 with only manual and mechanical treatments across 2,300 acres. Stream restoration will occur on up to 200 stream miles, similar to Alternative 2. Fish habitat improvements including lake fertilization and barrier modifications would be focused on areas with known decreased fish populations. Wildlife habitat improvements would be fully implemented per the *Interagency Wolf Habitat Management Program.*

Recreation maintenance, development, and decommissioning project activities are equivalent to Alternative 2 – and represent maximum support for maintaining current infrastructure and considering additional facilities. Trail maintenance is also maximized with ongoing maintenance, improvements, and consideration of new trails, similar to Alternative 2. Additional recreation-related facilities receive maximum consideration including winter sport access, outhouse development, campgrounds, campsites, cabins, and shelters.

To sum up, the combination of timber harvest, habitat improvements, and recreational amenity improvements will improve local quality of life and fully-support a growing tourism industry. Alternative 5 is estimated to yield 2,344 timber jobs and $135 million in direct income over the project lifetime. However, limiting the timber harvest to only 5 MMBF old-growth timber per year may limit flexibility for the timber industry to transition in a manner that is appropriate to current business practices, business models, and forest product markets. In contrast, proposed recreation-related project activities provide significant foundation for future tourism economic opportunity while also contributing to local quality of life. Project activities, considered as a whole, are not expected to disproportionately or adversely impact low-income or minority populations.

Cumulative Effects of Action Alternatives

Appendix C includes the present and reasonably foreseeable future actions to be considered in cumulative effects analysis. The cumulative effects area for socioeconomics is the project area. Cumulative effects examine the impacts from reasonably foreseeable activities on NFS lands and non-NFS lands on timber industry and jobs, non-timber industries and jobs, and community well-being over the 15 years proposed for the POW LLA Project. Cumulative effects related to other resource areas are discussed in their relevant resource specialist sections.

Present timber management projects on NFS lands within the project area include about 121 MMBF of both old and young-growth volume under contract on the Big Thorne and Kosciusko projects as well as small and microsales, . Present timber harvest activities on non-FS lands include an estimated 10.8 MMBF of old-growth under contract through various timber sales. Reasonably Foreseeable Future Activities could affect timber markets and employment. In total, the estimated foreseeable future NFS timber harvest in the project area is 34 MMBF over the next 5 years and future non-NFS timber harvest in the project area is 519.6 MMBF over the next 15 years. Other young growth harvest is planned on 38,920 acres over 15 years, which would be primarily destined for export.

Alternatives 2, 3, and 5 are expected to generate 656 MMBF, 644 MMBF, and 604 MMBF of NFS timber over the next 15 years, respectively. Combined with reasonably foreseeable future timber harvest on non-NFS lands, the regional timber supply will more than double. Processing capacity in Southeast sawmills has been significantly underutilized for years, averaging just over 12 percent from 2013 to 2017 (Parrent 2017). Excess capacity in these mills suggests they could respond fairly quickly to changes in timber supply in the region and absorb the increase in available volume without having to purchase additional equipment in the near term. Ongoing young- and old-growth timber harvest provide near-term stability for the timber industry, which promotes investment in mill infrastructure necessary to transition to a young growth industry. Timber industry employment rises and falls with trends in timber supply and markets. A predictable supply of timber influences hiring decisions and thus availability of jobs in logging, sawmills, log exports, and supporting industries such as trucking. Increased competition for workers could trigger higher wages and in-migration of new residents to Southeast communities. Growth and stability in project area communities could positively impact school enrollment and the overall well-being of Prince of Wales residents.

Present activities for transportation infrastructure development include 29 miles of roads on NFS and 7 miles on non-FS (state) lands. Reasonably foreseeable future activities include 566 miles of road construction on non-NFS lands on the project area over the next 20 years and new log transfer facilities. Alternative 2 proposes 35 miles of new NFS roads and 129 miles of temporary roads. Alternative 3 and Alternative 5 both propose construction of about 48 miles of NFS roads and 175 miles of temporary roads in the project area. Combined with reasonably foreseeable future transportation improvements on non-NFS lands in the project area, road development proposed in all three alternatives supports expansion of tourism and other recreation industries, generating income and employment opportunities for island residents. Transportation infrastructure improvements support the timber industry. Improved access could make more timber economic to harvest by lowering hauling costs, influencing appraisal values, prices, and revenues that could facilitate the shift to young-growth harvest. In addition, improved access for residents could facilitate subsistence activities, leading to greater well-being in project area communities.

Reasonably foreseeable future actions in land transfers could impact timber supply in the region. The Alaska Mental Health Trust land exchange will result in 12,350 federal acres in the project area being transferred and managed primarily for timber production. Non-NFS harvest and roads acreage includes a potential 14,000 acre land transfer to Sealaska under S1484 and potential road construction and harvest on those lands. Timber volume to become available as a result of land transfers is unknown, precluding evaluation of the social and economic effects of the action alternatives.

Actions that expand recreation opportunities could benefit both local residents in the project area and island visitors. Present and reasonably foreseeable future actions related to recreation resources include site development and closure, dispersed recreation and subsistence gathering, recreation site development and closure, cruise ship tourism. Consideration of new recreational amenities, in particular, creates long-term opportunity for a growing recreation and tourism industry while also contributing to local quality of life. All action alternatives contain improvements to recreation resources, at varying levels. Alternatives 2 and 5 represent maximum support for maintaining current infrastructure and considering additional facilities. Alternative 3 is generally limited to improving, maintaining, or developing infrastructure, focusing support on high-use or high-public interest sites that may not fully accommodate tourism industry needs or support long-term economic opportunity.

Reasonably foreseeable future activities with respect to fish and wildlife habitat the POW LLA Project area could impact social and economic well-being. Management actions on NFS and non-NFS lands that improve fish and wildlife habitat also improve hunting, trapping, fishing, and shellfish resources and create employment, subsistence, and tourism opportunities. All action alternatives propose timber harvest prescriptions that improve wildlife habitat, with Alternatives 3 and 5 placing the greatest emphasis on habitat improvements. Management activities support employment growth in the seafood and fishing industries, as well as outfitters and guides and subsistence resources that support Alaska Native and rural community lifestyles.

Effects from burgeoning interest in expanding mineral extraction (hard rock and rare earth) could impact social and economic conditions in the project area. New and existing stone, crushed rock, gravel, and other materials may be used or sold, generating materials and income to facilitate transportation improvements. With respect to rare earth mining, unknown timeframes are associated activities at Niblack and Bokan Doton-Ridge mines and neither project has submitted an operations plan. The economic benefits realized from the development of the Niblack projects would include roughly 150 high-paying mining jobs at the Prince of Wales mine and another 80 jobs at a Gravina Island processing facility. Bokan Doton-Ridge is expected to provide an additional 200 full-time jobs. Representatives from both mines testified to their commitment to employing local residents of Ketchikan and Prince of Wales Island, and using Southeast Alaska vendors and merchants. The positive effects on social and economic well-being from mineral development in the project area are potentially substantial, including the creation of 430 new jobs with emphasis on hiring a local workforce. These effects are the same for all Action Alternatives.

Soils

Soil productivity is the inherent capacity of a soil to support the growth of specified plants, plant communities, or a sequence of plant communities. Soil productivity may be expressed in terms of volume or weight per unit area per year, percent plant cover, or other measures of biomass accumulation. Maintaining soil productivity and minimizing soil erosion are primary concerns when managing soil resources on National Forest System lands.

Soil Quality Standards established definitions and some minimum size requirements for detrimental soil conditions. The standards state that 85 percent of an activity area should be maintained in a condition of acceptable productivity potential for trees and other managed vegetation. Activity areas are individual proposed young-growth stands, old-growth stands, and timber stands for restoration projects. The threshold value of 15 percent is established for assessing detrimental soil conditions at the stand or harvest unit scale. If detrimental soil conditions approach or exceed 15 percent of an activity area, soil restoration practices should be considered.

Methodology

Soil quality monitoring data collected over the last 25 years will be used to estimate effects to soils. For purposes of this analysis, we rely on the existing available soil quality monitoring data summarized in Landwehr (2018a). Landwehr (2018a) supplies the best available data for estimating detrimental soil impacts from the various activities.

Forest facilities including National Forest System roads, trails, recreation sites, hydropower facilities, powerline corridors, and mines under an approved plan of operation are considered part of the Forest's infrastructure, and are not subject to soil quality standards. Activities within the productive land base are subject to soil quality standards and include timber harvest, stream or vegetation restoration, temporary roads, landings, rock quarries, and wildlife enhancement projects.

The best available landslide frequency analysis will be used to estimate the effects of the alternatives on landslide production over a 20-year time period. Slope data will be overlaid with the unit pool to estimate the amount of potential old-growth and young-growth harvest on slopes over 72 percent gradient and miles of road on slopes over 67 percent gradient.

Spatial and Temporal Context for Analysis

Detrimental soil conditions including soil displacements, landslides, temporary roads and other conditions will be estimated by harvest unit or stand to ensure all activities will meet soil quality standards thresholds. Direct, indirect, and cumulative effects to soils occur at the stand or harvest unit scale. The analysis of cumulative effects will also summarize detrimental soil conditions and landslides at the project area scale.

The temporal bounds for the soil analysis dates to the time the initial management activity was accomplished. The temporal bounds for the landslide frequency analysis is within a 20-year period to coincide with available landslide frequency studies. The time frame for the effects analysis depends on the rate soils recover from a disturbance. Small soil disturbances typically do not have negative effects on soil productivity at the site, stand, or harvest unit scale. Larger, severe soil disturbances (where the topsoil is effectively displaced) can negatively affect soil productivity for decades or longer. Soil quality monitoring data is beginning to identify the recovery rates for soils from some levels of disturbance. Recovery rates have not been identified for all soils or groups of soils from all types of disturbances.

Units of Measure

To compare the effects to soils between the alternatives, the following measures will be used:

- estimated acres of detrimental soil conditions,
- estimated acres of management-related landslides over a 20 year time period,
- estimated acres of proposed old-growth and young-growth harvest on slopes over 72 percent gradient, and
- estimated miles of road construction proposed on slopes over 67 percent gradient.

These measures align with the Region 10 Soil Quality Standards and the Forest Plan.

Data Limitations

The lack of a landslide frequency analysis since the 1997 Forest Plan is a data limitation. The existing landslide frequency analyses summarized in Landwehr (2018b) predate the 1997 Forest Plan. The 1997 Forest Plan included direction to avoid timber harvest on slopes over 72 percent and road construction on slopes over 67 percent gradient. The 1997 Forest Plan direction effectively limited timber harvest on steep slopes, yet the landslide frequency analyses summarized in Landwehr (2018a) were all conducted prior to the 1997 Forest Plan. The analysis uses the best available information and should be considered conservative because the 1997 Forest Plan limited timber harvest on slopes over 72 percent gradient, and as a result landslide frequencies for harvested lands should have decreased since the 1997 Forest Plan.

There is an extensive body of soil disturbance monitoring data and soil quality monitoring data available on the Forest (Landwehr 2018a). However, the lack of exact soil and vegetation response to soil disturbances is a data limitation. In the absence of precise response information, the analysis takes a conservative approach using the best available data summarized in Landwehr (2018a).

Affected Environment

Soils on the project area range from very shallow to very deep, and very poorly drained to well drained. Mineral soils are primarily formed from glacial till deposits, with minor areas of post-glacial volcanic deposits, glacial outwash deposits, and uplifted beach deposits. Soils are typically less than a meter thick over bedrock on ridgetops and on upper mountain slopes due to localized glacial ice scouring. Valley bottoms and concave areas contain deeper soils often underlain by dense glacial till deposits.

Poorly and very poorly drained deep organic deposits (greater than 1 meter thick) commonly form over bedrock or dense till and support a variety of forested and non-forested wetlands. Poorly drained organic soils less than a meter thick over bedrock, are often found on broad ridgetops and glacially scoured benches or rock knobs.

The cool maritime climate causes slow organic matter decomposition and organic duff layers 5 to 20 centimeters or more thick cover most mineral soils. Displacement of the duff layer would lead to soil erosion in most circumstances.

Most soils are coarse textured and not easily compacted. Rooting depth is usually less than a meter and often less than 50 centimeters but can vary by soil drainage class. A few well-drained soils display deeper rooting depth.

Landslides are a natural erosion process and are a common form of erosion on steep slopes within the project area. Landslide research within the project area explored the relationship between landslides and timber harvest. The most common landslides are debris avalanches and debris torrents. Debris avalanches and torrents are shallow, rapid failures driven by rainfall and saturated soil conditions. There are approximately 11,357 acres of landslides mapped on the project area.

Karst topography has developed in many areas underlain by limestone. Soils over limestone are often well drained (due to internal bedrock drainage) and are often more productive than similar soils over non-carbonate rocks.

Well-drained organic soils can be subject to soil displacement from management activities or windthrow. Well-drained organic soils commonly occur on broken convex rocky terrain and are often less than 50 centimeters thick over bedrock. Areas of these soils are often small and occur in complex with mineral soils.

Past Activities and Soil Conditions

Soil productivity has been affected by timber harvest yarding activities, temporary road construction, borrow pits, rock quarry development, landings, OHV use, past mining developments, and root-wad harvest for stream restoration. To a lesser degree, invasive weed treatments and stream restoration practices have also impacted soil productivity. These activities have affected soil productivity through soil displacements or soil erosion, and rarely through other detrimental soil conditions. In most areas within young-growth stands, soils are productive and growing the desired vegetation at the desired rate. In some areas, detrimental soil displacements and detrimental soil erosion are affecting soil productivity.

As mentioned above, specified roads, recreation facilities, hydropower developments, and other planned infrastructure are not subject to soil quality standards. By regulation, OHV use is confined to designated trails and play areas and those areas are not subject to soil quality standards.

Landwehr (2018a) summarized soil quality monitoring information available for activities proposed on large landscape assessment areas. Landwehr (2018a) developed recommendations for estimating effects to soil productivity from proposed activities. Landwehr (2018b) also reviewed the pertinent literature and provided recommendations for estimating the effects of activities on landslide frequency on large landscape assessment areas.

Soil monitoring data indicates that soil compaction on skid and access trails is limited and overall the trails are not detrimentally compacted. Soil bulk density data collected to date has led soil scientists to believe that detrimental soil compaction is not a concern under normal, modern forestry practices (USDA Forest Service, 2016c).

Based on soil quality monitoring data summarized in the 2016 Forest Plan FEIS (USDA Forest Service, 2016c) and summarized in Landwehr (2018a), and based on reconnaissance of older young-growth stands in support of this and other projects (such as the Big Thorne Project EIS), soil scientists estimate less than 1 percent of the stands harvested prior to 1979 may not meet soil quality standards. These would be tractor-logged stands with high densities of primary skid trails or stands containing a high amount of temporary road, spar tree corridors, rock quarries, and/or post-harvest landslides. The monitoring data indicates stands harvested since 1979 would meet soil quality standards.

Abandoned and active mines occupy about 218 acres of the project area. Mines currently being operated under an approved plan of operations are not subject to soil quality standards. Abandoned mines in areas where other ground-disturbing activities are proposed will be included in detrimental soil calculations.

Root-wad removals for watershed restoration projects have resulted in approximately 5 percent of the stand in a detrimental soil condition, and only about 20 acres of root-wad harvest has occurred over the past 10 years. Soil quality monitoring at root-wad harvest sites is on-going.

With the exception of a very few young-growth stands harvested prior to 1979, existing soil conditions in the POW LLA project area are within the Region 10 Soil Quality Standards.

Past Activities and Soil Erosion and Landslides

Past activities including mining, timber harvest, road construction, and pit development have caused soil erosion and landslides. The rate of erosion depends on the amount and intensity of rainfall, vegetative ground cover, erodibility of the soil, slope length, and steepness of slope.

Based on monitoring data, a minor amount of soil erosion is occurring along decommissioned temporary roads and along spar tree corridors in previously harvested areas.

Landslides (mass wasting) are the dominant erosion process on steep forested terrain with high soil water levels in Southeast Alaska (Swanston 1969). Topographic, geologic, and soil conditions in combination with high rainfall and soil saturation are the major factors that contribute to landslide events in Southeast Alaska.

According to the current landslide inventory, there are 11,357 acres of landslides in the project area. Approximately 1,762 acres of landslides are associated with past timber harvest and road construction. All management associated landslides are considered detrimental soil conditions, even if associated with National Forest System roads or other infrastructure developments. The landslide rate in young-growth areas is typically higher than in adjacent old-growth areas. As vegetation grows in previously harvested areas, the landslide rate declines.

Landwehr (2018b) summarized available landslide frequency studies and developed recommendations for landslide frequency analyses on large landscape assessment projects. All of the landslide studies cited in Landwehr (2018b) occurred in, or partially in, the POW LLA Project area.

The application of BMPs since the Clean Water Act (1972) and results from subsequent monitoring of BMPs on the Forest since 1990 have shown that soil erosion (including landslides) associated with management activities since 1990 is minimized.

Climate change is expected to result in a wetter, warmer overall annual climate than currently exists. The projected change may cause an increase in the frequency and intensity of storms and may result in an increase in landslide occurrence and soil erosion (EcoAdapt 2014).

Harvest on Slopes Greater than 72 Percent

The 2016 Forest Plan (USDA Forest Service 2016a) states that slopes over 72 percent gradient are not considered suitable for timber harvest. These areas may be approved for timber harvest based on an on-site analysis of slope stability and a consideration of downslope resources at risk. Past harvest has included about 11,903 acres of slopes over 72 percent gradient (includes harvest on non-NFS lands). Proposed harvest on slopes over 72 percent will be used as one indicator to compare potential slope instability between alternatives.

Roads on Slopes Greater than 67 Percent

The Forest Plan requires avoidance of road locations on slopes over 67 percent gradient where practicable. A geotechnical analysis is also required for proposed road construction on slopes over 67 percent gradient. The digital elevation model for the project area, when overlain with the roads layer, identifies approximately 37 miles of existing roads on slopes greater than 67 percent gradient (28 miles on non-NFS lands, 9 miles on NFS lands). Proposed roads on slopes over 67 percent gradient will be used as an indicator to compare slope stability between alternatives.

Environmental Effects

Effects Common to All Action Alternatives

All action alternatives propose similar activities but the amount of each activity varies between alternatives as described in Chapter 2.

Soil conservation practices and BMPs are designed to minimize effects to the soil resource given overall project objectives. Monitoring data collected since 1990 indicates that soil conservation practices and BMPs have been effective at minimizing detrimental soil conditions. While effects have been minimized, they have not been eliminated.

Landwehr (2018a) provides estimates of detrimental soil conditions associated with each activity proposed within the productive land base (excluding facilities as described above) based on available soil monitoring information. All estimates provided in Table 80 assumes modern or contemporary forest practices are used and all Forest Plan direction is followed.

Table 80. Estimates of detrimental soil conditions for proposed activities that must meet soil quality standards (based on Landwehr 2018a).

Activity	Estimate of detrimental soil conditions (percent of stand)	Notes
Timber harvest in unharvested areas (old-growth harvest)	-Shovel on slopes less than 35% and partial suspension, use 3% -Full Suspension) <2% -Shovel on slopes over 35% gradient, use 9%	Sites and conditions are highly variable but we have quite a bit of data to account for the variability. Assumes no paludification or detrimentally altered wetness.
Timber harvest in young-growth stands	Same as timber harvest in unharvested areas	
Thinning with log removal for wildlife habitat in young-growth	3 percent up to 10 percent	Depends on the proposed treatment and unit layout. If corduroy shovel trails are left in place and not fluffed due to wildlife movement concerns, consider them detrimental and use up to 10 percent. Otherwise use 3%, like young-growth timber harvest.
Gap creation with ground based equipment in young-growth	1% to 9% of the gap acres (For the whole stand use 1%).	Gap acres only, not the whole stand. Monitoring was for all soil disturbance not just detrimental conditions.
Slash piling for deer movement in young-growth	<1%	If slash piling with heavy equipment is proposed, monitor the results. Excavator equipped with grapple will have different effects than a bulldozer.
Burning in clearcuts and young stands for wildlife forage. Slash pile burning.	0% Area of slash piles burned	As long as recommendations for ecological site and burn severity are followed. Consider slash piles detrimental soil conditions, burned or unburned.
Precommercial thinning of young-growth with equipment.	2% or less	

Activity	Estimate of detrimental soil conditions (percent of stand)	Notes
Root-wad harvest for stream restoration	5% in large openings or use the percentage of the stand impacted by the activity	With small discontinuous extractions the estimate would depend on the amount of root-wad trees extracted. Typically less than 1 percent of a stand.
Access trails for stream restoration	0%	If puncheon is used and fluffed after the activity.
Temporary roads	Use a 40-foot disturbed corridor width or 4.8 acres per mile	Assuming BMPs are followed and natural soil drainage is not impeded.
Landings (shot rock) Wood waste at landings Rock pits	0.25 acres per mile of road 0.42 acres per mile of road 0.45 acres per mile of road	Add 1.12 acres per mile of road (all roads) for landings, rock pits, and wood waste.

Based on the data presented in Table 80, all of the activities, when considered alone, result in less than 15 percent detrimental soil conditions. When two or more ground-disturbing activities occur in the same activity area (stand or harvest unit), there is potential to exceed the 15 percent detrimental soil condition threshold set in the Region 10 Soil Quality Standards.

The analysis and Implementation Plan considers activity areas where more than one ground-disturbing activity may occur, and requires an assessment of existing detrimental soil conditions in young-growth stands. The Forest Plan provides guidelines and management approaches for assessing existing detrimental soil conditions in young-growth stands prior to proposing more ground-disturbing activities in those stands. The soil restoration activity may be used if detrimental soil conditions approach or exceed 15 percent of an activity area.

As mentioned in the Past Activities and Soil Condition section, up to 1 percent of stands harvested prior to 1979 may not meet Region 10 Soil Quality Standards in their current condition. In these stands, either no new activity would be allowed or the new activity would be accomplished in conjunction with the soil restoration activity.

Landwehr (2018b) reviewed existing landslide frequency analyses on the forest and recommends using existing landslide frequency data for estimating the frequency of naturally occurring landslides and the effects of the POW LLA Project activities on landslide occurrence (Table 81). Activities that historically have contributed to landslides are road construction, rock pit development, and timber harvest. In other areas of Southeast Alaska, foot trails have contributed to slope instability and landslides, but no landslides are associated with foot trails on the project area. Roads associated with mine operations have contributed to landslides on the project area. Mining operations on steep slopes may contribute to landslide occurrence, but to date have not contributed to landslides on the project area, likely due to the gentler slopes where most existing mines are located.

Table 81 provides the recommended landslide frequency rates for timber harvest, roads and rock pits, naturally forested areas, and naturally non-forested areas. Landwehr (2018b) also provided the data limitations for the landslide frequency analysis.

Table 81. Suggested landslide frequency rates for harvested lands, unharvested lands, non-forested and low productivity areas, and roads and rock pits on the large landscape assessment areas.

Vegetation class	Landslide rate	Average landslide size	Notes
Non-forest or low productivity forested lands	1 slide per 19,720 acres per 20 years	1.5 acres	From fresh analysis of Landwehr (1998) data. 20-year time period. One slide was a rock fall and not included here.
Unharvested commercial forest lands	1 slide per 11,720 acres per 20 years	3.1 acres	From the 1985 to 1991 time period in Landwehr (1998).
Harvested lands	1 slide per 2,849 acres per 20 years	0.5 acre	From the 1985 to 1991 time period in Landwehr (1998).
Roads and Rock Pits	1 slide per 19.3 miles of new road construction.	0.5 acre	From the 20-year time period in Landwehr (1998).

Alternative 1 – No-Action

Direct and Indirect Effects

Under Alternative 1, no new timber harvest, road building, wildlife treatments, or watershed restoration activities would take place, and no soil disturbances would be caused by new management activities associated with the POW LLA Project. No rehabilitation efforts involving road construction, storage, and decommissioning would be completed on existing roads under this project. Roads in the project area will continue to receive routine maintenance and incidental use from hunters and other visitors.

Landslides would continue to occur in unharvested areas and existing harvested areas.

Vegetation in harvested areas would continue to grow and add stability to soils on those sites. Detrimental soil conditions would not change as a result of POW LLA Project implementation.

At the project area scale, timber harvest activities and road construction would continue on non-National Forest System lands. Timber volume currently under contract would be harvested on National Forest System lands.

Cumulative Effects

Cumulative effects to soils occurs at the stand or harvest unit scale. Since no areas are proposed for harvest and no new roads will be constructed, no cumulative effects will occur in those stands or areas.

At the project area scale, volume under contract on the Big Thorne and Kosciusko projects will result in about 6,154 acres of timber harvest and 29 miles of road construction. Reasonably foreseeable future actions include an estimated potential 101,273 acres of timber harvest on non-NFS lands and up to 566 miles of road construction on non-NFS lands on the project area over the next 20 years. The non-NFS harvest and roads acreage includes a potential 14,000 acre land transfer to Sealaska under S1484 and potential road construction and harvest on those lands.

Soils detrimentally impacted by past actions (about 17,521 acres) will continue to slowly recover over decades and centuries. Volume under contract and potential future timber harvests on non-NFS lands could result in and estimated 6,718 acres of detrimental soil conditions on the project area. Landslides associated with past and reasonably foreseeable future management activities will total about 1,863 acres by the end of the next 20 years. Total detrimental soil conditions at the end of 20 years are estimated at 26,102 acres including landslides, temporary roads, landings, rock pits, and soil conditions in harvest units.

Landslides will continue to occur in previously managed stands and unharvested areas and will be driven by storm events and soil saturation. Vegetation in previously harvested stands will continue to grow and add stability to the soils in those areas. Based on the recommended frequency analysis provided by Landwehr (2018b), all landslides, including natural and management related slides (past, present and foreseeable future actions) will occupy an estimated 11,836 acres after 20 years. The estimate is dependent on climatic events being similar to previous 20 year time periods. Climate change may increase landslide frequency as described above.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Detrimental soil conditions would increase by an estimated 1,549 acres across the project area. Detrimental soil conditions include yarding disturbance within harvest units, temporary roads, rock pits, landings, root-wad harvest, and landslides (over the next 20 years). The detrimental soil conditions would result from the activities identified in Table 80.

The Implementation Plan requires an assessment of detrimental soil conditions in young-growth stands before an activity is implemented. To date, detrimental soil conditions have been assessed on about 1,112 acres of young growth proposed for treatment in this project. If an activity will cause detrimental soil conditions to approach or exceed the 15 percent threshold, soil restoration activities should be considered. Application of the Forest Plan and Implementation Plan direction will ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed. No individual stand or harvest unit is expected to exceed Region 10 Soil Quality Standards for areal extent of detrimental soil conditions.

Activities proposed under Alternative 2 may cause an estimated 11 acres of landslides over the next 20 year time period based on existing landslide frequency analyses.

An estimated 501 acres of old-growth on slopes over 72 percent gradient would be considered for timber harvest. An estimated 382 acres of young growth on slopes over 72 percent gradient would be considered for timber harvest. Slope stability investigations have been completed on approximately 4,162 acres of old growth and as a result of those investigations about 948 acres of steep slopes are no longer considered for harvest in this project. Remaining steep slope areas will receive slope stability investigations following Forest Plan and Implementation Plan direction.

Based on available information, about 1.1 miles of road will be proposed for construction on slopes over 67 percent gradient. The overlay of roads and slopes in GIS indicates that the 1.1 miles occurs on approximately 33 segments, indicating an average segment length of 176 feet proposed on slopes over 67 percent gradient. The data indicates that no long, continuous road segments are planned on slopes over 67 percent gradient, and road locations on steep slopes are avoided to the extent practicable.

Cumulative Effects

Cumulative effects to soils occurs at the stand or harvest unit scale. Based on the existing monitoring data, no old-growth harvest stands are expected to exceed the 15 percent threshold for detrimental soil conditions. In young-growth stands detrimental soil conditions may exist from past harvest activities, and a small percentage of those stands may exceed the 15 percent threshold for detrimental soil conditions. If activities are proposed in these stands, soil restoration would be prescribed (if practicable) to return the detrimental soil conditions to below the 15 percent threshold.

The Forest Plan and Project Implementation Plan requires an assessment of detrimental soil conditions before activities are proposed. Application of the Forest Plan and Implementation Plan direction will ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed.

At the project area scale, volume under contract on the Big Thorne and Kosciusko projects will result in about 6,154 acres of timber harvest and 29 miles of road construction. Reasonably foreseeable future actions include an estimated potential 101,273 acres of timber harvest on non-NFS lands and up to 566 miles of road construction on non-NFS lands on the project area over the next 20 years. The non-NFS harvest and roads acreage includes a potential 14,000-acre land transfer to Sealaska under S1484 and potential road construction and harvest on those lands.

Soils detrimentally impacted by past actions (about 17,521 acres) will continue to slowly recover over decades and centuries. Volume under contract and potential future timber harvests on non-NFS lands could result in and estimated 6,718 acres of detrimental soil conditions on the project area. Landslides associated with past and foreseeable future management activities will total about 1,869 acres by the end of the next 20 years. Total detrimental soil conditions at the end of 20 years are estimated at 27,657 acres including landslides, temporary roads, landings, rock pits, and soil conditions in harvest units.

Landslides will continue to occur in previously managed stands and unharvested areas and will be driven by storm events and soil saturation. Vegetation in previously harvested stands will continue to grow and add stability to the soils in those areas.

Based on the recommended frequency analysis provided by Landwehr (2018b), all landslides, including natural and management related slides (past, present, and reasonably foreseeable future actions) will occupy an estimated 11,836 acres after 20 years. The estimate is dependent on climatic events being similar to previous 20-year time periods. Climate change may increase landslide frequency as described above.

Alternative 3

Direct and Indirect Effects

Detrimental soil conditions will increase by an estimated 1,782 acres across the project area. Detrimental soil conditions include detrimental soil conditions from yarding within harvest units, temporary roads, rock pits, landings, root-wad harvest areas, and landslides (over the next 20 years). The detrimental soil conditions would result from the activities identified in Table 80. No individual stand or harvest unit is expected to exceed Region 10 Soil Quality Standards for areal extent of detrimental soil conditions.

The Implementation Plan requires an assessment of detrimental soil conditions (in young-growth stands) before an activity is implemented. To date, about 1,112 acres of young growth have been assessed for detrimental soil conditions. If an activity would cause detrimental soil conditions to approach or exceed the 15 percent threshold, soil restoration activities should be considered. Application of the Forest Plan and Implementation Plan direction would ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed.

Activities proposed under Alternative 3 may cause an estimated 13 acres of landslides over the next 20 year time period.

An estimated 280 acres of old growth on slopes over 72 percent gradient would be considered for timber harvest. An estimated 724 acres of young growth on slopes over 72 percent gradient would be considered for timber harvest. Slope stability investigations have been completed on approximately 4,162 acres of old growth. The investigations identified about 948 acres as not suitable for timber harvest and those areas will not be considered for harvest at this time. Remaining steep slope areas will receive slope stability investigations following Forest Plan and Implementation Plan direction.

Based on available information about 0.6 miles of road are proposed for construction on slopes over 67 percent gradient. The overlay of roads and slopes in GIS indicates that the 0.6 miles occurs on approximately 22 segments, indicating an average segment length of 144 feet proposed on slopes over 67 percent gradient. The data indicates no long contiguous road segments are proposed on slopes over 67 percent gradient.

Cumulative Effects

Cumulative effects to soils occurs at the stand or harvest unit scale. Based on the existing monitoring data, no old-growth harvest stands are expected to exceed the 15 threshold for detrimental soil conditions. In young-growth stands detrimental soil conditions may exist from past harvest activities, and a small percentage of those stands may exceed the 15 percent threshold for detrimental soil conditions. If activities are proposed in these stands, soil restoration would be prescribed to return the detrimental soil conditions to below the 15 percent threshold.

The Forest Plan and Project Implementation Plan requires an assessment of detrimental soil conditions before activities are proposed. Application of the Forest Plan and Implementation Plan direction would ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed.

At the project area scale, volume under contract on the Big Thorne and Kosciusko projects will result in about 6,154 acres of timber harvest and 29 miles of road construction. Reasonably foreseeable future actions include an estimated potential 101,273 acres of timber harvest on non-NFS lands and up to 566 miles of road construction on non-NFS lands in the project area over the next 20 years. The non-NFS harvest and roads acreage includes a potential 14,000-acre land transfer to Sealaska under S1484 and potential road construction and harvest on those lands.

Soils detrimentally impacted by past actions (about 17,521 acres) will continue to slowly recover over decades and centuries. Volume under contract and potential future timber harvests on non-NFS lands could result in and estimated 8,374 acres of detrimental soil conditions on the project area. Potential future timber harvests on non-NFS lands could result in an estimated 6,407 acres of detrimental soil conditions on the project area. Landslides associated with past and reasonably foreseeable future management activities will total about 1,869 acres by the end of the next 20 years. Total detrimental soil conditions at the end of 20 years are estimated at 27,889 acres including landslides, temporary roads, landings, rock pits, and soil conditions in harvest units.

Landslides will continue to occur in previously managed stands and unharvested areas and will be driven by storm events and soil saturation. Vegetation in previously harvested stands will continue to grow and add stability to the soils in those areas.

Based on the recommended frequency analysis provided by Landwehr (2018b), all landslides, including natural and management related slides (past, present, and reasonably foreseeable future actions) will occupy an estimated 11,837 acres after 20 years. The estimate is dependent on climatic events being similar to previous 20-year time periods. Climate change may increase landslide frequency as described above.

Alternative 5

Direct and Indirect Effects

Detrimental soil conditions would increase by an estimated 1,700 acres across the project area. Detrimental soil conditions include detrimental soil conditions within harvest units and temporary roads, rock pits, landings, and landslides (over the next 20 years). The detrimental soil conditions will result from the activities identified in Table 80. No individual stand or harvest unit is expected to exceed Region 10 Soil Quality Standards for areal extent of detrimental soil conditions.

The Implementation Plan requires an assessment of detrimental soil conditions before an activity is implemented. To date, about 1,112 acres of young growth have been assessed for detrimental soil conditions. If an activity would cause detrimental soil conditions to approach or exceed the 15 percent threshold, soil restoration activities should be considered. Application of the Forest Plan and Implementation Plan direction would ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed.

Activities proposed under Alternative 5 would cause an estimated 14 acres of landslides over the next 20-year time period.

An estimated 137 acres of old growth on slopes over 72 percent gradient would be considered for timber harvest. An estimated 724 acres of young growth on slopes over 72 percent gradient would be considered for timber harvest. Slope stability investigations have been completed on approximately 4,162 acres of old growth. The investigations identified approximately 948 acres of soils as not suitable for timber harvest, and those areas would not be considered for harvest. Remaining steep slope areas will be investigated during project implementation following Forest Plan and Implementation Plan direction.

Based on available information, about 0.7 miles of road will be proposed for construction on slopes over 67 percent gradient. The overlay of roads and slopes in GIS indicates that the 0.7 miles occurs on approximately 27 segments, indicating an average segment length of 137 feet on slopes over 67 percent gradient.

Cumulative Effects

Cumulative effects to soils occurs at the stand or harvest unit scale. Based on the existing monitoring data, no old-growth harvest stands would be expected to exceed the 15 threshold for detrimental soil conditions. In young-growth stands, detrimental soil conditions may exist from past harvest activities, and a small percentage of those stands may exceed the 15 percent threshold for detrimental soil conditions. If activities are proposed in these stands, soil restoration would be prescribed to return the detrimental soil conditions to below the 15 percent threshold.

The Forest Plan and Project Implementation Plan requires an assessment of detrimental soil conditions before activities are proposed. Application of the Forest Plan and Implementation Plan direction would ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed.

At the project area scale, volume under contract on the Big Thorne and Kosciusko projects would result in about 6,154 acres of timber harvest and 29 miles of road construction. Reasonably foreseeable future actions include an estimated potential 101,273 acres of timber harvest on non-NFS lands and up to 566 miles of road construction on non-NFS lands on the project area over the next 20 years. The non-NFS harvest and roads acreage includes a potential 14,000 acre land transfer to Sealaska under S1484 and potential road construction and harvest on those lands.

Soils detrimentally impacted by past actions (about 17,251 acres) will continue to slowly recover over decades and centuries. Volume under contract and potential future timber harvests on non-NFS lands could result in and estimated 8,522 acres of detrimental soil conditions on the project area. Landslides associated with past and reasonably foreseeable future management activities would total about 1,866 acres by the end of the next 20 years. Total detrimental soil conditions at the end of 20 years are estimated at 27,805 acres including landslides, temporary roads, landings, rock pits, and soil conditions in harvest units.

Landslides will continue to occur in previously managed stands and unharvested areas and will be driven by storm events and soil saturation. Vegetation in previously harvested stands will continue to grow and add stability to the soils in those areas.

Based on the recommended frequency analysis provided by Landwehr (2018b), all landslides, including natural and management related slides (past, present, and reasonably foreseeable future actions) will occupy an estimated 11,837 acres after 20 years. The estimate is dependent on climatic events being similar to previous 20-year time periods. Climate change may increase landslide frequency as described above.

Conclusions

The soils analysis shows similar effects to soils between Alternatives 2, 3, and 5. The most new road construction (not over decommissioned subgrades) occurs in Alternative 2. Alternative 2 also proposes the most old-growth timber harvest on slopes over 72 percent gradient and the most new road construction on slopes over 67 percent gradient. Cumulative acres of detrimental soil conditions are very similar between the action alternatives.

In young-growth stands where effects to soils may exist from past harvest activities, it is essential that soil conditions be assessed prior to new activities taking place. Application of the Forest Plan and Implementation Plan direction would ensure detrimental soil conditions remain within Region 10 Soil Quality Standards in all stands where project activities are proposed.

The acres of landslides across the project area do not differ appreciably between the alternatives. This is due to larger landslides but few numbers in old-growth stands, and more landslides but smaller average size in harvested areas.

Transportation

National Forest System (NFS) roads are constructed to provide access to National Forest System lands and are included in the Forest Development Transportation Plan (see Transportation Standards and Guidelines in Chapter 4 of the Forest Plan). They are part of the National Forest Transportation System, as are other roads that are wholly or partially on NFS lands and are maintained for the long term. With the exception of a few administrative sites and campgrounds, most forest roads are single lane, constructed with blasted quarry rock, and designed for off-highway loads.

Within the project area, the demand for roads has primarily been a function of the demand for access to timber resources. 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 would be largely determined by the need to access timber resources.

Maintenance and reconditioning of existing NFS roads is an ongoing process that occurs on a periodic basis. Normally this type of work is determined to fit the category of routine repair and maintenance of roads that do not individually or cumulatively have a significant effect on the quality of the human environment and may be categorically excluded (FSH 1909.15, Chapter 30). Maintenance and reconditioning of NFS roads happen routinely, are currently authorized, and will continue to occur in the project area. This work is done through separate service contracts to reduce the backlog of deferred maintenance, comply with BMPs, and maintain the existing infrastructure. The timing of this work may coincide with the implementation of project activities, but is not part of this analysis unless the road is also planned to be used for proposed project activities. Any effects from ongoing road maintenance and reconditioning work are included in the cumulative effects analysis.

Units of Measure

The following units of measure are used to discuss the effects of the alternatives on transportation.

- Miles of NFS road constructed
- Miles of temporary road construction
- Miles of road maintenance
- Locations and required work for log transfer facilities

Spatial and Temporal Context for Analysis

The spatial boundaries for the transportation system analysis includes all roaded areas and potential roaded areas of the POW LLA Project. The temporal boundaries are now to the expected implementation of this project, about 15 years.

Incomplete or Unavailable Information

Physical conditions of transportation resources are subject to change through natural occurrences and normal use. While inventory and condition surveys record current conditions, changes may occur at any time. Traffic counts are not routinely collected on NFS roads, though the roads are managed and designed as low volume roads.

Affected Environment

The NFS roads in the area were originally built for logging and the associated administration, though substantial recreational and subsistence use occurs on them. Road construction in support of logging activities began in the 1950s and '60s. About 1,600 miles of NFS roads and 550 miles of temporary roads were built to support timber harvest.

Road Maintenance Levels

Maintenance Level defines the level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria. Maintenance Level 1 roads are considered closed to vehicle traffic. Maintenance Levels 2 through 5 are considered open and drivable. Decommissioning a road involves restoring roads to a more natural state. Convert means to designate a road to another use such as a hiking trail.

- Maintenance Level 1: Assigned to intermittent service roads during the time they are closed to vehicular traffic. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities.
- Maintenance Level 2: Assigned to roads open for use by high clearance vehicles. Passenger car traffic is not a consideration.
- Maintenance Level 3: Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car.
- Maintenance Level 4: Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced.
- Maintenance Level 5: Assigned to roads that provide a high degree of user comfort and convenience. Normally, roads are double-lane, paved facilities.

The Operational Maintenance Level (OPML) is the Maintenance Level currently assigned to a road considering today's needs, road condition, budget constraints, and environmental concerns. It defines the level to which the road is currently being maintained. It reflects the current condition and the ability to drive on the road.

The Objective Maintenance Level (OBML) is the Maintenance Level to be assigned at a future date considering road management objectives, traffic needs, budget constraints, and environmental concerns. The OBML may be the same as, or higher or lower than, the OPML.

Table 82. Road Miles by Operational Maintenance Level

	Operational Maintenance Level (INFRA database)					
OPML	**1**	**2**	**3**	**4**	**5**	**Total miles**
Miles	595	798	193	0	0.02	1586

Table 83. Road Miles by Objective Maintenance Level

	Objective Maintenance Level (INFRA database)							
OBML	**1**	**2**	**3**	**4**	**5**	**Decom.**	**Convert**	**Total**
Miles	848	520	177	11	0.02	28	2	1586

Access and Travel Management (ATM)

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. A roads analysis for the remaining NFS roads within the project area was completed in 2005. The Decision Notice for the *Access and Travel Management Plan Environmental Assessment for Prince of Wales and Surrounding Islands, Tongass National Forest* was signed on September 3, 2009.

Annually, each Ranger District 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 (*e.g.*, 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.

Descriptions of Travel Management Designations:

- Highway Vehicle only – These roads are open only to motor vehicles licensed under state law for general operation on all public roads within the state.
- Open to All Vehicles – These roads are open to all motor vehicles, including smaller off-highway vehicles that may not be licensed for highway use, but not vehicles that are oversized or overweight under state traffic law.
- Seasonal Designation – These roads are open only during certain portions of the year.
- Motorized Trail – These trails are open only to motor vehicles less than 50 inches in width at the widest point on the vehicle.

Table 84. Road miles by OBML and ATM designation

Objective Maintenance Level	Travel Management	Miles
1 – Basic Custodial Care	Motorized Trails	262
	Total	**262**
2 – High Clearance Vehicles	Open to all Vehicles	448
	Seasonal Designation	10
	Highway Vehicles Only	51
	Total	**509**
3 – Suitable for Passenger Cars	Open to all Vehicles	115
	Highway Vehicles Only	62
	Total	**177**
4 – Moderate Degree of User Comfort	Highway Vehicles Only	11
	Total	**11**
Total Road Miles		**959**

Marine Access Facility

A Marine Access Facility (MAF) is an area used by humans to transfer items from land to saltwater or vice versa, that contains a structure such as a mooring buoy, dock, Log Transfer Facility (LTF), boat ramp, or a combination of these. These facilities are often used for the movement of equipment needed for logging and road building. The transport of harvested timber from isolated islands in Southeast Alaska requires both land and water routes to reach processing facilities. Log transfer facilities are used to transfer logs to barges or rafts for towing. At least 33 LTFs have been constructed within the project area.

Boat launch ramps provide opportunities to access marine waters and lakes with trailered boats. There are presently seven launches in the project area. Launches are commonly associated with LTFs and barge ramp facilities. These launches are not maintained; at times, they may not provide suitable access due to tides, debris or other conditions. Boat launches exist at Luck Lake, Neck Lake, Polk Inlet, Winter Harbor, El Capitan, Labouchere Bay, and Ratz Harbor.

Float docks provide access and loading points for boats and floatplanes. The Forest Service maintains four docks in the project area; El Capitan, Camp Island, and Polk Inlet have marine docks designed for floatplane access. Control Lake has a dock for a boat used to access a recreation cabin.

Fish Passage at Road Crossings

Providing for fish passage at stream and road intersections is an important consideration when constructing or reconstructing 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 smaller or juvenile fish.

Most Class I and Class II fish stream crossings for NFS roads in the project area have been surveyed and categorized for their fish passage status. Issue 4 – Watershed Function has additional information.

Between 1998 and 2017, the Tongass has re-installed, retrofitted, or removed approximately 605 crossings that were not previously meeting passage standards in fish streams and potentially impeding fish passage. Of those, 247 were remediated by being removed and 358 of them were reinstallations. The estimated cost of this remediation is 18.4 million dollars, indexed to 2018 dollars. Approximately 80 percent of the reinstallations were replaced with culverts, 18 percent were replaced with bridges, and 2 percent were retrofits or maintenance occurred. Within the project area between 1998 and 2017, 213 sites have been replaced or removed. Of the 213 sites, 128 crossings have been removed, 28 replaced with bridges, and 55 replaced with culverts, all to provide passage.

Environmental Effects

The effects of roads on resources are discussed in their respective resource sections. The following paragraphs discuss the direct, indirect, and cumulative effects of the alternatives on transportation using the units of measure identified at the beginning of this section, with differences between the alternatives detailed in the tables.

New Road Construction

See NFS Road Construction and Temporary Road Construction Activity Cards (Appendix A). The need for road construction is largely determined by the need to access timber units. The design criteria for each alternative sets the amount of timber to be offered. The total road miles needed will be determined by the specific harvest units offered and the needed transportation network. This process is detailed in the Implementation Plan (Appendix B).

The Logging System Transportation Analysis (LSTA) identifies potential stands for timber harvest and the needed transportation network. The LSTA would be refined following direction in the Implementation Plan, Appendix B, to identify those stands and roads most likely to offer economically positive opportunities for harvest during the POW LLA Project. No alternative would harvest all potential stands identified within the LSTA, only the acreage needed to meet the volume in the Record of Decision would be harvested. Not all roads in the LSTA would be constructed, only those needed to harvest the selected stands. See Issue 3 – Timber Supply and Timber Sale Economic section for further information on LSTA development.

The LSTA estimates each mile of road would access about 179 acres of harvestable lands. Based on this estimate, the miles of road needed to meet the alternative design are shown below. For example, Alternative 2 shows 138 miles of new NFS roads (Table 85) but to meet the harvest volume 35 miles are expected to be built (Table 86). NFS roads will be constructed to OPML 2 standard. All temporary roads constructed would be decommissioned after their use period is over.

Table 85. Miles of new road construction to access all potential LSTA acres

All LSTA Roads – New Construction to Access all Potential LSTA Harvest Stands (Miles)				
	Alt 1	Alt 2	Alt 3	Alt 5
NFS Roads	0	138	138	138
Temporary Roads	0	505	505	505

Table 86. Miles of estimated new construction to meet alternative design volume

Estimated New Construction to Meet Alternative Design Volume (Miles)				
	Alt 1	Alt 2	Alt 3	Alt 5
NFS Roads	0	35	48	49
Temporary Roads	0	129	175	180

Road Maintenance

See the Road Maintenance Activity Card. Road maintenance includes the repair or upkeep of a road necessary to perpetuate the road and provide for its safe use. Work items may include surface rock replacement, culvert repair and replacement, bridge replacement, slide removal, reconditioning ditches, shoulders, roadbeds, brushing, and other items that contribute to the preservation of the existing road. Reconditioning restores a road to a useable level, work items can include culvert installation, bridge installation, ditch cleaning, shoulder clearing, roadbed clearing and shaping. Opening a stored road is normally considered maintenance. The road miles shown in the road maintenance table are for improving Maintenance Level 1 roads to Maintenance Level 2 standards. Currently open roads used for timber haul would be maintained by the timber purchaser commensurate with their use.

Table 87. Road maintenance (ML-1 roads)

Road Maintenance (ML-1 roads)				
	Alt 1	Alt 2	Alt 3	Alt 5
Miles	0	90	120	125

Rock Quarries

See the Quarry Development Activity Card. Rock sources would be needed for the construction, reconstruction, and maintenance of roads in this project. There are numerous rock quarries throughout the project area and usually there is one within a few miles of work sites. To the extent feasible, existing quarries would be used rather than developing new ones. In some cases, new rock quarries may be needed. Each mile of road requires about 0.45 acres with an average size of 1.5 acres. The number of quarries needed to meet alternative design volumes are shown below. Quarry sites would be developed within 500 feet of a road and avoid Class I and Class II stream buffers, old-growth habitat reserves, and eagle and goshawk nest tree buffers. With either the expansion of an existing quarry or the development of a new site, the area footprint would generally not exceed 3 acres. Development of rock quarries are an irreversible and irretrievable commitments of resources. The extraction of shot rock or gravel would be apparent and would alter the landscape, even with screening.

Table 88. Number of potential Quarry Development Sites

Quarry Development Sites			
Alt 1	Alt 2	Alt 3	Alt 5
0	49	67	69

Log Transfer Facilities

See the Log Transfer Facilities Activity Card. Log transfer facilities (LTF) are used to transfer logs and timber products from land-based transportation forms to water-based transportation forms (or vice-versa). These facilities are often used for the movement of equipment needed for logging and road building. Remote road systems with no connection to the Prince of Wales road system require the use of an LTF. In addition, it can be cost effective to utilize an LTF rather than truck logs when long haul distances are required.

An area for upland operations adjacent to the LTF is required. The space needed for upland operations adjacent to the LTF is directly related to the type of facility, volume of timber that may be handled annually, and the life of the operation. It is expected that LTFs used in this project would require about 5 acres of uplands.

Table 89. Project area log transfer facilities: status and required work

Log Transfer Facilities with Expected Use		
Location	Status	Required Work
Suemez	Existing	Maintenance
Lancaster	Existing	Maintenance
Heceta	Existing	Maintenance
Calder	Existing	Maintenance
Tuxekan	Existing	Maintenance
Thorne Bay	Existing	Maintenance
Polk	Existing	Maintenance
Coffman	Existing	Maintenance
Marble	Existing	Reconstruction
El Capitan Passage	Existing	Reconstruction
Orr Island	Planned	New construction
Browns Bay	Planned	New construction
N. Red Bay	Disposed	Reconstruction
Orr Island west	Disposed	Reconstruction
Orr Island east	Disposed	Reconstruction

Thirteen existing LTFs are proposed for use and two new sites are proposed for all alternatives. Five of the existing sites would require reconstruction to meet current use standards. The estimated current cost for the required work for all LTFs is $3,830,000. Typically, LTFs are reconstructed to facilitate both log transfer to barges and direct to water. Other existing LTFs, including those on non-NFS lands, may be used if needed; a complete list of LTFs is in the project record. The Forest Plan, Appendix G – Log Transfer Facility Guidelines provides detailed information for LTF siting and development.

Travel Analysis Process

The desired condition for the Forest transportation system is guided in part by 36 CFR 212.5 – Road System Management.

The Travel Analysis Process is a three level, science-based system of analysis. The first level is the Forest-wide Roads Analysis, which is an analysis for the entire Tongass National Forest (*Tongass National Forest – Forest-Level Roads Analysis* 2003). The Forest-wide Roads Analysis provided management recommendations for maintenance level (ML) 3, 4, and 5 roads.

The second level is the Prince of Wales Roads Analysis, (*Roads Analysis Objective Maintenance Level 1 and 2 Roads, Tongass National Forest Thorne Bay and Craig Ranger Districts* 2005). This report details the analysis methods and recommendations for travel management for ML 1 and 2 roads on the Thorne Bay and Craig Ranger Districts. Copies of these analyses are located in the project record. Combined, these analyses recommend road management objectives for all existing NFS roads within the project area.

The third level is a project-level analysis. A travel analysis for this project was conducted in accordance with FSH 7709.55 for the proposed NFS roads. The recommended operational and objective maintenance levels and a proposed travel management strategy for each road were assigned. The project travel analysis is located in the project record.

Costs by Alternative

Road development costs are based upon regional average costs for constructing roads in Southeast Alaska. Costs are applied based upon an average cost per mile for different classifications of road construction and reconstruction. Estimated costs shown below are for the road miles needed to meet the volumes for each alternative. Construction needed for access to a project would be part of the contract. Timber harvest contracts would include the costs of road construction. Some years, congressionally-appropriated funds are allotted for road projects as part of the budget. These must be used for the intended purpose.

Table 90. Estimated road development costs under each alternative

Road Development Costs				
	Alt 1	Alt 2	Alt 3	Alt 5
NFS Road Construction[1]	$0	$7,020,000	$9,550,000	$9,780,000
Temporary Road Construction[2]	$0	$19,320,000	$26,290,000	$29,940,000
Road Maintenance[3]	$0	$3,140,000	$4,270,000	$4,370,000
Totals	**$0**	**$29,480,000**	**$40,110,000**	**$41,090,000**

[1]Estimated at $200,000 per mile.
[2]Estimated at $150,000 per mile.
[3]Road maintenance is the estimated cost to improve OPML 1 roads to OPML 2 level suitable for log haul, estimated $35,000 per mile
Note: Costs are estimated based on road miles, but are not exact values; these values are presented to provide a relative comparison between the alternatives. All costs are subject to change.

Cumulative Effects

The cumulative effects area for the transportation system is the project area. Cumulative effects examines the impacts to transportation infrastructure from reasonably foreseeable future activities on NFS lands and non-NFS lands over the 15 years proposed for this project.

Forest Service transportation projects completed will vary from year to year, based on available funding and need. These include maintaining or improving existing roads and bridges, placing roads in storage, and improving fish passage at road crossings.

Road construction for non-NFS lands primarily includes roads needed for timber harvest. Plans that are known for other landowners are shown in the *Catalog of Present and Reasonably Foreseeable Future Activities* table in Appendix C. GIS records indicate 1,661 miles of roads on non-Federal lands within the project area.

The State of Alaska Department of Transportation and Public Facilities has completed a 2004 Southeast Alaska Transportation Plan (SATP). This show a variety of alternatives for State transportation networks within the project area. Copies of both plans can be found in the project record. Currently paving the road from Neck Lake to Whale Pass is in the design phase of the 2004 SATP; no construction date is set.

S.1484 – ANCSA Admiralty Island Land Exchange Finalization Act of 2017 could remove about 23 miles of NFS road from federal ownership. Sixteen of the 23 miles are open to all motorized vehicles; the remaining 7 miles are closed roads. The LTF located in Lancaster Cove could also be transferred from federal ownership.

Forest Vegetation

The POW LLA Project proposes old-growth and young-growth timber harvest and intermediate stand improvement treatments resulting in changes to forest vegetation in portions of the project area. Timber harvest and intermediate stand treatments will cause changes to forest structure, species composition, and stand health and stability. Changes in vegetation are determined by a prescribed silvicultural system that meets project goals and objectives while adhering to 2016 Forest Plan direction.

Desired Conditions

The desired condition for stands within the POW LLA project area is determined by Forest Plan LUDs with desired conditions specific to young-growth management described in Chapter 5 of the 2016 Forest Plan (pp. 5-2 to 5-8). The goals and objectives of the LUDs in the POW LLA project area are presented in Chapter 3 of this document (see Land Use Designations). Also, see Figure 2 in Chapter 1.

Methodology

Inventory and Analysis Methods

Initial project area information was obtained from the Tongass National Forest GIS library, aerial photos, and the Forest Service Activity Tracking System database (FACTS). In addition, extensive young-growth inventory data in stands 40 years in age or older has been collected in the project area over the past several years, as well as an inventory of old-growth stands including using walk-through assessments to stratify potential harvest stands.

Information on the current condition of old-growth stands has been collected using walk-through assessments to stratify potential harvest stands based on the vegetation series (DeMeo *et al.* 1992) and a net standing timber volume estimate (Schroeder, 2017a). An intensive plot inventory was then conducted on a representative subset of each stratum (Schroeder, 2017b). These data have also been entered into an FPS database and extrapolated to non-inventoried stands in the same vegetation series and volume stratum.

The information gathered by these inventories is used to describe and diagnose existing stand condition, which includes stand characteristics, species composition, stand structure, regeneration, windthrow risk, and disease and decay severity. Complete silvicultural prescriptions will be written during implementation when timber harvest projects are identified.

Spatial and Temporal Context for Analysis

The analysis area for direct and indirect effects to forest vegetation is National Forest System lands in the POW LLA project area. The cumulative effects analysis area includes all lands within the POW LLA project area. The timeframe used to analyze effects is the next 100 years or the projected time between defined stages of stand development.

Units of Measure

Measures used to disclose the effects on vegetation from the proposed timber harvest include:

- Forest Structure: changes to stand structure over time
- Forest Health and Productivity: changes in forest health and site productivity

- Regeneration and Species Composition: changes in regeneration and species composition of each individual stand
- Windthrow Risk: effects of wind hazard

Affected Environment

Introduction

The POW LLA project area is a mosaic of coniferous forests in managed and unmanaged conditions, interspersed with muskeg, scrubland, and alpine plant communities. Forest stands younger than 150 years old are considered young-growth on the Tongass for timber inventory purposes. Most young-growth stands in the project area originated primarily from large-scale even-aged clearcut harvest that began in the mid-1950s. Higher volume stands, primarily consisting of large-diameter spruce and hemlock trees, were targeted during these large-scale harvests; as a result the residual old-growth stands proposed for harvest tend to be scattered among even-aged young-growth and contain relatively higher percentages of western redcedar and Alaska yellow-cedar than what has been historically harvested.

Young-growth is categorized as either commercial or precommercial. Average stem diameter, volume per acre, and percent of volume present in trees containing two 32-foot logs all contribute to whether an individual young-growth stand is commercially viable. Additionally, the stand's place in the landscape, the current market economics surrounding saw timber, and other external and situational forces influence whether a stand may be considered "commercial" at any given time. For the purpose of this analysis, commercial young-growth stands are considered to be 55 years or older.

Species Composition

The primary species in the old-growth and mature timber types are western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), mountain hemlock (*Tsuga mertensiana*), western redcedar (*Thuja plicata*), and Alaska yellow-cedar (*Callitropsis nootkatensis*). Higher percentages of Sitka spruce are found along streams and other well-drained sites. Forested muskegs occur throughout the project area and contain a high percentage of Alaska yellow-cedar. Muskeg areas also support shore pine (*Pinus contorta*) and mountain hemlock (*Tsuga mertensiana*). Mountain hemlock is also more prevalent at higher elevations. Red alder (*Alnus rubra*) is found on disturbed sites such as roadsides, certain harvested stands, and along stream banks.

Young-growth stands are primarily dominated by western hemlock and Sitka spruce. The older young-growth stands being considered for harvest generally contain less cedar as the earlier harvests focused on high volume spruce and hemlock stands that grew on the most productive sites and at lower elevations. Sitka spruce and western hemlock tend to have a greater competitive advantage on the higher site areas while cedars are generally better represented on mid to lower site quality areas. Sitka spruce was the favored tree in early precommercial thinning operations and emphasis on yellow-cedar as a crop tree developed in the early 1990s. Current precommercial thinning activities across Prince of Wales Island favor the retention of yellow-cedar. The understory shrubs are primarily blueberry (*Vaccinium* spp.), huckleberry (*Vaccinium parvifolium*), and rusty menziesia (*Menziesia ferruginea*). Many other species of vascular plants, lichens, and mosses occur throughout all habitat types or plant associations. The amount, distribution and mix of understory plants varies between old-growth and young-growth stands and is dependent on many ecological components, including stand structure, site quality and the plant association of the stand.

Table 91. Project Area Species Composition on Lands Proposed for Harvest (Percent Trees per Acre)

	Old Growth	Young Growth
Sitka spruce	7	31
Western hemlock	63	56
Western redcedar	17	7
Alaska yellow-cedar	12	<1
Mountain hemlock	<1	<1
Red alder	<1	5

Stand Productivity

Productivity of forests is largely defined in terms of site quality, which is usually measured in terms of timber volume an acre can produce in a given period of time. Site quality is the sum of many environmental factors including soil depth and drainage, aspect, microclimate, etc., and varies both within and among individual stands.

Old Growth

Old-growth forest lands are stratified into high, medium, and low volume strata as a proxy for estimating site productivity. The acres of existing old-growth forest by volume strata for each Timber Analysis Area (see the Timber Supply and Economics section) is shown in Table 92. Table 93 shows the old-growth acres identified by the LSTA for the POW LLA Project from which the action alternatives will harvest from (see Table 28 for harvest acres by alternative).

- **High Volume Strata** – Areas within timber inventory volume classes 5, 6, and 7 on non-hydric soils, and on hydric soils with slopes greater than 55 percent. These are considered to be highly productive acres.
- **Medium Volume Strata** – Areas within timber inventory volume classes 5, 6, and 7 on hydric soils with slopes less than or equal to 55 percent; areas within timber inventory volume class 4 that are either on non-hydric soils, or are on hydric soils greater than 55 percent. These are considered to be medium productivity acres.
- **Low Volume Strata** – Areas within timber inventory volume class 4 that are on hydric soils with slopes less than or equal to 55 percent. These acres are considered to be low productivity acres.

Table 92. All old-growth forest acres across all LUDs by volume strata and Timber Analysis Area on NFS lands in the POW LLA Project Area.

	Volume Strata		
Timber Analysis Area	**High**	**Medium**	**Low**
North 20	4,640	839	517
Calder Red Bay	23,589	8,496	3,834
El Cap	7,068	3,590	1,225
Whale Pass	9,034	6,886	6,777
Devilfish Bay	12,900	10,679	7,706
Kosciusko	13,492	3,512	2,427
Orr Marble Island	5,461	3,314	2,146
Coffman Cove	28,115	25,687	26,563
Heceta Island	11,395	4,912	3,348

	Volume Strata		
Timber Analysis Area	**High**	**Medium**	**Low**
Greater Staney	22,184	14,677	11,529
Thorne Bay	49,339	29,545	17,572
Outer Islands	22,270	28,189	9,552
Harris Twelve Polk	35,037	33,446	12,588
Greater Suemez Island	16,999	15,100	8,103
Sukkwan Island	8,516	10,191	5,967
Kassa Inlet	24,063	15,307	3,844
Cholmondeley Moira	34,836	21,028	14,026
Dall Island South POW	40,742	38,985	13,627
Total Project Area	**369,680**	**274,383**	**151,351**

Table 93. Potential old-growth harvest acres by Timber Analysis Area and volume strata and also as a percent of total existing volume strata acres.

Timber Analysis Area	Potential Harvest Acres			Percent of Existing (from Table 92)		
	High	Medium	Low	High	Medium	Low
North 20	1,241	260	287	26.7	31.0	55.5
Calder Red Bay	4,135	1,632	789	17.5	19.2	20.6
El Cap	671	237	86	9.5	6.6	7.0
Whale Pass	2,493	1,779	1,344	27.6	25.8	19.8
Devilfish Bay	0	0	0	0.0	0.0	0.0
Kosciusko	633	185	163	4.7	5.3	6.7
Orr Marble Island	747	435	303	13.7	13.1	14.1
Coffman Cove	1,033	938	811	3.7	3.7	3.1
Heceta Island	2,382	791	352	20.9	16.1	10.5
Greater Staney	4,095	1,854	879	18.5	12.6	7.6
Thorne Bay	769	755	730	1.6	2.6	4.2
Outer Islands	0	0	0	0.0	0.0	0.0
Harris Twelve Polk	4,230	2,596	625	12.1	7.8	5.0
Greater Suemez Island	350	294	342	2.1	1.9	4.2
Sukkwan Island	11	54	0	0.1	0.5	0.0
Kassa Inlet	0	0	0	0.0	0.0	0.0
Cholmondeley Moira	1,995	627	505	5.7	3.0	3.6
Dall Island South POW	0	0	0	0.0	0.0	0.0
Total Project Area	**24,785**	**12,437**	**7,216**	**6.7%**	**4.5%**	**4.8%**

Young Growth

Stand productivity can vary considerably across and within young-growth stands, typically being highest in the valley bottom and decreasing with elevation. Site quality plays a significant role in all aspects of stand development. Higher site quality generally translates into taller trees and higher volume per acre. Higher site quality allows for heavier stocking (more trees per acre) to be carried in the stand over time and results in faster changes in tree characteristics and stand structure. Height to diameter ratios increase faster on high sites and live crown ratios will tend to decrease faster due to the effects of inter-tree competition as a result of this heavier stocking. In general, young-growth stands nearing commercial age within the project area are located on high or medium productivity sites.

Stand Structure

Forest stand structure is defined as the horizontal and vertical distribution of components including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris (Helms 1998).

Old-growth structure varies depending on habitat type but generally contains large trees over 150 years in age, multi-layered canopies, and moderate shrub understory. Structural complexity has developed through stem and limb breakage caused by small, intermittent disturbance events and insect/disease activity. Coarse, woody debris typically is abundant on the forest floor as large, decaying logs. Some whole trees may lay horizontally, uprooted by windthrow.

Young-growth structure varies by habitat type but also varies by age, site quality and whether the stand has been precommercially thinned or received other intermediate treatments. Young-growth stand development typically follows the predicted structural stages of stand initiation, stem exclusion and understory reinitiation defined by Oliver and Larson (1996).

- *Stand Initiation* – A new cohort with up to thousands (per acre) of newly germinated trees occupies the site. Residual shrubs and herbaceous plants respond to the increased light for 8 to 10 years on average, at which time the conifers begin to overtop vegetation. Stand species richness is greatest at this stage of development. Other biological attributes during this phase include rapid tree growth, high browse production and poor snow intercept. This stand has seedlings and then small saplings.
- *Stem Exclusion* – By approximately age 15 to 25 years, the trees begin competing for light and few, if any, new trees are regenerate. Out-competed trees begin to die. During this phase a dense canopy cover reduces light reaching the forest floor. Understory plants decline rapidly and can be completely eliminated in 35 years unless openings are created in the canopy. When the canopy closes, the trees are larger saplings and then pole-sized trees. Later in this stage, there are pole-sized trees and small sawtimber. Suppressed trees may still be sapling sized.
- *Understory Re-initiation* – The trees continues to suppress the understory shrubs and herbs for up to 100 years with understory plants not re-appearing until age 120 to 150 when overstory trees begin to die and allow enough light to reach the canopy floor for understory plants to become established again. During this phase understory forage production increases and snow interception is effective. These trees are pole-sized and small to mature sawtimber.
- *Old Growth* – From roughly 150 years on, large trees dominate at a density of about 200 trees per acre, snags and woody debris are present and vertical canopy structure has diversified. Tree growth eventually becomes static with decay and mortality equaling in-growth. There are increased understory plants with gap phase disturbance from wind and natural mortality of large overstory trees along with increased edge effect. Snow intercept is still occurring and the multilayered crown adds to the improved habitat diversity.

Stand age does not directly correlate to a particular stand structure, however there are loosely defined age and size ranges that help define the typical young-growth stands in the project area. A variety of other stand attributes including tree diameter, trees per acre, basal area, and live crown ratio also contribute to a stand's overall structure but do not, individually, describe it completely (Tongass Young Growth Management Strategy, 2014).

Precommercial Young Growth

Young-growth stands available for intermediate precommercial treatments in the POW LLA project area are between the ages of approximately 15 to 30 years of age and rarely to age 40. Stands older than 45 are considered nearing commercial size and therefore will often have an intermediate treatment delayed until an economical opportunity for treatment arises. Stands currently ready for precommercial thinning activities and other intermediate treatments were harvested between the late 1970s up to the early 2000s. The age classes commonly found in precommercial young growth are discussed below.

Age Class 0–15 Years (Harvested Between 2003 and 2017)

There are roughly 8,600 acres (5 percent) of young growth within the 0 to 15 year age class. Canopy cover in this age class can be open to almost completely closed with tree density ranging from 1,500 to 10,000 TPA and crown ratios at 75 to 100 percent depending on site quality. Understory shrubs and herb cover can be dense to sparse depending on the stocking of the site and age.

Trees in this age class are considered seedling or sapling size and are mostly all under 5 inches DBH.

Age Class 15–30 Years (Harvested Between 1988 and 2002)

There are roughly 49,000 acres (26 percent) of young growth within the 16 to 30 year age class. Stands within this age class that have yet to be precommercially thinned have begun to enter the stem exclusion stage and very little light can penetrate to the forest floor. Stand canopy cover ranges from 75 percent to 100 percent with crown ratios being fairly small at 25 to 30 percent reflecting the inter-tree competition. At this stage understory vegetation can be very sparse to absent. Tree densities drop to around 3,000 TPA and understory vegetation may be more abundant on medium quality sites as they tend to take longer to reach the stem exclusion stage.

This age range is considered the optimal window for precommercial thinning. Most stands that are treated are thinned between the ages of 15 and 30 years. Precommercial thinning can interrupt or delay stem exclusion and reduces tree stocking from 3,000 trees per acre to approximately 220 – 300 TPA. Of the 49,305 acres of young growth in this age class, 9,384 (19 percent) have been precommercially thinned.

Trees in these stands are considered pole-size and do not usually have any commercial value. Trees are generally greater than 5 inches DBH but less than 9 inches DBH with an average Quadratic Mean diameter (QMD) of around 4 inches DBH. On poorer sites the average DBH may be considerably smaller.

Age Class 31–45 Years (Harvested Between 1973 and 1987)

The 61,812 acres (33 percent) of precommercial young growth that fall within the 31 to 45 year age class are generally considered to be outside the PCT “window”. Stands in this age class are largely too advanced for precommercial thinning but do not have enough merchantable wood to make commercial thinning economically feasible. These stands, if unthinned, are in the stem exclusion stage with almost complete canopy cover and very little, if any, understory vegetation. If the trees have been thinned, then the densities are much lower, generally averaging 220 to 300 TPA, the crowns are larger, diameters are larger and there may be understory vegetation present. Approximately 65 percent (40,512 acres) of this age class has received at least one precommercial thinning treatment.

Generally the trees in these stands are pole-sized, ranging from 6 inches DBH to 12 inches DBH with some larger stems scattered throughout the stand. QMD averages around 7 inches DBH. On higher quality sites there may be a commercial component with an average QMD of 10 inches DBH and up to 50 trees per acre or more with a 14 inches DBH or larger. On poorer sites the average DBH may be closer to 5 inches and areas of sparse vegetation may still be present.

Commercial Young Growth

The commercial viability of young-growth stands depends on several factors; one of the most important is site productivity. The oldest young-growth stands on Prince of Wales and the surrounding islands occur on low elevation, relatively high productivity sites. Many of these older (greater than 55 years of age) young-growth stands contain acreage that fall within beach corridors, alluvial deposits and productive salmon streams where timber harvest is limited by the Forest Plan. Many of these stands have never been precommercially thinned and remain in the stem exclusion phase. Some of the oldest stands (70+) are beginning to enter the understory re-initiation phase as natural disturbance and gap dynamics begin to take effect, particularly along shorelines, riparian edges, and sites with high exposure to storm winds.

Age Class 46–55 (Harvested Between 1963 and 1972)

There are 52,090 acres (27 percent) in this age class. Trees in these stands are generally too big to be treated precommercially, yet often do not carry enough volume or piece size to provide an economical commercial harvest. Trees in this age class are growing very rapidly, often putting on a thousand board feet per acre, per year, due to the highly productive sites occupied by many of these stands. Commercial opportunities, whether regeneration harvest or commercial thinning, are likely to exist in these stands during the 15 year lifetime of this document.

Age Class 55+ (Harvested Before 1963)

Across the POW LLA project area, there are 18,423 acres (10 percent) greater than 55 years of age. Depending on assumptions defined for economic harvest (see Timber Economics Section) or other resource considerations, the number of acres projected to be commercially viable for the near-term (1 to 15 years) ranges between roughly 1,000 in 2019 to over 35,000 in 2033. The number of acres increases annually as additional stands in the 46 to 55 age class "grow into" a merchantable volume class.

Forest Health and Natural Disturbance

Hemlock dwarf mistletoe (*Arceuthobium tsugense*), decay fungi, Alaska yellow-cedar decline, and wind disturbance are the primary concerns related to forest health and natural disturbances in the POW LLA project area when analyzing effects from vegetation management. In young-growth forests the primary concern is windthrow hazard in residual stands adjacent to even-aged harvest, or in variable retention harvest units with high exposure to storm winds.

Dwarf Mistletoe

The occurrence of dwarf mistletoe in late successional western hemlock stands is widespread throughout Southeast Alaska, and was recorded in many of the proposed harvest areas in the project area at varying infestation levels. Dwarf mistletoe is apparently limited by climate (elevation and latitude), becoming uncommon or absent above 500 feet in elevation and 59º N latitude (Haines, AK) (USDA Forest Service 2008b). It often produces cankerous swellings at the point of infection of limbs or main stems. It reduces the vigor and growth rate of infected trees and reduces the quality of timber. Heavily infected western hemlock trees have branch proliferations (called "witches' brooms"), bole deformities, reduced height and radial growth, less desirable wood characteristics, and a greater likelihood of heart decay, top kill, and death. These symptoms are all potential problems in stands managed for wood production. Growth loss in heavily infested stands can reach 40 percent or more (Thomson *et al.* 2008).

Clearcut harvest is an effective method of controlling hemlock dwarf mistletoe if reduction or eradication of the disease is consistent with management objectives (USDA Forest Service 2001). Substantial reductions to timber are only associated with high disease levels, however. High levels of hemlock dwarf mistletoe will only result in regenerated stands if numerous large, intensely infected hemlocks are well distributed after harvest (USDA Forest Service 2007b: p. 44).

Reconnaissance plots completed during 2016 and 2017 across the potential harvest old-growth stands showed 68 percent of acres with a low rating, 26 percent rated moderate, and 6 percent rated high. In young-growth, preliminary data shows trace amounts of dwarf mistletoe present throughout the project area, with higher concentrations existing along boundaries with old-growth stands and in stands with infected residual hemlock trees present.

Decay Fungi

Approximately one-third of the old-growth timber board foot volume in Southeast Alaska is defective, largely due to decay from heart-rot fungi (USDA Forest Service 2015b). Heart and root-rotting fungi in trees can weaken the support structures, thereby leading to breakage. As the broken portion of the tree falls to the forest floor, it may wound adjacent trees and lead to eventual infection of the damaged trees. This process decreases the overall health and windfirmness of the trees in the stand, leading to decreased ability to provide a future timber supply and therefore reducing the stands ability to reach its desired condition. This process in old-growth forests also contributes to diversity in stand structure through gap dynamics.

Decay-causing fungi are present in all old-growth stands within the project area. Twenty percent of the sampled acres rated low for the occurrence of decay fungi (a low rating was given if less than 30 percent of the trees sampled exhibited stem decay), 59 percent of the sampled acres rated moderate (30 to 50 percent of the trees sampled exhibited stem decay), and 21 percent of the sampled acres rated high (more than 50 percent of the trees sampled exhibited stem decay). Decay fungi is most abundant in late successional western hemlock stands, and volume loss associated with the decay is concentrated in hemlock and to a lesser extent spruce. Redcedar and yellow-cedar are considered less susceptible to infection by disease and decay fungi.

Preliminary data on commercial-sized young-growth stands within the project area show defect and decay levels are extremely low throughout, with isolated incidents of decay and defect generally only where residual hemlock remain from the original harvest or in stems that have died due to competition from other trees.

Wind Disturbance

The major natural disturbance agent in Southeast Alaska is wind, also referred to as windthrow. Wind influences stand structure and development, including beneficial effects, such as exposure of mineral soil and mixing of soil associated with uprooted trees, which favors the regeneration of Sitka spruce and cedar, and the creation of ecologically beneficial large woody material.

Wind disturbance occurs over a continuum dependent on topographic features (Nowacki and Kramer 1998, pp. 1-8). Old-growth stand structure develops naturally through a process called gap dynamics, whereby small openings in the forest canopy, created by trees falling or dying, are colonized by shrubs, and eventually conifers. Some gaps are created by wind disturbance, in the form of uprooted trees and stem breakage. Over time, a multi-layered stand develops via gap dynamics. In areas where wind disturbance promotes gap dynamics, stands may reach a certain degree of stability with respect to wind.

The severity and frequency of wind disturbance is determined by many interrelated factors. These influencing factors include tree size and vigor, tree height-diameter ratio and crown size, slope, aspect, soil characteristics, stand composition, canopy structure and the characteristics of the surrounding topography, which may influence wind flow (Harris 1999). Timber harvest also has the potential to exacerbate the rate of windthrow in adjacent forest stands.

In the POW LLA project area, risk of high wind disturbance is generally found in areas with topographical exposure to prevailing southeast wind direction, or adjacent to newly created openings. The amount of existing windthrow in a stand is an important indicator of windthrow hazard. These characteristics and the stand's windthrow history are used to evaluate the windthrow hazard for each stand when the silvicultural prescription is developed during implementation (Stathers *et al.* 1994, pp. 15 to 17).

Windthrow and Young Growth

In general, the young-growth stands in the POW LLA project area will show little sign of any significant wind or weather damage. This is primarily due to their even consistency in age, heights and crowns. Rather consistent unbroken canopy is difficult for windthrow to get started in mainly because as the trees sway in the wind they dampen one another (Stathers *et al.* 1994). Being young, they most likely have not existed long enough to be exposed to a storm sufficient to overcome this dampening effect at any scale.

Once stands are opened up by harvesting, road construction or a large scale wind event the factors affecting individual tree stability become more important. Height-to-diameter ratio or the taper of the tree bole is a major concern in young growth. Tall thin trees are more likely to succumb to windthrow or stem breakage than trees with more robust bole taper. When the ratio of height to diameter is greater than about 90 the wind speed required to damage the tree is lower, and more likely to occur during any typical storm event (Stathers *et al.* 1994). Height-to-diameter ratios can be managed using appropriately timed stand treatments like precommercial and commercial thinning. Precommercial thinning reduces the height to diameter ratio and the susceptibility to wind damage. Thinning will be effective so long as the trees have not already obtained too high a ratio at which point the stand may be too much at risk to attempt the treatment. Precommercial thinning early in the rotation has proven to be an effective, low-risk method to positively influence more wind-resistant stem taper. Table 94 shows young-growth acres with and without PCT.

Table 94. Young-growth acres with or without precommercial thinning (PCT)

Young-growth acres with PCT	Young-growth acres without PCT
82,492	107,008

Hemlock is a shade-tolerant species that can survive and continue to add height growth in overstocked stand conditions. Dense stands of young-growth hemlock are prone to develop high height-to-diameter ratios if they remain unthinned. The greater the spruce component of young stands the less pronounced this condition tends to be. As a result, mixed species stands will develop better diameter growth and lower height-to-diameter ratios.

Alaska Yellow-cedar Decline

Yellow-cedar decline functions as a classic forest decline and is linked to climate change (Hennon *et al.* 2016). Yellow-cedar trees are killed by freezing injury to fine roots where there is insufficient snowpack to insulate them from lethal cold temperatures (less than 23 degrees F). Yellow-cedar is a long-lived tree, and many affected yellow-cedar trees established under the colder, more favorable climate of the Little Ice Age (1400 to 1850). An increased rate of yellow-cedar mortality began around 1900, spiked in the 1970s and 1980s, and continues today. On wet sites, where yellow-cedar faces less competition from western hemlock and Sitka spruce and is more abundant, yellow-cedar trees with shallow fine roots are particularly vulnerable to freezing injury. Research into root and foliar cold tolerance has shown that yellow-cedar roots are more vulnerable to this type of injury than associated conifers. Impacted forests tend to have mixtures of old dead, recently dead, dying, and living trees, indicating the progressive nature of tree death. From the time crown symptoms appear, it often takes 10 to 15 years for trees to die, making it difficult to associate observations from aerial surveys to weather events in particular years. Yellow-cedar is extraordinarily decay resistant and trees often remain standing for 80 to 100 years after death (USDA Forest Service 2016a).

Recent surveys have identified yellow-cedar decline on 110,314 National Forest System acres and 23,842 state and private acres in the POW LLA project area (USDA Forest Service 2017). The Tongass National Forest has partnered with the Alaska Coastal Rainforest Center and the University of Alaska Southeast to conduct economic feasibility studies of yellow-cedar salvage. In some settings, salvage recovery of yellow-cedar snags may yield valuable wood products and economic, social and ecological benefits. During project implementation, potential harvest stands will be assessed for the presence of yellow-cedar decline. Stands with yellow-cedar present but without decline may provide additional insight into site characteristics that help the species survive, and may serve as potential seed sources for nursery stock as well as locations where planting could increase yellow-cedar abundance and long-term survival. Silvicultural tools for conserving and expanding yellow-cedar's presence in the project area include uneven-aged management, planting, and precommercial thinning.

While the species has experienced little overall range contraction, local populations are becoming smaller and generally confined to favorable sites. Sites formerly occupied by yellow-cedar are transitioning towards western hemlock-dominated plant communities, including understory vegetation (Oakes *et al.* 2014, Hennon *et al.* 2016).

The Forest Service has developed a comprehensive conservation strategy for yellow-cedar in Southeast Alaska to account for yellow-cedar decline. This report, *A Climate Adaptation Strategy for Conservation and Management of Yellow-Cedar in Alaska* (Hennon *et al.* 2016), focuses on what is known about yellow-cedar decline and opportunities for the active management of yellow-cedar for 33 management zones in Alaska, four of which are in the POW LLA project area. Recommended management for this project includes planting and thinning to favor yellow-cedar particularly on high elevation and well-drained sites where long-term survival is favorable. The report is available for download at: http://www.fs.fed.us/pnw/pubs/pnw_gtr917.pdf.

Environmental Effects

Direct, indirect, and cumulative effects for the vegetation resource are estimated using quantifiable measures or indicators for actual effects, as appropriate. The level (magnitude and intensity) of effects are also assessed in terms of how widespread the effect is likely to be and how long it is likely to last. The effects of timber harvest on forest vegetation vary by silvicultural prescription and acres harvested. The following discussion of effects relates to the various components of the timber resource including stand structure, forest health and productivity, regeneration and species composition, and windthrow risk.

All proposed project activities are described in Appendix A and include resource specific direction to reduce or minimize effects. The activities not discussed below will have negligible effects to forest vegetation.

Silvicultural Systems

Silvicultural systems are defined as planned series of treatments for tending, harvesting, and re-establishing a stand of timber (Helms 1998). A silvicultural system will be selected for all proposed activities requiring a silvicultural prescription that best achieves overall project objectives as well as stand specific objectives and desired conditions defined by the underlying Forest Plan LUD.

Site-specific objectives that influence prescriptions include but are not limited to:

- Retention of old-growth characteristics, or the development of old-growth structural characteristics in young-growth.
- Providing for favorable timber sale economics and a sustainable level of forest products through time.
- Protection or enhancement of soils, watershed and aquatics, wildlife habitat, and scenery characteristics.
- Improvement of stand health and productivity.

Activity Cards have been prepared for even-aged, two-aged and uneven-aged silvicultural systems, as well as intermediate treatments proposed in this project (Appendix A). Additionally, the Implementation Plan in Appendix B includes decision trees for determining how the appropriate silvicultural prescription will be selected during implementation.

Even-Aged Management

Even-aged management results in stands with a single age class of trees, and is generally regarded as the most effective method of regenerating old-growth stands where growth of existing trees is exceeded by decay. In old-growth and young-growth stands it is the most efficient harvest method to maximize timber production and achieve economic objectives (see Activity Cards 01 and 13).

Under this system, clearcutting or clearcutting with reserves would be prescribed and all or the majority of the merchantable trees would be harvested. Merchantable-size trees could be retained for other resource requirements or objectives.

Additional silvicultural treatments may be prescribed post-harvest including tree planting, precommercial thinning, and pruning (Activity Cards 11, 05, and 09). These treatments would be prescribed to influence species composition, increase individual tree growth, promote wood quality and enhance wildlife habitat.

Two-Aged Management

Two-aged management results in stands with two distinct age classes of trees providing for additional stand structure over even-aged management (see Activity Card 02).

Two-aged management prescriptions would be used in young-growth stands to maintain stand structure and habitat connectivity beneficial for wildlife, but could also be used to help minimize increases in watershed peak flow rates and shorten time periods between entries when compared to even-aged management. A second entry could occur in about 40 years or at a time when the second cohort of trees has been precommercially thinned and the slash from the initial treatment has broken down and does not restrict wildlife movement.

Under this system, patch clearcutting or clearcutting with reserves would be prescribed to retain least 30 percent of the stand in an unharvested condition. A patchwork of openings up to 20 acres in size would be dispersed evenly throughout the stand. These areas would progress through structural changes similar to even-aged management, including intermediate treatments. Timing of the second entries into these stands would be dependent on the individual stand's site quality, and would be assessed as part of the diagnosis and prescription process during implementation.

Uneven-Aged Management

Uneven-aged management results in stands with three or more distinct age classes of trees with a range of diameter classes reasonably well distributed across the stand. In old-growth stands it is the most effective method for maintaining old-growth structure while removing a percentage of the merchantable volume in the stand. In young-growth stands that are currently in an even-aged condition, this method will create a multi-aged stand structure through a series of periodic entries (see Activity Cards 03 and 14).

Under this system, single-tree and/or group selection prescriptions would be used with harvested openings generally two acres or less in size. Group selections would harvest no more than approximately 33 percent of the stand area during any entry and single tree selections would retain least 50 percent of the existing tree basal area during each entry. In young-growth stands, tree selection may vary between basal area reduction, diameter-based designation, and removal of trees in small groups or in strips. Specifications for cut and leave trees in stands under uneven-aged management will be established during prescription development at implementation.

Intermediate Treatments

Intermediate treatments occur after stand establishment and prior to regeneration harvest to improve species composition, stand structure, growth, quality, and health, as well as wildlife and riparian habitat conditions.

For the POW LLA Project, intermediate treatments include precommercial and commercial thinning, pruning, girdling, slash treatment and planting (see Activity Cards 04, 05, 06, 07, 08 09, 10, and 11).

Stands considered for commercial thinning are anticipated to be at or near the volume per acre necessary for economic viability by the time treatments occur. Commercial thinning will be prescribed primarily to enhance wildlife habitat and address scenery, recreation, and hydrologic objectives.

Direct and Indirect Effects on Species Composition and Regeneration

Alternative 1 – No-Action

Alternative 1 proposes no new harvest in either old growth or young growth. Trajectories of species composition would depend on the current conditions and site quality of the individual stands. However, in general, as natural processes create small openings in the forest canopy western hemlock would have a competitive advantage of other species. At some point in the future, it is expected that some stands would suffer larger-scale disturbance from a severe storm event, leading to regeneration of those stands. Regeneration would likely be prolific with species composition similar to the former stand. There would be no opportunity to plant yellow-cedar in new, more suitable long-term sites.

Alternatives 2, 3, and 5 – Old-Growth Harvest

Even-aged Management and Two-aged Management

Where even-aged and two-aged management are prescribed, the resulting tree regeneration is expected to be vigorous and representative of the approximate species mix of the former stand. Regeneration survey data shows that tree regeneration in previously harvested stands in the project area is comprised on average of about twice as much Sitka spruce, about equal or slightly more cedar and somewhat less hemlock trees per acre than what is estimated to have occurred prior to harvest.

Regeneration of yellow-cedar has been raised as a concern. Both cedar species and Sitka spruce are relatively shade intolerant and therefore larger openings created by even-aged and two-aged management provide a favorable site for regeneration. Even-aged and two-aged management creates conditions favorable for intermediate treatments, such as tree planting and precommercial thinning (Activity Card 5). There would be a good opportunity to introduce yellow-cedar on well-drained sites favorable for long-term survival of the species, and where it is currently absent, through planting (Activity Card 11). Where healthy populations of yellow-cedar exist prior to harvest, precommercial thinning to favor cedar regeneration and inter-planting could be utilized to increase yellow-cedar abundance in the post-harvest stand.

Uneven-aged Management

Where uneven-aged management is prescribed for old-growth harvest, understory regeneration would be limited to parts of the stand where harvest occurs. Natural regeneration would occur in the unharvested portions of the stand at levels similar to an unharvested stand; however, the limited openings and low ground disturbance created during harvest would favor hemlock regeneration and may limit the regeneration of spruce and the cedars. To offset this, treatments would prioritize the retention of spruce and cedar advanced regeneration, as well as smaller-diameter intermediate spruce and cedar trees with good vigor (Deal and Tappeiner 2002). Uneven-aged single tree selection does not offer a good opportunity for intermediate treatments to manage species composition (such as planting or PCT), but due to the good species mix and the flexibility of single-tree selection and group selection prescriptions, it is unlikely that a significant change in species composition would occur.

Alternatives 2, 3, and 5 – Young-Growth Management

Even-aged Management

Even-aged management in commercial young-growth would produce a flush of understory vegetation and extensive tree regeneration. Sitka spruce and western hemlock would naturally occupy the openings, being the dominant species in the current stands. Opportunities for planting redcedar and yellow-cedar on favorable sites to increase diversity would be plentiful. Side-lighting into the residual stand from the openings would enhance understory plant abundance and diversity in those adjacent areas.

Two-aged Management

The effects of two-aged management on species composition and regeneration are essentially the same as even-aged management. In openings created, vigorous young stands of spruce and hemlock would be initiated. When compared with even-aged management, the increased occurrence of edge associated with two-aged management would increase the effects of edge and side-lighting on the residual stands. Openings created by two-aged management would create opportunities for planting redcedar and yellow-cedar on favorable sites through planting.

Uneven-aged Management

Under an uneven-aged prescription, smaller and more linear openings are expected to regenerate adequately with both spruce and hemlock. Due to the limited openings, the more shade-tolerant western hemlock is expected to have a competitive advantage. Where openings up to the allowable 2 acres are created, there would be an opportunity to plant less tolerant species that may be under-represented in the matrix, such as redcedar and yellow-cedar. The extensive edge created under this system would greatly enhance understory plant occurrence and diversity over the existing condition.

Commercial Thinning

Commercial thinning, where implemented to achieve timber production objectives, will likely remove more hemlock per acre than spruce. The more economically-desirable spruce and cedars will often be targeted for retention to facilitate more economic regeneration harvests in the future. Redcedar and yellow-cedar is under-represented in these older stands and could be retained depending on stand objectives. Understory vegetation is expected to respond positively to the treatment, as retained tree crowns would have to be kept wide enough to allow for harvesting equipment to move through the stand.

Where commercial thinning is implemented for habitat restoration objectives, there is potential for the creation of small openings similar to uneven-aged management. Understory vegetation would respond positively to these activities, particularly along edges or in canopy gaps. Where larger openings are created, planting redcedar or yellow-cedar may be considered if necessary.

Precommercial Thinning

Precommercial thinning is a valuable tool for improving species diversity and stand productivity during the early phases of stand development. Where implemented, PCT could prioritize the retention of cedars. Both species would be thinned to a more narrow spacing than other species, to increase in the occurrence of the cedar in young-growth stands long term.

Where cedar species are not present, spruce and hemlock would be retained on a spacing determined by stand objectives. Where wider spacing is implemented, there may be regeneration, especially of hemlock, but overall, regeneration in PCT stands is not expected.

Table 95. Summary of Direct/Indirect Effects on Species Composition and Regeneration

Activity	Silvicultural System	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Old-growth Harvest	**Even-Aged**	No foreseeable change.	Better conditions for establishment of cedars and spruce in regenerated stands on 9,972 acres. Increased opportunities for planting and managing regenerated stands for yellow-cedar.	Better conditions for establishment of cedars and spruce in regenerated stands on 3,253 acres. Increased opportunities for planting and managing regenerated stands for yellow-cedar.	Better conditions for establishment of cedars and spruce in regenerated stands on 4,244 acres. Increased opportunities for planting and managing regenerated stands for yellow-cedar.
	Uneven-Aged		Likely increase in percentage of hemlock regeneration in harvested areas on 13,297 acres.	Likely increase in percentage of hemlock regeneration in harvested areas on 9,760 acres.	Likely increase in percentage of hemlock regeneration in harvested areas on 2,122 acres.
Young-growth Management	**Even-Aged**	No foreseeable change in species composition. Regeneration would remain effectively non-existent until a natural disturbance event opened canopy space.	No foreseeable change in composition. Regeneration would be maximized on 15,156 acres. Increased opportunities for managing stands for yellow-cedar.	No foreseeable change in composition. Regeneration would be maximized on 15,630 acres. Increased opportunities for managing stands for yellow-cedar.	No foreseeable change in composition. Regeneration would be maximized on 15,630 acres. Increased opportunities for managing stands for yellow-cedar.
	Two-Aged				
	Uneven-Aged		Likely increase in percentage of hemlock regeneration in harvested areas on 4,210 acres.	Likely increase in percentage of hemlock regeneration in harvested areas on 21,040 acres.	Likely increase in percentage of hemlock regeneration in harvested areas on 21,040 acres.
Intermediate Treatments	**Thinning Planting Pruning**	No foreseeable change in species composition. Regeneration would remain effectively non-existent until a natural disturbance event opened canopy space.	Activities would improve species composition and facilitate management for yellow-cedar.	Activities would improve species composition and facilitate management for yellow-cedar.	Activities would improve species composition and facilitate management for yellow-cedar.

Direct and Indirect Effects on Stand Productivity and Forest Health

Alternative 1 – No-Action

Old-growth Stands

It is expected that forest growth would continue to be exceeded by decay in old-growth stands. Insect and disease processes would persist at approximately current levels but due to the general lack of vigor in unmanaged stands, the forest remains at risk and vulnerable to insect and disease attack. Hemlock dwarf mistletoe, where present, would remain in the stand and may infect hemlock stems that regenerate in gaps adjacent to infected overstory trees. This would reduce the vigor and growth rate of hemlock trees, while producing a low quality of timber, and in some cases, killing trees.

Young-growth Stands

In general, commercial size young-growth stands in the project area are typically healthy and growing well with no foreseeable insect or disease issues that need immediate attention. Stands that have received intermediate treatments will generally be more stable and vigorous. Unthinned stands may have stagnant growth and poor vigor that results in the stand having poor stability. Thinned stands will be more stable, and also growing more quickly than if left untreated. Stands that are untreated under this alternative will be more susceptible to decay and damage as the trees that die off and fall will damage standing trees, allowing access for decay agents. Uneven-aged, two-aged and commercial thinning treatments open up crowns and reallocate resources.

Without PCT, precommercial size stands would remain predominantly in a stem exclusion stage. The tight spacing between trees causes stress that would allow for an increased chance that insects and diseases could more easily take hold and spread. The overall productivity of the stand may be somewhat less than the full potential due to this overcrowding. Although these stands are relatively insect-, disease-, and defect-free, there would be a forfeiture of any opportunity to remove trees that are less likely to meet desired conditions and to promote the growth of those that are. Currently there are no foreseeable insect or disease issues in these stands; however, in light of a warming climate, there is potential for future issues to develop that are not apparent today if these stands are left in an overstocked condition. Yellow-cedar on poor sites would be susceptible to cedar decline.

Alternatives 2, 3, and 5 – Old-Growth Harvest

Even-aged Management

Under an even-aged prescription, stand productivity for the purpose of volume production would be maximized. The risk of insect, disease and decay outbreaks within the newly established growing timber crop would be minimized. The newly created stand would be comprised of vigorous, disease-free trees. The insect and disease processes at work within the stand boundaries prior to harvest would be mostly eliminated, with the exception being along the edges where stands abut residual old-growth hemlock. Along these edges, young hemlock trees would be potentially at risk of dwarf-mistletoe infection depending upon the levels of infection in the surrounding residual trees.

Uneven-aged Management

Productivity and stand health would generally decline where uneven-aged management is prescribed in old-growth. Trees retained under uneven-aged management, and any in-growth within newly-created openings, would be at risk of infection by the disease and decay already present within the stand. This risk would generally be proportional to the amount of basal area retained. In stands with a high retention prescribed, the potential for damage to retained trees during harvest activities is higher, as wounds created provide entry-points for decay organisms. Hemlock dwarf mistletoe would remain in the stand and likely infect the hemlock regeneration even with selection criteria favoring the removal of infected overstory trees. Larger trees with high defect would likely be retained for wildlife, and would continue to occupy growing space while continuing to decline in vigor. These trees are not expected to experience an increase in growth rate or health as a response to the increased growing space created by harvest.

Alternatives 2, 3, and 5 – Young-Growth Management

Even-aged Management

Where even-aged management is prescribed in young-growth, there would be effectively no change in either the risk of insect or disease activity or the productivity of the land. Stands would be reset to the stand initiation phase of development, and will experience the same risk factors as the trees they replace. Reserve trees left within the unit boundaries may be infected with mistletoe or decay that could spread to the new cohort initiated from the even-aged harvest. While even-aged management using larger openings provides the lowest risk of damage to residual trees during the logging operation, a small number of trees are likely to be injured along the margin of openings and adjacent to roads and trails.

Two-aged Management

There would be no expected increase or decrease in productivity, and a slight increase in the risk of insect or disease activity in stands where two-aged management is implemented. The retained portions of the stand are not expected to be at any major risk of declining health within the projected rotation time, however, the increased edge resulting from smaller, more frequent openings increases the risk of harvest-related bole wounded when compared to even-aged management. Wounds become entry points for decay organisms and may attract insects such as bark beetles.

Uneven-aged Management

Uneven-aged management carries the greatest potential for insect and disease activity among commercial young-growth treatments for two primary reasons. First, multiple entries occurring in the same stand exposes residual trees to harvest-related injury several times over their lifetime. Wounded trees are more susceptible to decay organisms and if stressed, may attract insects such as bark beetles. Second, uneven-aged management results in older age classes of trees occupying the landscape than the other two systems. Growing older stands allows more time for decay and other issues to develop as the older trees become less vigorous.

Commercial Thinning

Commercial thinning for timber management objectives would maintain or increase the growth rate of dominate and co-dominant trees by removing trees in the lower crown classes and increase timber volume over the rotation.

Commercial thinning for other resources objectives can simulate development of more complex canopy structures and increase the amount of understory forage for wildlife and maintain or improve scenic quality. Average tree health could decline in these stands, if diseased and/or dying trees are retained to provide snag habitat and accelerate the late-seral structure desired in these stands. A higher proportion of healthy trees with good form and higher value could be targeted for harvest to improve project economics than in stands commercially thinned for timber production.

Precommercial Thinning

Precommercial thinning improves forest health and insect and disease resistance long-term by removing diseased trees early and opening growing space that reduces competition stress and mortality. Where PCT is used, stress on trees due to overcrowding would be reduced. Trees would be better spaced and individual trees that exhibit signs of disease or decay would be a priority for removal. During PCT operations, yellow-cedar can be promoted on sites where decline is of less concern.

Table 96. Summary of Direct/Indirect Effects on Forest Health and Productivity

Activity	Silvicultural System	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Old-growth Harvest	**Even-Aged**	Decline in general vigor and forest health outpaces growth until natural disturbance.	Forest health and productivity would be maximized on 9,972 acres.	Forest health and productivity would be maximized on 3,253 acres.	Forest health and productivity would be maximized on 4,244 acres.
	Uneven-Aged		Forest health and productivity would generally decline or remain unchanged on 13,297 acres.	Forest health and productivity would generally decline or remain unchanged on 9,760 acres.	Forest health and productivity would generally decline or remain unchanged on 2,122 acres.
Young-growth Management	**Even-Aged**	Increased susceptibility to insect and disease due to high densities on 19,366 acres.	Virtually no change in forest health or productivity on 15,156 acres.	Virtually no change in forest health or productivity on 15,630 acres.	Virtually no change in forest health or productivity on 15,630 acres.
	Two-Aged				
	Uneven-Aged		Slightly higher risk of insect and disease activity over time on 4,210 acres.	Slightly higher risk of insect and disease activity over time on 21,040 acres.	Slightly higher risk of insect and disease activity over time on 21,040 acres.
Intermediate Treatments	**Thinning Planting Pruning**	Decreased vigor and increased susceptibility to insect and disease due to overstocking.	Forest health and productivity would be improved on 4,500 acres per year.	Forest health and productivity would be improved on 4,500 acres per year.	Forest health and productivity would be improved on 4,500 acres per year.

Direct and Indirect Effects on Stand Structure

Alternative 1 – No-Action

No additional old-growth or young-growth harvest would occur on NFS lands under Alternative 1. Timber harvest would continue to occur on those areas under contract or if already NEPA-cleared. Old-growth stands would remain in a predominantly old-growth condition. Disease and decay would continue to degrade the structural integrity of mature and overmature trees, causing eventual mortality and increasing the stands' susceptibility to frequent, small-scale wind disturbance events. Understory vegetation would occur where these disturbances create canopy gaps. Some stands within the project area may eventually experience larger-scale disturbance due to a strong storm event, leading to the regeneration of the stands in what would likely be a two-aged or possibly, in extreme cases, an even-aged condition. Young-growth stands would continue to grow, however in the absence of thinning experience slower growth rates with trees failing to reach their diameter potential at maturity.

Previous NEPA-cleared young-growth stands of precommercial thinning age (15 to 35) would continue to be thinned at an assumed rate of 1,500 to 2,000 acres per year for the next 5 or 6 years.

Stands receiving treatment would experience a longer period of time in the stand initiation stage, with higher levels of understory plants. Unthinned stands of lower productivity would advance similarly to thinned stands of higher productivity, and unthinned stands of average to high productivity would continue into stem exclusion and are expected to stay in that structure for the next 50 to 100 years before transitioning to the understory re-initiation stage.

Commercial-aged young-growth stands would continue growing at a steady rate until they reach the peak of their annual growth. These stands would take longer to develop old-growth structure and may remain in a stem exclusion stage for an extended period of time, limiting the amount of understory vegetation beneficial for wildlife. Incremental advancement of disease and decay, coupled with small-scale disturbance events, would prompt gap dynamics toward the end of this timeline and the stands would progress through the understory re-initiation phase and eventually to old-growth.

Alternatives 2, 3, and 5 – Old-Growth Harvest

The structure of the forest would be changed by harvest under all of the action alternatives. The spatial and temporal scope of this change would vary by alternatives (Table 97).

Even-aged Management

Clearcutting or clearcutting with reserves under even-aged management would result in the creation of relatively homogenous young-growth stands primarily without any older residual trees present within harvest unit boundaries. New stands would develop from seedling establishment, through stand initiation and into stem exclusion, where extreme competition for canopy space would shade out understory vegetation. Eventually the stand would enter the stage where overstory tree mortality opens the canopy and re-initiates understory development. At this stage, the stand would begin to develop characteristics representative of old-growth forests. The length of time any young-growth stand spends in any of these phases is dependent on site productivity, the susceptibility of the site to small or large-scale natural disturbance, and any future treatments that are applied, such as thinning.

Uneven-aged Management

Uneven-aged prescriptions in old growth would result in stands with numerous residual trees remaining after harvest, dispersed throughout the stand. Openings up to 2 acres would result in increased understory vegetation and new tree regeneration. Stands with a low to moderate windthrow risk would be prescribed a retention level no less than 50 percent of the live basal area. Stands with a high rating for windthrow risk, as well as stands with wildlife, watershed, or scenery concerns would be prescribed a retention level no less than 75 percent of the live basal area. Regular, periodic entries in the future are expected to maintain three or more distinct age classes and a range of diameter classes in a reasonably well-dispersed manner across the stand, with the intended result being a stand of high structural diversity.

In stands prescribed a 50 percent retention, post-harvest stand structure would be expected to resemble stands transitioning between understory re-initiation and old-growth. The understory re-initiation is the structural stage just before a naturally developing stand begins to attain true old-growth structure (Oliver and Larson 1996, p. 259-275). These stands would have three age classes, consisting of residual dominant trees, residual intermediate and suppressed trees, and the understory that would be initiated by opening the canopy.

Where 75 percent retention is prescribed, post-harvest structural changes would be minor. The stand would retain old-growth structure after harvest and through to the next harvest entry if unaffected by a major natural disturbance event.

Due to the relatively intact nature of the post-harvest overstory in the 50 and 75 percent retention stands, the stand initiation and stem exclusion phases as seen after even-aged harvesting would not occur, barring a large natural disturbance.

Alternatives 2, 3, and 5 – Young-Growth Management

The structure of the forest would be changed by harvest under all of the action alternatives. The spatial and temporal extent of this change vary by alternatives (see Table 97).

Even-aged Management

In young-growth stands where even-aged management is prescribed, the entire stand would be harvested and naturally regenerate. These stands would advance through the stand development process, entering stem exclusion between 15 and 30 years post-harvest and remaining there until either the next harvest entry occurs or the stand transitions naturally into understory re-initiation structure through small-scale disturbance. The length of time these structural phases last will depend upon whether the stand receives intermediate treatments (such as thinning, etc.) and the productivity of the land.

Two-aged Management

In young-growth stands where two-aged management is prescribed, at least 15 percent of the harvest area would remain intact, with retained trees either grouped or distributed throughout. Harvest openings would progress through structural changes similar to even-aged management, including intermediate treatments. Second entry timing into these stands would be dependent on the individual stand's site quality, and would be assessed as part of the diagnosis and prescription process during implementation.

Uneven-aged Management

Where uneven-aged management group selection is used, roughly two-thirds of the stand area would be retained in the first harvest entry. Where individual tree section is used between 50 and 75 percent of the stand basal area would be retained. These areas would continue to advance from late stem exclusion to understory re-initiation structure. The harvested areas would regenerate as homogenous young growth and move through the same structural stages as the even-aged system already discussed. The second entry would be planned to occur in about 30 years. This entry would similarly harvest another third of the stand. Following this harvest, there would remain one-third of the stand in late understory re-initiation structure that would be trending toward old-growth structure. One-third of the stand would be in 30-year-old stem exclusion from the first harvest and follow-up precommercial thinning (PCT) if thinned, and one-third would be regenerating new growth. A third entry would then occur 60 years in the future harvesting the oldest portion of the stand. Harvest in this manner would result in stands of high vertical and horizontal structural diversity due to the variability in age, tree size, and individual tree characteristics. Repeated harvest entries in this manner would generally mimic a natural regime of frequent but low-intensity disturbances.

Commercial Thinning

Where commercial thinning is used, stand structure would be expected to change from stem exclusion to a condition resembling understory re-initiation. The extent to which this change occurs will be dependent upon the objectives of the prescription. Where timber production is the primary objective for the stand, the post-harvest stand would likely have evenly-distributed residual trees. Trees selected for retention would be of high value for future commercial harvest, while defective or excess codominant and dominant trees would be removed from the stand.

Where resources other than timber production are the primary objective of the treatment, the stand structure following thinning may more closely resemble a multi-aged stand moving from understory re-initiation toward old-growth. Small openings that are created would be occupied by understory vegetation, and higher defect trees would be retained following harvest to encourage future structural development.

Precommercial Thinning

Stands proposed for PCT generally range from the stand initiation stage to stem exclusion. A PCT treatment would delay and/or remove the development of the stem exclusion stage where present and promote the development of understory re-initiation stage structure sooner in stands that are already in stem exclusion. In non-development areas where the desired condition is ultimately old-growth-like structure, PCT would promote conditions that allow that objective to be achieved sooner than if left untreated.

Precommercial thinning in riparian and beach fringe areas would promote the development of understory re-initiation and old-growth structure sooner. Within-stand diversity can be increased by favoring trees with specific characteristics important for wildlife. Unthinned wildlife corridors would be maintained as needed to assure wildlife access after thinning. Leaving these areas unthinned would provide additional structural diversity to these stands and, due to the limited area, is not expected to affect the development of advanced stand structure.

Stream and floodplain Restoration

Where riparian instream work occurs adjacent to precommercial size young-growth stands, some trees would likely need to be cut for access trails between the stream and the existing road system. The number of trails will be minimized and not expected to effect the stand structure at the stand level.

Table 97. Summary of Direct/Indirect Effects on Stand Structure

Activity	Silvicultural System	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Old-growth Harvest	**Even-Aged**	No foreseeable change.	9,972 acres converted from old-growth structure to homogeneous young-growth stands.	3,253 acres converted from old-growth structure to homogeneous young-growth stands.	4,244 acres converted from old-growth structure to homogeneous young-growth stands.
	Uneven-Aged		13,297 acres remaining in a predominantly old-growth structure post-harvest.	9,760 acres remaining in a predominantly old-growth structure post-harvest	2,122 acres remaining in a predominantly old-growth structure post-harvest
Young-growth Management	**Even-Aged**	Continued stand structural development	15,156 acres regenerated from current condition to early stand development.	15,630 acres regenerated from current condition to early stand development.	15,630 acres regenerated from current condition to early stand development.
	Two-Aged				
	Uneven-Aged		4,210 acres would receive treatments that create more heterogeneous forest structure.	21,040 acres would receive treatments that create more heterogeneous forest structure.	21,040 acres would receive treatments that create more heterogeneous forest structure.
Intermediate Treatments	**Thinning Planting Pruning**	No foreseeable change.	Canopy closure would be reduced, and understory vegetation increased on up to 4,500 acres per year.	Canopy closure would be reduced, and understory vegetation increased on up to 4,500 acres per year.	Canopy closure would be reduced, and understory vegetation increased on up to 4,500 acres per year.

Direct and Indirect Effects on Windthrow Risk

Alternative 1 – No-Action

Under Alternative 1, old-growth stands would remain in a predominantly old-growth condition, experiencing relatively frequent, small-scale disturbance events until a large-scale event occurs. Windthrow risk to old-growth stands in the project area would remain relatively unchanged.

Commercial harvest and thinning of young-growth would not occur. Because of overstocking, trees would generally have a high height-to-diameter ratio, which would decrease their long-term resistance to windthrow. In the short term, while stands retained the dense structure of stem exclusion, risk to windthrow would be decreased.

Alternatives 2, 3, and 5 – Old-Growth Harvest

Even-aged Management

Where even-aged management are prescribed, the entire overstory is removed within the bounds of the stand. In these stands, windthrow risk would be eliminated. Young-growth stands that replace the harvested stand would have a more uniform canopy with vigorously-growing, flexible upper stems, and would typically be more windfirm. The lower wind risk of these stands is expected to last through the next rotation (approximately 100 years in the future).

Exposed stand edges would, however, have increased risk of windthrow in the first few years following harvest due to the adjacent opening. Clearcuts can increase windthrow hazard by increasing surface wind speed and turbulence. Windthrow damage is usually concentrated within the first 30 to 60 feet of the boundary. Above 2 or 3 acres, opening size does not appear to play a role in the amount of windthrow (Stathers *et al.* 1994).

Stands where two-aged management is prescribed have both large openings and increased edge and may therefore have a slightly higher potential for wind damage. This may be somewhat offset by the limited opening sizes, and with strategic placement or shape of the openings during implementation.

Windthrow will be assessed for each individual stand at implementation. In stands rated for high windthrow risk, specific measures will be prescribed to reduce or minimize risk to adjacent stand edges or along stream buffers that protrude into harvest openings. Additionally, RMAs within harvest stands that have stream channel stability concerns and potential for windthrow, will be evaluated for RAW (Reasonable Assurance of Windfirmness). Those RMAs determined to be at risk will receive a field review, and a specific windfirming prescription would be determined.

Uneven-aged Management

Where uneven-aged management is prescribed, windthrow risk can be mitigated by increasing basal area retention requirements. The more intact a canopy remains post-harvest, the more likely that wind risk would remain approximately the same as in the stand prior to harvest. Monitoring results from the Alternatives to Clearcutting Study reveal approximately a 5 percent loss of basal area with a 75 percent basal area retention prescription (McClellan 2007).

Under Alternatives 2, 3 and 5, stands with a high windthrow risk would be prescribed no less than 75 percent retention. A mostly unbroken, continuous canopy would remain after harvest in stands with a 75 percent retention prescription. This would reduce the risk of windthrow along stand edges and adjacent to stream buffers that protrude into the harvest area. In most cases, the uneven-aged prescription would eliminate the need for additional windfirming treatments in RAW zones.

Alternatives 2, 3, and 5 – Young-Growth Management

Even-aged Management

Where even-aged and two-aged management are prescribed, the entire overstory is removed within the bounds of the stand. In these stands, windthrow risk would be eliminated. The future young-growth stand created would typically be equally windfirm to the stand it replaced. Exposed stand edges would, however, have increased risk of windthrow in the first few years following harvest due to the adjacent opening. This risk is increased in relation to the difference in age between the newly created stand and the adjacent stand. For example, an intact old-growth stand adjacent to a recently harvested young-growth stand would have a much higher risk of windthrow than a 20 year old, even-aged young-growth stand. Windthrow risk can be minimized through careful planning of how the shape, location, and proximity of one harvested stand relates to another.

Two-aged Management

In two-aged management the potential for wind damage to stand edges might be slightly higher than under even-aged management because of the increased edge, however this may be somewhat offset by the smaller opening size associated with these prescriptions. Windthrow risk can be minimized through careful planning of the size, shape and location of openings.

Uneven-aged Management

Where uneven-aged management is prescribed, opening size would generally be limited to 2 acres or less, and all other harvest would occur within the matrix of the stand as single tree selection. In areas of high windthrow risk, harvest activities will retain at least 75 percent of the original stand's basal area. This level of canopy retention is considered to be windfirm (Stathers *et al.* 1994).

Commercial Thinning

Commercially thinned young-growth stands would have an increased risk of windthrow immediately after treatment. However, stands with high risk for windthrow would maintain at least 75 percent of the pre-treatment basal area. Openings created with prescriptions designed for habitat restoration would be designed to minimize windthrow risk.

Precommercial Thinning

Stands receiving precommercial thinning would have an increased risk of windthrow immediate following treatment. Residual tree spacing prescribed would mitigate this risk, and over time the treated areas would stabilize. Precommercial thinning promotes tree and stand characteristics that impart long-term windfirmness.

Table 98. Summary of Direct/Indirect Effects on Windthrow Risk

Activity	Silvicultural System	Alternative 1	Alternative 2	Alternative 3	Alternative 5
Old-growth Harvest	**Even-Aged**	No foreseeable change.	Windthrow risk would be eliminated on 9,972 acres. Risk would be increased along edges of openings greater than +/- 3 acres.	Windthrow risk would be eliminated on 3,253 acres. Risk would be increased along edges of openings greater than +/- 3 acres.	Windthrow risk would be eliminated on 4,244 acres. Risk would be increased along edges of openings greater than +/- 3 acres.
	Uneven-Aged		No foreseeable change.	No foreseeable change.	No foreseeable change.
Young-growth Management	**Even-Aged**	Near-term resistance to windthrow would increase due to stem density. Long-term windfirmness would decrease as stands underwent structural development.	Windthrow risk would be increased along edges of openings greater than +/- 3 acres.	Windthrow risk would be increased along edges of openings greater than +/- 3 acres.	Windthrow risk would be increased along edges of openings greater than +/- 3 acres.
	Two-Aged				
	Uneven-Aged		4,210 acres would receive treatments that only slightly increased risk of windthrow.	21,040 acres would receive treatments that only slightly increased risk of windthrow.	21,040 acres would receive treatments that only slightly increased risk of windthrow.
Intermediate Treatments	**Thinning Planting Pruning**	No foreseeable change.	Decreased risk of windthrow long-term on up to 4,500 acres per year.	Decreased risk of windthrow long-term on up to 4,500 acres per year	Decreased risk of windthrow long-term on up to 4,500 acres per year

Cumulative Effects

The analysis area for cumulative effects is the entire POW LLA project area. The following are the activities expected to have cumulative effects to forest vegetation within the next 15 years:

- Continued timber harvest under the Big Thorne Project Stewardship IRTC and other sales under contract from the Big Thorne Project EIS
- Future sales from the Big Thorne Project EIS and Soda Nick EA for both young growth and old growth
- Small sales including microsales under contract, as well as future microsales
- Firewood cutting and free use sawtimber removal along existing roads
- Continued precommercial thinning on NFS lands throughout the project area
- Continued timber harvest under the GNA Kosciusko YG contract in young growth on Kosciusko Island
- Harvest on non-National Forest System lands within the project area

Precommercial Activities on All Land Ownerships

The POW LLA project area has approximately 380,950 acres of young-growth resulting from past even-aged harvest across all ownerships. Of these acres, roughly 192,275 are located on land owned by entities other than the National Forest System, and 80,445 acres were harvested less than 30 years ago. These stands are now in, or approaching, the window for precommercial thinning. Additionally, approximately 8,000 acres of young-growth on NFS lands are currently NEPA-cleared and awaiting PCT treatment.

Where accomplished, PCT would delay or prevent the stem exclusion phase of stand development and result in higher levels of understory vegetation, improve overall stand productivity, likely favor spruce and cedar over western hemlock, and improve windthrow risk over the long-term.

Present and Reasonably Foreseeable Future Commercial Harvest on All Land Ownerships

Several timber sales and integrated resource projects covered under the Big Thorne Project EIS are currently sold and under operation. Approximately 872 acres of even-aged harvest and 420 acres of uneven-aged harvest remain to be implemented under that decision, from which various small sales will be offered and likely harvested on an average of 100 acres per year for the next 5 to 10 years. Approximately 1,461 acres of young-growth timber on Kosciusko Island will be harvested from the decision on the Kosciusko Vegetation Management and Watershed Improvement Project EA. Of these, 396 acres are planned for even-aged, 856 acres are planned for two-aged, and 209 acres are planned for uneven-aged management. On Heceta Island, 250 acres of young-growth salvage harvest is currently being planned.

There are 132,270 acres of potentially economical forested land under other ownership within the project area. Approximately 38,290 of these acres are even-aged young-growth of which 1,124 are currently greater than 46 years old and are anticipated to be commercially viable within the next 15 years. The remaining 93,980 acres are currently old-growth with at least 8 MBF per acre.

These other ownerships include the State of Alaska, the Alaska Mental Health Trust, the University of Alaska Trust, and various native corporations, the largest of which is Sealaska Corporation. The rate and location of future old-growth harvest for these other ownerships is unknown, but estimates can be made based on public 5-year schedules, rates of past harvest, and capacity of the local industry. It is assumed, based on these estimates, that 5,807 acres of old-growth harvest per year across these other ownerships, for a total harvest over the next 15 years of 87,110 acres. It is also assumed that 100 percent of these acres will be managed through even-aged harvest, and that this harvest would result in the creation of even-aged forests in addition to that proposed in the POW LLA Project. Acres harvested on non-FS land would undergo effects similar to those harvested under an even-aged management system as described above, and any future precommercial activities would have effects as outlined above.

The rate and location of future young-growth harvest on other ownerships is subject to the same unknowns as that of old-growth. For the purpose of estimating effects, it is assumed that all 1,124 acres considered to be approaching a commercially viable age class will be harvested under even-aged management over the next 15 years.

Regeneration is expected to be vigorous and representative of the approximate species mix of the former stand. Slight changes in species composition in the project area may occur as a result of harvest operations and follow-up treatments such as precommercial and commercial thinning.

Stands heavily affected by yellow-cedar decline are naturally progressing toward hemlock-dominated communities (Oakes *et al.* 2014). Western redcedar and mountain hemlock may also replace yellow-cedar on lower productivity sites, thus increasing their overall presence on the landscape (Hennon *et al.* 2016). Planting of Alaska yellow-cedar can be used where site conditions allow to maintain or increase its composition in the stand or group of stands and reduce the effects of yellow-cedar decline. It is unknown whether or to what level non NFS landowners would use this management approach.

Effects of timber harvest to forest vegetation are usually confined to the harvested stand area and its immediate vicinity. However, when the landscape-scale of many stands is considered, the primary effects of timber harvest results in greater structural diversity and improved vegetation health and productivity. While windthrow risk will temporarily increase along edges of residual stands following harvest, risk will likely decrease overall as more stands are converted from high-defect old growth to vigorous young growth under even-aged management. The rate of harvest, variation in site productivity, spatial relationship of harvested stands to reserves, and the locations of ownership boundaries in relation to federal land affect the scale and intensity of these impacts to the landscape.

Wetlands

Objectives are to conduct land management activities so that loss of wetland functions and values caused by harvest, road construction, and recreation development are minimized and/or avoided whenever practicable.

Methodology

Effects to wetlands will be assessed by overlaying the National Wetlands Inventory layer with existing and proposed activities. The acres of wetlands impacted by existing and proposed roads, trails, recreation sites, mines, and other activities will be estimated. The number of acres of wetlands impacted by timber harvest will be estimated. Monitoring data and literature will be used to describe the effects the various activities on wetland function.

Units of Measure

The measures used to compare the effects of the alternatives include:

- acres of wetlands impacted by roads, trails, recreation sites, mines, and other developments; and
- acres of wetlands impacted by timber harvest.

Spatial and Temporal Context for Analysis

The spatial analysis area for the affected environment and direct, indirect, and cumulative effects is the same as the project area since all wetland effects are expected to be within the project's boundary. The temporal bounds of the cumulative effects analysis includes all existing wetland disturbances since the beginning of land management in the project area to the reasonably foreseeable future. Past, present, and reasonably foreseeable future projects are described in more detail in Appendix C of this FEIS.

Data Limitations

The National Wetlands Inventory map does not cover Coronation and Forrester Islands. Forrester Island is a National Fish and Wildlife Refuge and no management activities are proposed there. No activities are proposed on Coronation Island. The shoreline used for the POW LLA project area boundary does not match the shoreline in the National Wetlands Inventory Layer.

The differences in shoreline are mostly in the intertidal area, and in many cases consist of small off shore rocks, rocky shore or other intertidal areas below mean high tide, where the only proposed activities are log transfer facilities. Non-exempt activities like marine access facilities require U.S. Army Corps of Engineers permitting.

Affected Environment

Wetland Characterization

Wetlands are defined as "those areas that are inundated or saturated by surface water or groundwater with a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted to life in saturated soil conditions." (40 CFR 230.41 (a) (1). Wetlands are valued for their physical, chemical, and biological functions. Wetlands moderate flooding, reduce runoff and sedimentation, provide wildlife and plant habitat, and may help sustain stream flow during dry periods. Physical functions may include flood conveyance, surface and ground water regulation, sediment retention, and temperature moderation. Chemical functions may include nutrient storage, pH moderation, and carbon storage. Biological functions include habitat for terrestrial, aquatic, and marine plants and animals. In addition, forested wetlands are an important component of the forest land base.

Wetlands have been affected by past timber harvest and associated activities (road construction and rock pit development), as well as recreation developments, hydropower, and mineral developments. Stream restoration has had negligible effects on wetlands and in some instances has enhanced wetland habitats and functions.

Due to the extensive nature of wetlands in the POW LLA project area, wetland avoidance was not feasible during past road planning and past construction activities. Some wetlands are valued for their timber resources while others support low volume or non-forested wetland types.

The National Wetlands Inventory (Cowardin 1979) was used to identify wetland types in the project area. An explanation of different wetland types can be found in Cowardin (1979) and in the 2016 Forest Plan Amendment FEIS.

Existing Wetland Disturbances in the Project Area

Past timber harvest activities, road construction, mineral developments, trails, recreation sites, and other management activities have disturbed and displaced wetlands in the project area. Table 99 displays the acres of wetlands harvested and acres of wetlands impacted by past road construction. There are approximately 893,745 acres of wetlands mapped on the project area (about 39 percent of the project area).

Table 99. Wetland Acres and Existing Wetland Disturbances in the POW LLA Project Area

				Palustrine			
Unit	Estuary	Riverine	Lacustrine	Forested	Scrub-shrub	Emergent	Other
Total wetland (ac)	22,529	444	34,538	555,821	115,844	153,541	11,028
% of wetland type in project area	1	0.02	2	24	5	7	0.5
Harvested on federal, state, and private lands (ac)	953	9	109	29,431	1,432	2,985	157
Roaded on federal, state, and private lands (acres)	37	0	4	2,849	104	410	7
Impacted by facilities (recreation sites, trails and mines, hydro) (acres)	4	1	4	30	18	25	0
Total impacts (ac)	994	10	117	32,310	1,554	3,420	164
% of wetland type impacted	4.4	2.3	0.3	5.8	1.3	2.2	1.5

Note: Calculation of roaded acres based on 40-foot wide disturbed soil road corridor. Sums may not match due to rounding. Timber harvest on non-forested sites is due to inclusions at the scale of mapping harvest units and wetlands. There is no National Wetlands inventory for Coronation or Forrester Islands. Hydropower sites convert wetlands to deepwater or seasonally inundated wetlands.

About 9 percent of past harvest has occurred on forested wetlands. These wetlands are common across the project area, covering 24 percent of the project area. In areas of harvest, changes to wetland hydrology are temporary as vegetation regenerates and provides interception and evapotranspiration surfaces similar to pre-harvest conditions. Wetlands with timber harvest are expected to remain wetlands.

Road construction covers wetlands with road fill and hillslope hydrologic connectivity can be lost due to road ditches and road fills. Impacts to wetland hydrologic function is typically limited to a few meters on either side of the road corridor as long as proper drainage structures are installed to ensure hydrologic connectivity is maintained (USDA Forest Service, 2016c).

Wetland Avoidance

Wetlands are avoided to the extent practicable. On the project area, on a percentage basis, more roads and timber harvest occur on upland sites than on wetland sites. Approximately 17 percent of the existing NFS roads are on wetlands, and only about 9 percent of the existing harvest is on wetlands, whereas about 39 percent of the project area is mapped wetland. Interpretation of these numbers suggests that road construction has avoided wetlands to the extent practicable on the project area. The forested wetlands in the POW LLA project area often include stands of commercial timber and are managed for their timber resources. The most economical way to access the forested wetlands timber stands often involves building road. Within the context of overall project objectives, including economics and minimizing harm to the environment, past road construction has avoided wetlands to the extent practicable in the project area.

Environmental Effects

Activities common to all alternatives (such as invasive plant treatments, treatments to correct blocked karst features, precommercial thinning treatments, and instream treatments to address water quality and habitat issues) would adhere to the Forest Plan, R10 Soil Quality Standards, and National and R10 Best Management Practices and are not expected to negatively affect wetland resources.

Effects Common to all Action Alternatives

All action alternatives propose some level of timber harvest and road construction on forested wetlands. The effects of timber harvest (primarily increased soil moisture levels) on forested wetlands are expected to be temporary. All harvested sites are expected to regenerate naturally based on many decades of regeneration surveys. Trees are expected to grow more slowly on wetland sites. No new effects to wetlands from young-growth harvest are anticipated unless new road construction is needed, which is analyzed as part of the effects of road building.

The effects of road building on wetland varies based on the substrate (soil type) and the landscape position of the wetland. Regardless of the type and location, road construction on wetlands results in a loss of wetland acreage. Based on research and monitoring conducted on the Tongass National Forest (much of it in the project area), hydrologic effects beyond the disturbed soil (road) corridor are expected to be limited to within a few meters of the road (Glaser 1999, Kahklen and Moll 1999, McGee 2000, and Landwehr 2011).

Due to the preponderance of wetlands and the interspersed nature of wetlands with uplands on the project area, complete avoidance of wetlands from proposed road construction activities is not practicable. All proposed roads would be constructed according to State-approved BMPs as required by 33 CFR 323. All roads through wetlands would also follow the 15 baseline provisions provided in 33 CFR 323.

The action alternatives also include potential trail and recreation site developments. Impacts to wetlands from trails and recreation sites are similar to roads if fill is used. Some trails are native tread, in which case the wetland remains wetland. If rock or gravel fill is used, wetland functions are lost in the filled areas.

Unlike most forest roads, which fall under the silvicultural exemption from the U.S. Army Corps of Engineers' 404 permitting activities, recreation sites and trails through wetlands would require a 404 permit. The permitting process further ensures that wetland losses will be held to the minimum feasible number.

Alternative 1 – No-Action

Direct and Indirect Effects

No wetlands would be impacted under Alternative 1 due to no timber harvest, road construction, trail construction, or other developments as a result of the POW LLA Project.

Cumulative Effects

Approximately 35,079 acres of timber have been harvested from wetlands in the project area (all ownerships). Vegetation on forested wetlands harvested in the past would continue to grow toward hydrologic maturity (many stands have already reached this stage).

About 3,413 acres of wetlands have been converted to road surfaces, ditches, and fill slopes in the project area. Wetlands impacted by roads in the past would continue to be impacted. Vegetation would occupy ditch lines and, in the case of closed roads the roadbed, may be occupied by red alder or other vegetation. The road prism would remain in an upland condition. Road ditches, where present, support a variety of upland and wetland vegetation depending on local conditions and seed sources.

Under Alternative 1, an additional 25,362 acres of forested wetland could experience timber harvest on non-NFS lands, and 566 acres of timber from wetlands are under contract on National Forest System lands.

With the implementation of the reasonably foreseeable future projects, an additional 687 acres of wetland could be roaded on non-NFS lands and 32 acres on NFS lands. Open, drivable roads in the project area would continue to receive incidental use by recreation visitors. Vegetation would grow in ditch lines on all roads, and on closed roads vegetation will likely colonize the road surfaces.

Mines, trails, hydro facilities, and recreation sites currently occupy about 80 acres of wetlands. No new impacts from mines, hydro facilities, or recreation sites are assumed under Alternative 1.

About 93 percent of wetlands in the project area would remain in a natural condition.

Alternative 2 – Proposed Action

Direct and Indirect Effects

A description of direct and indirect effects to wetlands are described in the effects common to all action alternatives section above. Alternative 2 proposes to harvest old-growth timber from approximately 5,913 acres of forested wetland. Road construction under this alternative would convert about 117 acres of wetland to road. Alternative 2 also proposes to construct up to 10.3 miles of trail on wetlands, impacting about 3 acres. Construction of winter access sites would also impact about 1 acre of wetland.

Cumulative Effects

Cumulative effects to wetlands from reasonably foreseeable future actions are described in Alternative 1 and, following implementation of Alternative 2, cumulative timber harvest from all past, present, and reasonably foreseeable future actions would impact approximately 66,920 acres of forested wetlands in the project area.

Roads, recreation sites, hydro facilities, mines, and other developments would fill or alter 4,333 acres of wetlands.

Under Alternative 2, about 92 percent of wetlands in the project area would remain in a natural condition.

Alternative 3

Direct and Indirect Effects

A description of direct and indirect effects to wetlands are described in the effects common to all action alternatives section above. Alternative 3 proposes to harvest old-growth timber from approximately 3,307 acres of forested wetland. Road construction under this alternative would convert about 66 acres of wetland to road. Construction of winter access sites and trails would also impact up to 4 acres of wetlands.

Cumulative Effects

Cumulative effects to wetlands from reasonably foreseeable future actions and following implementation of Alternative 3, timber harvest from all past, present, and reasonably foreseeable future actions would impact approximately 64,314 acres of forested wetlands in the project area.

Roads, recreation sites, hydro facilities, mines, and other developments would fill or alter 4,282 acres of wetlands.

Under Alternative 3, about 92 percent of wetlands in the project area would remain in a natural condition.

Alternative 5

Direct and Indirect Effects

A description of direct and indirect effects to wetlands are described in the effects common to all action alternatives section above. Alternative 5 proposes to harvest old-growth timber from approximately 1,618 acres of forested wetlands. Road construction under this alternative would convert about 76 acres of wetland to road. Construction of winter access sites and trails would impact another 4 acres of wetlands.

Cumulative Effects

Cumulative effects to wetlands from reasonably foreseeable future actions and following implementation of Alternative 5, timber harvest from all past, present, and reasonably foreseeable future actions would impact approximately 62,625 acres of forested wetlands in the project area.

Roads, recreation sites, hydro facilities, and other developments would fill or alter 4,291 acres of wetlands.

Under Alternative 5, about 92 percent of wetlands in the project area would remain in a natural condition.

Conclusions

The wetlands analysis shows similar effects to and loss of wetlands from roads between all action Alternatives. Alternative 1 proposes no new activities in wetlands. Alternative 2 involves more acres of timber harvest and more miles of road construction on wetlands; thus, the impacts to wetlands from implementation of Alternative 2 are more than the other action alternatives.

The 15 Federal Baseline Provisions and State Approved BMPs are used to avoid and minimize impacts to wetlands. The POW LLA Project Implementation Plan incorporates the existing Forest Plan direction for activities occurring in wetlands.

Recreation site developments and other developments not subject to the silvicultural exemption must go through the Army Corps of Engineers 404 permitting process. The permitting process provides further assurance that wetland impacts would be minimized or avoided.

Chapter 4. References and Lists

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Distribution of the Environmental Impact Statement

A letter or email with notification of the availability of this FEIS, either online or via electronic media, was sent to the following parties. These parties either commented on the project, requested a copy of the DEIS or FEIS during scoping or at some other time during the NEPA process, or are part of the Tongass National Forest mandatory mailing list (Forest Service Handbook 1909.15, Sections 23.2 and 63.1). In addition, notification of the availability of the online copy was sent to emails on the self-subscribed email list for this project. A complete list of recipients is in the project record.

Federal, State, and Local Agencies

US Fish and Wildlife Service
National Marine Fisheries Service
Alaska Department of Environmental Conservation
Alaska Department of Fish and Game
Alaska Department of Natural Resources
State Historic Preservation Office
Environmental Protection Agency
U.S. Army Corp of Engineers

Tribes and Native Corporations

Central Council of the Tlingit and Haida Indian Tribes of Alaska
Craig Tribal Association
Hydaburg Cooperative Association
Klawock Cooperative Association
Organized Village of Kasaan
Wrangell Cooperative Association
Sealaska Corporation
Shaan-Seet, Incorporated
Kavilco, Incorporated
Klawock-Heenya Corporation
Organized Village of Kake
Ketchikan Indian Corporation
Organized Village of Saxman
Metlakatla Indian Community

Businesses, Organizations, and Individuals

The Tongass National Forest emailed a notification with a link to the EIS electronically via the self-subscribed GovDelivery system to the businesses, organizations, and individuals who have requested to receive emails. Individuals may also have requested a hard copy or electronic copy of the document. The list of individual email addresses and names is in the project record.

Glossary

The following terms are included in this document and apply to Forest Service land management and effects analysis. The terms below are not found in Chapter 7 Chapter 7 of the 2016 Forest Plan. Definitions for other technical terms used in this document may be found in Chapter 7 of the 2016 Forest Plan.

Abiotic: Non-living. Climate is an example of an abiotic component of ecosystems.

Affected environment: The natural environment that exists at the present time in an area being analyzed.

Age class: A distinct aggregation of trees originating from a single natural event or regeneration activity, or a grouping of trees, *e.g.*, 10-year age class, as used in inventory or management.

Amphipods: Any member of the invertebrate order *Amphipoda* (class *Crustacea*) inhabiting all parts of the sea, lakes, rivers, sand beaches, caves, and moist (warm) habitats.

Annualized direct jobs: Annualized jobs are all the Alaska jobs (excluding indirect jobs) supported by offered timber volume. Actual annualized jobs may vary by timber sale purchaser and specific business practices.

Aspect: The direction a slope faces. A hillside facing east has an eastern aspect.

Average snow winter habitat: POG forest below 1,500 feet. POG is defined as all seven-size classifications including SD-4H, SD-4N, SD-4S, SD-5H, SD-5N, SD-5S, and SD-67 in the SDM GIS data. It is considered in reference to deer winter habitat.

Biotic: Living. Green plants and soil microorganisms are examples of biotic components of ecosystems.

Browse: Twigs, leaves, and young shoots of trees and shrubs that animals eat. Browse is often used to refer to the shrubs eaten by big game, such as deer.

Canopy: The part of any stand of trees represented by the tree crowns. It usually refers to the uppermost layer of foliage, but it can be use to describe lower layers in a multi-storied forest.

Climax: The culminating stage in plant succession for a given site. Climax vegetation communities are stable, self-maintaining, and self-reproducing.

Compaction (soil compaction): The reduction of soil volume. For instance, the weight of heavy equipment on soils can compact the soil and thereby change its properties, such as in its ability to absorb water.

Composition: What an ecosystem is composed of. Composition could include water, minerals, trees, snags, wildlife, soil, microorganisms, and plant species.

Conifer: A tree that produces cones, such as a pine, spruce, or hemlock tree.

Cover: Any feature that conceals wildlife or fish. Cover may be dead or live vegetation, boulders, or undercut stream banks. Animals use cover to rest, feed, or escape from predators.

Decommissioning (roads): To remove those elements of a road that reroute hillslope drainage and present slope stability hazards. For NFS roads, decommissioning removes the road from the National Forest Transportation System. Action on the ground for decommissioning ranges from blocking the entrance and removing drainage structures to obliterating the road, returning the natural contours, and replanting vegetation. The end result is the stabilization and restoration of unneeded roads to a more-natural state (36 CFR 212.1).

Deep snow winter habitat: HPOG is forested habitat below 800 feet on south- and west-facing aspects (HPOG is equivalent to SD-5S, SD-5N and SD-67), and is considered in reference to deer and marten winter habitat.

Deer winter range (habitat): An area, usually at lower elevation, used by big game during the winter months; usually smaller and better-defined than summer ranges.

Ecology: The interrelationships of living things to one another and the environment, or the study of these interrelationships.

Edge: The more or less well-defined boundary between two or more elements of the environment, *e.g.*, a field adjacent to a woodland or the boundary of different silvicultural treatments.

Felling: The cutting down of trees.

Final Environmental Impact Statement (FEIS): The final version of the statement of environmental effects required for major Federal actions under Section 102 of the National Environmental Policy Act. It is a revision of the Draft Environmental Impact Statement (DEIS) to include public and agency responses to the draft. The responsible official chooses which alternative to select from the FEIS, and subsequently issues a Record of Decision (ROD).

Forage: All browse and non-woody plants that are eaten by wildlife and livestock.

Forest-wide Standards and Guidelines (S&G): A set of rules and guidance that directs management activities and establishes the environmental quality, natural renewable and depletable resource requirements, conservation potential, and mitigation measures that apply to several land use designations.

Geographic Information System (GIS): Information processing technology to input, store, manipulate, analyze, and display spatial and attribute data to support the decision making process. It is a system of computer maps with corresponding site-specific information that can be electronically combined to provide reports and maps.

Geomorphology: The study of the forms of the land surface and the processes producing these surfaces. Also the study of the underlying rocks or parent materials and the landforms present that were formed in geological time.

Habitat diversity: The number of different types of wildlife habitat within a given area.

Habitat type: A way to classify land area. A habitat type can support certain climax vegetation, both tree and understory species. Habitat typing can indicate the biological potential of a site.

Harvest unit (timber): A portion of a timber sale within which Forest Service specifies for harvest all or part of the timber to meet the requirements of a timber sale contract.

Hydric soil: A soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.

Hydrologic recovery: A return to natural conditions of water collection, storage, and discharge.

Hydrology: The science dealing with the study of water on the land, in the soil and underlying rocks, and in the atmosphere.

Intermediate treatment: The removal of trees from a stand sometime between the beginning or formation of the stand and the regeneration cut. Types of intermediate treatments include thinning, release, and improvement cuttings.

Litter (forest litter): The freshly fallen or only slightly decomposed plant material on the forest floor. This layer includes foliage, bark fragments, twigs, flowers, and fruit.

MBF: A measurement term for lumber or timber. One board foot (BF) is the amount of wood contained in an unfinished board 1 inch thick, 12 inches long, and 12 inches wide. MBF is one thousand board feet.

Mature timber: Trees that have attained full development, especially height, and are in full seed production.

Mortality: Trees dying from natural causes, or subsequent to incidents such as storms or insect and disease epidemics. The term mortality can also refer to the rate of death of a species in a given population or community.

Mosaic: Areas with a variety of plant communities over a landscape, such as areas with trees and areas without trees occurring over a landscape.

Natural resource: A feature of the natural environment that is of value in serving human needs.

Notice of Intent (NOI): A notice in the Federal Register of intent to prepare an environmental impact statement on a proposed action.

Patch: An area of homogeneous vegetation, in structure and composition.

Predator: An animal that lives by preying on other animals. Predators are at or near the top of food chains.

Prescription: A planned series of treatments designed to change current stand structure to one that meets management goals taking in consideration ecological, economic, and societal constraints.

Qualitative: Relating to or involving comparisons based on individual qualities.

Ranger District: The administrative sub-unit of a National Forest that is supervised by a District Ranger who reports directly to the Forest Supervisor.

RARE II: Roadless Area Review and Evaluation. The national inventory of roadless and undeveloped areas, within the National Forests and Grasslands.

Recharge: The addition of water to ground water by natural or artificial processes.

Record of Decision (ROD): A public document separate from, but associated with, an environmental impact statement that identifies all alternatives, provides the Agency’s final decision, the rationale behind the decision, and the Agency’s commitments to monitoring and mitigating.

Recreation site: A specific site and/or facility occurring within a Recreation Place. Examples of recreation sites include: recreation cabins, trailheads, picnic areas, and wildlife viewing blinds.

Red crossings: Passage barriers to various life stages of fish; generally culverts placed improperly.

Regeneration: The renewal of a tree crop by either natural or artificial means. The term is also used to refer to the young crop itself.

Regional Forester: The official of the USDA Forest Service responsible for administering an entire region of the Forest Service.

Road Storage: The process/action of closing a road to vehicle traffic and placing it in a condition that requires minimum maintenance to protect the environment and preserve the facility for future use.

Scale: In ecosystem management, it refers to the degree of resolution at which ecosystems are observed and measured.

Sedge: A family of plants with solid stems found in marshy areas.

Shell midden: A term referring to shell and bone that have been discarded after harvest and processing for subsistence use.

Spawning area: The available area in a stream course which is suitable for the deposition and incubation of salmon or trout eggs.

Succession: The natural replacement, in time, of one plant community with another. Conditions of the prior plant community (or successional stage) create conditions that are favorable for the establishment of the next stage.

Successional stage: A stage of development of a plant community as it moves from bare ground to climax. The grass–forb stage of succession precedes the woody shrub stage.

Terrestrial ecosystems: Plant communities that are not dependent on a perpetual source of water to grow.

Throughfall: the precipitation that passes directly through a canopy or is initially intercepted by aboveground vegetative surfaces and subsequently drips from the canopy.

Trail: Routes less than 48 inches are designated as non-motorized trails. Trails greater than 48 inches but less than 60 inches may be designated for non-motorized or motorized (ATV) activities. Roads converted to trails may be designated for non-motorized or motorized (ATV) uses.

Vegetation management: To change species composition or structure of plant communities through human intervention regardless of the purpose, or to protect communities from some types of disturbance such that natural changes continue to occur.

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